FOREWORD

A forum Safety for the Future arose out from the idea and the need to see security problems as a whole, and yet separately, through a prism of scientists and experts in order to bring science, company practice and economy together. This year, we are conducting the forum for the fifth time, with new elements of security phenomena researches in the area of management, engineering and ecology. A spectrum of phenomena which have an influence on a particular subject becomes wider and wider. Namely, it is a fact that environment, in which individuals and legal entities exist, becomes more complex. It is consist of familiar and unfamiliar circumstances. Managing those circumstances is possible to a certain extent, if there is an optimal and necessary quantum of knowledge. Hence, the knowledge is foundation on which is necessary to build capabilities of individuals and legal entities in order to be able to recognize, prevent and react on threats.

Crisis management has become everyday need, essential for survival of an individual, companies or society as a whole. It is more and more difficult to assess the risk of events with negative effects at the very beginning of their occurrence, and coping with negative consequences leaves harder effects on society. Scientific research of security phenomena has become priority of society sustainable development.

Scientific findings do not always come to those who perform security tasks, such as individuals or legal entities. Therefore, there is a need for scientists and experts to meet and exchange ideas, opinions and knowledge. Materialization of knowledge is carried out daily in the process of modern business. Exposed to the impacts of a turbulent environment, and focused on sustainability, modern business requires permanent monitoring of changes and adaptation to these changes.

Comprehension of the environment in which the modern society exist, is possible if there is the necessary knowledge of the phenomena that characterize it. Only knowledge provides an opportunity of preventive action through an efficient risk assessment system. Only knowledge, formed as a symbiosis of science and profession, has quality and strength, which guarantees the possibility of preventive action and an optimal level of readiness to react to negative events. The resistance of contemporary society to negative events depends on the degree of knowledge development.

Proceedings from the 5th International Conference - Security and Crisis Management - Theory and Practice, presents a new value in the observation of a portfolio of security phenomena at the strategic, company, and individual level. The papers published in the proceedings are new findings and views of the author. A wide range of issues, confirms the assumption of the necessity of such a conference. The papers presented at the last four conferences have unambiguously demonstrated the need for regional cooperation and the harmonization of joint capacities.

The papers within Management-Engineering-Ecology conference give the proceedings particular quality. These papers are, in the proceedings, given through special section. The complexity of working and any other environment inevitably links management and engineering elements. The need of application of engineering methods in management processes arises.

The exhibition part of the event and practical demonstration exercises aim to ensure that consumers of implemented safety show new achievements and opportunities in solving various security problems. The intention of the organizer is, by carefully selecting the theme for demonstration exercises, to trace the way of applying the principles of practicality and the
obviousness in the process of education and training the individuals to respond in different situations.

The proceedings represent a review of existing knowledge, source of a new one, assistance in solving security problems, a support for practitioners dealing with security and a source of initiative to advance existing knowledge in the field of security and crisis management. By this way, we invite all stakeholders to improve the quality of the future editions with their work.

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CLIMATE CHANGE AND SECURITY

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Abstract: Security implications of climate change have become increasingly present in policymaking and research domain since the early 2000s. The same climate change impacts can lead to different outcomes in different contexts. As a result of its context-dependency, climate change should be seen as exposing already existing vulnerabilities rather than causing them. Therefore, climate change does not necessarily cause insecurity, but increases the risk of insecurity instead. As such it touches upon various domain like disaster risk management, critical infrastructure management, migrations, resilience and vulnerability management etc. This paper has for its aim to shed light on some security threats that may come as a consequence of climate change, like health, food, water security etc. It elaborates general impacts of climate change on different aspects of security while also reflecting on Serbian context.

Keywords: climate change, security, human and biophysical systems.

1. INTRODUCTION

Over the past decades security studies become increasingly diversified moving from traditional understanding of security from the external military threats towards priorities such as economics, human rights, epidemics, social injustice and environment. The security implications of climate change have become increasingly present in policymaking and research domain since the early 2000s. The climate change is perceived as long-term risk with a far-fetching implication for the social and biophysical systems, thus, its potential security implications are very broad and complex. It is not only the magnitude and pace that define the impacts of climate change on social and biophysical systems but equally it’s distributed vulnerabilities and adaptive capacity. Thus, the same impact can therefore lead to different outcomes in respect to a given context. As a result of its context-dependency, climate change should be seen as exposing already existing vulnerabilities rather than causing them. Therefore, climate change does not necessarily cause insecurity, but increases the risk of insecurity instead.

Minor changes in climate can (but may not) have a significant impact on the probability distribution of temporal events in space and time, as well as on the intensity of possible extremes [1]. Given the complexity of the climate system, climatologists warn that crossing a certain threshold in global warming can lead to a critical tipping point, and an exponential increase in the greenhouse effect without the possibility of mitigating this effect [2]. The transition to the state of irreversible warming of the global climate system is linked to decisive points and processes. Scientists warn that a significant number of critical point exceedances will trigger some of the elements of this process if the global average temperature rises by more than 2°C relative to the pre-industrial level [2] like the reduction of Greenland ice cover,
Arctic glacier melting, destabilization of tropical forests in the Amazon region, changes in monsoon patterns in India, [2]. Such complex changes in the climate system can lead to amplification of the effects of climate impacts on global security by different means. This paper has for its aim to shed light on some security threats that may come as a consequence of climate change, elaborates general impacts of climate change on different aspects of security while also reflecting on Serbian context. The following is an overview of some of the most significant impacts of climate change on security of biophysical systems and social communities.

2. POTENTIAL CLIMATE CHANGE TREATS ON SOCIAL SYSTEMS

Although certain impacts of climate change on human systems are often geographically heterogeneous and depends not exclusively on changes in climate variables but also on social and economic factors, for a significant part of the global population, food, water security [3], and public health [4] is severely threatened by the effects of climate change [5].

**Food security.** Climate change impacts on agriculture includes possible reduction and stagnation of yields, as well as destabilization of yields due to various factors. Since agriculture is a large consumer of freshwater, with ever-increasing need for irrigation, the qualitative and quantitative changes of the available freshwater may adversely affect the agricultural production. Also, because of the increase in mean annual temperature, an extension of the growing season can be expected, especially in the northern geographical areas [6]. Research indicates that climate change negative impacts on crop yield have so far been more common than positive impacts, especially in maize and grain, and predict potentially reduced yields of -20% to -50% until the end of the century [7]. Such changes may seriously threaten food production in the future. Destabilization of food supply can volatile food prices and especially have significant impacts on import-dependent developing countries. Moreover, there is growing evidence that climate change affects food security and that increased food prices increase conflict risks.

The agricultural sector in Serbia has suffered enormous losses in recent decades caused by frequent and intense droughts. Some analyzes estimate the bottom line of direct loss were $ 4.6 billion, for damages resulting from drought-related yields since 1994., out of which direct damage to maize yield, as the most vulnerable crop, counts for $ 2.2 billion [8]. According to the evaluation of the impact of droughts on crop yields in eastern Serbia for the period 1998-2000, the average yield has dropped by 40.9% compared to drought-free years [9]. Based on the 2012 Census of Agriculture [10], 631,522 agricultural households were registered in Serbia employing approximately 1.5 million people, meaning that the livelihood of close to 25% of the population depends on agriculture. Conditions for agricultural production will change with climate change. With increasing temperatures, it is possible to expect an extension of the vegetation period and an earlier onset of vegetation of 20-30 days by the end of the century, but equally longer drought periods by the end of the century. Such changes will affect both the planning of production and the selection of suitable varieties and the phenology of the plants, as well as the yield of individual crops. Certain scenarios for the period 2071-2100 indicate a significant decrease in maize yield for the entire territory of Serbia, for irrigation-free conditions. Studies indicate that applying optimal irrigation, observed for all scenarios, can significantly increase yields, especially in Central Serbia (57–97% in Vojvodina and 77–285% in Central Serbia) [11].

**Water security.** Water stress is often seen as a severe threat to the livelihoods of marginalized groups, and thus as closely linked to human insecurity. Future shifts—will increase competition over scarce water resources, both within and between states. Climate change will
have a profound impact on the availability of water resources and water quality in the future. Increased water stress will have significant security implications for communities living in regions already exposed to water shortages and those dependent on rain-fed agriculture in dry or semi-dry areas. Over a billion people worldwide do not have access to clean drinking water, while 2.4 billion do not have access to sanitary water [12]. Increasing pressure on water resources due to population growth, unsustainable consumption patterns and uncontrolled water use, will increase this number significantly by the end of the century [13]. In addition to direct impacts on health and food production, reducing water resources can further increase the risk of conflict over basic resources. Studies estimate that between 150 and 600 million people will be exposed to such a risk if temperatures rise in line with global forecasts [14]. In this regard, the uncertainty surrounding climate change predictions notably impedes rational water planning. The share of Europe's endangered areas in terms of water resources is expected to raise from 19% today to 35% by 2070, which may increase internal migration [15].

Water management is recognized as one of the most vulnerable sectors in Serbia regarding climate change. Measurements have indicated a negative trend in the overall flow of water in rivers in Serbia since the mid-twentieth century, with an average long-term trend of -3%. This trend is expected to continue in the coming decades, especially after 2050. Such changes will affect the overall water security, as well as the dynamics of floods and droughts, the intensification of erosion, torrents and floods on small rivers; increase of large waters on large rivers, increase of water temperature and increase of concentration of pollutants in conditions of reduced water quantities [16].

**Human health.** Globally, the impact of climate change on human health is relatively small compared to the effects of other impacts and is not quantified enough, but should not be neglected. Estimates indicate that negative impacts will outweigh the beneficial impacts of climate change on health. However, it is challenging to isolate the effects of climate from other non-climatic factors on health security, except in the case of direct physical impacts most often caused by extreme weather events. For example, heat waves affect increased mortality, especially in individuals with respiratory problems and cardiovascular disease [17]. Some studies estimate that the number of deaths in Europe caused by heat waves, without adaptation measures, will vary between 60000 and 165000 annually by 2080, while, the death toll from severe colds is expected to range between 60000 and 250000 annually [18]. Floods, on the other hand, affect the population directly, through interruptions to vital drinking or electricity delivery services, destruction of houses, injury and drowning, and the like [19]. Moreover, climate change can affect the significant distribution of vector diseases [20]. In addition, droughts, floods and storms affect the onset of disease due to contaminated water sources [20], while high temperatures can adversely affect food storage and quality [6]. Climate change will affect the availability of drinking water and sanitary water and, in this regard, may endanger the sustainability of sanitation systems. Predictions indicate that climate change can produce significant negative impacts on mortality rates. World Health Organization Simulations [21] estimates 65,000 deaths of the elderly population caused by heat waves, 48,000 caused by diarrhea and 60,000 malaria by 2030, in the case of no adaptation measures. Under optimistic scenarios, up to 250,000 deaths are estimated by 2050. Some beneficial impacts include reducing deaths due to severe cold. The risk of increased mortality due to heat waves is different depending on age, location and socio-economic factors [22].

**Security treats related to extreme events.** Climate change leads to an increase in the frequency and intensity of severe weather events that frequently lead to direct material or economic losses. While certain disasters, such as droughts and sea level rise, occur slowly over years or decades, others, such as cyclones and wildfires, occur suddenly and have immediate consequences. Given their different temporal dimensions, these types of disasters pose
different security challenges and require tailored response. It can be expected that the value of economic losses due to extreme climate events will increase in the future. However, current evaluations of economic losses only relate to direct material losses and do not take into account the indirect economic costs reflected in the increased risk of public health, ecosystem integrity and lost cultural heritage [6]. The inclusion of indirect losses further increases the possible overall impact of climate change on economic security. In Europe, the warmest recorded years were 2014 and 2015 [23]. Since 2003, when a record number of heat wave deaths (70000) were recorded, Europe has experienced several years with tropical temperatures [24]. In addition to heat waves, extensive damage in Europe has been caused by floods. According to the NatCatSERVICE database, approximately 1,500 floods occurred in the period 1980-2016, with over 4,700 casualties, and direct material losses of more than 150 billion euros. More than half of registered floods occurred after 2000 [25]. The share of flood damage in total in damage from other natural disasters is over 30%. In 2010-2014 only. In 2000, 8.7 million people were affected by the floods. A rise in floods by the end of the century is projected for the British Isles, France, Spain, some parts of the Balkans and the upper reaches of the Danube [24].

In this regard, studies further point to the frequency of natural disasters in Serbia, most notably floods, droughts and forest fires. The risk of these natural disasters will increase with climate change. Increases in temperature, severe weather, floods and storms can adversely affect the quality of life in Serbian municipalities. Data for the period 2000-2011 indicate that Serbia was more exposed to natural than technical and technological disasters, where they account for 62% of the combined number of natural disasters, 55% of which are floods [26]. The 2014 floods confirm these trends. According to [27] more than 30 casualties were suffered in floods, with direct loss amounting to EUR 810.1 million, while losses were estimated at EUR 661.9 million. Damage to residential properties was estimated at € 231 million, while the infrastructure, transport, communications and water supply sectors suffered damage of € 192.1 million. More than 50 municipalities were affected by the floods, while many cities and towns suffered substantial damage. The first report by the Republic of Serbia to the UNFCCC points to water management, forestry, agriculture, biodiversity and nature protection, and health as potentially the most vulnerable sectors to climate change [9]. In recent decades, global warming has caused profound changes in forest areas in Serbia. Frequent fires have caused an estimated € 465 million in loss, while drought damage in the period 2000-2009 amounted to RSD 36.5 billion [28]. According to data from the Serbian Chamber of Commerce and the Institute for Agricultural Economics in Belgrade, drought damage in 2012 amounted to over € 2 billion and in 2011 to about € 500 million [29]. At the same time, the intensity and extent of afforestation have been reduced from 20,000 hectares to less than 3,000 hectares a year, together with a decline in the quality of available forests.

Based on [30], the share of weather-dependent sectors in total gross national income, excluding Kosovo and Metohija, in 2005 is amounted to 47.18%, with estimated annual losses only in the agriculture and water management sectors (as highly sensitive) with several dozen casualties and close to 85 million euros of in material damages annually. Estimates of potential annual losses for all weather-sensitive sectors include more than 100 casualties and between 130 and 400 million euros in material damages per year.

Approximately 18% of the territory of Serbia is threatened by floods (~500 major settlements, ~500 large commercial buildings, ~1200 km of railway and ~4,000 km of roads) [31]. Climate change is expected to contribute to increased vulnerability to floods through the occurrence of more intense rainfall, as well as through more frequent incident of large waters [32]. Total reported economic losses in Europe caused by extreme climatic events from 1980 to 2013 amounted to approximately € 400 billion, while average annual losses increased from € 7.6 billion in the 1980s to 13 billion euros in the 1990s and 13.7 billion euros after 2000 [24],
while the number of climate extremes in the NatCatSERVICE database increased from 80 to about 140 per year between 1980 and 2016 [25].

3. POTENTIAL CLIMATE CHANGE THREATS ON THE SECURITY OF BIOPHYSICAL SYSTEMS

So far, studies of the consequences from climate change have focused primarily on security of human systems overlooking the mediating role of ecosystems and the services they provide to society. Losses and damages to human systems are often caused by permanent or temporary disturbances to ecosystems services caused by climatic stressors.

Evidence of the observed impacts of climate change is the most comprehensive for natural systems. The impacts of unfavorable climatic conditions, such as heat waves, droughts, floods, cyclones, and forest fires, cause change and reveal significant damage to many ecosystems and their provisioning services (e.g. provision of food, water, fuel and wood or fiber), regulating services (e.g. climate, disease regulation and water purification), and supporting services (e.g. soil formation, nutrient cycling and primary production) [33]. Impacts on human systems security can be direct, or indirect through damage to natural systems and the ecosystem services they provide to society.

Oceans are one of the key elements in the climate system, as they affect weather patterns both locally and globally. Changes in the climate system, such as warming and increasing the concentration of greenhouse gases, can lead to warming and increasing acidity of the oceans, which can have major consequences on the functioning of marine ecosystems, in terms of their productivity and reduction of biodiversity and consequently lead to quantitative and qualitative regressive changes in ecosystem services [34].

Freshwater systems are essential for the functioning of all ecosystems and almost all human activities, and are closely linked to changes in the climate system. Any change in the climate system affects the hydrological cycle. In this sense, the impact of climate change is most clearly reflected in the possible changes in the spatiotemporal distributions of water resources, such as seasonal changes in total water flow in rivers, dynamics of extreme rainfall and droughts, etc. [6]. Moreover, changes in precipitation and melting trends of glaciers in many regions affect hydrological cycles, and consequently the water security in terms of its available quality and quantity. In response to changing climatic conditions, many terrestrial, freshwater species have shifted their habitats to new geographic areas, seasonal activities, and migration patterns [35].

Climate change will produce a broad range of beneficial and negative impacts on terrestrial ecosystem biodiversity, both at the level of genetic change and at the ecosystem level. Some of the changes include increased risk of species extinction, migration [6], and changes in phenology and distribution of certain species [36]. Changes can lead to confusion in the life cycle context of certain species and food sources [37]. Changes in soil moisture (caused by evaporation, droughts, or even heavy rainfall), and increased erosion from the wind and water will affect retention capacity as a key soil feature in the hydrological cycle, and decrease soil productivity in many areas [6] affecting food security of human settlements.

In terms of biodiversity and natural ecosystems in Serbia, climate change can lead to changes in phenological cycles, physiology and behavior of certain species, cause morphological changes, loss of existing habitats and new species, changes in the number and distribution of species, as well as increased number of pests and diseases, genetic changes and extinction of certain species with lower adaptive capacity [16].
Forests are a vital source of food, water, timber, energy and are a habitat for many plant and animal species. Changes in the temperature and distribution of precipitation will affect the health and productivity of forests and forest ecosystems services in various ways, which can cause significant environmental and economic consequences. Climate change is also expected to significantly intensify forest fires [6]. Forest fire risk estimates a possible increase in 21st century wildfire territory by 50% for the scenario up to a mean global temperature of 2°C, and up to 200% for the A2 scenario without additional measures [38]. For scenario A1B, without adaptation measures, it is estimated that 300,000 people per year will be affected by river floods in EU countries by 2050, and 390,000 people by 2080, depending on the scenario, from sea floods to the end century to be endangered between 775,000 and 5.5 million annually [24]. Droughts, insect invasions and forest fires have significantly affected forest ecosystems in Serbia. In the long term, anticipated climate change can lead to significant transformations of forest ecosystems, shifting its boundaries, increased risk of endangered species, as well as altered distribution and composition of forests in Serbia. For example, by the end of the century, almost 90% of beech forests will be found outside of their natural bioclimatic habitats, while 50% will be found in areas where a significant rate of forest extinction can be expected [16]. Furthermore, long-term effects include, among other things, increased intensity of forest fires and a general decrease in forest biodiversity. Climate scenarios predict more frequent extreme events, with the expectation that intensification processes will be intensified in the future.

Given the foregoing, and the fact that the security of many vital human systems is directly dependent on the state of ecosystems, the seriousness of the challenges that potential climate impacts on biophysical systems pose in this respect is obvious.

Trend analyzes show that the entire territory of Serbia has been facing a significant increase in temperature since the middle of the previous century with eight of the ten warmest years have been recorded since 2000 indicate a significant increase in mean maximum and minimum daily temperatures. Moreover, in this period there was a significant increase in the number of summer days, tropical nights, duration of heat waves, an increase in heavy and extreme rainfall indices and a decrease in the number of frosts and ice days [39]. The climate changes projection for Serbia foresees the continuation of the observed temperature rise trends for the A1B and A2 scenario. Precipitation is expected to decrease significantly by the end of the century. As with the temperature, the most pronounced precipitation deficit is expected during the summer season. Also, the scenario A2 predicts a drier climate in the last observed period, with rainfall decreasing as much as 30% in some parts of Serbia [16, 40, 41]. Thus, it is highly likely that aforementioned security issues will be increasingly challenged in the future.

4. CONCLUDING NOTE

The intensity of greenhouse gas emissions in relation to the national product in Serbia is many times higher than the world average. In this regard, in proportion to its territory, population and size of the economy, Serbia contributes significantly to global warming and climate change [42]. Reducing the negative and taking advantage of the positive effects of climate change on the security of social and biophysical systems calls for the urgent integration of climate change adaptation aspect into all levels of planning, development policies and sectoral strategies and plans. Management of the effects of climate change on diverse issues of security is a complex management process and requires decision-making under uncertainty, which involves considering a number of factors, which makes the decision-making process itself more complex. Although the legal and strategic framework that will come along the adoption of Law on Climate Change will provide guidance and commitments for beginning of the activities in this domain, for their consistent and effective implementation it is crucial to
develop national decision support system for managing adaptation projects at national and subnational level. The absence of a unified system may delay the start of synchronized activity at all spatial-management levels which may further contribute to the growing insecurity of social and biophysical systems under the changing climate.

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REFERENCES


8


PHISHING AND PHARMING ATTACKS AIMED AT
IDENTITY THEFT OF INTERNET USERS

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Abstract: Phishing and pharming, as a form of identity theft of Internet users are increasingly presents in modern world. The goal of phishing and pharming is to obtain confidential information about the identity of the person. Phishing and pharming are a kind of combination of social engineering and technical possibilities of modern information and communication technologies. Some examples of phishing and pharming attacks are: false alarms of banks, false administrator messages, corruption of the DNS services on the computer system by malicious code. The study found that many subjects across the world were attacked by phishing and pharming attackers. The research used normative methods and legal and logical methods of induction and deduction. This paper is the part of research project No. 47009 (European integrations and social-economic changes of the economy of Serbia on the road towards the EU), financed by the Ministry of Education, Science and Technology of the Republic of Serbia.

Key words: Identity theft, phishing, pharming, law, security

1. INTRODUCTION

Phishing and pharming represents a form of cyber-crime based on the methods of social engineering. This form of cyber-crime is becoming more dangerous and cause increasing damage to citizens and businesses.

The term "phishing" first appeared in 1996 when a group of hackers stole usernames and passwords of AOL account through an email message, "hook" on which the service AOL users "hooked" [11]. The term Phishing originates from the analogy that the fraudster uses e-mails as bait to fish for profitable personal information from an unsuspecting sea of Internet users [7]. Phishing refers to a method used by identity thieves to acquire personal information (e.g., names, passwords, Social Security numbers and credit card details) by using fraudulent e-mail messages that appear to originate from a legitimate business [7]. During perform a phishing attack, the phisher uses a combination of technical fraud and so-called social engineering [6].

In the majority of cases the phisher must persuade the victim to intentionally perform a series of actions that will provide access to confidential information. Communication channels such as email, web-pages, IRC and instant messaging services are popular. In all cases the Phisher must impersonate a trusted source (e.g. the helpdesk of their bank, automated support response from their favorite online retailer, etc.) for the victim to believe [12].

A typical Phishing attack utilizes the following steps: In the first phase, the phisher sends an e-mail that appears to originate from a legitimate business. Phishers usually achieve this by
using familiar trademarks, tradenames and other common corporate identifiers. After that, in the second phase, the Internet Service Provider delivers the e-mail—which operates as bait—to an unsuspecting Internet user. The email typically creates a false sense of urgency by informing the user that there is a problem with his or her account. The e-mail then requests personal information from the user in order to validate the account. In the third phase, the recipient enters personal information or clicks on a phony website that mimics the appearance of the organization mentioned in the e-mail. Finally, in the fourth phase, The Phisher uses the information to commit identity theft and/or fraud [1].

There are several forms of phishing. For identity theft from personal computers that are in the system of the Internet a large number of methods is developed and their precise separation is practically impossible, but it can extract two basic forms: phishing with subdivisions vishing and smishing, and application of malware, from a subset of pharming [5].

The goal of phishing is to obtain confidential information about the identity of the person, identification number, user name and password, PIN, and other sensitive information. Some examples of phishing attacks are: false alarms of banks, false administrator messages, false messages about lottery winnings, fake sms-messages.

Another type of cybercrime that appeared in practice is called "pharming". Pharming, a portmanteau of the words "phishing" and "farming", is a type of cybercrime very similar to phishing, where a website's traffic is manipulated and confidential information is stolen. Pharming exploits the foundation of how Internet browsing works — namely, that the sequence of letters that form an Internet address, such as www.google.com, have to be converted into an IP address by a DNS server in order for the connection to proceed. This exploit attacks this process in one of two ways. First, a hacker may install a virus or Trojan on a user's computer that changes the computer's hosts file to direct traffic away from its intended target, and toward a fake website instead. Second, the hacker may instead poison a DNS server, causing multiple users to inadvertently visit the fake site. The fake websites can be used to install viruses or Trojans on the user's computer, or they could be an attempt to collect personal and financial information for use in identity theft. Pharming is an especially worrisome form of cybercrime, because in cases of DNS server poisoning, the affected user can have a completely malware-free computer and still become a victim. Even taking precautions such as manually entering in the website address or always using trusted bookmarks isn't enough, because the misdirection happens after the computer sends a connection request [8].

According to Phishing Activity Trends Report, the total number of phish detected in 1st quarter 2019 was 180,768. That was up notably from the 138,328 seen in 4Q 2018, and from the 151,014 seen in 3Q 2018. In 1Q 2019, APWG member MarkMonitor saw phishing that targeted Software-as-a-Service (SaaS) and webmail services jump to 36 percent of all phishing attacks. That’s up significantly from 30 percent in 4Q 2018 and 20.1 percent in 3Q 2018. Phishing against the SaaS and webmail category became the biggest category of phishing, eclipsing phishing against the payment services category for the first time. Attacks against cloud storage and file hosting sites continued to drop, decreasing from 11.3 percent of all attacks in Q1 2018 to just 2 percent in 1Q 2019. Founding APWG member MarkMonitor is an online brand protection organization, securing intellectual property and reputations through anti-fraud, brand protection, domain management, and anti-piracy solutions [2].

PhishLabs has been tracking the numbers of phishing sites protected by the HTTPS encryption protocol. HTTPS is used to secure communications by encrypting the data exchanged between a person’s browser and the web site he or she is visiting. HTTPS is especially important on sites that offer online sales or password-protected accounts. Studying HTTP on phishing sites provides insight into how phishers are fooling Internet users by turning an Internet security
feature against them (typically by using the HTTPS protocol’s lock icon in the browser address bar to assure users that the domain itself is ‘safe’). PhishLabs provides managed security services that help organizations protect against phishing attacks targeting their employees and their customers. In Q1 2019, 58 percent of phishing sites were using SSL certificates, a significant increase from the prior quarter where 46 percent were using certificates,” said John LaCour, CTO of PhishLabs. There are two reasons we see more. Attackers can easily create free DV (Domain Validated) certificates, and more web sites are using SSL in general. More web sites are using SSL because browser warning users when SSL is not used. And most phishing is hosted on hacked, legitimate sites [2].

2. LEGAL REGULATION OF PHISHING AND PHARMING IN THE EUROPEAN UNION


Special attention regarding phishing scams has been taken in new GDPR Regulation. Some provisions in this Regulation are relevant for this research. First of all, Article 7 stated: Where processing is based on consent, the controller shall be able to demonstrate that the data subject has consented to processing of his or her personal data. If the data subject’s consent is given in the context of a written declaration which also concerns other matters, the request for consent shall be presented in a manner which is clearly distinguishable from the other matters, in an intelligible and easily accessible form, using clear and plain language. Any part of such a
declaration which constitutes an infringement of this Regulation shall not be binding. The data subject shall have the right to withdraw his or her consent at any time. The withdrawal of consent shall not affect the lawfulness of processing based on consent before its withdrawal. Prior to giving consent, the data subject shall be informed thereof. It shall be as easy to withdraw as to give consent. When assessing whether consent is freely given, utmost account shall be taken of whether, inter alia, the performance of a contract, including the provision of a service, is conditional on consent to the processing of personal data that is not necessary for the performance of that contract.

Further, in Articles 25 and 32 GDPR Regulation, it states that taking into account the state of the art, the cost of implementation and the nature, scope, context and purposes of processing as well as the risks of varying likelihood and severity for rights and freedoms of natural persons posed by the processing, the controller shall, both at the time of the determination of the means for processing and at the time of the processing itself, implement appropriate technical and organisational measures, such as pseudonymisation, which are designed to implement data-protection principles, such as data minimisation, in an effective manner and to integrate the necessary safeguards into the processing in order to meet the requirements of this Regulation and protect the rights of data subjects. The controller shall implement appropriate technical and organisational measures for ensuring that, by default, only personal data which are necessary for each specific purpose of the processing are processed.

According to Article 33 of GDPR, in the case of a personal data breach, the controller shall without undue delay notify the personal data breach to the supervisory authority competent, unless the personal data breach is unlikely to result in a risk to the rights and freedoms of natural persons. Further, when the personal data breach is likely to result in a high risk to the rights and freedoms of natural persons, the controller shall communicate the personal data breach to the data subject without undue delay. The controller shall document any personal data breaches, comprising the facts relating to the personal data breach, its effects and the remedial action taken. That documentation shall enable the supervisory authority to verify compliance with this Article.

Whatever the solutions in GDPR Regulation, in practice an increasing number of phishing scam relating to this Regulation, before and after its entry into force, were registered.

In the Republic of Serbia, there is no unique legal act in conjunction with phishing and pharming, but some legal acts are especially relevant for phishing and pharming: Criminal Code of The Republic of Serbia and Law on Electronic Commerce. In Serbian Criminal Code some articles are important: article 208 (fraud), article 238 (unauthorized use of another's business name and other special mark of goods or services), article 243, paragraph 4 (forgery and abuse payment cards), and article 301 (computer fraud). On the other side, in Law on Electronic Commerce, very important is Article 8, which stated that sending commercial messages by electronic means, shall be permitted only with the prior consent of the person to whom has that kind of message is intended. Also, there is a fine of 100,000 to 1,500,000 dinars for a legal entity - the service provider, if it send unsolicited commercial messages without the prior consent of the person to whom such a message is intended.

3. SOME EXAMPLES OF PHISHING AND PHARMING ATTACKS

Practice shows that phishing affects the whole world. For example, a critical Pharming attack was reported in 2006 in Microsoft Corp’s software, where the attackers rigged the website with malicious code. The attackers also installed a "bot" on users' PCs, which gave the attacker remote control of the infected machine. The organizations should encourage the employees to enter the login credentials only on HTTP protected sites to prevent any pharming attacks. Even
the companies should implement proper security upgrades issued by a trusted Internet Service Provider (ISP) [3].

Further, in early April 2019, the Mimecast Threat Center team was alerted to a rare type of server-parsed HTML (SHTML) based phishing attack emerging from the UK. When users opened attachments in these phishing campaign emails, they were immediately redirected to a malicious site requesting sensitive information. Overall, 55% of this campaign was distributed in the UK, 31% in Australia, 11% in South Africa and 3% elsewhere. In the UK and South Africa, the finance and accounting sectors were mainly targeted, while in Australia it was largely the higher education sector. This phishing attack was unique in that it utilized SHTML file attachments, which are typically used on web servers [9].

In July 2019, Lancaster University students’ data stolen in cyber-attack. Records and ID documents of some Lancaster University students were accessed in the phishing attack and fraudulent invoices were sent to undergraduate applicants, a spokesman for the university said. Data from undergraduate applicants for 2019 and 2020, including their names, addresses, telephone numbers and email addresses, was accessed and fake invoices sent to some potential students [10].

Also, in 2019, cybersecurity firm McAfee reported that a popular phishing kit, called 16Shop, has recently turned its attention to Amazon. While the kit has been designed to scam Apple customers, a modified version is now targeting Amazon shoppers just in time for one of the biggest shopping days of the year. 16Shop enables malicious actors to send out emails disguised to look like they come straight from Amazon itself. The emails have PDFs attached that contain links that direct victims to a website that looks essentially identical to the Amazon login page. Of course, it’s not really an Amazon site. Instead, it’s a site designed to harvest information from unsuspecting victims who find themselves on the page. If you enter your login information and password, it is relayed to the malicious actor behind the scheme via Telegram message. Once they are in possession of those login credentials, they can access a considerable amount of your private information. Your Amazon account likely contains your full name, home address, birthday, credit card information and, in some cases, even your Social Security number. That’s all the information an attacker would need to commit a considerable amount of identity fraud or rack up charges on your card without your permission. If you use the same login information for other accounts, the attacker could also gain access to those, and any personal information that may be stored by or linked to those accounts [4].

4. CONCLUSION

Based on the foregoing, it can be concluded that the phishing attack will be more dangerous in the future. The whole world is in danger due to phishing and farming attacks. It is therefore necessary to take appropriate protection measures. First of all, the recipient of a potential phishing email must carefully check the email address of the sender and determine whether it has even small imperfections that are, in fact, the main indicator of potential fraud. Every person should never reply to email messages that ask for the submission of any personal information, especially if in an email asking them to confirm or update sensitive information. Also, everybody must avoid leaving personal data in e-mails that are sent. Fourth, if purchased over the Internet, people can use a credit card with a low credit limit, because they reduce the potential for harmful consequences. Finally, it is necessary to adopt uniform legislation to regulate phishing and farming, with stricter penalties for breaching the provisions.
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COOPERATION BETWEEN THE PRIVATE AND PUBLIC SECURITY IN ORDER TO REALISE SECURITY SYSTEM

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Abstract: The author discusses the theoretical interpretation of private security, comparing it through the practice of countries in which the private security system has long been developed and accepted as inevitable. For the sake of closer understanding of the cooperation between private and public security that appeared on the former Yugoslavia territory in the mid-1990s, its development is illustrated through the legal solutions of Serbia and Croatia. By analysing the theoretical consideration of the relationship between public and private security, practical solutions in major countries of the world, which have tradition in private security, as well as the newer solutions in some countries created by the breakup of the former Yugoslavia, at least five models of private security and police relations can be reached. The aim of this paper is to confirm the necessity for continuous improvement of the private sector and police relations, which is aimed at strengthening the country’s security system. In order to avoid any abuse of the private security sector, it is necessary to clearly define it by law, which will, inter alia, define the control method of the private security sector. The content analysis and comparison method proved to be successful in the subject matter realisation.

Key words: private security, public security, law, model

1. INTRODUCTION

The breakup of the socialist bloc, Socialist Federal Republic of Yugoslavia (SFRY), numerous socio-political, economic, social and other changes have also led to some significant changes in the security sector. Namely, the changes that occurred in the ownership of property, disappearance of social property and the expansion of private property, have also affected the security sector hitherto. The state is no longer the exclusive holder of property protection rights and some new entities, labelled as Private Security, are emerging. Although it is already well-known in the west, where it is also deeply rooted, it is completely unknown in our region. This scepticism about “something new” was further fuelled by prejudices that were based on ignorance, lack of information, rejection of inevitability of the changes that emerged. By accepting the current trends, these prejudices have disappeared, and the state, i.e. the state security sector, sees a useful partner in the private sector, as it strives for the same goal. The initial transition period in the security sector was fraught with problems, which reflected in the lack of legal regulations which would set the criteria for establishing and operating private security companies. In addition to the criteria, the law clearly defines the competence of the private security sector in comparison with state (conventional) entities of the security system. The state, certainly, remains the supreme authority when it comes to security. This authority over the private security sector is reflected in the fact that the state controls the private security sector through its establishment, operation and provision of services. On the other hand, the private security sector has a primarily preventive character, while repression remains the
responsibility of the state, i.e. the police. Regarding this, the cooperation between the public and private security sector must be continuous, appropriate and on time, in order to detect and eliminate security threats in a timely manner.

2. PRIVATE SECURITY - DEFINITION, PURPOSE, IMPORTANCE AND CONTENT

There is no complete agreement on the content of the private security concept. In 1976, the term “private security” was defined in the US Government report as an activity of privately funded business entities and organisations and self-employed people, who provide security-related services to specified clientele on a part-time basis, or to other entities which hire or employ them, or working for themselves, with the aim of protecting people, private property or interests from different risk types[11]. Private security is also defined as the security subsystem in the national security system, the basis of which is mainly the contracts concluded between the entities performing these tasks and the contracting authorities[1]. The term “private security sector” also refers to commercial security services provided by legal entities that are registered for it, as well as to private companies that have legal obligations to comply with certain security protection standards and procedures[4]. Basically, two basic approaches to defining the private security concept can be observed – the broader and the narrower one. According to the broader approach, private security is a set of organised forms of actions by voluntary and commercially-oriented non-state personnel, whose primary activities include confronting the various forms of criminal behaviour. Defined in that way, the private security includes: voluntary citizen engagement, private security business and private detective or investigative activity. The narrower approach defines private security as a set of legally based professional-type activities, outside the purview of state bodies, organised to provide certain services to protect personal and property security of citizens and to collect information. Private security defined in such a way includes: contract security (activities of private companies and agencies specialised in providing physical and technical security services on a contractual basis), own internal security and private detective activity[5]. Based on the fore-mentioned, it can be concluded that the private security concept has a dual meaning. On the one hand, it may refer to the provision of security services performed by privately owned companies or to those services themselves, i.e. security services performed upon the request of private individuals or business entities. It also allows the possibility for a public authority to hire a private company to provide certain security services, which inevitably extends the notion of private security. Therefore, in the broadest sense, the term “private security” could include all security activities not performed by the state itself and its authorities, while the private security sector would include private security companies and/or security products[6]. The aim of the private security is to contribute to the successful detection and elimination of security threats by professionalism and responsibility, thus contributing to a favourable security environment. There is, of course, an economic reason for achieving this aim, because it is a for-profit business. Market requests, supply and demand, purchasing power of the society, the security environment, certainly influence the design and achievement of the private security sector goals. The general importance of private security sector is reflected in the understanding of private security entities which are factors for security establishment and crime reduction, through the legal formulation of their work, increasing the citizens’ peace in conditions of increased presence and visibility of various protection and control forms, citizens often addressing the private security when they spot criminal or other illicit behaviour, and through citizens’ education on how to fight crime and security disruptions (taking previous preventive measures and preventing the escape of perpetrators of criminal offenses, informing the police, securing the scene etc., with private security emerging as a partner professionally performing the part of the security work and providing highly specialised services)[7]. The private security
entities’ activities cover a wide security area regarding the individuals’ protection, property and business protection, which in scope and quality exceeds the basic security standards that the state guarantees to every citizen. One should bear in mind that in the second half of the 20th century, there was a rapid growth and diversification of jobs performed by private security actors globally. These activities and jobs can be classified into the following main groups: private companies for physical and technical security and protection; detective agencies (private investigator jobs); security consulting, marketing and engineering agencies; entrepreneurs and individuals who provide certain security services (detectives, advisers, body-guards) as a registered activity. Regarding this, the most common actions and measures that are applied in modern conditions in individual’s protection, facility and business protection are: physical and technical protection measures (anti-theft measures also), and sanitary-technical, biological, chemical and health protection measures[8].

3. PRIVATE SECURITY SYSTEM

Private security system is a subsystem in the internal security system, which includes forces, their organisation and function, as well as a series of actions and measures within the physical and technical protection, in order to prevent various criminal and long-term threats to the security of individuals, property, business, for the purpose of clearer protection of certain facilities and other legal and natural persons who work or reside in them, but are not under the exclusive protection of state authorities. The entities involved in the private security system can be divided into internal and external. Internal entities include: managers- of all levels, in a broad sense, whereas in a narrow sense, only employees in the protection business are internal entities. External entities are: police, courts, prosecution, inspection authorities, communal police, local self-government authorities, public companies, as well as other legal entities affection private security.

4. PRIVATE SECURITY BUSINESS

Legal entities and entrepreneurs for private security, under the conditions prescribed by law, may be licensed for the following types of business:
- risk assessment in individual, property and business protection;
- individual and property protection by physical and technical means;
- maintaining order at public meetings, sporting events and other places of citizens’ gatherings in the area outside the jurisdiction of the Ministry of the Interior;
- technical protection system implementation planning, designing and supervision, installation, commissioning, maintenance of the technical protection system and user training;
- money transport and transfer provision and value shipments in the area that is not within the jurisdiction of the Ministry of the Interior.

5. COMPARING THE PRIVATE AND PUBLIC SECURITY SECTORS IN SERBIA AND CROATIA

Serbia

The Law on Private Security was adopted by the National Assembly of the Republic of Serbia at the end of 2013, and it stipulates that regulations for the implementation of this Law would be adopted within the 6 months from the day the Law enters into force, and that legal entities and entrepreneurs for private security, as well as the natural persons performing private security business must harmonize their work with the provisions of the Law within the 18 months from the day the Law enters into force. Bylaws should have completely regulated the vocational education and training of private security officers, on the basis of the analysis of the educational need to prepare training programs, prescribe all necessary conditions that legal
entities and entrepreneurs must satisfy in order to be granted the possibility to perform the mentioned training, prescribe the uniforms for private security members, the way of using the coercion means, the way of performing the technical protection, the legitimacy content and appearance of the private security officers, as well as to prescribe the criteria for determining the mandatory security facilities and minimum technical conditions for the mandatory installation of technical protection systems in banks and other financial institutions. In accordance with all the above-mentioned, the six-month deadline for the adoption of the bylaws in Article 85 of the Law turned out to be too short to fulfil the said obligations. The data from CoESS (Private Security Services in Europe, CoESS Facts and Figures 2011, p. 103) indicate that the private security sector in Serbia is growing steadily. The Law on Private Security (“The Official Gazette of the Republic of Serbia”, no. 104/13) regulates the obligatory security and protection activities of certain facilities, jobs, legal and natural persons’ jobs in the field of private security, conditions for their licensing, manner of conducting business and supervising the work. The Law on Private Security aims to: - fully regulate the activities of mandatory security and protection of certain facilities, as well as the activities of legal and natural persons in the field of private security; - to regulate the conditions for licensing of legal and natural persons for conducting private security operations; - to regulate the issues of training, passing the professional examination, and licensing of individuals for conducting private security activities; - to regulate the manner of conducting private security operations, the authorisation of private security officers, keeping records, as well as supervising the implementation of the Law. In the current circumstances, the application of the Law will not give expected results. In a better case, a considerable part of the security personnel will not complete the training within the legal deadline and will be subject to the sanctioning policy of the supervising authority. In a worse case, the actors in training and testing will lower the criteria in order to arrive in time to achieve the results required by the Law. It is thought that the job could be done poorly, in order to achieve the set goals. That would leave Serbian society in suspense, since the following license renewal cycle is in five years time. If this bad practice is not eliminated, the situation with poorly understood deadlines could be repeated, and the state is the most responsible entity for ensuring that the Law is enforced consistently and under equal conditions.1

Croatia

In Croatia, private security was originally regulated by the Law on Person and Property Protection from 1996, as amended in 1996 and in 2001. Security services offered by private security companies in Croatia are the following: physical security, physical control of entrance and exit, technical supervision and protection, cash and value protection during transportation (using armoured vehicles), personal protection, technical surveillance services in which the burglar alarm and fire prevention system are connected to the central control system. The Law on Private Security regulates the individual and property protection activity performance manner which is not provided by the state through its services and authorities. Private security operations may only be performed by registered legal entities, whereby the private security company founder may only be a natural person who has the police department approval. The Law on Private Security from 2010 introduced some new solutions that express high standards in the field of private security. Thus, the relationship between the police and the private security sector was established, as well as the responsibility of these entities when controlling and fighting crime. Also, the same Law repeals the restrictions on security companies which

1 The National Assembly of Serbia adopts amendments to the Law on Private Security, which provides for the deadline extension for implementation of that Law to January 2017, by which time the training of all private security officers must be completed. May 8, 2015
provided certain jobs, especially those related to the possibility of providing private security for the state authorities and representative authorities, i.e. municipalities, cities and counties[9]. The Law on Private Security requires private security sector members to undergo training and to pass examination at a licensed institution. However, individuals who were previously employed with the police, military police, security services, former court and prison guards and bailiffs are exempted from the examination if they have three years of work experience within these institutions.¹ Training can be conducted by institutions that have been approved by the Ministry of the Interior. The candidate who completes the security guard or bailiff training shall take the professional examination before the examining panel, appointed by the Minister of the Interior by Decision [10].

By analysing private security in Serbia and Croatia, it can be concluded that Croatia has long before understood the importance of private security due to its contribution to creating a favourable security environment for all citizens. The animosities that were initially present between the police and the private sector disappeared. There are no significant deviations in regulations in this area. They are present in the part related to the scope of work, so in Croatia it is allowed for the private sector to be engaged in certain jobs through state authorities, while it is forbidden in Serbia. Serbia has the opportunity to study the experience of the region during this entity’s design, thus avoiding the unnecessary stress and the repetition of mistakes made by others. In any case, the private security sector in Serbia has a quality basis for private security sector development.

6. PRIVATE SECURITY - POLICE RELATIONSHIP MODELS

Basically, the cooperation between police and private security entities should take place within the limits of their competences and powers, which state and non-state security entities may apply in certain situations. This cooperation may be initiated by either party, but in practice, it often occurs upon the request of the police, in situations where police officers are authorised to intervene and take appropriate measures, especially if individual or property security has been compromised. Some domestic authors argue that the nature of the relationship between the private security and police in the Republic of Serbia is characterised neither by cooperation nor rivalry. In such a milieu, private security cannot be treated equally, so the cooperation is only realised in the field of assistance to police authorities. Other theorists point out that the relationship between public and private security is characterised by unequal partnership, whereby their cooperation is not institutionalised, but is realised on a case-by-case basis, and its form depends on the level vital value protection provided [3]. It is also thought that the relationship between private security and the police is characterised by the following models: independence, complementarity, cooperativeness and partnership.

a. Independence
Independence is a model that implies that both private and public security actors have their own defined tasks, with these actors almost never making contact.

b. Competitiveness
Competition means a model of the relationship between private security and the police that lacks mutual trust. According to this model, the relationships of these security actors are characterised by competitive bidding for jobs, which most often makes it difficult and even impossible for them to cooperate.

¹ The training content and manner of passing the examination are regulated in more detail by the Rulebook on Training and Professional Examination, The Official Gazette of the Republic of Croatia, no.103/04 i 42/13.
c. Complementarity
Complementarity is a relationship model between private security and police, in which private security and the police coexist in the security service market side by side, with clear, precise boundaries in task distribution, along with complementarity in the conduct of their activities.

d. Cooperativeness
Cooperativeness defines a relationship model between private security and police, based on mutual cooperation, expressed through mutual support, with the aim of empowering each of the participants.

e. Partnership
Partnership is a relationship model between private security and police, where both security actors achieve the highest level of cooperativeness in action and complete equality between participants whose activities are aimed at achieving the mutual goal [8].

7. CONCLUSION
Relationship between private security and the police, freed from prejudices, intolerance, are essential for security system realisation and functioning in any modern society. Private security by the state can neither be neglected nor disputed. With such a negative attitude, this subject can easily go from security to non-security, which would significantly endanger the security system. The state should recognise the importance and role which the private sector can play in supporting state entities, and due to its position, determine it within the legal limits, thus preventing any abuse of the private security sector. The clear legal regulations will allocate competences in the security system; clearly specify the tasks and responsibilities for those tasks’ realisation. Through cooperation, the information exchange between the public and private sectors significantly narrows the space for criminal activity, which is of interest to every society. In doing so, one should not neglect the experience that countries have in these activities, especially the region with which we share similar security issues.

REFERENCES
RELIGIOUS CONFLICTS AND SECURITY CULTURE

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Abstract: There is a lot of various social conflicts in today’s modern world, among which religious conflicts are the most present and as such have an important place in security discourse. Security culture as one of the most important factors in the prevention of social conflicts, seen from a security perspective, places religious conflicts as necessary and as priority. People today and society as a whole live in an environment where unfreedom is on the scene and where the causes and processes of security threats need to be thoroughly investigated. In that context, this Paper aims to highlight primarily religious conflicts, their causes and consequences, but also point to security culture as one of the most important factors in the prevention of religious conflicts. Also, the Paper emphasizes the importance of pointing out the need to individuals, social groups, and especially the social and political elites, for the importance of security culture in the context of these social conflicts.

Keywords: Conflict, religious conflict, security, security culture, prevention.

1. INTRODUCTION

Looking at the current processes and changes present in today's modern society, a society full of various security challenges and threats, conflicts and conflict situations are certainly an inevitable and accompanying phenomenon. Also, by raising people's awareness of their rights and freedoms, capital transformation, open borders, faster flow of goods and services, scientific and technological development, endangering of religious freedoms and other causes increasingly contribute and benefit to today's conflicts. Most of the people have experienced conflict in some way, whether personally, or within a group or wider community. In a way, from a sociological point of view, conflicts are a kind of expected phenomenon among people, because people are different, and this difference is reflected in desires, political determination, sports and music taste, nation, religion, etc. Such persons will produce consequences that will result in conflict, in ordinary communication or any other relationship, so it can be rightly said that conflicts are an everyday and integral part of life. As well as word “security”, word “conflict” also became domesticated not only in the professional public, but also in everyday communication with people, electronic and written media, and especially in scientific discourse. The word itself in the foreground reminds on something with a fundamentally negative connotation, conflict or intolerance. However, the negative connotation is more linked to the conflicts in the past, while in the present period the negative sign is slowly fading away from the conflict, and they are increasingly viewed as a kind of phenomenon that does not have a necessary negative connotation in basic, but conflicts can produce the consequences of a constructive and destructive character. The consequences regarding conflicts, primarily depend on how they are managed. There are many different conflicts that arise, but it is certain that religious conflicts are becoming more frequent. Religious conflicts have existed in the distant past, they still exist today, and they will continue to exist in the future and will not disappear so quickly. Their frequency and duration are indicated by historical events and facts, which is why they are singled out as prevalent, not only within one country, but also at regional
and global level. Each conflict produces a certain consequence, but the consequences produced by religious conflicts in many cases are very serious and dangerous, and are usually an introduction to large-scale conflicts and huge consequences, primarily referring to armed conflicts between people, groups, nations and countries. They are also an introduction to economic, sports, cultural and geopolitical conflicts. Interest in religious conflicts has always existed, as religious conflicts are closely linked to religion, and religious beliefs and feelings are of great importance for individuals and groups. Conflict by itself imposes the need for its resolution, especially timeliness and prevention to influence on the causes that lead to conflict. Conflict resolution and its prevention is accessible to all and in these diversity processes it is a real challenge for everyone to tackle diversity.

Conflicts stimulate people to develop as personalities in their resolution and to strengthen their personal capacities. By nature, conflicts, and most often religious ones, had a certain connection with security and security culture. Security is fundamentally interested in all causes and phenomena that threaten the normal functioning of people, society, government bodies and institutions at all levels of organization, from local to global. Each form of conflict in some way represents a degree of negativity, which can turn into a security challenge and threat. A particular challenge are the conflicts that, with their destructive consequences, produce such a form of violence that directly threatens human lives and material goods. For that reason, majority of people, especially security entities and the scientific public, seek to find the best solutions for conflict prevention and resolution. Security culture, as a prevention factor, primarily addresses the issue of conflict resolution. In resolving religious conflicts the security culture is especially important today because of the increasing radicalization of social problems in the world, but also in our country.

2. RELIGIOUS CONFLICTS - DEFINITION, CAUSES AND CONSEQUENCES

Just as the study of conflict is quite complex, its definition is also accompanied by certain difficulties. The complexity of both studying and defining conflicts is reflected, first and foremost, by the great number of scientists who deal with and write about conflicts from different scientific disciplines. An additional difficulty in definition and defining them universally is the multitude of different types of conflicts. We still do not have a unique and universal definition in the context of the complexity and difficulty of defining conflicts. Regarding that, Beridan states “the task is simply difficult because the term has a broad interdisciplinary meaning, but also because it derives a large number of specific lower-order terms that characterize certain social phenomena. As a category, conflict has its philosophical, scientific as well as religious significance. In fact, etymologically, his interpretation from Latin is multiple: conflict (conflictare –to hit what from what; fight), conflict, dispute, debate that threatens to become more entangled, struggle, war, armed collision” [1, p. 17]. By itself, conflict represents negativity, it associates with riots, fray, war, psychopathology and as such has a very bad reputation. The complexity of the phenomenon of conflict has always been considered, from the earliest times, and today. Today there are also many theories that speak in the context of its complexity for definition and defining, so according to Milasěnović et al. “The complexity of the phenomena of social conflict sufficiently speaks its treatment as something unnatural and undesirable (early functionalism), to the understanding that they are an element of essence of social life, that they contribute to the cohesion of society and its integration. Their complexity is also evident in the views that they are the main driver of social development (Karl Marx), the disease to be treated (Kont), the materialization of life force, the will for power (Gumplowicz, Ward), or the tool of the "chosen" to subjugation, enslavement of people including entire nations. It can be said that social conflicts are an objective and
universal phenomenon that can be referred to as a historical and world phenomenon (occurring at the moment of development of the human community when there was a disproportion between population and natural food sources) and as a basic feature of the modern world. "[15, p. 55]. In defining social conflict itself, and in aim of better and fuller understanding, certain authors have defined conflict in different ways, and that diversity and unevenness is a consequence of differences not only in the idea, but also in the theoretical orientation of the author. According to Golenko, social conflict is "a conflict of opposite interests, goals, views and ideologies of different individuals, social groups and classes," the word conflict is "always a conflict of interest, a struggle for the possession of economic value, power, as well as cultural and moral values" [7, p. 25-27]. However, according to Rijavec and Miljković, "conflict is a situation in which two parties (persons or groups) want to achieve a goal that they perceive to be achievable by one party but not by both" [16, p. 2]. Unlike Rijavec and Miljković, contemporary American sociologist and economist K. Bulding, author of "General Conflict Theory", sees conflict as a "state of competition in which the parties are aware of the incompatibility of potential future positions and in which each side wants to take a position that is incompatible with the wishes of the other party" [14, p. 15]. A similar definition of conflict is given by Turen, according to which "conflict is a clear determinant of rivals or actors with whom it competes, as well as the sources of struggle over significant goods and values" [18, p.48]. According to the view of most authors who have the focus of their interest on religion and conflict, the prevailing view is that in the past, even today, in the modern age, religious conflicts are the most prevalent. In addition of the thesis that religious conflicts are prevalent, the point of view of Despotović and Gačinović is interesting, stating “this is especially characteristic today, when the accelerated processes of globalization led to the so-called space contraction and dispersion of global conflicts, affirming the sociological rule that there is a high level of interdependence between social conflicts. Connoting religious conflicts as the most common source in the history of conflicts, we must not neglect the fact that, although prevalent, they were in many cases just a mask for other, political, national, economic and geopolitical conflicts. The nature of religiously confessional teachings and beliefs, their exclusivity, low levels of tolerance, and often religious-confessional fundamentalism, formed a suitable ground for them to be taken as the cause or reason for the beginning of the conflict, behind which stood various interests of politics (territorial conquest, expanding the zones of civilization and geopolitical influence, plunder of the resources and wealth of a country or region, imposing new rules of trade, and the influence of religion itself, which was instrumental in the occasion)” [3, pp.11-12]. According to Milašinovic et al. "Religious conflicts, whether manifested as intra or inter-confessional conflicts and distances, together with ethnic conflicts, represent the most famous and controversial type of social conflict. The problem is that describing a conflict as ethnic or religious refers largely to prejudice and stereotypes. The starting point is that religious and ethnic warriors are irrational, driven by the motivations that come from the fog of history, which is why religious conflicts are considered extreme and exclusive, and interventions should be avoided in the event of their outbreak. Taking into consideration modern challenges and security threats at the national and international level, which are also expressed through modern forms of religious (within and between confessional) and interethnic crises and conflicts, it can be said that information technologies shape attitudes and beliefs to the greatest extent, explaining their meaning and significance” [15, p. 305]. Religious conflicts involve different actors and are closely related with religion. In the context of this, the same authors further state that “religious conflicts are waged between members of different religious traditions, but also between members of the same religion or confession. These conflicts manifested as conflicts between religions (Christianity and Judaism, Hinduism and Islam, Christianity and Islam) within one and between several countries, as well as between believers who belonged to one or different creed
or religions (between Roman Catholics and Orthodox or Protestants within Christian churches)” [15, p. 310]. Perhaps the greatest significance and intensity of religious conflicts was in the past, where they had their own convinent ground. However, “with the development of the modern country and the secularization of society, religious conflicts have lost their importance and intensity throughout history. However, that does not mean that religious conflicts have been completely eliminated as a factor of various confrontations and crises, both in developed and underdeveloped parts of the world. Thus, in India, Sri Lanka, East Timor and other regions of the world, religious conflicts today are by their consequences the most significant type of conflicts. With this in mind, it can be concluded that religion is a threat to social integration, just as it contributes to it, because ... history, with its numerous religious schisms, manifests the great power of religion to not only connect but also divide people and nations” [8, p. 310]. Except conflicts that occur between different religions (inter-religious conflicts), intra-religious and intra-confessional conflicts are also very common, which in their intensity and manifestation can be more acute than conflicts between different religions. According to Jevtić, “in modern society, religious conflicts rarely occur in a pure form and often have a political and ethnic form, content and background. This contributed that at the end of the twentieth century there is a significant change in the theoretical and political perception of religion as a factor of social conflicts, so the essential question at end of the twentieth century became a question of relations between religion and politics, religion and society” [10, p. 305]. From a security perspective, religious conflicts deserve special attention, especially the causes and consequences of religious conflicts. Due to the theological differences that were present in religious conflicts, opinions were that main causes of their origin were not in religion, but in its abuse. As with most social phenomena, so with religious conflicts, the causes are complex, diverse and conditioned. According to Milašinović et al. “The scientific analysis of the causes of conflict in general, as well as internal (religious and ethnic), is based on historical and social (political, ethnic, religious and ideological) conditions and factors, and the various interests and goals of the participants in them” [15, p. 313]. Also, referring to the causes of the conflict, Vidaković states that the causes of the conflict are “established, sufficient and necessary, direct (economic, political, etc.) sources of movement, development and change of social conflicts, concerning the distribution of social, especially material values, the appropriation of power, social power, reputation, prestige, domination over people and things, territories, etc.” [19, p. 42]. Religious conflicts are quite prevalent, especially in communities with multiple nations. Thus, according to Milašinović et al. "Violent religious conflicts are most prevalent in multinational, high-conflict and backward societies, where the nation and religion are closely linked and political regimes are distinctly undemocratic. Religious conflicts then emerge not as a companion, but as a basic factor in national conflicts. Such, essentially pre-political and tribalism societies, are characterized by an absence of democratic consciousness and tradition, burdened by the history and tradition of high-level religious intolerance and conflict, where religion forms the basis of collective consciousness and identity. National and religious chauvinism often occurs in these societies, which, if given a militant form, is transformed into religious fanaticism. Then in the name of religion there are mass atrocities, religious pogroms and huge human sacrifices. In theory, various causes are mentioned as causes of religious conflicts, most commonly: deep social crises (the collapse of the value system, anomic, social hopelessness and the unpromising prospect of the majority of the population); the politicization of religion and the manipulation of religious sentiments (by the clergy, when a clerical wing within a religious institution forms political parties or movements with political goals; or by the country or political entities, either in the form of imposing certain political beliefs or arbitration on religious issues by believers); the permeation of a religious and national complex (a combination of nationalism, national-chauvinism and religious fanaticism as a consequence of a real or apparent coalition of
religious and nationalist ethno-elites in order to win power or significant political positions in one country); and the existence of an undemocratic, authoritarian and totalitarian political regime and system of government that creates inequality in the social status of members of particular religions, creed and confessions "[15, p. 313-314]. It is evident that the causes of religious conflicts are mostly present in the backward multinational societies, where religion and nation are closely intertwined, where the most basic human rights and freedoms are not given importance. Religious conflicts are increasingly linked to politics, especially in today’s world, as, according to the same authors, “religious conflicts in modern society also encourage the establishment of political movements or parties and the acquisition of political power by radical clerical circles within major churches. Religious conflicts arising on these basis, most often in the name of defending "our religion", over time lose connection with religion and spread by the laws and logic of war. Religious conflicts also arise when there is an inequality in the social position and freedom to practice different religions or confessions, or a mass belief in the existence of such inequality is generated by political manipulation. Researchers point out that often, as well as para-religious and quasi-religious conflicts with a pronounced religious dominant, occurs when preventing the free profession of religion by the undemocratic political order. That is, in essence, a conflict between the political regime and part of a people of a particular religion. In those circumstances, ethnic, religious, and other minorities feel the need to protect them from the "majorization" that is or may be exercised by the "leading nation" and dominant religious institution. Religious conflicts have the highest intensity in the conditions of formation of a coalition of clerically oriented clergy, national-political and cultural elite. Then, through national-chauvinist ideology (which also contains a religious dimension), militarization and fanaticization of the largest part of society are produced, which is the second term for totalitarianism" [15, pp.317-318]. Every form of conflict, including religious conflicts, produce certain consequences. Consequences of religious conflicts most often lead to public outrage, violence, fear raising in certain religious groups and individuals, and are usually an introduction to conflicts with worrying consequences, such as armed conflicts, terrorist activities, war, etc.

3. SAFETY CULTURE

Without a clear link to security, safety culture cannot be completely understood. Security has always been of interest, especially in the years of this century, to both the professional and scientific public, and people in general. Security has its importance and weight, especially in modern society, where it is a precondition for the development of economy, sport, culture, people movement and exchange of goods and services among people at all levels of their organization, from local, national to international and global. In order to fully understand security culture and its relationship to religious conflicts, it is necessary to define security. Like conflicts, security also does not have a unique and unified definition, which leads to the conclusion that the term of security is very complex and not so clearly defined. In the context of this, it is valuable to see Mijalković and Keserović saying "there are almost no words such as security, which are more commonly used in modern life, and that the notion that it means at the same time less defined and clear. This term is used equally by security theorists in the broadest sense, but also by politicians, representatives of authorities, international organizations and the non-governmental sector, industrialists, farmers, medical professionals, ecologists, educators, lawyers, economists, meteorologists, citizens ... as well as police officers, soldiers, intelligence officers, prosecutors, judges and similar professions" [13, p. 38]. Thus, in the context of the importance of security. Williams says "security is an unusually interesting, often pernicious, but always significant topic" [22, p.39]. However, despite all the doubts about the definition of security and the lack of a single and unified definition of security, it is necessary to name a few in the context of better understanding. Dimitrijević thus states
that "the definition of security is multi-definitive and not universal." Everyone understands or perceives its meaning, and few can summarize and explain it. It is indisputable that, in the most general sense, “security exists when it exists and is freely manifested (achieved, developed and promoted, enjoyed) what is (for us) valuable and significant, and when such a situation is obviously certain, predictable and controlled, which also implies (our) ability to protect it from unwanted influences” [4, p. 38]. Compared to Dimitrijević, point of view of Vrsec’s is interesting in which "security in the highest sense implies such opportunities, relationships and conditions of social life and work that enable and ensure undisturbed (unhindered) productive executive and social activities and prevent internal and external dangers that could endanger the preservation of basic social values” [20, p. 71]. Security culture is present in all areas of human activity, like security, and as such must be acceptable to all people and present at every level of people organizing. Security culture is deeply connected with culture in general, and before the definition of security culture it is necessary to point out the meaning of culture. Authors Milašinović et al. with regard to culture and security culture, state "cultural science, as well as other humanities, does not deal with security culture specially and fundamentally. It is clear that there is sublimation of two terms present, namely 'security' and 'culture', which limit the field of interest but do not explain the substance of the problem by themselves. Culture itself, as a general term, is almost nowhere defined precisely, but represents a wide variety of interpretations and clarifications, which is why they need to be interpreted, starting from their genesis. The word 'culture' refers to Latin language, though it is only the lexical origin of the term" [14, p. 236]. However, according to Ilić, “culture is a complex multidimensional category and can be viewed from different perspectives. From a sociological view, culture implies a set of all those processes, changes, and creations that arose as a result of the material and spiritual intervention of human society. The fundamental meaning of culture is to facilitate the maintenance, extension and progress of human society” [9, p. 13]. In terms of sociological, as Eidus states, "from the security point of view, culture can be seen as an adopted and generally accepted way of protecting all those processes, changes and creations that have arisen as a result of social and material human creation, with the aim of progress, development and survival of society. Political culture is viewed at same time as a product and as an interpretation of history, which provides us with asomatic beliefs of who we are, where we are from and what our values are” [6, p. 41]. According to Stajic et al. “Security culture is largely a consequence of social heritage. It is also an idea in finding measures to overcome security concerns. Security culture strengthens the presence of security entities in the entire area, and increases the level of cooperation between citizens and security entities. It enables us to take care of our security in a responsible way, thereby exercising the right to be safe” [17, p. 34]. There were not a lot of attempts in trying to define a security culture. However, several authors have addressed this issue, and so according to Djordjevic, “security culture is part of the general culture of an individual, particular environment or society. A set of security insights that make individuals, environments and society more capable of recognizing methods, forms and actions of threat, as well as bearers of those activities, regardless of where and how they are displayed” [5, p. 23]. Regarding the fact that security culture is closely linked to the concept of security, and the concept of security objectively demonstrates a justified need for the introduction of new elements, so the security culture requires the introduction of new elements in its definition. In the context of this, according to Stajic et al. security culture is "a set of adopted attitudes, knowledge, skills and rules in the field of security, expressed as behavior and process about the need, ways and means of protecting personal, social and international values from all sources, forms and bearers of threat, regardless of place and time their expression” [17, p. 34-35]. In the further elaborating the security culture, Marjanović notes that "security culture includes awareness of legal obligations and the way of their fulfilling, rules of internal and external behaviour, protection
of one's own and others' security. In the security system, a security culture is a set of informal professional norms and values that operate in a security organization, and are in the function of performing security tasks and assignments. It is part of daily work (individual, professional, private security services, security organs) that continuously maintain the security system in optimal condition, in order to prevent the emergence or elimination of emerging threatening phenomena. Security culture is based on the principle of: a) morality - implies that the realization of a security function for one side can not be violation of security of other side; every individual must build his or her own security culture through building and respecting the principles of personal ethics; b) legality - it means respect of the norms of domestic and international legal order; members of security services with a low level of security culture often exceed or misuse the authority entrusted to them by society; c) consistency - members of security entities must consistently follow legal norms and procedures in the field of their duties; d) responsibilities - means the conscious, professional, quality and responsible fulfillment of the undertaken obligations; e) continuity - implies constant engagement of people, the application of methods and tools in maintaining and improving the security situation, as well as the continued willingness of the security system to respond to unexpected threats. In aim to prevent unwanted surprises, security entities would have to constantly monitor and evaluate the security situation and emerging threats" [12, p. 626-627]. Security culture in modern times is no longer the privilege of a particular group in society, but it is slowly becoming the right and obligation of the ordinary man and the groups in which people join. Through the security culture, we are enabled to identify thoughts about security itself, the security system, as well as its individual parts within specific subcultures. Security culture is manifested in several ways. According to Kekić, “a culture of security is expressed through thinking about security, or thinking about security. Our level of security culture depends on the way we think about security. The second way of expressing a security culture is in the form of security behavior, and the third way of manifesting a security culture is the attitude and approach to security - it represents the willingness and ability to respond to threats and challenges, either in material or spiritual sense. Hence, this form of displaying a security culture only comes to the fore when threats are realized or security challenges are identified” [11, p. 14].

4. SECURITY CULTURE - A CONFLICT PREVENTION FACTOR

Prevention and preventive measures play a very important role in all spheres of socio-political life. Therefore, prevention is also present in sport, culture, economy, health, security, etc. Prevention has always been and will be desirable and necessary. Also, prevention is a process that is constant, persistent and socially acceptable and justified. According to Vujaklija, prevention is (lat. preventio) “forestall, balk, obviate; rebuttal of objections for which is supposed that the opposite side could state; prejudice; a warning made earlier; detention, conversion, detention” [21, p. 735]. In relation to prevention, the prevention of conflict according to Burton represents "the removal of causal conditions (conflicts) and strong encouragement of a cooperative environment" [2, p. 18]. Today, when the modern man and society as a whole, are exposed to various security challenges and threats, the role and importance of security culture in the prevention of social conflicts is very recognizable. According to Milašinović et al. “security culture, today, is one of the most important factors in the prevention of social conflicts, at national and international level. Security culture of the individual, social groups and especially social elites is here particularly emphasized, as well as the need to socialize those contents that are necessary for the normal functioning of society. The radicalization of social problems worldwide and especially in our society imposes the need for a comprehensive, long-term and studious approach to the problem of security culture at all plans and levels and in all environments, especially in the field of education, from
elementary to university. The absence of content (practical and theoretical) related to these issues and the lack of goodwill for their socialization, starting with the individual, through the family and other social "mechanisms", have caused a "tide" of dramatic events that have had tragic consequences on world security and especially in our region" [14, p. 234-235]. Talking about security culture, the same authors further state that "seeing problem of security culture is possible in context of knowledge of the overall international relations and tensions that have produced a number of new threats to human rights and freedoms, as well as many nations and countries in the world. This is largely due to the absence of scruples, respectively a security culture, respect for international regulation and, of course, abuse of the "right of the stronger." Also, the absence of tolerance and the right of others to life, work, and freedom is largely concerned with the security culture of individuals, groups, power centers, policy makers from the general, through economic, military and others. The issue of security culture has been unjustifiably neglected not only in conflictology but in almost all humanities. The abundance of conflicts in the world, and especially in our region, require a more serious and broader approach to considering their manifestations, while not justifiably neglecting issues related to their ending, ie prevention" [14, p. 235]. Depending on the content, security culture can be a very prominent factor in ending and prevention of social, respectively religious conflicts. Entities in religious conflicts with a high level of awareness, tolerance, morality, and moral code are important determinants of the behavior of conflict entities. As stated by Milašinović et al. "though very pessimistic about the future and inevitability of conflicts, Huntington also cites the possibility of avoiding them in the 21st century, mainly emphasizing factors related to the security of culture, such as: embracing world multiculturalism, peaceful coexistence, and seeking what is common and unique in all civilizations. That constructive course represent the rejection of universalism, the acceptance of diversity and searching for commonalities. In the new era, civilization conflicts represent the greatest obstacle to world peace, and an international civilization-based system is the best protection against world war. The prerequisite for all of this lies in understanding, respecting the characteristics of others, their culture, philosophy, religion, customs, and traditions and, of course, refraining from resorting, by force, to their territorial integrity, national sovereignty, and especially material and cultural wealth. Today's world is confronted with a series of new security challenges, especially those related to mass acts of terrorism and new forms of transnational organized crime, all of which require a new approach and forms of confrontation, with preventive strategies, concepts and concrete measures being the primary. Education is one of the key issues, which would greatly contribute to raising the security culture, while general standardization as a priority would have not only common but also specific regional and national characteristics" [14, p. 242,244]. Considering that conflicts, as well as religious conflicts, are in some way the companions of today's modern society, whether they are manifested with less or greater intensity. They have taken on planetary proportions, and as one of the main problems in their ending and prevention, at least when it is about thinking of expert public, is in lack and the existence of permanent institutions that would deal only with the issue of conflict ending and prevention. Certainly, as suggested by domestic and international practice, many religious conflicts can be prevented by timely and institutional responses, such as the response of international organizations in the form of mediation, adopting proper recommendations and declarations, and the like. In the context of the prevention of religious conflicts, the same authors state the following: “the security culture must recognize all forms of violence in order to be able to defend the subjects and objects it protects. That means that the field of conflict is not just the one in which there is “blood”. The security culture of both the strong and the weak must be a competent defender of the totality and values of society. Concerning the problems of conflict, their prevention and alleviation of violent mitigation, "the power of society should be strengthened, because only democracy without violence enables the realization of a human community free of alienation,
freedom and subordination. Undoubtedly, in the global world, raising the security culture will have a capital effect in saving the human community from destruction and self-destruction, believing in the power of the human mind and its culture” [14, p. 246 - 247]. To fully understand the many security problems facing society, it is possible only through education, by the acquisition of security knowledge, as well as the spread of security culture. Contribution of security culture in prevention of religious conflicts has always been unquestioned, and its role in the field of conflict is gaining in importance, especially today, in a time of increasing transition and globalization of society.

5. CONCLUSION

In today’s world, and especially in societies in transition and in era of increasing globalization, conflicts and therefore religious conflicts are a reality. Religious conflicts are particularly expressed in undemocratic societies and societies where there is little or no awareness about diversity, especially in the field of religion and creed. Religious conflicts are followed with serious consequences, especially when religious extremism takes the form of mass religious fanaticism. In that understanding of the consequences of religious conflict, the prevention and resolution of these conflicts are of vital importance. Prevention and resolution of this type of conflict, especially in modern understandings of security, requires a full appreciation of the security culture. The security culture in the modern security age has the role of emancipating individuals and groups in a complete cultural pattern, especially bearing in mind the fact that the need for security is one of the most important human needs. In the context of security, the security culture must find the best solutions to achieve the best possible security for all through agreement, cooperation and negotiation. Education itself, which is also an integral part of the security culture, is directed at all subjects and actors of security to resolve conflicts and conflict situations peacefully. The goal of a security culture in the prevention and resolution of religious conflicts is to educate individuals and society about the causes and consequences of religious conflicts, but it also develops an awareness of people and society to view diversity as a normal phenomenon and that in every situation they try not to contribute to the emergence of conflict. The security culture must and should develop equally, such as safety and to develop mechanisms for the prevention and resolution of religious conflicts on the basis of tolerance, mutual respect and negotiation on peaceful principles. Also, it is the task of the security culture to, through its modes of action and the results it produces in practice in the field of resolving and preventing religious conflict, show its importance and value to individuals, social groups and political elites. Certainly, in the future, the emphasis will also be that resolving, especially the prevention of religious conflicts relies on a security culture, that, without any dilemma, has the perspective of development and upgrading in the time we live in, and especially in the time ahead.

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THE REPUBLIC OF NORTH MACEDONIA AND THE PREVENTION OF TERRORISM

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Abstract: Within the labor author will make the analysis of the contemporary security environment i.e. analysis of modern challenges and threats in the field of terrorism through an overview of domestic and foreign literature and analysis of electronic sources. The author will analyze the content of the National Strategy of the Republic of North Macedonia for Combating Terrorism from 2018. As a general strategic goal of the state for the fight against terrorism, it is determined: PREVENTION, PROTECTION, PROSECUTION AND RESPONSES and the author will determine the specific strategic goals for the realization of the general strategic goal.

Key words: terrorism, prevention, prosecution, protection, response

1. IMPORTANT CONTENT OF THE NATIONAL STRATEGY OF THE REPUBLIC OF MACEDONIA IN FIGHT AGAINST TERRORISM

Many countries, including the Republic of North Macedonia, normatively with their national strategy define the basics of the policy for the prevention and suppression of this security threat.

In order to implement intelligence and security reforms in the security sector, the Government of the Republic of North Macedonia is implementing the second National Counter-Terrorism Strategy in March 2016, which included a section devoted to the prevention of violent extremism and terrorism. The Government submitted the relevant Anti-Terrorism Action Plan in 2016 to the European Commission for comments and remarks. However, the 2016 Action Plan lacked implementation benchmarks, funding and monitoring estimates for monitoring and evaluation.

Furthermore, in February 2018 the Government of the Republic of North Macedonia adopted a National Counter-Terrorism Strategy for the period from 2018 until 2022, and this document is in accordance with the United Nations and European Union Strategies for Combating Terrorism [8]. With this document, the Republic of North Macedonia strives to coordinate ministries, government and non-governmental institutions in their activities.

For the purpose of long-term security, security, stability and prosperity of the citizens of our country, the Government of the Republic of North Macedonia also adopted a decision on the establishment of the National Committee for the Prevention of Violent Extremism and the Fight against Terrorism [7].

Violent extremism and terrorism are two separate and special problems that threaten the Republic of North Macedonia, the countries of the Balkans and the wider international community. Counteracting counter-measures such as enhanced border security, timely sharing of information, improved criminal legislation through local networks while counteracting the factors and drivers of violent extremism, counter-terrorism efforts and violent and destructive terrorist activities require countermeasures.
The National Strategy for the Prevention of Violent Extremism and the National Counter-Terrorism Strategy of the Republic of North Macedonia are linked institutional and organizational, according to the "four pillars" of the Global Strategies for the Prevention of Violent Extremism and the Fight against Terrorism of the United Nations (UN) and with strategies to prevent violent extremism and fight against terrorism in the European Union (EU) [3].

These strategies stipulate that it is necessary for the members of the National Committee for the Prevention of Violent Extremism and the Fight against Terrorism to identify the capabilities, capacities and needs of the ministries and institutions in order to ensure the safety and protection of the citizens and the sovereignty of the Republic of North Macedonia, identify the priorities, challenges and opportunities in strengthening the contribution of the Republic of North Macedonia in preventing future manifestations of all forms of extremism and factors that have helped road to terrorism.

PREVENTION – this action is undertaken when there are inflows of foreign terrorist fighters and activists, as well as the root causes of radicalization. PREVENTION – this action is undertaken when there are inflows of foreign terrorist fighters and activists, as well as the root causes of radicalization. However, if the prevention fails, it is necessary to undertake TREATMENT / EXECUTION (in a regulated way, to prevent terrorist threats, their allies and their safe shelters on the territory of the Republic of North Macedonia ...) at the same time always keeping the readiness for PROTECTION AND RESPONSE to threats to citizens and the critical infrastructure of the Republic of North Macedonia.

In essence, the prosecution focuses on the threats of violent extremism and terrorism (interruption, reduction, separation and defeat) in their roots, in shelters and wherever they threaten people and infrastructure. The third priority is PROTECTION - to people, to their property, key and critical infrastructure of all threats, which are clear and present, as well as from potential and growing threats. The fourth priority is ANSWER - actively, aggressively and always in a way that is transparent and in accordance with the rule of law, in the spirit of solidarity and in terms of the needs of the victims.

The aim of both of these strategies is to constantly monitor the threats of violent extremism and terrorism, as well as to monitor their preconditions, root causes, drivers and local-municipal, state and regional contexts specific for the Republic of North Macedonia. The Republic of North Macedonia must follow these new and growing challenges - it must monitor the criminal and terrorist networks and their collaborators and other threats that can cause instability of the state. This requires the need for improved and enhanced collective security and institutional cooperation in the strategic planning and implementation of the activities in the Republic of North Macedonia.

Further, the two strategies outlined provide a broad description of violent extremism and other terrorism.

Wide description of the VIOLENT EXTREMISM - It refers to the beliefs and actions of people who support or use ideologically motivated violence to achieve radical ideological, religious or political views. The central concept of preventing violent extremism is the importance of addressing the "favorable conditions" for the spread of terrorism. The acts of terrorism cannot be prevented only through repressive measures. It is essential to develop constructive grievance solutions that can be used by various radical ideological groups and their supporters.

Wide description of TERRORISM - Illegal use of violence and intimidation, especially against civilians, in the search for fulfillment of political goals. Terrorism is a serious crime. It can and should not be related to any nationality, religion or ethnicity. Some common features
include: dangers to life and property; seeks to deliberately undermine the democratic government, in particular by attempting to influence policy and legislators; and indiscriminate approaches to targeting, in order to inspire fear and terror throughout the population.

For every functional society, the rule of law is needed: investigation, (prosecution) prosecution, trial and imprisonment.

The strategy determines a methodology should give an answer to three questions: WHAT, HOW AND WHAT are the effects from the prevention of violent extremism and the fight against terrorism.

The basic principles for the prevention of violent extremism and for the fight against terrorism are determined: safe and secure citizens of the Republic of North Macedonia; to create efficient, responsible and inclusive institutions that will support the development of public confidence in institutions; to provide a stable environment for increasing economic development; and to ensure national unity and communities resisting radicalization and extremism. Regarding the HOW issue - an answer is given through "Transformational Effects".

Continuity of governance and full integration between government and society; expanding responsible and transparent governance; equal and fair access to justice; community-led and government-led harmonization; security for the population and other critical infrastructure; action against persons who represent a threat that cannot be rehabilitated; prevention of the linkage of narcotics, corruption, terrorism (rebellion) and crime; cross-border access for trade needs and not for terrorists / foreign terrorist fighters; creating economic opportunities for inhabited centers and access to the market and seeking and maintaining an information initiative.

2. SPECIAL STRATEGIC GOALS - FIGHT AGAINST TERRORISM

In the fight against terrorism, the Republic of North Macedonia has identified eight strategic goals for prevention, five strategic goals for protection, four strategic goals for the duration, and three strategic goals for response.

1. PREVENTION
   Strategic goal 1.1: Preventing terrorism threats;
   Strategic goal 1.2: Prevention of financing of terrorism;
   Strategic goal 1.3: Preventing radicalism over the Internet;
   Strategic objective 1.4: Strengthening institutional capacities for dealing with "foreign terrorist fighters";
   Strategic goal 1.5: Prevent radicalization and recruitment of terrorists by strengthening bilateral, regional and international co-operation;
   Strategic goal 1.6: Improving capacity through conducting assessments, analyzes and research related to terrorism threats;
   Strategic goal 1.7: Prevention of Chemical, Biological, Radioactive and Nuclear (HBCR) Threats;
   Strategic goal 1.8: Prevention of illegal arms trafficking

2. PROTECTION
   Strategic objective 2.1: Strengthening state border control systems;
   Strategic goal 2.2: Improving transport safety standards;
   Strategic objective 2.3: Protection of critical infrastructure;
   Strategic goal 2.4: Protection of objects of vital and public interest;
   Strategic goal 2.5: Strengthen and develop mechanisms to protect against cyber threats.
3. KEEPING
Strategic objective 3.1: Further harmonization of national legislation with international standards;
Strategic goal 3.2: Disclosure, identification and prosecution of perpetrators of terrorist acts related to terrorism;
Strategic goal 3.3: Disclosure, identification and prosecution of the perpetrators of terrorist financing;
Strategic goal 3.4: Strengthening bilateral, regional and international cooperation.

4. RESPONSE
Strategic goal 4.1: Strengthening the capacities of the relevant institutions to respond to a terrorist attack;
Strategic goal 4.2: Reduce and mitigate the consequences of terrorist attacks;
Strategic goal 4.3: Improve cross-cutting coordination;

With the National Strategy for Combating Terrorism, the Republic of North Macedonia should achieve the following results: More effective detection, documentation and research of criminal activities related to terrorist acts; Co-ordinated activities and information exchange at the sectoral level; Increased and effective international cooperation in the prevention and fight against terrorism; Increasing the awareness of the population about the importance of combating terrorism and the role and place of state organizations and other institutions participating in this struggle; Achieving a higher level of deployment of personnel and equipment of institutions involved in the fight against terrorism; Compliance with international standards and harmonization of national legislation with the European with legislation etc.

3. KEY PRIORITIES TO ACHIEVE PREVENTION, PROTECTION, INVESTIGATION AND RESPONSE

The strategy of the Republic of North Macedonia for Combating Terrorism from 2018 is based primarily on the European Union's approach to prevention and fight against terrorism. This strategic approach is determined taking into account the circumstances that the Republic of North Macedonia shares with other European countries the same geo-political space as the same democratic, cultural, civilization and other values. Furthermore, the security challenges facing the state are not significantly different from those facing other European countries as well as the European Union member states.

The harmonization of national measures in the fight against terrorism with the measures taken by the European Union are intended to contribute to the Republic of North Macedonia becoming a candidate for membership of the European Union and closer to Euro-Atlantic integration as a whole. The overall objective of the strategy is to suppress all forms of extremist and terrorist activity of the state's existing values - democracy, the rule of law and human rights and freedoms and make the state a safe place to live and work for its citizens. Specific objectives of the strategy are: Prevention of hate crimes, radicalism and terrorism in all emergent forms; protection of critical infrastructure; improving the procedures for the investigation and prosecution of terrorist offenses and related offenses; response to possible terrorist attacks and remediation of their consequences.

Prevention – Strategic measures in the field of prevention are aimed at preventing vulnerable individuals and groups from choosing violent extremism and terrorism as a means of achieving their goals. In this regard, special attention is given to measures that prevent the process of indoctrination in terrorist ideology, especially those forms that contain clear elements of inciting terrorism, directly or indirectly, publicly promoting acts of terrorism and recruiting terrorism. The aforementioned preventive measures need to be implemented through
cooperation with citizens and civil society organizations through community policing, developing specific security programs for vulnerable local communities and increasing the participation of local religious leaders, youth and women.

Key preventive activities are:
- Develop a system for early recognition of all forms of extremist behavior that may lead to terrorism;
- Develop a system of preventive action and checks to prevent the emergence of extremism in the procedures for granting residence permits to foreign nationals in the Republic of North Macedonia;
- Seize opportunities to encourage and recruit terrorism for vulnerable categories of people and the community;
- To promote values – democracy, the rule of law, tolerance and dialogue – to create specific educational programs for young people through curricula as well as extracurricular activities.
- Support the activities of citizens and civil society organizations aimed at preventing hatred and promote positive value (by highlighting positive examples of social values, tolerance, openness);
- Encourage and assist the academic community in further investigating terrorism hate crimes, to investigate hate speech and other community safety phenomena with a view to identifying key problems and developing and promoting preventive measures.

Protection – Reducing the overall vulnerability of terrorist attacks and protecting key infrastructure is an important part of the strategy. The measures envisaged to achieve this strategic goal are implemented through the adoption of minimum standards for the protection of critical infrastructure and other facilities of importance to the state as well as the promotion of real-time risk-taking procedures and threats.

Key preventive activities are:
- Improve the ISM – information-migration system and be operational and useable by security agencies;
- Develop a risk analysis system to establish a reliable database;
- Full implementation of the international standards in the field of cyber security, especially those related to the establishment of CERT – in the state and mechanism for monitoring and suppressing internet exploits for terrorist purposes;
- To develop a procedure for the analysis of oversight and security improvement projects for weapons depots, military equipment, explosives and dual-purpose supplies through the state.

Investigations and prosecution - The measures envisaged in the area of investigations and prosecution are aimed at further building and strengthening the legislative capacity and institutional capacity of intelligence-security sector, police and judicial sector. The main objective of these measures is the early detection of all terrorist plans and activities as well as repressive action against individuals, groups and networks who manifest terrorist intentions. Special focus of investigation-repressive activities will be directed to the: terrorist propaganda (especially over internet), recruiting for terrorist activities, financing terrorism, giving any support to terrorist, etc.

Key priorities are:
- Improvement of the legislative framework for the coordination of all operational and investigative activities, collection. Analytical processing and exchange of information. In this way, all law enforcement agencies will be able after continuous collection of operational data, to enter all data and information on terrorism into their own information system in
in accordance with the principle of the Register of Certain Aliens. So they will have all the information in time and can take timely measures to counter terrorism and avoid ineffective handling of such information.
- Strengthening of human and material-technical resources for conducting operational and investigative activities.
- Risk analysis and to develop repressive measures against enabling violent extremists/terrorists to access illegal weapons and explosives, including parts that may serve to make improvised explosive devices.
- Prevention of financing of terrorism and consistent application of standards related to the conduct of financial investigations in the investigation of terrorism-related offenses.
- Special attention has been paid to terrorism-related offenses and investigative activities aimed at preventing the channeling of illicit trafficking in weapons and explosives and other materials that may serve the purpose of committing terrorist-related offenses.

Response to terrorist attacks - The risk of terrorist attacks cannot be completely ruled out. It is necessary to assess and analyze the risks as well as the capacities of the competent structures i.e. it is necessary to identify the resources available and to develop ways to mobilize them whether civilian, military or private sector resources.

Key priorities are:
- Strengthen protection and rescue capacities at all levels and improve the state coordination system as well as clearly define all operational actions and mutual support in cases of terrorist attacks;
- Analyze existing legislation in the field of protection and rescue in particular international obligations and propose measures for promotion in cases of terrorist attacks;
- Develop program modalities to provide assistance to terrorism victims and their families;
- Improve cooperation with other states, international organizations in responding to terrorist attacks and other disaster.

4. CONCLUSION

Many countries, including the Republic of North Macedonia, normatively with their national strategy define the basics of the policy for the prevention and suppression of this security threat.

In order to implement the reforms of intelligence and security services in the security sector, the Government of the Republic of North Macedonia is implementing the second National Counter-Terrorism Strategy in March 2016, which included a section devoted to the prevention of violent extremism and terrorism, and then in February 2018 adopted a National a strategy to combat terrorism for the period of 2018 by 2022, and this document is in line with the United Nations and European Union counter-terrorism strategies.

For the purpose of long-term security, security, stability and prosperity of the citizens of our country, the Government of the Republic of North Macedonia also adopted a decision on the establishment of the National Committee for the Prevention of Violent Extremism and the Fight against Terrorism. The National Strategy for the Prevention of Violent Extremism and the National Counter-Terrorism Strategy of the Republic of North Macedonia are linked institutional and organizational, according to the "four pillars" of the Global Strategies for the Prevention of Violent Extremism and the Fight against Terrorism of the United Nations (UN) and with strategies to prevent violent extremism and fight against terrorism in the European Union (EU).
These strategies stipulate that it is necessary for the members of the National Committee for the Prevention of Violent Extremism and the Fight against Terrorism to identify the capabilities, capacities and needs of the ministries and institutions in order to ensure the safety and protection of the citizens and the sovereignty of the Republic of North Macedonia, identify the priorities, challenges and opportunities in strengthening the contribution of the Republic of North Macedonia in preventing future manifestations of all forms of extremism and factors that have helped road to terrorism.

Targeting aims to realize through adoption of terrorism prevention and fighting measures, terrorism protection, measures criminal harmonization and repairing damages from terrorist attacks. The main objective of prevention of terrorism is to reach the highest level of protection of state, of its citizens, protection of its values, interests and resources of threats and consequences of terrorism. Prevention of terrorism includes the following activities: Alignment of the National legislation with international low flows; Strengthening of the personnel capacities and technical capacities of the relevant state authorities; Improvement and improvement of the administrative capacities of the relevant state authorities; strengthening the State's Intelligence Capacity; Strengthening police and communities to prevent extremism and radicalization leading to terrorism.

The suppression of terrorism covers: Improve mechanisms for assessing the dangers of terrorism; improving mechanisms to monitor the spread of religious radicalism and extremist activity of individuals and groups in the country.

The objectives of the field of protection against terrorism include: Improving mechanisms for developing and strengthening the protection of infrastructure facilities of particular importance for the territory of the country; Improvement of mechanisms for strengthening the system of protection and supervision over the state border; Improvement of the traffic control system transport, storage and maintenance of weapons, explosives and other means that can be used for terrorist attacks; Improving the safety of land, water and air traffic.

Prosecution - Effectively prosecute and prosecute perpetrators of crimes, accomplices and other perpetrators who are in any way linked to terrorist activities.

Damage from terrorist attack – The following goals need to be achieved: Improved and developed national capacities necessary to repair the consequences of the attack and revitalize damaged systems; Developed systems for rescuing people, material and cultural goods and the environment.

With the National Strategy for Combating Terrorism, the Republic of North Macedonia should achieve the following results: More effective detection, documentation and research of criminal activities related to terrorist acts; Co-ordinated activities and information exchange at the sectoral level; Increased and effective international cooperation in the prevention and fight against terrorism; Increasing the awareness of the population about the importance of combating terrorism and the role and place of state organizations and other institutions participating in this struggle; Achieving a higher level of deployment of personnel and equipment of institutions involved in the fight against terrorism; Compliance with international standards and harmonization of national legislation with the European with legislation etc.

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### RISK ASSESSMENT IN ENGINEERING PROTECTION – MATRIX APPROACH

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**Abstract:** Engineering Protection, as a field of study consists of three parts: Safety and health at Work (SHW), Fire Protection and Environmental Protection. In each part a central place occupies risk management, or methods, techniques and tools for the prevention of hazardous events and reduce their consequences. Based on risk management is a process of risk assessment. Risk assessment in engineering protection is entirely empirical process of making engineering decisions based on knowledge and experience in order to improve level of the protection of resources and using certain so far known and recognized methods. Currently there are a large number of recognized methods for risk assessment which are mostly formed by various organizations and associations of engineers, that usually insurance companies. The paper presents the most pragmatic matrix (qualitative) risk assessment methods in the field of SHW, as follows: 3x3 matrix (OHSAS), matrix 4x4 (AS/NZS 4360) and the matrix 5x5 (MIL-STD-882B)

**Keywords:** risk assessment, matrix methods.

1. **INTRODUCTION**

One of the main characteristics of the modern era is the permanence of change in all spheres of life and work. Science ratio and frequency change is situated in a causal relationship, as is the study (a special field of technical sciences) are usually the cause of changes, but also the field of human activity, which permeate the repercussions of reflection of the same. Protection Engineering as a field of study in the field of technical sciences consists of three parts: SHW, Fire protection and Environmental Protection and is one of the most „sensitive” areas in terms of the impact of changes in frequency. Consequently the whole concept of engineering protection based on permanent integration into a process of a series of activities: the acquisition of new knowledge, training employees for new ways of working, implementation of new technologies in the work processes, all of which should be accompanied by new organizational structures.

Basically engineering protection of the risk management process, but the essence of this process is risk assessment. It is important to point out that the risk assessments, although purely empirically at the same time, however, and subjective process (depends on the knowledge of stages of the work process of the auditors risk), but if we follow certain algorithms, tools and principles, subjectivity, however, may be reduced to the lowest possible level.

In this paper, we present a group of methods (one by its access) for the assessment of risk in the SHW, namely the risk of the matrix. A characteristic feature of this group is the following method: (a) a first developed, (b) are the starting point for the other groups of methods and (c) in practice have proved to be most susceptible to all participants of the risk assessment.
2. DECISION-MAKING UNDER THE TERMS OF RISK

The very issue of decision-making as a process of coming to a decision, is highly interdisciplinary and can be studied from different aspects. Business environments and organizations are constantly changing, so the future consequences of decisions can’t be fully predicted. Decision-making process in a turbulent, dynamic, uncertain and changing environment becomes increasingly complex and demanding, and make informed decisions require any extensive preparation. In this regard, in an effort to comprehensively examine this problem, scientists have pore knowledge of classical economic/financial theory included a number of other scientific disciplines.[4]

Theory of decision-making is the result of joint efforts of experts in economics, psychology, philosophy, mathematics and statistics.[3] The theory of making a set of knowledge and the appropriate analytical technique with different degrees of formality designed to help the decision maker to choose alternatives based on the implications.[8] It is necessary to make a distinction between the normative and descriptive (behavioural) of decision theory.

Normative decision theory deal with the way in which decisions need to be made. Always seeking the best decision, it being understood ideal decision maker (DM), fully informed and rational.[8] The normative theory deals with the concept of rationality and logic of decision-making, as what they should be.[7] In the normative approach to decision problem is well defined - the principles of normative theories show how a perfectly rational individual should make decisions. This approach assumes certain rules that people, if they abide by, helped in the situation make the best decision.[3]

Descriptive theory describes how the decisions actually are made, and discuss the practical application of normative theory. The primary objective of the descriptive theory is to understand and explain how individuals are considering the available information and on the basis of how they come to some decision or choice. Descriptive decision theory concerns what the normative theory becomes isolated in terms of the criteria of rational behaviour. Centre to make things characteristics and limitations of the cognitive system, DM, and other psychological causes of the mistakes that he makes when deciding. Descriptive theories are focused on finding the tools, methods and software to help make better decisions.[8]

In theory and practice, one can find different approaches to decision-making. Access to decision-making that is increasingly gaining in importance is the decision based on risk assessment. Term risks can be associated with the uncertainty of those future events that may affect the outcome of the reporting process.[2] In general, there are three different conditions in which decisions are made, and which are based on the degree of predictability of the outcome of the future decision. Decision-making in terms of security means that up to a known outcome (result) of each alternative and the choice between alternatives based on the outcome of choosing one that is most appropriate for the organization. However, there are situations where you can’t know with certainty what will happen in the future, for themselves alternative outcomes depend on circumstances that are often unknown to us. In such cases, we are talking about the decision-making under uncertainty and risk conditions (detectable uncertainty). In conditions of uncertainty is possible to determine future events, it is possible to predict different outcomes of each alternative, but an unknown probability distribution, while in terms of the risks of each alternative has one of several possible consequences and likelihood of any effects known.[3]

Given the variability of both the organizations themselves, as well as the environment in which exist, the future implications of decisions can’t be fully predicted. Most of the decisions made in organizations contain some amount of risk. The condition risks is actually a wide range of
degrees of risk and there can be associated with decisions, in the sense that the lower the quality of information on the outcome of the alternative, that the situation is approaching a complete uncertainty and the risk of choosing this alternative higher.[1] Management seeks to know the size and nature of the risks associated with the adoption of economic decisions in a particular situation. Risk analysis is in most cases based on economic analysis and estimates of probability.[4]

3. RISK ASSESSMENT - PROCEDURE

In order to answer the question of how to conduct risk assessment, and what are the steps or procedures for conducting a risk assessment must first define the following:

- methodologies for carrying out risk assessments and
- procedure conducting risk assessments.

Conducting risk assessment methodology defined algorithm, tools and concrete way of implementing the process of risk assessment and the procedure of implementation of the process of risk assessment define standardized series of steps to ensure the implementation of the process in accordance with the recommendations of the relevant laws, regulations and best practice recommendations.[9]

In modern literature usually as a baseline risk assessment methodologies used method used published by the European Agency for Safety and Health at Work in guidelines and manuals for risk assessment. Based on the experience of the author in the work of the Risk Assessment, Image 1 shows a schematic representation of the steps of a risk assessment methodology.

As we have pointed out earlier in the risk assessment in engineering protection is an empirical process, which is based on making engineering decisions based on knowledge and experience in order to improve the protection of resources and using certain so far known and recognized methods. Currently there are a large number of recognized methods for risk assessment which are mostly formed by various organizations and associations (mostly insurance companies). Common to all methods for risk assessment is not to prescribe the election, or „pallet” of preventive measures to reduce and eliminate risks.

Correct choice of methods for assessing the risk allow the adequate application of preventative measures which would achieve a safer work place and working environment and less likely to cause work-related diseases and injuries employed because of danger and/or harmful effects, and hence to reducing the effects of consequences on the safety and health of employees and
security of assets. Depending on the risk assessment criteria all methods used in the field of HSW can be divided into three major groups: (1) qualitative, (2) semi-quantitative (combination) and (3) quantitative.[9]

4. QUALITATIVE METHODS OF RISK ASSESSMENT

Qualitative methods for risk assessment based primarily on personal experience and judgment of participants in a team to assess risk (risk assessors) and/or use of available qualitative data. This approach does not require information about previous threats, hazards, causes and effects, but causes the end result of the risk assessment is descriptive, qualitative risk stated size (for example: high risk, moderate risk, and etc).

Qualitative criteria used words such as: „rarely”, „amazing”, „possible ”, „probably” or „almost certain” to describe the probability of unwanted events and words like „fatal” „serious”, „male” , or „negligible” to describe the size of the damage-consequences. The qualitative methods of risk assessment most commonly used subjective criteria that are measured in qualitative scales. Consequently risk assessment is subjective in nature, and therefore subject to error. In practice, the optimal use of qualitative scale with three to seven qualitative description, as an expression of the professional approach to the analysis of potential hazards and / or identification. Methods with less than three qualitative description of the risk factors are very simple, but with more than seven lead to significant difficulty subjective character, associated with the inability of the participants in the team for the risk assessment to identify with some precision the qualitative description of the factors/the constituents of the risk.

The best known representatives of this group of risk assessment methods are the risk of the matrix or matrices risk rating. These methods are actually the essence of methods that belong to the group and semi quantitative and quantitative methods. Risk Assessors often used in the work of a risk matrix for establishing a logical connection between the result and the probability of the risk assessment of identified hazards/harmfulness. Also, they are used as defined by the uniform method of determining the degree, or level of individual risks estimated.

Forming risk matrix is carried out in three steps, according to the following: the ordinate ranks are applied to the probability (step 1), and the abscissa are applied to the result of ranks (step 2). The combination of the above levels of ranking gives the ranking of risks (step 3), as shown in Image 2. In order to reach these data (probability and consequences) it is necessary to collect information-the first step in all methods of risk assessment. Practical experience has shown that „check lists” the ideal tool for collecting information useful for identification of danger/hazards in the workplace and in your working environment. To obtain a comprehensive picture of all potential risks and hazards and, consequently, better risk assessment, it is necessary to examine all the participants (administrative and executive bodies and end users/workers) in the work process.
In practice, the most frequently used three kinds of matrix risk rating, as follows: (1) risk matrix 3x3 (OHSAS), (2) risk matrix 5x5 (MIL-STD-882B) and (3) risk matrix 4x4 (AS/NZS 4360 2004). European Agency for Safety and Health at Work in the Guide for Risk Assessment recommended 3x3 matrix, which was first defined in the standard OHSAS 18001, and is shown in Figure 3. The matrix has three levels for a qualitative description of probability (bit - amazing, medium - probably; high - very likely), as well as to describe the consequences (minor, major and serious). The risk also has three levels marked a qualitative description of: low, moderate, high. In contemporary literature, this method is often called „Singaporean method/model”, which is one variation of the above methods.[6]

<table>
<thead>
<tr>
<th>Probability of dangerous event</th>
<th>Result of dangerous event</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rare (1)</td>
<td><strong>Low risk (1)</strong></td>
</tr>
<tr>
<td>Possible (2)</td>
<td><strong>Low risk (2)</strong></td>
</tr>
<tr>
<td>Almost certain (3)</td>
<td><strong>Moderate risk (3)</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Low risk (2)</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Moderate risk (4)</strong></td>
</tr>
<tr>
<td></td>
<td><strong>High risk (6)</strong></td>
</tr>
</tbody>
</table>

Data from Image 3: Risk matrix 3x3
Source: Author

Risk matrix 4x4 (AS/NZS 4360) was formed in the standards of the Australian and New Zealand and belongs to the standard ISO 31000, which relate to the field of risk management. First appeared in 1995, and the last variation of this type of matrix for ranking risks appeared in 2009. The matrix is shown in Image 4.

The categorization of a probability of a risk matrix 4x4 according to the recommendations of the standard A /NZS 4360: (1) the highly unlikely (- -) may occur but that probably will never; (2) unlikely (-) can occur very rarely, or; (3) is likely to (+) can occur at times; (4) Very likely (+++) can happen at any moment it is almost certain that it will happen. Categorization of the result of a dangerous event for the 4x4 matrix of risk according to the recommendations of the standard AS /NZS 4360: (1) small, (I) are only the most basic first-aid measures; (2) moderate (II) it is needed a medical treatment; a few days of sick leave; (3) serious (III),
serious injury, or long-term disease; (4) disastrous (IV) death and permanent damage and permanent disability to work. The risk is categorized into 6 levels, level „S”- a top priority, and unacceptably high risk category according to the priorities of „P1” to „P5”. The priorities define the order and importance of action to reduce risk.

<table>
<thead>
<tr>
<th>Result of dangerous event</th>
<th>Small (I)</th>
<th>Moderate (II)</th>
<th>Serious (III)</th>
<th>Disastrous (IV)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very likely (+ +)</td>
<td>P2</td>
<td>P1</td>
<td>S</td>
<td>S</td>
</tr>
<tr>
<td>Likely (+)</td>
<td>P3</td>
<td>P2</td>
<td>P1</td>
<td>S</td>
</tr>
<tr>
<td>Unlikely (−)</td>
<td>P4</td>
<td>P3</td>
<td>P2</td>
<td>P1</td>
</tr>
<tr>
<td>Highly unlikely ( − −)</td>
<td>P5</td>
<td>P4</td>
<td>P3</td>
<td>P2</td>
</tr>
</tbody>
</table>

Image 4: Risk matrix 4x4(AS/NZS 4360)
Source: www.risk assessment matrix.com [10]

Risk matrix 5x5 (MIL-STD-882B) was formed by the estimator risk in the armed forces of the United States, which are of said matrix is implemented in the American military standard (American Military Standard or abbreviation MIL-STD), which is recommended three types of matrix risk assessment of this type, and to: (1) 4x6 (MIL-STD-882C), (2) 5x5 (MIL-STD-882B) and (3) 4x5 (MIL-STD-882D). Risk matrix 5x5 (MIL-STD-882C) comprises five levels (1 - Insignificant, 2 - Minor, 3 - moderate, 4 - Major and 5 - Catastrophic), or a qualitative description of the effects of the event, which relates to a professional illnesses, injuries, loss of equipment and hours of operation and environmental impact. The interpretation of the matrix 5x5 to assess the risk of MIL-STD-882B is shown in Image 5.

Image 5: Risk matrix 5x5 (MIL-STD-882B)
Source: www.risk assessment matrix.com [10]

Quantity of a description and definition of the probability of an adverse event is represented by five levels (A - Rare, B - Unlikely, C - Possible, D - Likely and E - Almost Certain). When using this risk matrix are identified four quantitative description of the level of risk (extreme, increased, medium and low risk). The risk is considered unacceptable if it is estimated to be High and an Extreme, and acceptable if it belongs to the field of secondary (Moderate) or Low risk.
5. CONCLUSION

The risk of injury at work in the last few years are often the subject of much debate and discussion. The risk, as the combination of the probability and consequences of dangerous events can certainly be reduced or eliminate only timely, diligent and preventive application of preventive measures for safe and healthy work when using the work equipment, to any individual (irrespective of the category of persons in the work process) should in their work permanently applied and that the same adheres to [5]. We love coming to the conclusion that these are preventive measures is necessary to make high-quality and objective assessment of risk.

In modern literature there are a multitude of methods of risk assessment, and therefore a problem of selection of adequate methods towards the process of being assessed, and valorizes risk. In this paper we present a group of methods that are considered basic for other methods, but also the simplest to understand the importance and essence of risk assessment in one of the segments of protection engineering.

From all this we can conclude that the preference is the use of a matrix of risk in the risk assessment process is reflected in the following - there is no possibility of accepting risks that are in the domain of unsafe work, and consequently gives the possibility of making a large number of administrative and engineering decisions to reduce the risk to an acceptable level. However, practical experience has shown that the risk assessors, when using the risk matrix susređu with a certain kind of limitations, including:

- possibility of applying the risk matrix only identified threat or harm, or risk matrix is not a tool for hazard identification or identification;
- a high degree of subjectivity in assessing risk and;
- only the possibility of a comparative analysis of the level of risk.

REFERENCES


MILITARIZATION OF THE EMERGENCY HEADQUARTERS

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Abstract: The activities of civil emergency headquarters or civil protection staffs, in emergency situations, are one of the essential segments of emergency management. The relations at the headquarters, while respecting the basic elements of emergency management, have to be such to enable quick and timely decision-making, but also complete and rapid implementation. Our view is that this can only be achieved through the application of command and control in the way military headquarters operate. Throughout this paper, we will outline the advantages and disadvantages of such a model of organization and functioning of emergency headquarters.

Key words: headquarters, management, structure, militarisation

1. INTRODUCTION

The issue of emergency management today is a significant segment of the security of the state and the local community. The risks of various natural, anthropological or techno-technical threats are part of the everyday life of a society and it must deal with those threats. It must first and foremost act in a preventive, but also in prompt, organized and planned manner in the event of an emergency.

The declaration of an emergency entails the special duties and obligations of all participants in the protection and rescue system, as well as prompt and planned action. The most ideal situation is that plans are in place, updated, and as such can be activated and applied to a specific emergency. All entities of the protection and rescue system should be involved in the development of these plans and make their comments and suggestions during the planning. The moment the plan is adopted, it is understood that everyone agrees with the plan and the plan is ready for implementation. There have to be also contingency plans, B-plans, and decision-makers, commanders of emergency headquarters have to quickly decide on their implementation. Emergencies, while unpredictable, with good planning, management, and command, can be partially controlled and ensured that the consequences are as low as possible for both people and structures and the environment.

Considering a large number of entities, that show up during response to an emergency, the issue of coordination of these responders are clearly raised and, on the other hand, the question of the managing or commanding for those forces.

This paper will outline the basic characteristics of civil emergencies in the sense of explaining the environment in which emergency staffs operate, as well as the basics of management, managing, and commanding. The focus is on the work of emergency headquarters in order to be a functional and efficient team. For the sake of better understanding, the emergency
headquarters of ten municipalities in Republika Srpska (Banja Luka, Šrbac, Laktaši, Gradiška, Prnjavor, Derventa, Modriča, Doboj, Bijeljina, Trebinje) were analyzed and the results of the analysis were shown in this paper.

2. BASICS CHARACTERISTICS OF CIVIL EMERGENCIES

Considering that an emergency is such a situation in which emergency services are not able to solve the issue of an accident or danger with their daily operational work or with their capacities, and then additional capacities outside those services as well as citizens are engaged to respond or prevent a specific event. A civil emergency is any event that can cause loss of life, damage to property and tangible assets, changes in the environment and disturbances in the normal functioning of a particular entity, whose actions and consequences cannot be prevented, mitigated or remedied by the community with regular or extended use of emergency services, it is already necessary to use special measures, forces, and resources with extended regime of activities. In a civil emergency, the state or local self-government unit is able to activate additional capacities, seek assistance and manage it.

With this in mind, it is necessary to clearly emphasize the characteristics of a civil emergency, which clearly highlights the challenges faced by emergency headquarters. Some of the key characteristics of civil emergencies are:

- in civil emergencies, the survival and material values of a community are called into question (frequent human casualties and great material damage);
- each civil emergency is specific and has its own peculiarities;
- civil emergencies imply an immediate response (now and immediately);
- influence on people is subjective and objective, that is, safety and security are endangered;
- ambiguity and uncertainty related to the nature of the danger and the potential consequences, or a high degree of change, because everything happens quickly (a domino effect whose direction and consequences are difficult to predict);
- in a civil emergency, insufficient or inadequate response resources are always manifested;
- lack of information due to disconnection of communication, internet, electricity, etc;
- a large number of forces and resources involved in responding, both local and regional, national and international, and the complexity of cooperation during response between services, agencies and other actors, but also those who do not know each other and who cooperate for the first time;
- the private and public sectors are forced to cooperate;
- specific structures are formed with special powers and tasks (emergency headquarters, specialist teams, etc.);
- public relations require special procedures and activities - Crisis communication.

With all of this in mind, it is clear that emergency headquarters face a number of challenges that occur simultaneously. Time is a segment that the staffs do not have, and their work is under extreme stress caused by a civil emergency as well as public pressure.

3. MANAGEMENT, MANAGING, COMMANDING

The term management is a continuous process of performing activities, and implementing decisions through other people, in order of applying knowledge to achieve maximum results and goals of the organization with minimal investment. The functions of management through which it should be realized are planning, organizing, managing and commanding, coordination and control. [5]
When it comes to managing and commanding then it is clear that it is an executive management function. Managing involves directing organizational units toward the achievement of the organization’s goals, while commanding is the issuing of orders to immediate task executors. Managing is realized through various standard operating procedures and defined processes while commanding is exercised through the issuance of special acts, which are instructions and orders. Managing is for the system but commanding is for the executors. It means there are two levels of executive function. In local self-government units, the system of protection and rescue is managed by an administrative body (civil protection department or section), while civil emergency managing and commanding are performed by emergency headquarter.

Fayol was considering commanding as a power that does everything that is necessary, in order to listen and execute orders. [7] The basic principles of managing and commanding, when it comes to military organization, are: unilateralism, subordination, unity, continuity, resilience, operability, and secrecy. [6] In addition to these principles, additional principles are introduced in modern organizations: legality, fairness and gradualism; effectiveness and efficiency; initiative and creativity; timeliness and security, and the principle of transparency is introduced instead of secrecy. All of these principles must also apply to the work of civil protection and emergency headquarters. Often there are problems between the command and the emergency staff related to misunderstanding of the managing and commanding relations.

In order to overcome problems and to successfully managing and commanding of civil emergencies, some measures must be taken to build trust and cohesion of the response teams, and to understand the managing and commanding relations, such as:
- become familiar with these entities and their capacities and limitations on their use,
- understand certain national, religious, cultural or political constraints,
- define an appropriate command and support system,
- establish liaison and contact persons,
- develop or agree on unique procedures,
- develop or agree on security measures and activities,
- develop or agree on what communication measures and protocols are used and ensure compatibility of communication and communication means,
- develop or harmonize which reporting matrices and what forms are used, etc.

From all, it is clear that emergency headquarters have to and should function as one team. This includes mutual understanding, teamwork, exercises, but also a clear set of regulations and other documents that clearly and unequivocally determine the duties, rights, and obligations for each of the staff members or teams.

4. HEADQUARTER AS AN ORGANIZATION AND TEAM

The headquarters is an operationally expert body that integrates and coordinates the work of all command bodies in the planning, organization, preparation, execution, coordination, and control or managing of emergency and rescue activities. [4] The headquarters is part of the command, a special body of functionally connected and united persons and bodies that assist the commander in managing and commanding the protection and rescue forces. General obligations of the emergency headquarters are provided by the Law on Protection and Rescue in Emergency Situations of the Republika Srpska [8] as follows:
- manages and coordinates the work of the subjects and forces of the emergency protection and rescue system in carrying out the assigned tasks,
- manages and coordinates the implementation of protection and rescue measures and tasks,
- consider and give its opinion on the proposal of the Threat Assessment and the proposal of the Plan of protection and rescue against natural and other disasters,
- monitor status and organization of protection and rescue and propose measures for their improvement,
- order the use of protection and rescue forces, aids and other means of emergency,
- works to regularly inform and inform the population about the risks, dangers and measures taken,
- monitor the organization, equipping and training of units and teams of protection and rescue, authorized, trained legal entities,
- cooperate with the competent authorities of protection and rescue of neighboring states in emergency situations,
- assesses the risk of a civil emergency; and
- make proposals, conclusions, and recommendations.

In the ten analyzed municipalities of Republika Srpska, it is clear that there are no the commands, but the headquarters are responsible for commanding and responding to an emergency, implying that they are incapable of functioning without command. There is a lack of command elements that enable emergency managing and commanding. The situation in Europe is somewhat different as and in most of the countries belonging to the European Civil Protection Mechanism, compared to the situation in Republika Srpska and BiH as a whole.

Talking about the modern concept of emergency management and the current state of affairs in the EU, and especially in the US, then it means, first of all, to speak about the Incident Management System (IMS). It is applicable to all participants in the protection and rescue system. The basic principles of this system are flexibility, standardization, and unity of effort. This implies that this system can be applied to a variety of incidents, whether small or large, local or national, with one or more agencies and participants. This defines standard organizational structures that enhance the integration and connectivity between jurisdictions and organizations. Standard procedures are set up to enable incident staff to collaborate effectively and foster cohesion among the various organizations, institutions, and individuals involved. Unity of effort means coordinating activities between different organizations to achieve joint action with the same goal. Unity of effort enables organizations with specific competencies to support one another while maintaining their governance system. [9] The key functions of the IMS are planning, operations, logistics, finance, and administration, which are also key elements of the command, while specialists and other officials of local self-government units or other levels of government may be used for a civil emergency management purposes. This is a very good example of the linear-headquarters structure of the organization.

Analyzing the basic elements relevant to the work of the headquarters in ten municipalities of the Republika Srpska, planning, operations, logistics, finance and administration, it is evident that eight of them have a person appointed for finance, and for the administration only four municipalities, for the operations there is man appointed in five municipalities, and only Trebinje has a person appointed for logistics (a member of the logistics support and coordination staff). The absence of the people appointed for these duties in the commands or current headquarters is a problem in the organization of the headquarters and does not allow its efficient, fast and teamwork.

It is clear that behind the successful work of the command and the staff stands the team. If a team is formed to perform an extensive task, then it is necessary to distribute the work among the participants and place them in certain interdependencies. With many connections and
interdependencies, interference is created and the work of the team or the headquarters is endangered. For ease monitoring of work, an efficient team should not contain more than 4 to 8 members and the optimal number is 6. [2] None of the ten analyzed emergency headquarters, except in two cases, have the same number of members, that is, headquarters have 8 to 17 members, not counting the commander, deputy and chief of staff. Bijeljina has the largest number of members (17) while Banja Luka has nine headquarters and Gradiska only eight. These headquarters are organized according to the protection and rescue measures in most cities, while in Gradiška they are appointed in accordance with their functions in the city (commander of Firefighter brigade, from "Electricity Distribution, from the Red Cross, etc.). The commander directs and commands directly to all participants, making more than ten connections. It is clear that the headquarters do not comply with the basics of the number and structure of effective teams with the optimal number of members.

The most significant advantages of teamwork include:
- increased motivation for work and increased productivity of work,
- better business results,
- synergy, as an added value in the work of the team,
- commitment of team members to team and organization goals,
- richness of a variety and diversity,
- good interpersonal relationships in the team,
- ability to respond quickly and adapt to organizational changes,
- readiness of team members for continuous learning and improvement,
- increased work discipline,
- more efficient decision making,
- reduction of complaints and dissatisfaction of employees or team members,
- greater willingness to take risks,
- improved communication between team members and awareness,
- rational utilization of human resources,
- cost reductions in business. [3]

On the other hand, the most significant disadvantages of teamwork are:
- stress and frustration,
- limiting leadership development, and
- fear of teamwork overload. [3]

It is clear that not all duties can be done by the commander or the Chief of Staff. The headquarters should include specialists in specific matters and they are members of the headquarters for the quality and purposeful use of forces and resources. Other members should be members of the command and in charge of basic functions such as planning, finance and administration, logistics and operations. It is a command that has a headquarters and represents a linear-headquarters-Weber system structure, it means that has a command line, a headquarters with specialists and bureaucratically regulated relationships (rights, duties and commitments, procedures), but also internal and external interaction as well as dynamics.

There is, very often, "strategic avoidance" in local communities - insisting that the main responsibility for the crisis lies with other authorities or levels of government. [1] However, the commander has headquarters. This means that he decides in accordance with the recommendations of the staff, which he may or may not accept. Commanders are commanding by their officers in the field, and he has its one representative at the headquarters. Staff members are advisers and should be headed by the Chief of Staff. The Chief of Staff is from civil protection structures and members of the staff are appointed in accordance with the protection and rescue measures defined by the Law and for which there is a real need through
the Vulnerability Assessment. Other elements are managed by the Deputy Commander and he takes care of finance, planning, operations, administration and logistics. Except for Chief of Staff and Deputy Commander, only the public relations officer and the security officer should be on the commander's direct link. Thus, the commander bears responsibility for everything but has only four direct connections for the functional operation of the command.

Headquarters for civil emergency in the ten analyzed local governments have a very different structure. What is common to all is that there is a commander, his deputy and the chief of staff, but in Modriča, the chief of staff is also a member of the staff for planning, operational and teaching activities. Their structure is strictly linear, and although it has a headquarters in the name, it does not exist in accordance with the above definition. This kind of organization of emergency headquarter is complicated, and it has a large number of connections and interactions in communication, which makes it difficult to make quality decisions but also complete communication at the staff. On the other hand, the commander has a Chief of Staff who is essentially not managing the Staff but is a member like anyone else, and his knowledge about civil protection is not being used adequately.

5. CONCLUSION

The establishment of a Command for civil Emergency, of which the headquarter is an integral part, would allow the number of connections to be reduced and thus provide better communication in emergencies. Specialists would be managed by the Chief of Staff and not by the Commander, and the rest of the structure would be managed by the Deputy Commander. The commander would basically have a deputy and a chief of staff on the line and with the help of them would command with the forces on the ground. This would speed up the work process, clearly demarcate responsibilities and get a 24/7 command as long as needed. This would also create teams of 4-8 members, which is justified both from the scientific standpoint of the organization and the work of the teams in the organizations.

Such a proposed organization of the command, basically a linear-headquarters structure, is similar to the structures of military command and headquarter, with elements of some other models, and there are some advantages and disadvantages. Although it is often emphasized that the linear model is good for emergency management, yet the complexity of the emergency and the large number of connections make it impossible to effectively managing, commanding and control of activities. The advantages of this linear-headquarter model are primarily reflected in the following: the commander makes decision on the basis of specialist proposals, in case of lack of knowledge it is balanced by the headquarters staff, the commander deals with managing and commanding and is focused on the system rather than dealing with various problems, which are in the hand of specialists. Moreover, the number of participants in communication has been reduced and the flow of information has been more clearly defined. Also, there are problems that arise from this model of work, which are primarily in the misunderstanding of the relations by specialists within the linear-headquarter model, and especially in the misunderstanding of the managing and commanding relations. It also takes a lot of education and training to bring all the commanding and managing structure elements into ability to respond effectively to emergencies. This is especially influenced by the bureaucratic segment of the model, which is characteristic of the police, the military and other emergency services, and the need to prescribe the duties, rights and obligations of all participants, and certain standard operating procedures. In any case, this model slows down a command that is not educated and trained, but otherwise, when the command is educated and trained, it provides a quick and effective response, and duties, obligations and procedures are known and the initiative, in that framework, may emerge.
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THE SECURITY OF CITIES - DEVELOPMENT
IMPERATIVE OF URBAN AREAS

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Abstract: Excessive urbanization, micro and macro population migrations and impact on an environmental security directly and indirectly affect personal and collective security. Inconsistent consideration of sustainable development, hypocritical attitude towards the ecosystems, and the pursuit of a comfortable life within the large concentration of people for the sake of profit and the convenience of a better life have endangered the security system in large settlements. Uneven infrastructural development, along with other life areas, primarily socio-economic and social part, significantly indicates that the causes of security threats and risks will increase. This is especially true for small and developing countries which, due to the series of cause-and-effect interactions in the security of large settlements, cannot adequately protect people and their tangible assets. Critical infrastructure has special treatment in this regard. The aim of this paper is to animate the authorities at all levels in order to perceive security issues from a holistic perspective, and focally from the security standpoint, and thus incorporate them in the city's development projects in the future.

Keywords: the security of cities (urban security), integrative operational centre, urban metabolism

1. INTRODUCTION

Migration processes in the World, on various grounds, have caused movement of people from rural to urban areas. In many ways, this issue has caused problematic content. Increased infrastructural development has caused problems from the standpoint of an environmental security, the emergence of a large number of critical infrastructure causes the engagement of forces and resources to work on their own security and continuous operation (banks, administrative apparatus, energy supply, military capacities, police stations, etc.), waste materials pollute already cluttered landfills, public health system establishes itself through the problems of the potential outbreaks of a large-scale epidemic, criminal milieu is being transformed into various manifestations, major events are a continuously being held (sports competitions, delegation visits, protests on various grounds, etc.). Local community transformations in large urban structures are necessary on many grounds. They are causally related, but, essentially, each of them has its own security-contextual plane. The lack of a boundary between the impact on human rights, the excessive use of force and the existence of various threats is extremely evident in cities where people meet their basic needs. The complexity of cities' security is reflected in the need of continuous monitoring and upgrading the existing security content, including smart technical and technological solutions.

2. CITIES - DEVELOPMENT IN A DYNAMIC SECURITY ENVIRONMENT

A complex and thorough review of local security processes has also induced views on economics, politics, culture and other elements to be observed through different angles. The
level of local communities that are being perceived as fundamental for many spheres of socio-economic and economic life, is becoming more and more prominent. The basis for detailed consideration is stimulated by the development of local communities as elementary subjects for development of a society in one territory.

In its sociological meaning, the local community is a general term used in sociology to refer to a social group residing in a particular area, whose members are connected by spatial proximity and the associated common needs and activities. The local community is determined by several elements: space, people, people's needs, activities through which those needs are being meet and people's awareness of belonging to the local community. One of the institutions which, in historical society development, has established and affirmed itself as a democratic institution of the local community is local self-government [10].

The conceptualization and design of local communities is determined by the constituent solutions of local authorities, local level politics, decision-making system and process, central and local government relations, service functions and local public finances. In this context, it is necessary to perceive which segment is fragmented for cooperation with other institutions, in order to support the development processes of one local government.

The urban areas of major cities in developed world countries had complex project arrangements and designs in order to bring several demanding segments in balance. As can be seen in Figure 1. - Increasing number of urban population, this trend is constantly increasing.

![Figure 1: Increasing number of urban population](https://www.google.ba/search?biw=1366&bih=662&tbm=isch&sa=1&q=migration+from+rural+to+urban+areas+2015&oq=migration+from+rural+to+urban+areas+2015&gs.)

The territorial organization of each international entity is based on the forms of local government. In countries where cities have been developed and established as constituent units, consisting of several municipalities, the territorial component includes both, the extension of the city toward its surroundings and its impact on suburban settlements. The size of basic local communities depends largely on tradition, but also on the role played by local authorities.

Small and developing countries generally pay little attention to these problematic contents. The contents are primarily reflected in the fact that population growth does not follow the development of other socio-economic and social values (cities as ecological premises and sources of climate change; bases of human security; sources and consumers of resources-
water, energy, etc.; public health centres; gravity transport points, etc.). The effective functioning of cities in democratic societies lies at the very core of gaining the legitimacy of a democratic order. This is especially important in transition societies, as such societies are most imbued with scepticism and distrust in system institutions in general. These countries are also constantly under attack by challenges, risks and threats, which further increases the dependence of all entities contributing to the security of cities.

The analysis shows that each city or settlement has its own region in which it has decisive influence, thus the relationship between the planned settlement and its region must be harmonized. The region's social development plans and regional spatial plans must be based on long-term development plans [6]. Very often the economy or other elements (e.g. education, health, tourism, culture, etc.) of two neighbouring regions complement each other so that the spatial plan needs to be harmonized.

The regional plan as the first phase of urban planning consists of the regional plan program and the general regional spatial plan. Based on the analysis and in accordance with the social development plans and the procedure that ensures democratic consideration of the proposal, guidelines for regional spatial planning are established. This consideration is limited to a period of 20 to 25 years.

In addition to the textual explanation and documentation, the regional plan also contains drafts including the following annexes:

1. The basic purposes of the space usage;
2. Comprehensive roads network encompassing all kinds of roads;
3. Overview of water flow regulation;
4. All elements that are relevant for the assessment and bringing the conclusions (sites with special cultural heritage, reserves, watercourses, etc.).

Upon the adoption of the regional plan, the development of an urban program is initiated. The urban program is in its core linked to the regional plan and represents the second phase of urban design. The scope of this study is conditioned by the size of the place being worked for, and sometimes for some reason it may be made in a shortened procedure. The urban program is considered by professional and community organizations and forums, who comment, provide remarks and accept or reject the program. Only after complete consideration by the public and experts is done, it is possible to proceed to the development of a General Urban Plan (GUP) according to the adopted program.

The General Urban Plan contains a technical and economic rationale, a proposal for the method and stages of realization, and graphical annexes necessary for understanding and overview of the idea. These include the following:

− Area covered by the GUP;
− The basic traffic network with connections to the regional transport network;
− The basic purpose of areas including urban planning boundaries;
− Organization of residential zones and housing;
− Network of social, school, sports and other public buildings;
− Infrastructure solution method, i.e. water supply, electricity supply, energy supply, etc.

Further annexes may also be attached or requested if they are of specific importance (urban zones or cultural and historical heritage sites).

The following phase of urban planning is the Detailed Urban Plan (DUP). This is the ultimate form of urban design, that is, certain technical solution based on the adopted GUP. Such plan
contains all elements of an urban-architectural solution, such as: dimensions and size of the objects, street profiles, green area solutions etc. All this work is done by specialized organizations, urban planning institutes, which in addition to architects assemble various other experts including geologists, geographers and doctors.

The modern approach scrutinize content of the urban metabolism compounding several important elements of urban living. Figure 2: The framework of urban metabolism shows a comparative overview for Barcelona, Malmo and Freiburg.

A culture in security development and long-term trust are the elements that are perceived in order to achieve greater level of awareness and trust in institutions. Perception of the city security and its place in the security system of an integrated state system is formed in various ways and with many influential factors. Each of these factors is separate, but in collaboration with other factors, it assigns tasks to local communities to create a safe environment for their citizens.

A specific approach, which is characteristic for cities, could be determined through human security, which envisage seven security domains: food, health, environment, personnel, community, economic and political form of security. [2] This acceptable approach has its foothold in modern understandings of security, exactly due to the fact that it perceives domains specific for cities and indicates the need for their problematic multivariate understanding.

The analytical approach determines that security of cities is very often considered separately or the quantitative and qualitative analysis is not sufficiently deliberated at all. In addition, it is not considered interactively in relation to other segments of the city's development.

The City of Banja Luka in Bosnia and Herzegovina (The Republic of Srpska Entity) can be explored as an example of an urban settlement, or a populated place as well as a unit of local self-government. It represents the political, administrative, financial, university and cultural centre of the Republic of Srpska. Analysing the spatial plan of the city of Banja Luka [12], it can be seen that security aspect are at no place precisely and directly addressed. It is also unambiguous that security standpoints are considered in other ways as well, but in the modern
observation of the security of cities, the synergy of security and socio-economic and social view on these problematic contents is essential.¹

This plan identifies a detailed qualitative description with a number of maps indicating all segments that this type of plan should have. In certain segments of the above stated plan there exist direct parts that are related to some of the security segments such as E.II.-Climate changes, Z.II.-Improvement of devastated and endangered lands, Z.II. –Environmental protection that points to the environmental safety. Similarly, in the same Plan, the definition of infrastructure in subchapter G.5 through paragraphs referring to transport, hydro-technical infrastructure and energy, indirectly refer to energy security and critical infrastructure. It is also evident that in other parts of the Plan, there can be found links related to the security of participants in traffic, public safety, etc.

The development of multivariate threats and risks in urban areas, however, requires that issues in these populated areas should be analysed thematically and from several various aspects. A detailed analytical-synthetic and inductive-deductive approach with other scientific and practical solutions would suggest that optimisation of the engagement of human and material-technical means in order to protect citizens in cities could be better. In-depth research would probably show that fire fighting vehicles which are supposed to extinguish the fire are not moving via the optimal route, that in case of emergency states some parts of the city are not adequately blocked, that in the operational monitoring centre there are no enough sufficiently developed standard operating procedures for individual cases, etc.

Zarko Culibrk, author of the book “Emergency Management” [1] points out that in emergency management, existing approaches in planning, event prediction and management phases will not be sufficient, key resources can be quickly depleted and political sensitivity and social tensions will increase. In case of unlimited complex emergencies, community development is no guarantee that the situation will be resolved. Some communities may be developed, but they will not have institutions that can “fight” with complex emergencies or even more dangerous irregular emergencies.

The emergence of a crisis in cities is proportional to the increase of security and other consequences in several convergent directions. If it is a possible terrorist attack then the consequences are incomprehensible and long lasting. In the book "Banja Luka - Terrorism and Response", the author of the manuscript Dragisa Jurisic [3] indicates that there are certain types of activities of first responders, and their cooperation and communication in the development of plans is realized in the field of necessity, but not in the field of comprehensive analysis and coordination.

However, city authorities may also face crisis situations that go beyond their capabilities, indicating the need for systems to be linked to lower, and especially higher levels of decision-making, especially in terms of security. In his paper „The Crisis Management Model“, the author Goran Maksimovic [7] determines the importance of the whole system coherence. In his comparative reviews with other countries, treated by the author in his work, there can be seen an example of the Kingdom of Denmark, which has in its legal basis a decisive citations stating that commissions for preparedness for immediate help and reaction have to be formed at the municipal level in case of crisis management situations.

¹ The authors did not intend to point to the documentation regulating the development of these types of plans.
3. A SYSTEMIC APPROACH TO CITY SECURITY CONSIDERATIONS

It is evident that the security of cities must be accessed systematically. System theory, in this context, involves the application of process control and command functions (planning, organization, management, coordination and control). For the purposes of this paper, the emphasis is on coordination of local city services (without neglecting the fact that security of cities is also based on other complex grounds).

At this presentation the coordination of city services with security, defence and protection institutions at higher and lower levels is distinctively stated. Operational centres, city crisis centres, etc. are emerging as a possible coordinating element. This is certainly complemented by the fact that material and technical means (camera placement, different sensors, the use of unmanned systems, global positioning system, hardware and software solutions in different areas of security and protection - public security, traffic safety, security of the critical infrastructure, security of property, persons and business, monitoring schools, banks, etc.) that would support timely and meaningful decisions, especially in crisis situations are necessary.

The development of analysis and tools for risk assessment is completed by the possibility for preventive action. Kekovic [5], in his book, refers to the need to introduce quantification and qualitative monitoring of possible risk occurrence. This distinctively directs the development directions of application of the mathematical methods and analyses, that is, software monitoring of crises and crises of large systems, as cities essentially are.

**Figure 3:** Coordination of city security services

Milica Mladenovic, [9] an author of the article “Risk Assessment of terrorist attacks by application of expert choice solutions”, through risk size criteria, possible alternatives, comparison criteria, alternative indexes, goal synthesis, etc. clearly indicates the need for decision making supported by computer animation and this approach (which is quite acceptable for the city's security systems and even necessary in complex security conditions).
This points to the possible creation of the software that would be useful and optimal for monitoring the situation in the city in real time. An example of one such software package (with executable on-screen segments) is presented in Figure 4: A software solution for monitoring the security status of cities and other segments of the city.

This also requires a contemporary integrated operational centre that should have the following tasks:

- Collect and consolidate information on the city's crisis situation;
- Secure the receipt of information from various sources and form a comprehensive, unique operational picture of the current state of the city;
- Ensure conditions for efficient coordination of all participants in the crisis management process;
- Provide transportation means for cooperation with regional partners (if crisis exceeds capacities of the city);
- Provide communication and order transfer mechanisms to execute coordinated use of units for different purposes;
- Provide support to efforts and coordination of intersectoral operations.

Essentially, this centre should also be able to analyse, evaluate the situation and edit the software application in real time so that citizens can have information relevant to security (implications, possible further threats, free shelters, etc.).

Of course, such a highly sophisticated approach must also be verified, requiring city authorities and security authorities and services to plan, organize and execute exercises of various level and type (Map-MAPEX exercises, exercises supported by simulation programs, exercises with active participation of commands and units, checks of individual services separately, etc.).

The aforementioned approach will largely engage the consideration of the city security on a different basis. One of them is to introduce terms and complexities in the conceptual-categorical apparatus as societal security, which refers to the ability of a society to preserve its essential features due to the changing circumstances and despite possible or real threats. [4]

The practical implementation of these solutions is achievable in many segments of city security.

The importance of city security is recognized at both European and World level. In 1987, the European Urban Security Forum (EFUS) was founded in Barcelona as a non-governmental
organization, which gathers today around 300 members from many European countries and represents cities with a total population of 30 million. The main objective of this forum is to strengthen crime prevention policies and to promote the role of local authorities in the adoption of national and European laws and policies referring to security of cities. [13]

4. CONCLUSION

Considering the aspirations of people to be more and more protected, security is now considered a right and an obligation that is inseparable from the right to liberty, the right to life, the right to work, etc. The level at which this can initially be achieved is the local level. The organization of cities, as larger populated areas, provides these benefits but also causes multivariate threats that are unpredictable and long-lasting. The levels of prevention and resolution of implications and consequences are different, thus it is recognized that the security of cities is conditioned by the functioning of higher security levels, up to the national security, but also by contemporary security challenges arising from the specifics of the local community, which are of geographical, cultural, ethical, demographic, ethnic, social, industrial, communication and other nature.

Urban emergency management is a complex process that takes place in several phases. These phases have multivariate and multidimensional cause and effect effects if they occur in larger populated areas. Effects that are longer lasting than those in rural settlements or partially populated geographical areas are also being multiplied.

A synchronized interactive approach, in order to ensure the safety of citizens at the required level, is necessary in cooperation with the city authorities, especially with civil protection services, the fire service and the medical service. This calls for coordination across all security segments. Real-time monitoring is imperative in order to respond optimally to the differential manifestations of crisis situations. The need to form an integrative operational centre is more than essential.

Future infrastructure projects in cities should clearly follow the security aspects and take into account the need for citizens to have available information on the security situation in the city. The need for legal procedures and harmonization with the laws at European and World level is essential.

REFERENCES

GEOGRAPHY IN GEOSPATIAL INTELLIGENCE - C4IRS AND CYBER SECURITY

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Abstract: Information in 21st century represents power, and with that, safest and most legitimate "machine for dominating". Since ancient times, people have used maps to represent information about real places. This allowed them to visualize and think about these places while not actually being physically present. Information becomes displayed at a reduced scale organized by a cartographer. It expresses a view of extensive regions impossible to see from a single vantage point and communicates information about the represented space. Consequences from the rapid growth of information technologies and their usage for army purposes make information one of the key concepts of the unconventional warfare. Application of Geography in the Army for getting information is widespread all over the world, but this paper gives an overview and make particular ideas for further development in usage of GIS for geospatial intelligence - C4IRS and Cyber security. Today, in western societies, more people are employed collecting, handling, and distributing information than in any other occupation. Computers, optical fiber, copper wire, and electromagnetic waves link people to the vast array of information handling devices. Our society is truly an Information Society. Our time is the Information Age.

The main aim is getting specific information about objects, buildings and devices on the ground through geo-location and plots field data (various digital, video images), further management and planning strategies for ensuring proper cyber security, and also in other way, getting information from the intelligence services based on the information from the C4IRS. In this paper, despite the overview of usage geography for georeconnaissance in army, is presented an application for the soldiers on the battlefield for live streaming (drones and video camera) and live processing of the decisions from their commands, getting real time track log with moving map (through a GPS signal), which displays their current coordinate location, and their protection in cyber space of heading directions given by their commanders. The development of this kind of application based on GIS will make a breakthrough in geospatial intelligence, helping in the everyday life.

Keywords: Geography, cyber, geospatial, security, GIS.

1. INTRODUCTION

None of the most important weapons transforming warfare in the 20th Century –the Airplane, Tank, Radar, Jet Engine, Helicopter, Electronic Computer, not even the Atomic Bomb –owed its initial development to a Doctrinal Requirement or Request of the Military.” [1] Since ancient times, people have used maps to represent information about real places. This allowed
them to visualize and think about these places while not actually being physically present. Information becomes displayed at a reduced scale organized by a cartographer. It expresses a view of extensive regions impossible to see from a single vantage point and communicates information about the represented space. Today, in western societies, more people are employed collecting, handling, and distributing information than in any other occupation. Computers, optical fiber, copper wire, and electromagnetic waves link people to the vast array of information handling devices. Our society is truly an Information Society. Our time is the Information Age. One interpretation, made by Thomas M. Barnett’s that “connected” societies require less need for US military interventions (figure 1). [2] Barnett draws on a fascinating combination of economic, political, and cultural factors to predict and explain the nature of modern warfare.

Figure 1. Thomas P.M. Barnett’s original characterization of “The Pentagon’s New Atlas.”

This division between the connected and non-connected areas of the globe drew the association between the lack of the free flow of information and the areas where US military forces were most likely to be engaged. The author’s premise is that the more “connected” the less likelihood of a need for military intervention by the US military.

In book of global theorist Parag Khanna, Connectography: Mapping the Future of Global Civilization, he redraws the way humanity is organized according to lines of infrastructure and connectivity rather than our antiquated political borders. This emerging global network civilization holds the promise of reducing pollution and inequality - and possibly even overcoming geopolitical rivalries, and he asks us to embrace a new maxim for the future: "Connectivity is destiny."

2. GEOSPATIAL INTELLIGENCE - C4IRS and CYBER SECURITY

Armies in the 21st century have to manage with difficult operations in the field of unconventional warfare. Today, battles are won in the middle of the big cities and on the computers in the operational center where the information is the most powerful tool. Buildings and streets are the new battlefield, in which every corner hides different type of danger. Soldiers have very difficult task, to observe and save themselves from the various attacks. To eliminate these dangers and transform them in favorable role, armies must change "old" topographic maps with new modern maps which allow to the armies in the world to be one step ahead of the enemy. The term “modern” map, covers, of course, not only the up-to-datedness, transparency (that is, being able to be used simply, from the user’s point of view) and increasing precision, but also a higher-than- average information content that supports
military use to the greatest extent possible, considering special military aspects. [3] This is what GIS is about: to display special kind of information about specific area with unlimited amount of essential mapping information (layers), used to display the knowledge base of that area.

The term “geospatial intelligence” means- “ the exploitation and analysis of imagery and geospatial information to describe, assess, and visually depict physical features and geographically referenced activities on the Earth”. GEOINT consists of imagery, imagery intelligence, and geospatial information.” [4] Our main idea in this scientific paper is to discover, describe, explain, and interpret geographic and cyber information in order to anticipate a subject’s use of geography. A outcome to this can be stated as: Cyber information is an artifact of a subject’s use of geography. Advanced technology now provides the capability to use and combine geospatial data in different ways to create interactive/dynamic, customized visual products. It allows the analyst too quickly make more complex connections between different types of data and information than previously possible. Geospatial products can now leverage a wider variety of data, including from other INTs (such as SIGINT, HUMINT, and MASINT), through collaborative processes, to provide more accurate, comprehensive, and relevant products. GEOINT can also be combined with other INTs, such as SIGINT, to develop custom products. The result of these advances is a transformation in the analytic and technical processes used to create geospatial products. It is the cumulative effect of all these changes that propelled the evolution of the GEOINT discipline. GEOINT professionals represent and are drawn from a Aeronautical Analysis, Cartography, Geodetic Sciences, Geospatial Analysis, Imagery Analysis, Imagery Sciences, Marine Analysis, Regional Analysis, Source Analysis, The richness of available open source information, generated either by social media or other sources, is too complex to accumulate and analyze using current approaches. Analysts often use multiple sources of information to create actionable intelligence. The datasets are large in volume, and are typically stored across multiple databases in several locations. This requires queries to be pre-specified – filtering significant amounts of data before an analyst has an opportunity to decide if it’s important. This query-retrieve procedure effectively removes the possibility of the “lucky find,” because the analyst has to know what they want to query. The datasets are becoming more complex while the transaction costs are decreasing.

GIS is widely used in almost all the branches of the modern armies. Capabilities that use GIS are following: Command and Control, Defense mapping organizations, Base operations and facility management, Force protection and security, Military engineering, Mine clearance and mapping, Mission planning, Terrain analysis etc.[5] C4IRS defines a Command, Control, Communication, Computer, Information system, Reconnaissance and Surveillance. Geo-reconnaissance determine specific type of information gathered from the visual observation or other detection methods, which give us information’s about the terrain, geographical elements of it, objects on that specific area, that can help us to create a better picture for the enemy and the resources they are using. So, one of the ways of data gathering is by aerial photographs and space images. Advantage of these kinds of collecting data is the possibility of gaining information without getting any contact with the earth surface directly, but with contacting a mediatory unit carrying information about the surface. As that kind of mediatory unit which carry an assessing equipment to gain information are today's popular unmanned aerial vehicle (UAC) commonly known as a drone. With proper equipment they can be used to observe and make live photographs of the enemy terrain. This method will reduce the usage of people risking their life for the purpose of collecting information. [6]

From the US Army’s “Cyberspace Operations Concept Capability Plan 2016-2028” cyberspace is one of five domains; the others are air, land, maritime, and space. These five
domains are interdependent. Cyberspace nodes physically reside in all the other domains. Activities in cyberspace can enable freedom of action for activities in the other domains, and activities in the other domains can also create effects in and through cyberspace. As Figure 2 illustrates, Cyberspace can be viewed as three layers (physical, logical, and social) made up of five components (geographic, physical network, logical network, cyber persona, and persona). While these five components describe the boundaries of cyberspace, the information that flows through these components has to be recognized as unique in its own right. [7]

![Figure 2: The Three Layers of Cyberspace (physical, logical, social) & 5 components (geographic, physical network, logical network, cyber persona, persona).](image)

The layers of cyberspace as viewed above consist of the interdependent networks of IT infrastructures and data resident within those structures. The interdependent networks of IT infrastructures and resident data that define cyberspace exist in one or more layers of cyberspace. All the layers must be considered as they relate to the information environment, the operational environment, and the operational area. [8]

The **physical network layer** includes both geographic and physical network components. The geographic component is the physical location of elements of the network. The physical network component includes all the physical equipment associated with links (wired, wireless, and optical) and the physical connectors that support the transfer of code and data on the networks and nodes. As an example, physical networks components may include wires, cables, radio frequencies, routers, servers, computers, radars, weapons systems, telecommunications systems, personal digital assistants, and other networked devices where data is created, manipulated, processed, and stored.

The **logical network layer** consists of the components of the network that are related to one another in ways that are abstracted from the physical network. For instance, nodes in the physical layer may logically relate to one another to form entities in cyberspace that are not tied to a specific node, path, or individual. Websites hosted on servers in multiple physical locations where content can be accessed through a single uniform resource locator or web address provide another example.

The **social layer** consists of both a cyber-persona layer and a persona layer and are abstractions of the logical network, and it uses the rules of the logical network layer to develop a digital representation of an individual or entity identity in cyberspace. This layer consists of the people who actually use the network and therefore have one or more identities that can be identified, attributed, and acted upon. These identities may include e-mail addresses, social networking identities, other web forum identities, computer Internet protocol addresses, and cell phone numbers. Cyber-personas hold important implications in terms of attributing responsibility and targeting the source of a cyberspace threat. Because cyber-personas can be complex, with elements in many virtual locations, but normally not linked to a single physical location or form, significant intelligence collection and analysis capabilities may be required.
In summary, information is the only benefit that is stolen by replication. As such, securing it is problematic because, for it to be of any use, it needs to be available for access. In USA DOD is written “The Department and the nation have vulnerabilities in cyberspace. Our reliance on cyberspace stands in stark contrast to the inadequacy of our cyber security – the security of the technologies that we use each day.”

3. GEOGRAPHY OF GEOSPATIAL INTELLIGENCE AND CYBERSPACE

“I invoke the first law of geography: everything is related to everything else, but near things are more related than distant things” (Tobler 1970) Tobler’s statement is high-level, domain-neutral, and problem independent in scope and is problematic to evaluate empirically as a result. Keep in mind there are potential downsides (or dark sides) to use of data. Open data is not immune to exploitation. In 2016, N.A. Raymond poses a potential scenario where an NGO managing displaced persons (IDPs) allows a UN agency to publish a map showing the camps with the largest numbers of IDPs, while at the same time another NGO working to assist demobilized child soldiers allows another UN agency to provide their data in the open as well. Combined, these two sources of GeoInt enable a local armed force looking to reclaim their liberated child soldiers from the locations where their efforts will give up the greatest payback. They attack a camp and re-abduct the children based on the UN-NGO provided GeoInt. Most of the time, we concern ourselves with unlikely situation, but there are obviously other considerations.

We should recognize the tremendous power of information technology and vigorously promote its development. The melding of the traditional economy and information technology will provide the engine for the development of the economy and society in the 21st century.” [9] Internet communication technologies (ICTs) play an increasingly important role in terms of how individuals express themselves and communicate with each other. Public office holders, as well those who speak to power, recognize the increasing importance of ICTs and related technologies, which combined make up the domain of cyberspace. Within the Department of Defense, it is now considered a domain equal in importance to land, air, sea, and space and is the medium through which e-commerce, e-education, e-hobbies, e-politics, and e-conflict all take place. To no one’s surprise, cyberspace has become an increasingly contested space - an area of strategic geopolitical competition. Contests are frequent and occur on a daily basis, from the formation of military cyber commands (the US is not the only one to stand one up), to the filtering of social media tools by repressive regimes, to the creation of new tools and methods designed to circumvent them. The contests over and within cyberspace are the result of an increasing entanglement of competing geostrategic interests mutually dependent on and targeting a common information space. We are constantly reminded that the environment we are talking about is only several decades old, and in a short period of time it has gone through exponential growth and evolution that continues unabated.

Flouting geography challenges the idea of the sovereign nation state, and it is this challenge of the state’s independence that is at the heart of many of the issues surrounding the current governance of cyberspace. It was designed as a solution to a military problem of message exchange between soldiers without letting their enemies know where they were. The resulting architecture is evolving and decentralized, and the routing of the messages has nothing to do physical locations. The shape of the network was and is in constant flux. When the Web started expanding rapidly, the growing value it provides to countries forced most governments to either accept the status quo of Web governance or form their own policies at the domestic level, risking pushback from the international community. Maintaining a network separate from the rest of the Web is a common practice where security concerns in lower-level network operations exists. From the user perspective, the abstract online world defies ties to either
geographic or political boundaries, but it does depend on physical infrastructure that has a geographic location. Every country adapts domestic and foreign policies that impact the Web, some of which can affect the activities of the user community. Strategic geopolitics is therefore interwoven into the development of these policies.

Geo-location technology is not currently 100% accurate in providing the location of an IP address. When the user’s IP address is loaded on a proxy server that doesn’t expose the user's IP address, it is practically impossible to locate the physical location of the user. Some estimates place the country accuracy at about 99%. For IP addresses in the US, it is 90% accurate on the state level, and estimated at 81% accurate within a 40 km radius. Many worldwide users indicate as little as 55% accuracy within 25km.

When you use other parameters, it can get more accurate. For example, Digital Element utilizes as much information as possible from a list of available information for this uses audience segmentation capabilities and targeting based on parameters such as:

- Country
- Region/State
- City
- Zip/Postal Codes
- Custom Regions*
- Connection Type
- Mobile/ Wifi
- Longitude/Latitude
- Phone Area Code
- Time Zone/ Language

- Proxies
- ISP
- Domain
- ASN
- Confidence Factors
- Home/Business
- Industry Codes
- Company Name
- Org Name
- Demographics

**Figure 3.** Audience segmentation capabilities and targeting based on parameters.[10]

In line with Cyber Intelligence and Security of geo-information it might be helpful to review some of the salient points presented so far.
- Attempts to map both the Internet and where explicit knowledge is located has been frustrated by a lack of understanding of the synergies between such diverse fields as communication theory, geography, economics, GIS, and strategic studies – among others.
- Information is physical. Geospatial information references a physical location. Explicit information cannot exist without a physical infrastructure to support it. Cyberspace is created as a domain by this infrastructure and has a geospatial component as well than can be expressed as a set of septuple coordinates associated (connected) through the ICT infrastructure.
- The ICT infrastructure provides the possibility of a transaction based relationship between distant points that extends the application of Tobler’s 1st Law of Geography.
- As ICT infrastructure increases, access to information increases. Social change is more likely in areas where this increase is occurring.
- There is an intelligence value to the phenomena of the messages sent over such ICTs as social media. These messages have a geospatial component.
- The intelligence value is recognized in the IC, and studies at leading universities are being funded by the IC to further the Body of Knowledge (BOK) in using new HUMINT sources found in the Open Sources.
- The current understanding and practice of Cyber Intelligence is limited to attacks and defense on the infrastructure.
- Bodies attempting to censor the flow of information tend to provide blocks on the infrastructure and ignore or are incapable of monitoring and exploiting the sources of the
communications. Needing the connectivity to function, the blocks are soon lifted when the impression of “control” seems established.

![Figure 4: Model of C4IRS and CISCO Open Platform for Cyber Safety and Security Information Centar (3C2SI)](image)

CISCO Cyber Safety and Security Information Centar (3C2SI) will give control for sensitive information in Incident Collaboration, Mobile Force, Citizen- Authority Interaction, Sensing and Actuation, Mission Critical Network, Command and Control. An application for the soldiers on the battlefield for live streaming (drones and video camera) and live processing of the decisions from their commands, getting real time track log with moving map (through a GPS signal), which displays their current coordinate location, and their protection in cyber space of heading directions given by their commanders through 3CSI.

**TABLE 1: CISCO Solutions in Geospatial Network Intelligence & Cyber Space**

<table>
<thead>
<tr>
<th>Solution Description</th>
<th>Connectivity</th>
<th>Network Visualization</th>
<th>Traffic Optimization</th>
<th>Mobility and Location</th>
<th>Network Management and Monitoring</th>
<th>Storage</th>
<th>Identity</th>
<th>User Communications</th>
<th>Core</th>
<th>Application Networking</th>
<th>Security</th>
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<tbody>
<tr>
<td>Cisco IOS Software</td>
<td>✓</td>
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<td>Cisco Wireless and Mobility Solutions</td>
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<td>CiscoWorks Network Management Solutions</td>
<td>✓</td>
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<td>Multiplayer Data Center Solution</td>
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<td>Cisco Trust and Identity Management</td>
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<td>Cisco ISR Multiservice Routers, Catalyst Switches</td>
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<td>Cisco Unified Computing</td>
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<tr>
<td>Cisco Wide Area Application Services, Cisco AVE Application Control Engine, Cisco AVS Application Velocity System, Cisco Application Content Networking Solution</td>
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5. CONCLUSION

GIS has a fast growth in today world, but his capabilities are not explored completely. The possibilities that are offered from GIS have a wide range of use, and because of it, this information system nowadays is more and more used in various fields of study. Of course that military industry discovers different ways of composing this information system in manufacturing of new devices, vehicles and weapons and also in integrating of the GIS in the existing technologies.

Some of the usage of GIS is for geo-reconnaissance and C4IRS which was previously described in this paper. These subjects are already explored and have application in armies around the world for: tracking units or soldiers, reconnaissance of the enemy’s terrain, adding war-fighting symbols and tactical editing of the data from the battlefield, rapid and massive transferring of messages and orders, coordinate conversion, digital terrain elevation data information etc. A military information system based on connecting of these two powerful usages of GIS, will help the armies in the world and the decision makers for better observation on the mission or battle and giving specific orders based on the information’s collected from geo-reconnaissance and live-streaming of the situation on the battlefield. Input values for the commanders represent the data from the geo-reconnaissance i.e. the situation on the enemy's terrain and the geo-location of the own units and soldiers. The command make a decision which represents an output value of the system, and it is send to the soldiers as a voice order or as movement navigation.

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[9] (Jiang Zemin, August 2000),
ZONE OF UNCERTAINTY IN DECISION-MAKING PROCESS ON THE USE OF SECURITY FORCES

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Abstract: The paper focuses on the theoretical determination of the zone of uncertainty, the reasons for its origin and the ways to overcome it in the decision-making process on the use of security forces. In this decision-making process, the security forces leaders are constantly under certain temporal, social, economic or other constraints. Furthermore, an aggravating circumstance is the lack of information on necessary events that are most often manifested as the zones of uncertainty.

Keywords: zone of uncertainty, security forces, modern environment

1. INTRODUCTION

The modern dynamic environment entails a large number of unknowns in which security forces leaders have to make decisions on the engagement of forces. Part of this unknown is related to the enemy, i.e. its military dimension and what is associated with hostile action. The second part of the unknown is related to one's own strength, ability to resist the enemy, and related aspects. The interaction of these unknowns later leads to smaller or larger zones of uncertainty. The zone of uncertainty is a burdensome environment in which security forces leaders constantly have to make decisions about the use of security forces.

The concept of the zone of uncertainty has been increasingly mentioned in modern literature. It is mentioned in the same form in different sciences that give it specific meaning. In medicine and psychology, it is associated with the discovery of illnesses [1], but also with many common mental disorders [2]. In economics and marketing, it deals with the customer's attitude about the problem of choosing when buying [3]. It finds application not only in securing regions and facilities [4], but also in other scientific fields. What is common to all is that in each case there is a problem of decision-making objectively caused by ignorance of a complex environment or subjectively caused by the structure of the decision-making personality.

For the purpose of reviewing the zone of uncertainty in the decision-making process on the use of security forces, the conceptual determination of the zone of uncertainty will be considered in Chapter Two. In the Third Chapter the reasons for the occurrence of a zone of uncertainty will be discussed. Chapter Four will outline possible solutions in preventing and overcoming decision-making problems in an environment where there is a zone of uncertainty, after which a conclusion will be given.

2. CONCEPTUAL DETERMINATION OF THE ZONE OF UNCERTAINTY

The conceptual understanding of a zone of uncertainty must go from realizing the real problematic situation in which a certain level of ambiguity arises. The ambiguity is most often caused by a lack of information about the situation or by the inability to predict the future with
respect to a decision. While preparing and planning security operations, a great deal of information will be gathered about a potential enemy. This is the universal link of any security forces operation. In developed countries, ways of collecting information are constantly being updated and modernized. The information dimension is becoming increasingly important since the domination in that environment contributes most to the success of the operation. This is especially important for low-intensity conflict [5] and modern hybrid warfare [6]. Smaller states try to parry the large, with various asymmetric actions. Terrorism is a global threat that has proven to be the biggest problem for preventive action, however, conventional conflicts of security forces are also a major challenge.

There will always be some incomplete information in the intelligence work that will lead to some ambiguities. The ambiguity in some situations may be overcome by a different interpretation, certain assumptions about the situation, or otherwise. However, if it is not resolved in some way, it most often grows, binds to itself other more or less known information. Eventually, the ambiguity evolves into a zone of uncertainty. The zone of uncertainty, unlike ambiguity, makes it difficult to make less important and major decisions in the decision-making process. In some situations it also makes it impossible as the situation looks completely unknown. Seldom can an example be given of deciding on the use of security forces in a modern environment in which a smaller or larger zone of uncertainty has not occurred.

3. THE REASON FOR THE OCCURRENCE OF ZONE OF UNCERTAINTY

The occurrence of the zone of uncertainty cannot be accurately perceived, i.e. it is not possible to say that there is one reason that most often occurs in such situations. The unknown that will grow into a zone of uncertainty can be directed by the enemy as well as by one’s own forces. It is realistic to conclude that, in different situations, the combination of these unknowns will have a decisive influence on forming a zone of uncertainty. The aforementioned aspect of the observation can be called external conditions of occurrence and it is always in the environment of those who make the decisions.

Beside the external, the internal conditions for the occurrence of the zone of uncertainty cannot be excluded. A part of the decision-makers will see that there is a zone of uncertainty in situations where other decision-makers will not see it. This situation can be viewed from different aspects. Also, to consider the reasons for the occurrence of the zones of uncertainty, it is important to mention the significance of all persons participating in any way in the decision-making process. Security forces leader holds the most important role, however, the following points show that other persons in the command or headquarters, i.e. in the leading team that conducts the operation, are also quite important. Persons who are involved in the process and make less important decisions cannot be ignored.

The most important factors for the occurrence but also prevention and the overcoming of the zones of uncertainty will be singled out in the following text from the external and internal conditions of the occurrence of the zone of uncertainty.

3.1. Qualifications of the persons

The first aspect is job qualification. A better-educated or trained leader will be more prepared for the various situations that may challenge his future work. Today's complex environment confronts security forces leaders with a number of challenges that are most often unique.

Training security forces decision-makers implies different levels of education or specialization depending on the job that the persons will do in the future. In both domestic and international practice, through a theoretical understanding, education seeks to acquaint the student as much
as possible with the environment in which the security forces are engaged. From the theoretical settings adapted to the current situation emerges the practical or applied part of the education, which deals with a large number of situations that pose certain challenges to future security forces leaders. The situations being studied tend to explain the behavior of the leaders in current and most likely situations.

In this respect, a school system that is said to be good in the field of security is emerging, as long as it follows modern trends and conveys focused knowledge.

However, it is obvious that one level of education is not enough for the whole career of the security forces leader. Specializations are necessary. Specializations must include more specific trainings for specific duties of different levels and professions to justify their existence. Specializations cannot have a structure of education where the future leader is trained for lower positions and in which he partly acquires general knowledge, partly professional and specialist one. A higher level of education, at least one part of it, must provide specialization to certain higher duties. In this way, the person prepares for future actual duty but also for decision-making about the security forces. A person can hardly be an expert in a number of areas because the areas considered in the engagement of the security forces are broad.

Essentially, education that realistically approaches current problems, upholding the basic principles of science and casting doubt on previous knowledge will inspire the beginning of a new theoretical way that will become the base for acting in different situations.

The principle of not criticizing leads to dogmatic behavior and no output can be of good quality because it does not contain new ideas, nor does it validate the old one. In this regard, the quality of education will be reflected in practice, and better education will lead to better results for all leaders attending it. Leaders who have not had the opportunity to receive this type of education will not be prepared for the different situations that await them. For them, zones of uncertainty will be more frequent. Such cases can be seen beyond the consideration of the security forces. Placing inexperienced leaders in head positions is something that automatically leads to the condition that the work is not done in the best possible way. In the private sector, this practice has long since been put out.

It can be concluded that the school has a great impact on solving the zones of uncertainty. However, that is not the case for every school, only for the one that is properly directed towards modern tendencies.

3.2. Psychological aspect

The zones of uncertainty create a certain pressure on the personality after which the person may show different reactions. Different psychological personality profiles will approach the problem diversely. Intelligence and perception can have a positive effect in eliminating the zone of uncertainty. However, the temperament and character of a particular decision-maker are also very important.

Some persons will not accept the assistance and suggestions of experts and will base the decision on personal experience. Throughout history, there have been successful military leaders who based the decision on their understanding of the environment and situation without taking the advice of others into consideration. However, today's environment, being complex and dynamic, stands out from anything that existed in the past and requires a new approach. The experiential aspect can be used, but to a certain extent and in certain situations. Most often it can have a positive effect on lower-level decisions.
For fear of error, some persons will procrastinate to make the decision until the last moment, and then make a hasty decision, while some will try to delegate their leadership duties to the superiors or subordinates by "running away" from responsibility. When considering the psychological aspect, the teamwork in decision-making should also be mentioned, since it is most often used in the operations of the security forces. Group psychology can express its specific traits at certain moments and thus contribute to deepening or reducing the problematic situation.

There are many leadership schools that strive to make good leaders, better decision-makers, but none of them can fundamentally change the existing personality traits that will emerge in a crisis. Therefore, the system should function in such a way in order to enable the right persons to come to right places.

3.3. System (organizational) aspect

System solutions can help reduce uncertainty zones. System solutions to this aspect may imply doctrinal and normative regulation of a particular area in which the zone of uncertainty arises. Regulation means proper and detailed issuing of decision-making procedures. There will be less space in such procedures where one does not know what to do. Procedures should be designed to issue as much detail as possible. Working on such regulations has led to the so-called 'Standard Operating Procedures'.

The detail of the issued procedures has the advantage of reducing the number of situations that were not considered and thus reduce the number of zones of uncertainty. On the other hand, issuing such procedures requires a large time sacrifice and excessive paperwork, which in some situations may be too complex to review, especially if the time period in which the decision has to be made is limited.

In addition to procedures, system solutions may also include specific guidelines that are used in common situations. Examples of system solutions and guidelines are diverse. In some states, there is a guideline not to negotiate with terrorists in the event of abduction. In addition to the largest number of positive outputs of this guideline, which substantially prevents future similar situations, in some situations in simpler cases it may prevent making a decision that will reduce the loss of human and other resources. The vast majority of system solutions provide overwhelmingly positive results, but in a small number of cases they can bring leaders into certain zones of uncertainty because the action that seems to lead to a better solution represents the opposite of the system guideline and solution.

4. SOLUTIONS

Taking preventive steps certainly contributes to reducing zones of uncertainty. The ambiguities that develop and evolve must be addressed in a timely manner. For this reason, priority must be given to obtaining information on the unknown or unclear and relevant for decision-making. Collecting priority data and focusing on the essential elements can help to partly reduce ambiguities. Directing the information gathering management puts the development of ambiguities in control. Engaging the maximum capacity of not only subordinates but also superiors will in most cases yield a particular solution or part of a solution. This way, zones of uncertainty will appear less frequently.

In most of the existing decision-making processes regarding the use of security forces, it has been made available to the command, headquarters and the leading team to identify ambiguities and propose a solution. The leader decides on the proposed solution or directs the resolution of the ambiguities. In this sense, active participation of the leaders in the decision-making process can lead to faster resolution of the zones of uncertainty.
If it is not possible to obtain the information that would reduce the ambiguity, then that information should be analyzed through the effects it can cause. In this respect, preventive action should be taken. The leader can reduce the significance of the effect of the unknown information and thus accept a certain degree of risk. In these ways, ambiguities will not grow into zones of uncertainty, and so this can be considered as prevention. In part, zones of uncertainty can be solved by different methods of multi-criteria or multi-attribute decision-making. However, due to its complexity, this approach is limited only to those parts of the decision-making process where the main decision on using the unit is made. Furthermore, this situation requires enough time. There are methods that guide the whole decision-making process, but preparing them requires having a large experience base of similar operations.

5. CONCLUSION
The modern environment is becoming increasingly unpredictable. The importance of proper preparation for zones of uncertainty is increasing. Preparation must cover all the circumstances in which a decision is made, from preparing organizational and system solutions, through receiving proper education, to selecting appropriate persons who take part in the decision-making process.

Working with zones of uncertainty must represent an expected situation in which the people involved in the decision-making process, especially the team leader, will be able to rationally approach. One cannot be fully prepared for every situation, but the education system can contribute to the knowledge of similar situations. Furthermore, the leadership traits of high quality that are manifested through relationships with people contribute to a better resolution of the situation.

There is no universal solution for the zones of uncertainty. There is only a solution that implies realistic and correct handling of situations where a more or less significant decision has to be made.

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Abstract: The basic requirement of Mine Action is to understand the environment in which activities will take place. Good decisions will only be made when are governed by all relevant information and understanding of the environment. Generally, Mines and other Unexploded Ordnance (UXO) are a problem because they represent a risk for life and health of people and animals and because they limit all forms of development. In the Republic of Serbia the significant areas are contaminated with cluster munitions, air bombs – rockets, mines and other UXO on land and in inner waterways influence that government organizations and other participants in Mine Action need to know more about operating environment factors such as National history, stockpiles and production of anti-personal mines; international cooperation; funding humanitarian demining; ecological issues; economy; maps; collections of data; coordination; multiple clearing UXO on locations; standards; emergency services; climatic conditions; specialized companies and nongovernmental organizations; tenders; legislation.

Keywords: Mine Action, Operations management, Operational environment, Unexploded Ordinance (UXO), Explosive Remnants of War (ERW)

1. INTRODUCTION

The vision of the United Nations is a world free from the threat of mines, explosive remnants of war (ERW), including cluster munitions, and improvised explosive devices (IEDs), where individuals and communities live in a safe environment conducive to sustainable peace and development, where no one is left behind, where the human rights and the needs of victims are met and where they are fully integrated as equal members of their societies.[10]

Mine action operations accelerate the return of land to productive use and help establish a safe environment where people affected by conflict can rebuild stable and dignified lives. Mine action entails more than removing landmines from the ground. It includes 5 types of actions: 1) Clearance: Removing and destroying landmines and marking/fencing off contaminated areas; 2) Education: Helping people to understand and avoid the risk, identify mines; 3) Victim Assistance: Providing medical assistance and rehabilitation services to victims; 4) Advocacy: Advocating for a world free from the threat of landmines; and 5) Stockpile destruction: Helping countries destroy their stockpiles.[2]

In the Republic of Serbia, the presence of mines and other explosive remnants of war limits access to livelihoods and obstructs reconstruction after the end of a conflict. Often, mines have not been laid in contained areas but placed around a variety of strategic areas without any specific pattern. As a result, civilians, peacekeepers, aid workers and soldiers alike often have no way of knowing if they entered a mined area.[2]
Specificity and complexity of the problem present the fact that apart from mines remaining in the territory of the Republic of Serbia, Serbia also encounters with numerous challenges related to clearance of the areas contaminated with unexploded 1) cluster munitions, 2) air bombs – rockets and 3) other UXO. All these unexploded ordnances are either remaining as a result of the 1999 bombing, or are caused by an explosion and fire in a military depot, or are remaining from previous armed conflicts (Image 1).[11]

Cluster Munitions are used during NATO Operation Allied Force in 1999 when aeroplanes dropped cluster bombs in 16 municipalities in the Republic of Serbia without Kosovo and Metohija. During the bombing, NATO forces used the cluster bombs: RBL-755, CBU-87, CBU-99, AGM – 154/A and BL-755 which contained 145-247 pieces of cluster munitions type MK-1, MK-4, MK-118, BLU-97A and BLU-97A/B. In the territory of the Republic of Serbia, cluster munitions can be still found in the area of around 2,500,000 sqm. Following the International Mine Action Standards, bis 2018, the area of 11,258,195 sqm has been cleared.[1]

Air Bombs – Rockets it is assumed that from the 1999 bombing, they can be found in around 150 locations in the ground at the depth of up to 20 meters. Survey of other locations suspected to be contaminated with unexploded air bombs – rockets is in progress.[1]

Mines are been along the border with the Republic of Croatia until 10 November 2009 following 44 projects by the SMAC and with the supervision of the SMAC, and still, are in along the administrative line with Kosovo and Metohija. Unregistered mine contaminated areas (groups of mines): The remaining areas contaminated by mines did not have registries and had not been planted in specific patterns, which aggravated survey and clearance efforts.[11]

Other Unexploded Ordnance (UXO) and Explosive Remnants of War (ERW) on land mainly appeared after fire and explosion at the military depots in Paraćin, Kraljevo, Vranje, where various types of unexploded ordnance or their parts are located outside of military objects in the area of about 13,500,000 sqm.[1]

Other Unexploded Ordnance in inner waterways existed as consequence of conflicts in Second World War (1941-1945), Yugoslavia (1991-1995) and NATO Operation Allied Force in 1999. In the Đerdap Gorge, on the Danube River, in the vicinity of Prahovo, in 1944, 23 sunken German war vessels containing a large quantity of unexploded ordnance, including anti-ship mines, were sunken. These UXO pose a threat to people and the environment and significantly obstruct navigation in this part of the Danube. It is suspected that in the Sava river, in the area of the Jamena Village, improvised mines are remaining from the 1999-1995 conflicts. From the 1999 bombing of the Republic of Serbia, unexploded air bombs-rockets can be found in the Sava River and the Danube River.[1]

In the Republic of Serbia, the UXO and ERW protection management system is decentralized and different organisations, manage and implement anti-mine action activities, within their competencies. The state authorities responsible for clearing UXO and ERW are the Ministry of Internal Affairs, the Ministry of Defense and the Mine Action Center.

Ministry of Interior, through the Emergency management sector, provides civil protection. Civil protection represents the organized response of the state to the dangers that endanger the population, material goods and the environment in case of an emergency that exceeds the possibilities of regular activities of the competent authorities. So far, 173 specialized civil protection and rescue units and 27 teams of these units have been formed in the territory of the Republic of Serbia.[7]
Ministry of Defence, organize the demining and destruction operations of UXO in military complexes, performed by demining and destruction units of the UXO, specially trained personnel for destruction of UXO and persons for control and expert supervision of these operations from Serbian Armed Forces.[4]

The Mine Action Centre (SMAC), realize big project providing donations and control over those projects which are realising by specialized companies for Explosives Ordnance Disposal. The SMAC, among other things, conducts surveys of the locations contaminated with cluster munitions, mines and other ERW, keeps records on it, makes projects and project tasks for demining, executes quality control of demining works during and after the completion of works, issues certificate that certain area determined with a project is demined, that is, cleared from mines and ERW in accordance with the International Mine Action Standards. Also, the Centre conducts international cooperation and works related to the provision of donations for demining. It supervises appliance of international contracts and standards in the field of demining and executes other works determined by the law.[1]

2. THE OPERATIONAL ENVIRONMENT

The Operational Environment is a composite of the conditions, circumstances, and influences that affect the employment of capabilities and bear on the decisions of the mine action team. The Mine Action subjects must have a keen understanding of the Operational Environment and be able to make decisions based on the conditions, circumstances, and influences around them.[9]

By researching available open sources literature these operating environment factors in the Republic of Serbia, in most cases are: history, stockpiles of anti-personal mines; production of antipersonnel mines; international cooperation; funding humanitarian demining; ecological issues; economy; maps; collections of data; coordination; multiple clearing UXO on locations;

Image 1: Mine Action Operational Environment in the Republic of Serbia
Source: https://sindikatvatrogassaca.org.rs/5391-5391/
standards; emergency services; climactic conditions; specialized companies and nongovernmental organizations; tenders; legislation (Image 1).

**History** shows that since the beginning of the wider operational use of explosive ordinance in military activity on the territory of the Republic of Serbia in the borders from 2006., several major armed conflicts have occurred: First Balkan War (1912-1913), Second Balkan War (1913), First World War (1914-1918), Second World War (1941-1945), NATO Operation Allied Force (1999). Beside armed conflicts, other accidents make an additional problem. For instance, in 2006. The explosion in the Paračin military warehouse exploded one-third of the 3,500 tons of ammunition that was being stored there.[6]

**Stockpiles of anti-personal mines** in the Republic of Serbia were destroyed bis May 2007.[1]

**Production of anti-personnel mines** is closed and antipersonnel mines are no longer produced in the Republic of Serbia.[1]

**International Cooperation** achieves with numerous subjects in the field of mine action. Cooperation with the International Trust Fund for Demining and Mine Victims Assistance (ITF), as well as regional cooperation through various forms of the work of the Southeastern Europe Mine Action Coordination Council, gives good results in the field of mine action. After the foundation of the SMAC, ITF strongly supported the SMAC at first providing donations for the training of personnel, technical equipping and survey of the mine suspected area, and in 2003 started funding our projects for humanitarian demining. ITF and the SMAC signed the Memorandum of Understanding which further enhances cooperation between the SMAC and ITF.[1]

**Funding** directly influences on solving problems connected with humanitarian demining. Upon the foundation of the SMAC, representatives of relevant international organizations have requested that the SMAC, as well as centers in other countries in the region, is founded as an independent state authority out of so-called ministries of force.[1]

Despite the difficult economic situation in the country and modest funds from the National Budget, Republic of Serbia endeavor to secure funding of demining either by submitting projects to ITF applying for their funding, or lobbying with other foreign donors to provide funds for implementation of projects. However, in 2015, the funds €100,000 for demining operations have been allocated from the Serbian State Budget for the first time. Also, the funds have been allocated in 2016. This trend has been continued on an annual basis and in 2018 the Serbian Government allocated the double amount of funds for demining operations, and it is expected that the Serbian Government will continue to allocate the funds for demining operations throughout the requested extension period.[1]

**Ecological issues** come from the high level of environmental pollution from UXO. They pose a constant danger to people and property and greatly complicates the infrastructure development of economic and other capacities in the Republic of Serbia. Studies on the impact of landmines have showed that landmines have, forced populations to overuse certain natural resources leading to numerous environmental challenges such as erosion, land subsidence, etc.

**Economy** is threatened by the inability to access transport routes, or use energy sources (electricity lines) may also have implications on local poverty levels.[3]

**Maps** in the Republic of Serbia are mainly produced by the Republic Geodetic Authority and Military Geographical Institute.

The Republic Geodetic Authority is a special organization performing professional and public administration works about state survey, real estate cadaster, utility cadaster, basic geodetic
works, address registry, topographic-cartographic activities, property valuation, geodetic-cadastral information system, The National Spatial Data Infrastructure (NSDI) and geodetic works in engineering-technical fields. The Sector for Geodetic Affairs provides spatial services and products from the scale of 1: 5 000 and larger in analogue and digital form.[8]

The Military Geographical Institute is an institution of the Serbian Armed Forces and produces geospatial data and various types of cartographic, graphic, photographic and textual-numeric products in digital and printed form as Topographic maps, Geospatial database, Orthophoto products, Digital elevation model and Relief maps. In addition to these products, the Military Geographical Institute produces transparent topographic, geographical and thematic maps. Almost all products are available to civilian institutions. The current products of the Military Geographical Institute are: Topographic map 1: 25.000, 1: 50.000, 1: 100.000, 1: 250.000, Geographical map 1: 750,000 and International map 1: 1,000,000.[5]

Collections of data are not on organized and on accessible way presented among participants in Mine Actions. Every relevant subject in Mine Action has its database, on the way which is organised to contribute to his organisation. No standardised forms are made and no obligations for exchange data is made. In practice, all organisation have good cooperation but they are not legally obligated to do so.

Multiple clearing UXO on locations are conducted in several locations. During and immediately after the bombing, the Serbian Army and police conducted the removal of unexploded cluster munitions from the surface, which contributed significantly to the safety of people and substantially influenced the reduction of the number of the injured, above all, children. Given that cluster munitions that went through the ground were not detected and destroyed, the removal has to be done now to provide complete safety to people.[1]

Standards are mainly based on the International Mine Action Standards (IMAS). Following the International Mine Action Standards, the first clearance operations in the Republic of Serbia were organized in 2003.[1]

Emergency services in the Republic of Serbia could be: Police, Firefighters, Ambulance (medical assistance and first respond), and others depending on the task.

Climactic conditions influence in the manner that contaminated areas are inaccessible during some periods of the year causing operation delays. Consequently, most of the suspected areas are not appropriate for the use of mine detection dogs or machinery.[11]

Specialized companies and nongovernmental organizations exist in the Republic of Serbia. They are registered for these works, technically are equipped and have adequate personnel.[1]

Tenders procedures for the selection of contractors for implementation of humanitarian demining/clearance projects funded by international donations conduct donors, as a rule with the participation of international foundations through which they channel their funds. In other cases, tender procedures are conducted by an investor.[1]

In the legislation of the Republic of Serbia, several laws and other regulations directly or indirectly regulate activities related to the management of UXO, mines and EORs.

The Labor Law indirectly refers to the implementation of anti-mine action activities, because it regulates that the employer is obliged to provide the employee with working conditions and organize work for safety and protection of life and health at work, following the law and other regulations and consequently about mines and EOR, as well as that the employee has the right to safety and protection of life and health at work. Rules on occupational safety during the construction works further regulates that when earthworks are carried out on old war spots or
warehouses, before the commencement of works, the existence of unexploded projectiles and other dangerous objects and materials. Law on Disaster Risk Reduction and Emergency Management defines what are the Explosive remnants of the war (ERW) and what it includes protection against them. The work of the Mine action centre was prescribed by the Law on Ministries.[1]

3. CONCLUSION

Knowledge of the operational environment is important for a Mine Action to identify good and bad influences on activities.

In, the Republic of Serbia in most cases of Mine Action operational environment factors are being considered: history, stockpiles of anti-personnel mines; production of antipersonnel mines; international cooperation; funding humanitarian demining; ecological issues; economy; maps; collections of data; coordination; multiple clearing UXO on locations; standards; emergency services; climatic conditions; specialized companies and nongovernmental organizations; tenders; and legislation. Each of these factors has an individual impact or this effect can occur in combination with other factors.

Essential, the operational environment does not pose a risk to participants in Mine Action as long as they comply with the accepted international standards. Funding is the biggest problem because it depends on the goodwill of donors. The removal of UXO and ERW is carried out by the capacities of the state authorities, but for the more extensive and expensive projects the money to cover the costs of human and material costs remains a problem.

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INFLUENCE OF APPLICATION OF PRECAUTION AND SAFETY MEASURES ON THE PROCESS OF REALIZATION OF THE EXERCISES WITH MINES AND EXPLOSIVES ON MILITARY ACADEMY

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Abstract: Training cadets is being realized in order to prepare for the realization of various tasks in crisis situations. One way to prepare is through realization of different exercises. The Ministry of Defense and the Serbian Army exercises are organized and implemented in accordance with the rules and regulations. Existing rules allow convergence of conditions to real situations. In order to bring situation conditions close to real, during exercises different pyrotechnics, military and exercises explosives ammunition are used, but in the same time ground is selected to be as close as it can to real space. In such conditions there is significant risk. Implementing security and safety measures during exercises, conditions are being formed to control risk level. Through presentation of Engineering training exercise that is being carried out with all of the cadets, a portion of complexity of implementation of security and safety measures during preparation, organization and realization of exercises is shown.

Keywords: exercises, precaution and safety measures, risk, prevention

1. INTRODUCTION

Exercises using pyrotechnics and explosives are conducted on many levels and in different units. For the purpose of paper, exercises performed by cadets of all branches and services at Military academy during school are considered. The need for these kind of training and exercises came upon using Learned lessons system. Although Engineering units are designed for fortification during operations, principles of Engineering units’ engagement specify that they are used, in terms of fortification, only in main course of operation. All other units that are not on the main course of operation, are left to do fortification for their own needs on their own. When it is known that for realization of fortification is needed for personnel that is familiar with handling explosives, there is a need for future command staff to go through proper training during school. In this way all future officers get familiar with part of the resources belonging to Engineering units (pyrotechnics and explosives) and get training in safe and proper usage.

A prerequisite for successful realization of pyrotechnic and mine exercises is knowledge and application of appropriate safety measures, which significantly reduces the risk of possible injuries. For that reason, proper law regulations (laws, bylaws, rules, regulations) that regulate and limit the level of risk during exercises are implemented. This paper presents a part of the regulations, which, when applied, affect the safe operation of cadets in the course of realization of exercises.

2. ABOUT EXERCISES

Exercise is the highest and most complex organizational form of practical training which commands and units of the Serbian Army (hereinafter SA) use to train and evaluate for
conducting declared missions. [6] The fact that cadets are trained for engagement in SA units imposes the need for reference to said source. Because of the knowledge needed for the later call, in the course of their training planning, organization and implementation of different types of exercises takes place in accordance with the Instructions of the exercises in the SA. Instruction of the exercises in the SA precisely defines objectives of performing exercises. [7]

All exercises are prepared and conducted based on the doctrinal documents and are in line with the rules of usage of units, study programs, card of class they are attached with, orders and guidelines for training, command training plans and training programs of the units of SA. In order to create realistic training conditions, exercises are performed in environment as real as it can. Enemy actions appear with respect to the possibilities of weapons and military equipment, as well as the principles and rules of the usage of armed forces that are considered for the purpose of the exercises. Units are dimensioned according to needs of the task that is considered during exercise. As is true for enemy forces, own forces assigned tasks execute in accordance with the rules of use of units.

Modern environment imposes requirements that operations are performed in night conditions, terms of imitation use of nuclear, chemical and biological weapons, terms of electronic and counter electronic actions, hostile civilian environment and in terms of natural disasters. All this should be considered during exercises and in accordance with given task and exercise scenario.

Based upon Instruction of the exercises in the SA all exercises are divided on basis of four criteria, according to: [8]
- type,
- goal,
- participants and
- engaged forces.

For the purposes of paper, the focus is on training exercises. Training exercises are exercises carried out for training or practicing commands and units to execute assigned missions. Training exercises are usually conducted during or at the end of a period of intensive training operating cycle of the unit. It’s carried out on all levels, and the exercise type is chosen based on command/unit training assessment and mission for which unit is preparing. Training exercises are preceded by tactical practicing. [9]

Tactical practicing for Military academy cadets is starting point for training in role of commander. It is performed on the ground, in space (a practice site, polygon) with the main objective for cadets and officers to rehearse and train to carry out combat and non-combat activities. Tactical practicing is running towards the contents of tactical training. Duration of tactical practicing on a single segment depends on the achieved level of proficiency of cadets. [10]

Subject teacher who carries out tactical practicing is responsible for planning, organizing and realization of exercise. He makes corresponding plan and scenario alongside complete review of implementation exercise ideas. Enemy activity is imitated by engaging certain number of personnel and resources. Specificity tactical practicing is expressed by the fact that both combat and non-combat operations are repeated until the required level of training individuals and units is reached. During the exercise insists on the proper implementation of combat and non-combat activities, while the necessary application of the knowledge acquired during the incite our classrooms and skills acquired during previous training and education.
3. RISKS DURING THE REALIZATION OF EXERCISES

The very concept of the risk, depending on the different fields of human activity, is defined and interpreted differently, but it is mainly based on two basic elements: exposure and uncertainty. However, regardless of the activity in question, in the human nature is a desire to have knowledge of future events. The goal is to predict specific outcomes, i.e. result of action. Outcome - the result may not always be favorable to a person who expects a solution. This is why there is a desire to reduce the number of adverse outcomes - results, and increase the number of favorable. One way to shift the outcome is to choose an appropriate alternative for risk management.

For employees of SA risk is something that members constantly face in. Because of that one can’t say if it is good or bad. The reason lies in the fact that the risk is measure of “deviation of expected outcome”. [4] Bad consequences, as outcomes – results, are shown thru increased spending of resources, jamming functions and processes, exert influence on the ability to carry out missions assigned to units. On the other hand, good consequences, as outcomes – results, give better results than expected and unexpected possibilities for the organization. Based on the above it can be concluded that the characteristics of the work of military personnel, from the aspect of risk management, is presented in two stages: assessment (analysis) of the risk and the response to the perceived risk. Typical for military personnel is the fact that most of the decisions are made during combat operations (or during training for combat operations). For that reason, activities (risk management) of decision maker are pointed towards reducing uncertainty and increasing the level of security in the realization of the set tasks in achieving the set goals.

During the realization of exercise risk can occur that is being represented through the use of motor vehicles, the engineering machines, live and blank ammunition, combat and practicing mines and pyrotechnic compositions in order to imitate real combat. With the use of upper mentioned resources, as possible aspect of considering risk one needs to consider working in difficult conditions (in case of high or low temperatures, at night), high altitudes, on water and under water, in case of possible appearance of poisonous snakes… Working in mentioned difficult conditions and by applying various resources and equipment, it is tried to achieve for cadets to develop planning, organizational and decision making abilities for conducting given tasks in environment as close to combat, realistic. By spotting all possible hazards, changes in existing activities and their application in a real system, the decision maker reduces the risk to an acceptable level and ensure greater protection of human and material resources and secure the implementation of tasks in combat operations, according to the time available, the approved expenditure and combat conditions imposed. [3] The risk, as the combination of the probability and consequences of hazardous events can certainly be reduced or eliminated entirely by timely, diligent and fully implementation of the provisions of the Ordinance on preventive measures for safe and healthy work when using the work equipment, to any individual (irrespective of the category of persons) should in his work permanently applied and to comply with the same. [1]

4. PRACTICAL FORM OF CLASSES

Practical forms of classes are training facilities during which checking of all previously theoretically learned and overcome elements are taking place. Contents which are processed through the practical forms of classes include knowledge from a variety of professional and specialist and general-educational subjects, as well as certain skills. The complexity and interdependence of mutual knowledge and the necessary skills requires very extensive and comprehensive approach to the possible risks during the implementation of different exercises.
This paper is focused only on training exercises which all cadets perform in the field of Engineering. As this are training exercises, certain activities are set as known, while some parts are set as unknown or changeable depending on time of realization. In order to provide functionality for more complete insight into the activities to be executed, the schedule for the realization is achieved gradually.

The very course of planning, organizing and realization of the exercise is followed by vast number of possible risks. Risks can be seen during the execution of various stages and contents, such as: transport (man power, practice mines, ammunition and other pyrotechnics) on various transportations, choice of parking place for vehicles, organization of unloading and storage of materials used for exercise (practice mines, ammunition and other pyrotechnics), securing working area (exercise area), traffic control during work, securing cadets while work on the water, controlling the accuracy of working with blank ammunition and combustible pyrotechnic compositions.

Starting point for risk prevention during exercises is preparation of conductor of this form of training. During preparation there is a choosing of theme, processing methods, devising scenarios of exercise, exercise location planning, assessment of resources needed to perform the exercise (time, human, material, financial), consideration of the legal framework necessary to ensure the exercises, preparing personnel participating in the exercise (performers, controllers, security, servicing unit, etc.) and prediction of certain protection measures (in accordance with the theme). Based on the positions, conductor prepares plan (study or reminder) of implementation which is based on estimated risks and hazards provide for specific measures of protection in relation to the topic, the weather, the place of performance, the level of cadets with whom there training. [2]

Preparation of participants starts by introducing cadets on the theme of which will realize in the form of special classes. Preparation involves the presentation of the conditions in which the training will be implemented, what is expected of cadets, what it takes to carry and prepare. Cadets are presented with the prescribed precaution and safety measures in different stages of the exercises. Listed precaution and safety measures cadets write down in appropriate notebooks to carry along with them to training sessions. The next phase is directed to inspection of completed tasks, obtained during the theoretical preparation of the cadets. The next phase is directed towards organization of transporting unit to the region of exercise realization. To this end, check of the vehicles (buses, trucks, SUVs) and drivers who drive them is being performed. For prevention relevant legal provisions are pointed out and requests for application of them is set. The provisions are taken from:

- Law on Road Traffic Safety,
- Rules on the safety of military participants in road traffic (СВЛ 10/2014),
- standard safety measures of Rules of service of the Serbian Army, Title VII,
- Rules on Safety and Health at Work in MoD and SA (СВЛ 23/2018),
- Operating Instructions for warehouse of mines and pyrotechnics,
- Rules of fire protection in MoD and SA (СВЛ 1/2015),
- Rules of change and amend of Rules of fire protection in MoD and SA (СВЛ 9/2018),
- Rules of protecting life force in MoD and SA (СВЛ 23/2018) and
- appropriate written orders of his superiors.

As the paper devotes attention to exercises related to the content of Engineering performed by cadets, therefore exercises with school and live mines and explosives (M&E), it is necessary to point out precaution and safety measures prescribed by Instructions and exercise program with live mines and explosives: [5]

- performing exercises must be approved by the order of the superior;
exercise with live M&E can be performed only by persons who are professionally trained for that;
- exercise with live M&E can be performed only with persons who are previously trained to work with practice M&E;
- untrained personnel are forbidden to work with live M&E;
- before each exercise with live M&E, all soldiers (cadets) and officers are to be familiar with precaution and safety measures that are provided for the respective practice ground, exercise and M&E, prescribed Instructions and other regulations and instructions;
- undisciplined exercise participants are to be removed from exercise and hold responsible;
- training of the soldiers (cadets) and officers is allowed only with correct and tested – checked live M&E;
- it’s forbidden to use malfunctioned and unchecked live M&S;
- during exercises, and generally during work with live M&S, soldiers and officers, no matter in what roll they are in, must wear helmets in the practice area;
- it is forbidden to smoke or start fire in the exercise area near the M&S and during work with M&S and flammable substances;
- M&S are not to be left in the open field without guard, nor in the objects meant for living, objects for livestock and in the other objects that are not in the proper distance from alleged objects and secured;
- equipment for activating (blasting caps, fuses etc.) are not to be carried in pockets, bags and similar, but in proper and original packages. During engagement they are not to be left down on the ground, floor or any other spot where they are not obvious and where they can be stepped on, instead, if they are not to be immediately used, they should be put in the proper package, original package, field warehouse; handling of slow-burning fuses must be very careful, especially during winter. When it’s raining or snowing ends of slow-burning fuses are to be isolated with insulating tape so the black powder core doesn’t get wet, and during winter on low temperatures fuse is easy to brake so black powder core can be easily interrupted;
- during activation of slow-burning fuse is not allowed to shorten the slow-burning fuse below a length of 60 cm;
- in case of expected lightning (thunder), draw blasting caps of explosive charges - mines (where possible), be sure to disconnect the main lines of intermediate conductors, main cables separated from the power source and pull them out of the activation cells, and all the ends needs to be insulated;
- at arranged (type made) exercise areas, during activation slow-burning fuses and the explosive charges weight 100 grams, in one shift can be up to 10 soldiers, and on temporarily exercise areas not more than 6, which allow elders insight and control of every soldiers’ work;
- if any explosive charge fails (malfunctions), the approach time is not less than 30 minutes after executed activation;
- activation of explosive charges that failed is to be carried out only by electric wires, and as a backup cord wire is to be made for activating all of the charges;
- during the insertion of detonating caps in explosive charges and when clogging explosive charges, it is forbidden to use force;
- when performing exercise with live AT (anti-tank) mines it is to use mines with which the unit is equipped – has (except TMRP-6, when it is supposed to use practice mines);
- fuses are meant to be kept from shocks, impacts, direct sunlight and other heating sources and mechanical influences;
- damaged fuses are not to be used, but destroyed;
- fuses are not to be put in their place by force. Bearings are to be checked for mechanical damages and cleaned, as well as the threads of the lids (in mines which have the lid);
– mines with fuses in the bearings (armed mines) is strictly forbidden to transport, clean and store;
– it is forbidden to dismantle, cut or delineation of fuses and mines in any way to unauthorized personnel. All of M&S are to be used only in a way that is corresponding with the rules and instructions according to planes and programs;
– mine does not throw and do not strike against hard objects. Fuses need to be carried separated from mines, in original packages, except with the mines in which the fuses are packed with the mines by packaging technology;
– mines are to be armed in the prescribed manner, in the place ant at the time as provided by exercise elaborate and the order of a superior officer;
– do not take mines out of the frozen ground, nor when the fuse is stacked by ice, but destroy them on spot;
– do not allow for soldiers to gather in mine field and at the place of stocking of the M&S in greater number than necessary, regulated or ordered and provided by work organization. Forbid access to the warehouse to personnel that is not meant to be engaged there;
– after every hour of work with live M&S, personnel are to be given 10-15 minutes’ brake, and when the working conditions are bad (low temperature, snow, rain, storm etc.) brakes should be given more often. Brake spot must be outside of elements preparation area, and is determined by the person in charge;
– inactivated (failed) explosive charges and mines must be destroyed at the place where they’re at. It is forbidden to gather for destroying in one place.

Apart from the mentioned prescribed measures, right and duty of the teacher is to define and indicate in his reminder a certain extent and define more precisely certain actions and activities, although they are not defined by the Instructions.

Regardless of the quality and comprehensiveness of the preparations of all exercise participants, the competent officer (the teacher) should respect the gradual functioning. The gradual approach involves showing certain actions, then their explanation and taking actions with the realization in stages (steps, phases). After certain number of repetitions, it can be ordered to begin exercising of unit with conducting activities according to granted norm. During rehearsals controlled situations are created, approximate to combat, in order to realize quality preparations for the following cadets’ duties. Once properly implemented actions (along with a certain number of repetitions) and achieved standards, can be accessed to evaluating the level of training achieved in executing planned tasks.

5. CONCLUSION

During career of professional officer there are many tasks that carry certain risk level when realizing. The very existence of the risk, to a lesser or greater extend, must not be an obstacle towards delegated mission execution. The goal of the realization of exercises with cadets is that they get familiar with situations in which the emergence of controlled risk and stressful situations during school, in order to properly react when they find themselves in real-life situations in their future workplace.

Very exercises are performed in controlled conditions. Rules and regulations define to realize exercises in realistic conditions. However, the realistic conditions should not be an end unto itself, but must primarily take into account the health and safety of all participants in the exercise. The conditions in which the exercises are carried approaching realistic only to the extent that will not lead to distortions of health and safety of participants. For that end, all of the participants get to know themselves with safety and precaution measures before exercise realization, in order to be capable of applying them during work.
Each individual is responsible for its own safety and health, as well as the safety and health of the people in their environment. However, the class teacher is the most important person in the preparation and realization of exercises. He is also the most responsible person who is obligated to inform all of the participants of the precaution and safety measures and to provide to all participants consistently apply them, without any improvisations. His duty is to know the aforementioned precaution and safety measures, to insist in their application, to foresee possible situations and to take corresponding preventive measures in order to remove (or decrease) risk intensity.

REFERENCES
USE OF RIVER FLOTILLA IN A FLOOD EMERGENCY

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Abstract: The paper explains the possible involvement of the River Flotilla in an emergency caused by floods. Following the declaration of an emergency caused by floods in a particular part of the Republic of Serbia, River Flotilla units may be used. The use of River Flotilla units is facilitated by one of the Army's assigned missions, which is the third mission - supporting civilian authorities in countering security threats. The units of the river flotilla can be used both in the stage of development and in the stage of rehabilitation of the consequences of an emergency, with a focus on the second stage. The paper will discuss the theoretical concept of emergency situations, legal and doctrinal regulations governing the use of military units in emergency situations, will present some of the capabilities of river flotilla units and realistic indicators of engagement in the emergency situation caused by the floods that hit the Republic of Serbia in 2014.

Keywords: river flotilla, emergency, flood.

1. INTRODUCTION

It is evident that in the last decade, in all seasons, floods have increasingly affected the functioning of society, disrupting the normal life and work of the population and social communities. Floods annually cause significant damage to the global economy and economy of our country. "Induction is a natural occurrence that indicates an unusually high water level of rivers and lakes, which causes water from the river bed or lake valley to flow over the coast and floods the surrounding area." [3] According to statistics, annual flood losses are measured. tens of billions of dollars, up to 15% of GDP in some countries. If the consequences are caused by a flood, such that a particular municipality of the Republic of Serbia cannot eliminate them with its own resources and resources, then it is forced to declare an emergency and seek assistance from the state.

After the declaration of an emergency caused by floods in a certain part of the Republic of Serbia, if the lives and health of humans and animals and material goods are endangered, at the request of the authorities responsible for protection and rescue, units of the Serbian Armed Forces may be engaged in providing assistance to the population. The third mission of the Serbian Armed Forces identified support for civilian authorities in countering security threats, which is realized through part of the second task - assistance to civilian authorities in the event of natural, technical and other disasters. The units of the Serbian Armed Forces that can be used to assist civilian authorities in the event of an emergency caused by floods are River Flotilla units.
In order to better understand the use of River Flotilla units in the emergency caused by floods, as well as to understand the rights and obligations of members and units of the flotilla, the work is divided into four sections: the first focuses on the understanding of terminological distinction regarding the emergency situation in the second the legal framework for use by the units of the Serbian Armed Forces in emergencies, in the third the doctrinal framework for the use of the army and the flood itself as part of natural disasters and in the fourth part for units of the River Flotilla and their use in the emergency situation caused by the 2014 floods.

2. THEORETICAL CONCEPT OF EMERGENCY SITUATIONS

An abundance of emergency terms and definitions can be found in the professional literature. The first thought is of a danger, which from a security standpoint is defined as the state of a system that can endanger the health of humans, animals, material and natural resources. “The term emergency has first appeared in Russian literature at the beginning of the 20th century. When regular activities cannot prevent, mitigate or eliminate the consequences of a hazard, they are given the character of emergencies. The term emergency is used in English, which is a condition introduced by natural disasters that threaten to endanger the normal functioning of life in a part of the territory or in the entire territory of a state, as a rule introduced by the governor of a particular state. ”[2]” The United Nations They define emergencies as a consequence of disasters, and define them as a serious disintegration of the functioning of society, causing human and material losses or losses of the natural environment, preventing a country from using its resources to survive in the affected environment. ”[5]” literature, emergencies are defined and classified according to the object of the threat: danger to life, health, public good and the environment. In some countries, represented by Germany and Croatia, the term emergency is equated with the term catastrophe, which also means a sudden and progressive event whose impact on people is of immaterial value so devastating that emergency services and the affected community are not in a state of disrepair. opportunities to respond to it properly, and are forced to respond by introducing emergency measures and seeking the assistance of the neighboring and wider community. ”[4]

According to the Law on Disaster Risk Reduction and Emergency Management (Official Gazette of the Republic of Serbia 87/2018) A state of emergency is a state that arises from a declaration by the competent authority when the risks and threats or consequences have been caused to the population, environment and material and cultural property of such magnitude and the intensity that their occurrence or consequences cannot be prevented or eliminated by the regular operation of the competent authorities and services, which makes it necessary to use special measures, forces and means to strengthen and eliminate them with a reinforced regime of operation.

The term emergency in the Ministry of Defense and the Serbian Armed Forces is not used, but the terms event, emergency and emergency are in use. An event and an extraordinary event are defined by a special instruction which is an integral part of the Rules of Service of the Serbian Armed Forces, in which an emergency event is defined as any unexpected event occurring during planned or ordered activities, which results in endangering the life and health of people, disappearance or destruction, combat weapons, weapons, ammunition and explosive ordnance caused by the accidental or deliberate use of actions and procedures, failure to take appropriate measures or force majeure. While the event has a broader meaning and is not only related to the planned or ordered activities, it also applies to the leisure or non-working hours of members of the military. The state of emergency is related to the entire territory of the Republic of Serbia and is declared by the Government of the Republic of Serbia, while the emergency in individual municipalities is declared by the Assembly of that municipality.
It can be concluded that an emergency situation is a milder form of emergency. An emergency situation in a municipality arises when regular activities cannot prevent and eliminate the consequences of the danger, and when the envisaged measures at the state level are not sufficient to assist that municipality because other municipalities in the territory of the state are in the same situation, then the emergency situation grows into state of emergency.

3. LEGAL FRAMEWORK ON THE USE OF MILITARY SERBIA IN EMERGENCY SITUATIONS

With the 2006 Constitution of the Republic of Serbia, the competence of the Serbian Armed Forces is, among other things, to perform other missions and tasks in accordance with the Constitution, law and principles of international law governing the use of force. The Defense Act of 2007, with the 2015 amendment in Chapter Seven, provided for civil protection to be organized and prepared as a system for the protection and rescue of humans, animals, material and cultural property, from natural disasters, technical and technological disasters and disasters, as a consequence of terrorism, war and other major disasters, in accordance with the applicable regulations, principles and requirements of the Geneva Convention and other rules of international humanitarian law. The Disaster Risk Reduction and Emergency Management Act of 2018 regulated the powers and powers of protection and rescue. This law constitutes the normative basis for the further regulation of this field by other laws and by-laws, in accordance with the competences of each of the subjects of protection and rescue.

The Law on Defense defines, inter alia, the sitting, in the case of natural disasters and other major disasters in which the life and health of humans and animals and material possessions are endangered in a certain territory, units of the Serbian Armed Forces may, at the request of the authorities responsible for protection and rescue, engage in providing assistance to the population, in accordance with a separate law. It is also regulated that the Chief of the General Staff of the Armed Forces of Serbia, ie the commander-in-chief of the competent command of the Armed Forces of Serbia, on the basis of special authority of the President of the Republic of Serbia, may order measures to protect and save people, material and cultural property from natural disasters, technical and technological and other major disasters. and the use of parts of the Armed Forces of Serbia to eliminate adverse effects that may arise from non-military security threats. The third mission of the Serbian Armed Forces, defined by the Law on the Serbian Armed Forces, among other acts, was defined through two tasks, namely support to civilian authorities in countering security threats, terrorism, separatism and organized crime and other assistance to civilian authorities in case of natural disasters and technical problems. The 2012 Serbian Army Service Rule also regulated this area at points 165 to 168 and 170 and 171.

Through the aforementioned acts, starting from the highest legal act of the Constitution of the Republic of Serbia, through the Law on Disaster Risk Reduction and Emergency Management - from 2018, through the Law on Defense, the Law on the Serbian Armed Forces, up to the Rules of Service of the Serbian Armed Forces Serbian Armed Forces in an emergency caused by floods as one of the natural disasters or one of the unarmed security threats. Within the framework of these constitutional and legal regulations, the use of the Serbian Armed Forces and, consequently, of a part of the Army of the River Fleet in emergency situations caused by a natural disaster is authorized.

4. DOCTRINARY CONCEPT OF USE OF A FLOAT FLOAT IN CASE OF FLOODS

One of the non-military or unarmed security threats is natural disasters and only one part of the flood. Flooding is manifested by the appearance of more water on the surface of the earth
in the form of rising groundwater levels. A classic example of floods is when the river bed cannot receive the excess water and the excess must flow out of the river bed. The EU Floods Directive defines a flood as covering water that is not normally covered by water. The most frequent causes of floods are rivers and lakes with high rainfall and sudden melting of snow and ice, while the lake is usually caused by a strong earthquake or a strong storm.

"As already stated, there are many definitions of the flood as well as classification according to different criteria. Some of them are, according to Gavrilović LJ. According to the criterion of the conditions of occurrence, floods are divided into:
- floods caused by rain and snowmelt;
- ice floods;
- floods caused by high water incidence;
- torrential floods;
- flooding caused by landslides;
- floods caused by the destruction of dams.

Also, according to Gavrilovic LJ., Given the time of the flood wave formation, floods are divided into:
- calm floods - floods on large rivers that take ten or more hours to form a large water wave;
- torrential floods - floods on mountain watercourses that form a large water wave in less than ten hours.

According to R. Stojanovic, according to the causes of occurrence they are classified as floods caused by:
- heavy rainfall;
- ice accumulation in watercourses;
- landslides or earthquakes;
- the destruction of dams and war operations. "[1]

According to the Doctrine of the Serbian Armed Forces, from 2010, one of the tasks of the military is to support civilian authorities in countering security threats. Also, according to the Doctrine of the Army of Serbia, pages 25 and 26, as well as to the Doctrine of the Land Army, 2010, page 12, as well as the above-mentioned legal regulations, the second task of the third mission of the Serbian Army is to assist civilian authorities in the event of natural disasters. technical, technological and other accidents. The Doctrine of the Army of Serbia 2012 operations on pages 36 and 37 defined the third non-combat operation to support civilian authorities in countering unarmed security threats. Part of the units that will be inevitable in the event of a flood are River Flotilla units. It includes unique tools and equipment that can be used, not only in areas affected by floods along waterways, but also in flooded areas throughout the Republic of Serbia.

Therefore, it can be concluded that in addition to the legal framework and doctrinal documents, they have literally regulated the use of units of the Serbian Armed Forces in non-combat operations, ie in assisting civilian authorities in the event of natural disasters, one of which is flood. The doctrinal regulation of the use of the Serbian Armed Forces in the event of natural disasters also regulates the use of the River Flotilla, which is an integral part of the mainland army, and therefore of the Serbian Armed Forces.

5. CAPACITIES OF RIVER FLOTYL UNITS WHICH CAN BE USED IN THE EVENT OF FLOOD

The river flotilla was formed in 2008, when pontooner units were included in it. With the command in Novi Sad, the brigade rank, it consists of two river units, two pontoon battalions,
a command and logistics company. The units are deployed in Novi Sad, Belgrade and Sabac. [7] These units are an indispensable factor in providing assistance to the population, especially on the waterways in Vojvodina. The command of the River Flotilla includes all the forces that perform their tasks in inland navigation, which enables the efficient execution of missions and tasks, especially in the framework of assistance in case of natural and technical disasters on and in the inland waterway.

Training of River Flotilla units for the third mission area is related to the assigned mission to the unit, and these forces are trained as part of a regular mission where the third mission is marginalized and the focus is on the first two missions. Training of human beings in the area of the third mission is well done with the forces intended for these tasks, which include the units of the River Flotilla. These units are also equipped with special means for water and water work, and these are amphibious vehicles that were in engineering units until 2007, boats, watercraft and lifejackets on the water and other means and equipment for water and under water.

As an example of the engagement of the River Flotilla in the Polavas, flood engagements that hit the territory of the Republic of Serbia and lasted from 14 to 20 May 2014 were presented. The first day of the flood wave 14.05.2014. It should be emphasized that the engagement of parts of the River Flotilla that were sent from Novi Sad to a regular assignment in Sabac, Koceljev and Loznica, instead of an exercise in Titel. Although this engagement does not fit into the legal framework for the use of the Serbian Armed Forces in emergency situations, as no emergency or emergency has been declared yet, River Flotillas units have been used in a real situation, due to endangering the lives of the residents of these cities, instead of the planned exercise.

One of the assets that is only part of the River Flotilla and used in the 2014 floods in Obrenovac for the evacuation of human resources and assets is the PTS-M Amphibious Transporter. This resource expired more than a decade ago but is still in use and can be successfully used at increased risk on navigable rivers and flooded areas. The evacuation capacities and speed of manpower have shown that it is much more efficient than landing boats, both rubber and aluminum, located in other units of the Serbian Armed Forces. A transporter is a caterpillar amphibious vehicle that can navigate and can move on land. The weight of the conveyor is 17.7 t. Land load 5 t with diesel consumption from 130 to 150 l per 100km. It can carry 70 people, or cargo up to 10 t, at speeds of up to 10 km / h with diesel consumption from 45 to 50 l per hour. It is located in the pontoon lines, which are located on the banks of the Sava and Danube. The tool is in use with difficult maintenance, because it does not produce spare parts due to obsolescence and running out of resources, but has excellent characteristics and capacities and no similar tool is available in other state systems.

"On the second day of the flood wave, on Thursday 15.05. when the Government of the Republic of Serbia declared a state of emergency, a total of 700 members of the Serbian Armed Forces were recruited with available motor vehicles, boats, tank trucks and water pumps. On that day, 296 people were evacuated from the affected areas. On Friday 16.05. 1900 members of the Army were engaged throughout the Republic of Serbia in the lowland settlements south of the Sava and Danube. On Sunday 17.05. and the day before the amphibious transporters, which are part of the river flotilla, were evacuated from Obrenovac 2072 people. "[6]

The Ambient PTS-M transporter is a tool that has excelled in evacuating people from flooded Obrenovac and could be used in any similar emergency caused by floods not only along navigable rivers but also in central and southern areas of the Republic of Serbia. The problem with using this product in other parts of the country is its timely transportation to the desired location. The vehicle must be covered by rail or train and certain roads and lines are blocked
during an emergency caused by a flood. In addition to this facility, the units of the River Flotilla also contain other vessels that can be used on navigable rivers, where these units are located.

6. CONCLUSION

The state of emergency is differently defined by more than the state, and in the Republic of Serbia by more authors and more normative acts. The most acceptable definition is also the most recent one, dating from November 2018 in the Disaster Risk Reduction and Emergency Management Act. The flood emergency is just one kind of emergency and is not uncommon in the Republic of Serbia in the last decade. Legal and doctrinal acts define and elaborate the use of the Serbian Armed Forces and, consequently, parts of the Army - River Flotilla in an emergency caused by floods as one of natural disasters or one of the unarmed security threats. The analysis and scientific description of the contents of the documents governing this area concluded that the River Flotilla was engaged in assisting the civilian authorities only after the emergency had been declared.

River flotilla and its units Amphibious conveyor pontoon lines are units and assets that have been used and can be used in the event of an emergency caused by a flood. On the basis of all the above, it can be concluded that the River Flotilla can be used in an emergency caused by the flood, thanks primarily to the technique of pontoon lines whose amphibious PTS-M transporters became famous in the 2014 floods in Obrenovac. In order to make these assets more accessible in the wider territory of the Republic of Serbia, and not only near navigable rivers, it is necessary to introduce pontoon lines into the composition of other units of the Army. Funding is also needed to acquire new assets and techniques or to modernize and maintain existing equipment.

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CAMOUFLAGE IN RESOURCE PROTECTION FUNCTION

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Abstract: Resource camouflage is a task that is constantly planned and realized. It is accomplished by concealment, imitation, and fraudulent acts. It is undertaken to reduce own losses, protect the secrecy of the deployment of forces, cover up activities, real intentions, actions and other planned activities of the units of the Army, which diminish the effect of the enemy and increase the ability to protect their own forces. The tasks of camouflage are accomplished through the use of various means and techniques, as well as technologies. The development of modern developments in various fields of science has found application in the tasks of protecting forces. To this end, different materials are used to make the uniforms. They paint different patterns and shapes of camouflage patterns. Colors and coatings are being developed to reduce reflection when viewed by technical means. For the purpose of misleading conclusions, armored combat vehicles are masked by the application of technical and technological solutions that on the observation screen create a passenger car display. In order to improve camouflage effects, experiments are performed based on the natural characteristics of wildlife. Efforts are being made to get the possibility of the controlled application of their natural abilities under artificial conditions.

Keywords: camouflage, digital reflection, natural camouflage, models.

1. CAMOUFLAGE

The planning and execution of various combat operations cannot be imagined without the application of certain elements of force protection. Force protection, as a substantive (influential) factor of combat operations, "implies the preservation of combat potential of deployed forces in the combat zone, the fight against all threats from enemies, natural and technological disasters and the prevention of actions"[9]. Depending on the situation, the time available and the type of actions, the protection of forces is achieved through: camouflage, combat security, anti-electronic and anti-aircraft protection, fortification, nuclear-chemical-biological protection, dispersion, mobility, as well as detection and warning of a threat.[9]. As such, it "represents an integral and essential part of any operation"[7].

Camouflage includes concealment, imitation and false actions. It is undertaken to minimize its own losses, to protect the secrecy of the deployment of forces, and to conceal activities, real intentions, actions and other planned activities of the Army units.[7] To this should be added the fact that "it is undertaken to reduce the effects of the enemy's actions and to increase the ability to protect own forces"[8]. In addition to the use of camouflage and formation means of camouflage, the fabrication of false fire and radar positions, false runways, the installation of models contributes to deceiving the enemy and protecting own forces in the operation.[8] It is organized and implemented continuously at all levels and in all structures of the Army and society.[8]
From the above it can be concluded that "camouflage is a skill that should be understood as a creative application of past experiences, which in the new conditions (increasingly sophisticated means of reconnaissance and observation, high mobility of combat technique, characteristics of modern combat operations, etc.) seek original solutions. self-initiative and creative spirit."[22]

Camouflage, as a content of force protection [9], can be divided according to: purpose (individually, tactically, operationally and strategically), conditions and material used for camouflage (using natural land and weather conditions and materials and using artificial materials and means – environmental and formation) and methods of execution (by hiding, concealing and deceiving), each is intended to "disable or make it difficult for the enemy to locate and identify our objects, technical means and units, and thereby disable or make it difficult for the enemy to choose a viable target for attack" [22].

The issue of camouflage is not a phenomenon that deals exclusively with the territory of the Republic of Serbia. Other armies in foreign countries have a similar approach to defining camouflage. [12, 2] Various papers have been published on issues related to camouflage. A. V. Holbrook (A., W., Houlbrook (1999)), in his work, presents some considerations about the need to develop capabilities, based on the development of technical tools for image processing, in order to discover masked objects and assets in different terrain and environment. [14] In order to better disguise soldiers while performing tasks in different terrains Ch. McNab (Ch., McNab (2002)) considers the persistence and necessity of changing uniforms throughout the 20th century and the need to introduce a camouflage pattern. [16] The issue of the quality and durability of the camouflage pattern was addressed by G. Gramer and T.R. O'Neil (G., Cramer, T., R., O'Neil (1999)). [6] Through a scientific analysis, they have proved the need for the introduction of the digital pattern and its effects on camouflage. In addition to the introduction, P. Forbes (P., Forbes, (2009)) points to the need for constant analysis of different camouflage patterns. [12] G. Hartcup (G., Hartcup, (2008)) points to the importance of the use of concealment and deception (as camouflage content) in war events. [13] The question of the application of camouflage colors, their harmonization with the surrounding colors and their optimal ratio to form the required camouflage pattern, wrote K.D. Mitchell and C.R. Staples (K., D., Mitchell, C., R., Staples (1999)). [18]

2. THE ISSUE OF CAMOUFLAGE IN MODERN CONDITIONS

The constant development of modern technologies and optoelectronic reconnaissance devices has influenced the need to develop camouflage content focused on specific techniques and technologies. The report on the possibility of movement of a tank in space illustrates the best the degree of development of modern technological and electronic means for deception during the movement of war equipment. It is well known that these means are very difficult to mask. One of the possible solutions was presented through the application of technological advancements that display a passenger car image on observation screens. [25]. The existing camouflage pattern (pattern on uniforms and camouflage means) is constantly checked and adjusted to the degree of development of observation means. It is not surprising, therefore, that the literature contains various analyzes of the degree of conformity of camouflage effects with the environment [26, 5]. Not only the effects of camouflage patterns (on uniforms or meshes) are analyzed, but also the degree of camouflage of the vehicle by removing the shadow created by the vehicle during movement [27]. The degree of camouflage and the influence on the way of waging war is constantly and vigilantly monitored [20] and certain assumptions are made about the possibility of applying modern technical innovations on the battlefield [21]. Existing camouflage capabilities of standard assets are constantly analyzed with a tendency to improve
them [17], and the ability of existing assets is analyzed in relation to the environmental and technical impact [11, 15, 24, 10].

Available published contents indicate that is very meticulously approached to the issue of camouflage and constant analysis is carried out with a tendency for continuous development and application of various means and techniques. Recent examples indicate that the reconnaissance tasks employ mini and micro drones that are equipped with very strong optoelectronic means for gathering space information.

3. EXPERIENCE ON CAMOUFLAGE TASKS

Tasks, from the content of the camouflage, apply to each unit, which must mask its own positions, (using different execution methods) according to the available capacities. In order to perform the camouflage tasks more fully, an analysis of the camouflage capabilities for protection is performed. The starting point is the degree of development of modern means at the disposal of the enemy and the tasks of the unit in defense of the territory that must be realized. A possible solution is to apply appropriate measures of deception, concealment and concealment.

To this end, available forces and capacities (of the Army and civilian companies) can be engaged in the tasks of organized production of various types of models and baits. Models that are made and set up according to the plan, can greatly affect the enemy listed in the wrong conclusion and enormous costs.

During the 1999 NATO aggression, the starting point for a successful deception were information of the timing of the reconnaissance aviation of enemies of the position of our forces. Such information were distributed to units which plased the assigned and self-made models to appropriate locations and induced the enemy to make poor judgments and decisions. Models were set up on false fire positions, which were "revived" by occasionally simulated engagement of their own forces. For the sake of real positioning, some unmasked characters were deliberately left behind.

The problem of protecting more complex systems and objects, e.g. planes, airports, bridges and other similar objects have been mostly solved by making of models or by decorative and scenographic painting. By that approach bridges where protected with decorative camouflage (material for making jacks - jute, placed over and around the bridge structure and later painted (in accordance with the surrounding color), thereby misleading the enemy about the exact location of the object).

The problem of camouflage the position of units is compounded by the need to maneuver and move forces in the operation area. It was the application of motor vehicles that made it possible to detect the position. One possible solution is to enforce a ban on the use of military motor vehicles and to use only vehicles borrowed from civilians.

There is no possibility to use adequate borrowed vehicles for artillery-rocket air defense units and artillery units. On the basis of this fact, their actions were specially organized and coordinated in detail in order to identify possible areas of fire positions where the assets could be masked. To this end, the means of fire force were placed under natural masks (in forests) or within artificial objects (garages) and, when necessary, exited on fire positions. After the action, they were quickly housed in garages that were on a safe distance from the masked shelters, and people were moving away from the facilities into previously prepared shelters. After cooling the pipes and systems, the means of fire force returned to the masked shelter under the cover of darkness.
The movement of war equipment (traces of wheels and tracks on land outside communications) is constantly followed by the danger of creating uncamouflage signs. Such problems can be solved in the following ways: by the use of agricultural connecting machines (harrows, saucers); overlapping of branches (hides potential danger due to rapid drying of cut off vegetation); by replacing the clod (as far as possible) in the direction of the tracks or by raising the grass with the rakes. In the case of inability to adequately mask the tracks, it may be possible to design models to simulate the means by which fired from these positions.

The principle of diversity must always be upheld in all places. One example is the solution to park tractors and old tractor trailers that are partially masked in the made shelters for armored vehicles (tanks and combat armored vehicles). In order to create a thermal reflection, barrels were installed beneath the means in which sawdust was burned to give the impression of engine operation.

The fact that the fertilizer releases the temperature, which provides the aggressor missiles a thermal reflection that is identified with the means of war technique, has been used to clean the surface of the earth at the garbage dump and to place metal plates in the same place. Thanks to the temperature and metallic reflection, the enemy consumed a considerable number of missiles in great material value by shooting garbage.

Reduction of the ability to spot combat vehicles and increase the resistance to the action of certain missiles was accomplished by the use of rubber conveyor belts, which were easily mounted on combat vehicles and objects. Mounting on vehicles achieves: more difficult detection and detection of the right dimensions of the means, reducing the transmission of signals from the wheels and from the parts that can be hot (engine exhaust, engine part of the tank) for the infrared observation spectrum, longer protection because the material can survive field use.

An important fact, to be nurtured and developed, is presented through the ingenuity of the military personnel and the use of available resources from the immediate environment. Ideas can be very diverse. The cardboard tubes (from the textile factory, on which the tufts are wound) are shortened to the length of the mortar tubes, painted and placed in larger laurels and supported by sticks. Placed like that and partially masked, credibly represented the mortars.

In order to more accurately represent the position of mortar (and other) units, the false positions were partially masked, buried and revived. The depth of trenches of 20-30 cm was visually increased by spreading the bottom with ash. In a situation where there was not enough manpower to demonstrate the movement, dolls of people (from the windows of various shops or factories) were used to get dressed in uniform and dressed like that were placed in positions. Shooting at them could not be absent. The production of cannon models from trees and local vegetation in different localities was quick and effective.

For the purpose of presenting the position of the anti-aircraft assets, the construction of a gigs (vehicle similar to a carriage) for two people was used. The wheels were removed from them, the horse's shoulder frame was painted black and aimed into the air. In this way, an anti-aircraft prepared to act on airspace targets was simulated. For a more realistic view, a colored cardboard was placed on the bottom of the frame. The model created like that was partially masked and placed on the edge of the forest to be noticed.

4. FOLLOWING RESEARCH TASKS

The lessons learned from the aggression of NATO forces during 1999 were very useful in drawing a large number of lessons. One example is an analysis of our solutions by the US Army (specifically related to the use of rubber conveyor belts for ore) for vehicle camouflage.
[19] The reports of pilots and reconnaissance bodies were checked through research into the impact of the aforementioned means on the degree of camouflage and protection of the means using them.

Other countries have developed and tested new models of camouflage nets, patterns for camouflage suits, and the application of camouflage paints at various bases (for the purpose of protecting the environment). In conclusion, the need for the development of acrylic based paints was defined. Regardless of the quality of the colors, the fact of the necessity of developing a digital camouflage pattern, consistent with the development of reconnaissance tools, has not been forgotten.

One of the observations from the field, during reconnaissancing of our positions, points out that during the NATO aggression, very few camouflage nets have been used to mask vehicles in motion. Such information was used to define the task of examining the reasons (positive and negative) why this method of camouflage was not applied. As a possible solution for overcoming negative indicators and implementing positive solutions, some companies have started to produce camouflage covers (similar to tarpaulins) for certain parts of combat vehicles and motor vehicles. Such covers are multifunctional, provide multispectral protection against detection, identification, enhance survival, sustainability, facilitate logistical support and affect climate control for vehicles and equipment. [23]

The level of scientific advances in electronic means is used in exploring the possibilities of camouflage military assets and equipment. An example of such advancements is the Swedish company BAE systems. They have developed a system for adaptive thermal signature management. By placing a "cloak" - a blanket (built from electronic broadcasters) over a tank, it creates a reflection of the tank to be invisible, blended into the environment or one of the images (text, small object or a car). The system was presented at the DSE 2011 in London. [3]

Other countries, as a possible solution, have taken advantage of the realized effects of models, and have continued to develop models whose production is simpler than the one we used. They develop models of different assets that are the same size as the real ones, but inflate. In order to create a complete impression (in addition to the visual one, a thermal reflection is also required), they are equipped with heat-emitting motors to give a true picture of the real asset. [1] The level of development of such models goes beyond the limits of the improbable, as often "shocking news" can be seen in newspaper headlines about the sudden appearance of new modern assets in locations, it is not clear when and how they arrived there.

The reason for this much commitment to the tasks of camouflage should be sought in the fact that the method of gathering information on the situation in space - the area of operation for the last 20 years has been performed by various drones. This makes the task of camouflage very complicated. In order to overcome the problem, the use of drones for preliminary checking of the degree of the work done on position camouflage was started, in order to eliminate the uncamouflage signs.

5. CONCLUSION

Camouflage, as a content protection force, has proven its importance and proves daily. The tasks of gathering information are carried out in peace and in war. In line with this fact, the demands placed on conducting daily research into the degree of conformity of certain colors, patterns and shapes (on camouflage elements) with the environment are not surprising. Research is being conducted on the application of certain colors and coatings that reduce or disable the original reflection of the means on the screens.
One solution is to use different models that lead the enemy to a wrong conclusion. To this end, models of all inflatable combat assets are being developed.

Developing "overlays" that display an image just behind the "overlays" is within the realm of science fiction (due to the high cost of development). However, the steps that are being developed in this field should not be surprising. This issue can be expected to receive the necessary attention and to enhance its development. The situation is similar with the development of means that reduce the emission of temperature reflection into space.

As a possible solution in reducing the possibility of discovering positions and assets, the application of state-of-the-art technical achievements is presented. Cameras with different readings are applied or different sensors that respond to specific light spectra are applied. The published contents point to the tendency to collect data from the environment through the use of electronic means, with particular attention to the possibility of interfering with them in order to protect the resources and the people. To this should be added the fact that in solving the set requirements, the animal world, with its characteristics, is not forgotten. [4]

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CORPORATE SECURITY BASED ON THE CRISIS
CONCEPT AND THE SITUATION IN THE REPUBLIC OF
SERBIA

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Abstract: Modern organizations, with complex organizational composition, represent a challenge for various factors that impair their security. The environment in which such organizations operate is also complex and changeable. The conditions in which such an organization can be found can be very complex, with possible negative outcomes for the organization’s goals. Predicting events that could have catastrophic consequences or seriously disrupt an organization's goals is a priority of the security function. Poor response or delay in response may lead to such conditions that the security of the organization is severely impaired. Possible crisis situations are at the top of the organization's business priorities.

Key words: organization, security, crisis

1. INTRODUCTION - DESCRIPTION OF THE PROBLEM

The great social changes of the late 20th century caused the security challenges and threats to the business of large economic systems to evolve. Operating in such a turbulent environment, businesses are increasingly exposed to environmental hazards. Threats and risks are characterized by diversity, manifest diversity and concealment, whereby manifestations become more flexible and sophisticated. Thus, in recent years, a whole new range of threats and risks has been recorded, while on the other hand, the earlier forms have completely disappeared or taken on different contents and forms. Such a trend requires companies to find new instruments and mechanisms and norms in order to protect capital, profits and property, and in general business and to protect their interests. Corporate security has a special place in this. Corporate security aim is to ensure the vital values of the company in accordance with the applicable legal provisions of the country in which it operates and in the best interests of the company.

2. THE ORIGIN AND SOCIAL ASSUMPTIONS OF CORPORATE SECURITY

Corporate security has deep social roots. Security has become a particular aspect of company practice, that is, how to preserve interests, meet needs, and at the same time provide capital increases. Modern conditions have complicated the operation and survival of the companies, and the result is that many have survived and many have disappeared from the economic and social arena.

2.1. Danger and endangerment as a prerequisite for corporate security

Various forms of hazards with a portfolio of consequences, among other factors affecting human existence, have directed individuals toward association. People quickly realized the gains and benefits of grouping and association, in terms of providing easier protection. So,
danger and endangerment were not a matter of the individual any more, but of the group or society. The question is why the threat was actual for society. Considering that endangering is a series of related phenomena, processes, interactions and their sources of origin, it can be concluded that it exerts influence on all flows and processes in society and on all social groups.

The deep social changes in the economic, social, legal, political and moral spheres over the last few decades have created new social milieus for businesses, both nationally and internationally. Especially with the development of traffic and the incredible acceleration of the flow of people, goods and information in a relatively simple and inexpensive way, it complicates all business processes and creates new risks for the business of companies. These contemporary developments also bring with them specific security challenges as new, contemporary aspects of compromising the security of companies and their interests evolve on a daily basis. In order to prevent or preclude the negative consequences and effects of threats, company management pays increasing attention and importance to corporate security.

2.2. The emergence and development of corporate security as a social phenomenon

We need to look for the reasons for the emergence and development of corporate security in certain social conditions that have influenced the creation of need to establish the function of economic entities protection.

The rapid economic growth of the late 18th and early 19th centuries influenced, among other things, the rapid development of corporate security as a business activity. Economic development, which was unstoppable, changed the economic, social and political relations that existed at the global level, as well as the way in which people lived in rural and urban areas, and above all their relation to capital. “Private capital had to find a model of protection, to remain protected by those who would endanger it without being able to develop, grow and expand into larger expanses and employ more and more workers who would create an increasing surplus through their work.” [10] This confirms that the pursuit of constant increase is the primary feature of capital, which also served as a basis for the creation and development of a corporate security function on this basis in order to contribute to the achievement of the basic business objective - profit creation. Considering all the significant social changes that have occurred since the emergence of corporate security, today we can see only the basic purpose, which is to protect the assets and assets of economic entities, while the overall approach and methodology of work is conditioned by modern business processes. Although corporate security is not a new security content, it has only recently become the new discipline of security science. “It is a young scientific discipline, which is in the stage of development and verification of scientific status. At this stage of scientific construction and situation, it is indisputable that corporate security, as well as other separate, specific scientific disciplines, which gradually emerge from the home security sciences, has a valuable fund of systematic knowledge in this field, a conceptually categorical apparatus, its own principles, methodological instruments for the study of phenomena and processes within its subject of research and theoretical systems that provide a starting and conceptual basis for its further development.” [6]

2.3. Modern concepts of corporate governance

There is no single definition of corporate governance that can be applied to all situations and covers all legal systems. The various definitions that exist today are highly dependent on the organization or author, as well as the country and legal tradition. However, there are several common elements that indisputably form the essence of corporate governance, namely:

1. There is an interpretation of corporate governance as an “institutional matrix that structures relationships between owners, managers and boards”. [7]
2. Corporate governance principles are, as a rule, evolutionary and should be viewed in the light of significant changes in circumstances in different countries, regions and around the world. Companies need to innovate their corporate governance practices and adapt them to meet new environmental requirements and use new opportunities in the market to remain competitive in an ever-changing world. [8]

3. Good corporate governance is based on the principles of transparency, availability, efficiency, timeliness, graduality and accuracy of information at all levels, contributes to sustainable economic growth, enhances the efficiency of companies to improve their access to all types of external financing. [5]

Corporate governance have to enable the organization to function in a secure environment. In such circumstances, it is possible to meet corporate goals. The risks that arise in the management process are inherent in the conditions in which the organization operates. The scientific definition of corporate conditions will allow a more accurate observation of those conditions. It will allow management to manage more efficiently.

3. CRISIS CONCEPT AND CORPORATE SECURITY

Crises are a constant of modern business. The willingness of an entity to identify, analyze and take measures aimed at preventing or responding to environmental influences that have attributes of threat is the right measure of the effectiveness of the corporate security system. The capacity for response and prevention cannot be created in the short term, but rather represents an expression of the company's culture of dealing with crisis management.

3.1. The concept and origin of the crisis

Does disrupting the company's secure environment generate, in front of the company, requests for the engagement of extraordinary forces and resources to protect its own aspirations and needs. The answer is certainly yes. Achieving basic security needs is a basic requirement of company existence. By disrupting the ability to fulfill these needs, a state that deviates from "normal" is created. The newly created situation, in which the company has to spend time and resources, change the circumstances in which it performs activities in order to return to its regular state, is a crisis.

The word crisis is probably today one of the most commonly used words in everyday speech, by politicians, journalists and social conversation. Despite its frequent application, there is no clear and unambiguous conceptual content of the term crisis, but there are numerous and often different interpretations.

Most crises come from a combination of individual mistakes, organizational failures, and impact of the environment. As different crises follow different critical paths, crisis researchers need a methodology that enables them to reconstruct and compare each crisis process. A "new" theoretical perspective is needed - an evolving field of complexity studies and a renewed interest in evolutionary perspectives to link different factors that function at different levels of analysis. Such an analysis can help us understand the combination of human error, organizational pathology, and environmental imperatives into processes that cause disruption of the system, but it does not tell us why and where only some tensions, problems, and worsening circumstances are defined by the term crisis and catastrophe. We need to understand how the escalating crisis process intersects with political and social reasoning processes. A personal, national or international situation where there is a threat to priority values, interests or goals is a crisis. This attitude undoubtedly points to the direction and form of the negative impact of situations at different levels, to a person's safe environment. Thus, the crisis represents a special state of changed circumstances, in which the company's individual and
social needs for survival and development are seriously impaired. However, a crisis should not be explicitly understood as a negative course, but at the same time it can present a very serious chance. [3]

3.2. The conditionality of crises with social conflicts and interests

Company and social needs grow with time and degree of development. In the early stages of company development, the needs were far simpler than when the first companies were created or today. The company fully realizes its needs in society, so that the impact of social crises is as significant for the individual and the company, as much as the impact of individual crises. In the realm of social crises, persons in power, both individually and in organized groups (parties, associations) play an unusually important role. The fact that crises are not bad luck or God's punishment indicates that the causes of crises are real occurrences, all around man, and that the disturbance that arises in social systems cannot be prevented. It is precisely in this field that the authorities who have been given the mandate to protect the "ordinary" man from all adversity are at the forefront. They, therefore, determine the beginning of the crisis, its end, the forces and means of dealing with the crisis, as well as the finances and ways of fighting it. Linear reasoning, which suggests that major events must have great consequences, has provided a different approach and understanding of crises, which emphasizes the increasingly complex consequences.

The central theme or problem of a company and society is the creation, protection and development of fundamental and generally accepted values. The expression of needs of the company and society in achieving these goals is materialized through social interests. Given the complex and uncertain development of man and society, each company and society takes a very careful approach to defining its own interests. The projection of defined interests in national interests is the peak of taking measures to protect identity of society, and requires finding a place for the company in that system. However, the complexity of social phenomena has one of its roots, precisely in defining national interests. Namely, if a society or state defines its interests, without respecting in whole or in part, the interests of its environment, the conditions for conflict arise. Conflicts are as old as man and society. They represent social relations, which content can be different, so much that their specificity can be shown through: war, fight, friendship, hostility, alliance, etc. Conflicts throughout history have changed independently of the participants' knowledge of them, that is, their objectification has taken place even after a certain distance of time. Conflicts, in a revealed or hidden way, generate certain consequences for the value of human society. The materialization of consequences is instantaneous or temporally displaced, in accordance with the interests of „one who writes history“. Multi-causality, multiplicity and multidimensionality of conflict are fertile ground for generating different types of crises.

3.3. Impact of modern crisis trends on security

The modern crisis has endemic features that indicate that the modern crisis is the logical correlate of increasingly complex systems that, for technological, financial or political reasons, cannot meet security requirements. The modern crisis is complex by nature: it consists of new combinations of known crises that point to solutions, which, however, prove to be precisely the sources of escalation. Moreover, modern crises tend to self-perpetuate; the process turns into a bewitched cycle that feeds on uncertainty and incertitude about causes and causal chains. There is no return to normal as future crises re-emerge in changed forms. The modern crisis is also the result of perceived values of society and ways of threats perceiving.

There are several phenomena in modern theory that more closely define the impact of crises:
- Transnationalization
Modern aspects of crisis generation and development depend on technical and technological development, development of security culture, integration of security at different levels, etc. This points to complexity of crisis observation and response to them. It is the responsibility of the organization's management to monitor the crisis and forecast the situation.

4. CORPORATE SECURITY SITUATION IN THE REPUBLIC OF SERBIA

Today, corporate security is considered to be one of the most important strategic and managerial resources for successful business in modern conditions. When it comes to Serbia, it can be said that implementation of the corporate security system is lagging behind the Western countries. Regarding the official strategy documents of the Republic of Serbia: National Security Strategy, Defense Strategy, etc., there are no closer definitions regarding corporate security, but only the category is mentioned, but in the context of the privatization of the security sector. Unfortunately, there is not yet one effective regulation that would more closely and accurately regulate the corporate security system. The lack of regulation of this matter and the lack of legal basis for the organization and functioning of the security system in corporations is the main cause of its lag, stagnation and improvisation in practice. However, not all areas of corporate security are unregulated, but there are certain areas fully covered by law, others partially and the third are not regulated at all. The analysis of regulations that directly affect the area of corporate security and protection of persons, property and business can be done by isolating and interpreting certain provisions of applicable regulations that directly determine the obligations of organizations, ie. business entities in the area of risk assessment.

Particularly characteristic of the Western Balkans and Serbia is that the non-state security sector is expanding, while, on the other hand, corporate security is very under developed and the private security sector is engaged in corporate security. Such practices have led to the absence of internal organizational units for corporate security in most of the companies. Even if they exists, they are usually large corporations (most often in multinational companies), and most often within the broader organizational units that are in charge of only a part of the corporate security business. Most companies accomplish only some of the corporate security functions that are performed by hiring individuals who already work for the company or by contracting with specialized agencies. Exception are the works related to physical and technical safety, fire protection, often prevention and emergency response. On the other hand, security culture education and development programs are very low on the priority list. Corporate security is not even considered in companies of which many have stopped working or have gone through the process of failed privatization.

As already stated, corporate security in Serbia is only in the development phase. In order to reach the required level of corporate security development, first of all it is necessary to thoroughly and comprehensively regulate this matter, both by the state, by adopting appropriate laws and regulations, by regulating above all the competences, rights and obligations within the security system. Strengthening security controls in all its segments by competent state institutions and consistent application of the law is of great importance. On the other hand, business entities, and especially those for which there is an increased degree of security risk, are obliged to introduce a system of responsibilities, procedures, measures and actions through internal acts and, of course, apply them consistently. This would avoid identifying with the private security sector and thus create a basis for further development. The perception of corporate security and the need for its development depends largely on the state.
Specifically, the question arises “why one would develop a fire protection service if they did not have to, and in addition have a state fire service free of charge”. By creating documents at the strategic level, that is, at the doctrinal level, the effect of the development of this field and of the awareness of the need for the existence of a corporate security system would be achieved. On the other hand, responsibility for own safety would be complete, and the system would evolve over time.

5. CONCLUSION

Corporate security has gained importance in recent years. Its importance stems from the real need to consider the issue of protecting people, property and business as a whole and from all aspects. Its goal is to contribute to the realization of company interests through the activity of protecting the person, property and business of the company. This is especially important at a time when a whole new range of threats and risks were recorded, while on the other hand the earlier forms completely disappeared or took on different contents and forms. Companies need to keep up with the time, keep up with the changes and act on them timely.

The company is characterized by a state of permanent „tension“. Namely, there are rare cases where company practice is without some problems. Internal or external in nature, or combined. More factors that affect the company will mean more complex problems. Building a company protection system is therefore of paramount importance. Monitoring of changes in the environment is extremely important, but it is not possible to do it occasionally, when problems are already noticed. Crisis symptoms are all around the company, only with a developed system of perception and identification the early signs of crises can be observed and analyzed.

Development of crisis management indicates the need to develop knowledge that enables the identification of crisis symptoms and the development of crisis scenarios. Expert knowledge is crucial because it is about influencing known working conditions, as best known to the professionals performing those jobs. An organizational structure that facilitates the efficient transfer of information is very important, without disturbing the segment of monitoring information from the environment.

In the Western literature, corporate security as a scientific discipline has a long tradition. Unfortunately, this is not the case with Serbia. In our country, corporate security development is not satisfactory. Some progress has been made over the last few years, however, much remains to be done to put the concept of corporate security into practice. A particular problem is the lack of integrity of the structural elements of corporate security as a scientific discipline, which leads to the identification with private security. The consequences of lagging behind in the development and study of corporate security indicate that there will be problems in the future. Namely, the expectation is the same or greater extent of emergencies, but also emergencies due to the lack of adequate corporate security systems.

In the future, it is imperative to form corporate security as a scientific discipline and build its elements. It is necessary to regulate the area at the strategic level through strategic documents and then to regulate with quality laws. In such an environment, corporate security and its factors can be expected to develop. Also, it is implicit to reduce the damage and increase the influence of companies in social life.

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THREAT ASSESSMENTS FOR THE AREA OF THE MURSKA SOBOTA POLICE DIRECTORATE IN CASE OF NATURAL AND OTHER DISASTERS

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Abstract: The article presents threat assessments for the area of the Murska Sobota Police Directorate, which are an integral part of the Murska Sobota Police Directorate's action plan for natural and other disasters. They are a basis and point of departure for the drawing up protection and rescue plans for particular type of disasters that may occur in the area of the Police Directorate, such as floods, earthquake, aircraft accident, nuclear accident, use of weapons or means of mass destruction for terrorist purposes or a terrorist attack with classical means, a railway accident, a large wildfire, a mass epizootic outbreak, an accident on a motorway or in a tunnel, and a human epidemic or pandemic, with the concept of responding to particular consequences of natural and other disasters.

Keywords: national security, system of protection from natural and other disasters, action plans, protection and rescue plans, threat assessment, Police, Slovenia

1. INTRODUCTION

The system of protection against natural and other disasters is aimed to ensure safety of people, animals, property, cultural heritage and the environment against natural and other disasters with the goal of reducing the number of accidents and preventing or reducing the number of casualties and other consequences of these incidents. It is interconnected with other subsystems of the national security system and is embedded in international mechanisms in this area.

The Ministry of the Interior of the Republic of Slovenia represents an integral part of internal security system. Its core mission is ensuring the highest level of security in the country. All work areas of the ministry are related to its fundamental role and task. In accordance with its competencies, the national police force, as an authority within the Ministry of the Interior of the Republic of Slovenia, takes part in the system of protection against natural and other disasters, at the level of the local community, the region and the state [1].

The Murska Sobota Police Directorate, which is one of eight police directorates in the Republic of Slovenia, has a plan of activities for the event of natural and man-made disasters, which includes threat assessments.

Plans of activities are appended to national protection and rescue plans. They are drawn up by competent authorities or municipal administration services and competent ministries and other state authorities.

Plans of activities ensure the implementation of activities that are under the competence of an authority or service. They serve to determine those in charge of tasks, the organisation of their
operation, measures to mitigate the consequences of disasters and the manner in which tasks are carried out. They also define the necessary material, financial and other means for the implementation of tasks. Plans of activities are adopted by the head of authority or service.

The action plan of the Murska Sobota Police Directorate (hereinafter: action plan) is drawn up on the basis of the Organisation and Work of the Police Act, Tasks and Powers of the Police Act, Protection against Natural and Other Disasters Act, Degree on the Content and Elaboration of Protection and Rescue Plans and internal acts of the Ministry of the Interior of the Republic of Slovenia and the Police and is harmonised with regional protection and rescue plans for the Pomurje region.

The action plan governs the implementation of the tasks of the Police Directorate in the event of natural or other disasters. The action plan determines those in charge of tasks, the organisation of their operation, measures to mitigate the consequences of disasters and the manner in which tasks are carried out. It also defines the necessary material, financial and other means for carrying out the tasks.

The action plan is activated upon receipt of a notification of flood, earthquake, aircraft accident, nuclear accident, use of weapons or means of mass destruction for terrorist purposes or a terrorist attack with classical means, a railway accident, a large wildfire, a mass epizootic outbreak, an accident on a motorway or in a tunnel, and a human epidemic or pandemic.

The action plan is also used in case of other large-scale natural and other disasters.

An integral part of the action plan is threat assessments, which are a basis and point of departure for the drawing up protection and rescue plans for particular type of disasters that may occur in the area of the Police Directorate.

2. DESCRIPTION OF THE AREA

The Murska Sobota Police Directorate (hereinafter: the Police Directorate) is a medium-sized police directorate and covers an area measuring 1,337 km². There are a total of 27 municipalities, 346 villages and 83 civil parishes in this area. There are a total of 118,293 inhabitants (Statistical Office of RS, situation on 2011). The area is divided into four administrative units (Murska Sobota, Ljutomer, Lendava in Gornja Radgona).

The Police Directorate borders the Republic of Austria in the north (64.2 km of the state border), the Republic of Hungary in the east (102 km of the state border) and the Republic of Croatia in the south (61.1 km of the state border).

The majority of important roads in the area of the Police Directorate are sealed, with only a few unsealed roads left in some villages. Practically every house is accessible by roads. There is a motorway crossing the area of the Police Directorate, linking Maribor with Pince at the Slovenian – Hungarian border, as well as an expressway linking the motorway with the road to Hungary.

The population density in the area is within the Slovenian average and amounts to 89.4 inhabitants/km².

From 1945 to the present several disasters have been recorded in the area of the Police Directorate, with disasters as a result of heavy rainfall and storms being the most prominent.

Data on disasters show that in the area of the Police Directorate since 1988 there have been periods of heavy rain or flash storms with strong winds and hail once or twice every year, which cause a lot of damage. Due to the geological structure and configuration of the terrain
in the hilly areas of the Police Directorate, small landslides occur after heavy storms or prolonged rainfall, which may destroy roads and buildings.

A major danger is potential flooding of the rivers, such as Mura, Ledava and Ščavnica. This is especially true of the Mura, which if it flooded and damaged the dams may threaten larger villages and towns in the area of the Police Directorate. The Mura has flooded before.

In 2007 there was a major fire in a biodiesel plant. There were no other fires or disasters involving hazardous substances.

Organisations that use various hazardous substances in the productions present the highest risk for hazardous substance disasters. Any unprofessional or negligent handling of hazardous substances may cause a disaster.

Some companies warehouse large quantities of hazardous and flammable substances, such as gasoil, liquefied gas, residual fuel oil, various oils, corrosive substances and lye. All these companies are located fairly close to watercourses flowing into the Mura, Ščavnica and Ledava.

Land development and general climatic conditions as well as changed wind directions cause frequent destructive weather phenomena, which result in broken trees and uncovered roofs.

Occasionally in winter there is a lot of snow, which though usually not dangerous also should not be neglected.

3. THREAT ASSESSMENT

A threat assessment for the area of the Police Directorate, which is based on the data included in the global threat assessment drawn up by the Civil Protection Headquarters for the Pomurje area, is a basis and point of departure for the drawing up protection and rescue plans for particular type of disasters that may occur in the area of the Police Directorate.

3.1. Flood threat assessment

Floods may be caused by large quantities of precipitation over a long period of time, particularly when snow is melting, and by very intense rainfall in a short period of time (an hour and more).

The level of threat in the area of the Police Directorate is relatively high since this area is a high flood risk zone and consists predominantly of a plain, with the rivers Mura, Ščavnica and Ledava occasionally spilling over.

During long and intense rainfall there may be occasional short-term floods on a small or large scale due to swollen local watercourses all over the Pomurje region.

Flood threat does not only depend on the intensity of water wave but also on its duration. This can cause the dykes to get soggy, which increases the risk of their collapsing. The threat of flood is also reflected in the use of land (pasture, meadow and paddocks).

Flood threat is not getting any better. In some aquatic areas the situation is getting worse due to increased precipitation and tributaries and land development that changes the water situation as well as on account of poor maintenance of river beds, canals and dykes.

Several small and large landslides have been triggered by storms in different parts of the Police Directorate and a number of buildings (mostly basements) have been flooded. These floods caused damage both on the infrastructure and other buildings, while landslides and floods resulted in large amounts of debris to be cleared.
Storms may cause a lot of damage to the economy as well when business premises are flooded or at risk of being flooded, which causes production failures, destruction or damage to cultivated land and costs of disaster relief.

Floods and storms may also indirectly lead to epidemics, as result of contaminated water entering the water system, shortages of water and debris contaminated with faeces and other organic waste.

3.2. Earthquake threat assessment

In the Republic of Slovenia tectonic and neotectonic shifts in different directions have caused the creation of several seismic zones. Between these zones there are seismic faults, which are characterised by seismic activity along the fault or at least in some parts.

In the region of Pomurje the risk of earthquake is low and the threat to population is minimal. The safety of the population in case of an earthquake does not only depend on the seismic vulnerability of buildings in which they live but also on the seismic vulnerability of other buildings. Most people spend a lot of time in kindergartens, schools, at work, hospitals, old people’s homes, etc.

The highest number of deaths and injuries occurs when an earthquake takes place at night or weekday morning. These are the times when people are mostly home, at work or in at school.

An earthquake in the Pomurje region would possibly be accompanied by chain-reaction accidents, such as fires and explosions, hazardous substance accidents and landslides, sčips and floods.

3.3. Aircraft accident threat assessment

In the area of the Police Directorate there is an airport (Murska Sobota – Rakičan), which is intended for sporting activities and has two grass take-off/landing strips, and an airfield in Krapje, with a grass take-off/landing strip.

Most aircraft accidents occur at or near airports, especially during take-off and landing.

Potential victims of a plane crash are not just passengers or crew, but also people on the ground where an aircraft crashes. The consequences of such accident, direct or indirect, also affect victims’ families, rescue team members as well as the environment and infrastructure.

Aircraft accidents typically happen without warning, suddenly and unexpectedly, their frequent casualties are passengers and crew members, they may occur at places that are not easily or immediately accessible and may also affect residents if an aircraft crashes in a populated area.

Aircraft accidents may be caused by technical and other factors (engine or aircraft construction failure, loss of control, poor flight control, human factors, etc.), natural and other disasters (inclement weather, fire) and terrorist attacks and other forms of mass violence.

With this type of accidents, the number of casualties is invariably high and often there is a death toll.

The worst scenario of an aircraft accident would involve two large passenger planes, affecting a large area of ground and causing a lot of people to be injured. The death toll of an aircraft accident might get even higher due to chain-reaction accidents – an aircraft crash in a populated area can lead to damage to infrastructure, fires, explosions and a crash of an aircraft carrying hazardous substances can cause uncontrolled leakage of hazardous substances, fires and explosions.
In the case of a smaller scale aircraft accident involving smaller aircraft or light aircraft, this also implies a lesser possibility of chain-reaction consequences in the form of demolition of residential or industrial infrastructure and consequent fires and explosions.

A large scale accident involving a large passenger plane crashing in a densely populated or industrial area would result in the destruction of residential or industrial infrastructure as well as fires and explosions Given that we cannot predict an aircraft accident because it can be caused by a variety of factors that are unpredictable, we cannot rule it out – instead we must prepared for it.

3.4. Railway accident threat assessment

In the Pomurje region there have been no rail accidents partly because rail transport had lost losing its significance. Thus the railway network in the Pomurje region was very limited and passenger and freight transport were scarce. The situation improved slightly with the upgrading of the train line to Hungary.

As traffic on this line grows every year so do the risks. As the entire line gets electrified, the threat will increase further and there will be an added risk of electric shock in the event of power lines being interrupted and other dangers.

Railway accidents that could occur in the Pomurje region and would, in terms of scale and consequences, require the involvement of the Pomurje Protection and Rescue forces (hereinafter: ZRP) of the region and local communities, are: a collision of two trains or a train derailment where a large number of people are injured and need to be cut from wreckage, given first aid and taken to hospital, accidents involving tanker trains transporting petroleum products and other hazardous substances, which if spilt would contaminate underground water, soil or atmosphere, cause explosions and fires and put people and the environment at risk, collisions of trains and road vehicles at railway crossings where a large number of people are injured and need to be cut from wreckage, given first aid and taken to hospital and train derailment where electric lines are cut at the tracks.

In the region of Pomurje there were some minor railway accidents, especially single accidents at unsecured road-railway crossings, which most commonly involved a train and a car or a lorry or tractor.

It would be difficult to assume that people, animals, property and cultural heritage would be at risk, since a major railway accident would be expected to endanger mainly passengers on the train and people in the immediate vicinity of the accident (train station, road junction, etc.). In an accident involving transport of dangerous goods, besides passengers, people in the immediate vicinity of the accident would also be at risk. There would also be a danger of contamination of soil and groundwater in the immediate vicinity of the accident site. This could result in explosions and fires as well as direct or indirect shocks to electricity /after the electrification is completed/, so that facilities in the immediate vicinity could be endangered, especially in the event of an accident at a railway station in towns or populated areas. Given that the railway network in the region has been poorly developed so far and that the routes run mainly on the outskirts of towns, the possibility of a major rail accident and thus a greater threat to people, animals, property and cultural heritage is low; however, it should not be ruled out. There have been no major rail accidents in the Pomurje region, but as international freight traffic through the region increases following the new rail link with Hungary, this accident risk has increased. Thus it will be necessary to re-evaluate the level of risk of railway accidents over time, and to change or modify the risk assessment accordingly, as well as to obtain the expert assessment and emergency response measures from the Slovenian Railways.
3.5. Nuclear or radiological accident threat assessment

3.5.1. Radiological disaster

Radiological accidents are extraordinary events that require protective measures due to increased ionizing radiation and contamination by radioactive material or contamination.

Radiological accidents can occur in radiation facilities (industrial, research and medical facilities with radiation machines or with radioactive materials and landfills with mining or hydrometallurgical tailings) when handling closed or open radiation sources, particle accelerators and other sources of ionizing radiation.

A radiological accident can occur anywhere due to uncontrolled dangerous sources of ionizing radiation (discarded, lost, found, stolen), irradiation and contamination of the population for some unknown reason, a fall of a satellite with radioactive materials and transport of radioactive substances.

3.5.2. Nuclear accident

Nuclear accidents are extraordinary events that require protective measures against the dangerous release of energy after a nuclear chain reaction or after the breakdown of products from a chain reaction. Nuclear accidents can also be radiological. This is especially true of accidents at nuclear power plants, since they contain a large amount of nuclear and radioactive materials which, in case of major deviations from normal operation, may expose people to radiation or be released into the environment. Nuclear facilities where nuclear and radiological accidents can occur are nuclear power plants, research reactors, vessel reactors, radioactive material storage and disposal facilities and industrial facilities (e.g. nuclear fuel production).

3.5.3. Ionizing radiation

Ionizing radiation is radiation with enough energy to damage a substance. The sources of ionizing radiation are natural and man-made. The source of ionizing radiation can be a radioactive substance that radiates due to unstable atoms as well as a device (such as x-ray machine). Due to radioactive substances in the environment (soil, air, water and also food), human beings are constantly exposed to ionizing radiation. Radiation is external or internal and we talk about radiation dose that the body receives.

External radiation occurs if radioactive isotopes are in the human environment. When split, they irradiate by emitting penetrating radiation. In this case, the exposure to radiation is proportional to the time spent in the radiation range. Internal irradiation occurs due to the introduction of radioactive substances into the body by inhalation of contaminated air, the consumption of contaminated food and drink and the introduction through the skin, especially if damaged. Ionization can cause damage to biologically important molecules in the tissue, which can lead to cell damage or death. When a large number of organ or tissue cells are destroyed, the effects on the organism can be very serious, even fatal, and manifest themselves relatively quickly after irradiation. These effects are called deterministic and are characterized by having a threshold - they are not observed below a dose that is lower than the threshold. Above the threshold, however, the effects are compounded by the dose received. Radiation can cause changes in the cell, which may represent one of the first events in the transformation of the cell to a cancerous form. Radiation carcinogenicity increases with increasing dose but manifests itself after a while. This is a stochastic effect or effect due to statistically determined cell defects. If the radiation causes damage to the reproductive cells, the consequences are only shown in the offspring (hereditary effects). In the event of a nuclear accident, radioactive substances are mostly released into the atmosphere and spread in the form of a radioactive cloud. The level of risk from radioactive contamination of the environment depends on the
type and amount of activity of the individual groups of radionuclides released (rare gases, radioisotopes of iodine, long-lived fission products). Transmission and distribution depend on the weather. Radioactive particles are deposited during the transfer (dry deposition) or are washed away by precipitation (wet deposition) on the surfaces below them.

Human exposure to radioactive radiation occurs through three major transmission pathways, by inhalation of radioactive airborne particles, ingestion with water and food, and direct external radiation from a radioactive cloud or from contaminated soil.

The type and level of threat change over time.

The sources of ionizing radiation in the region are the Murska Sobota general hospital: the consequences of an accident would be felt primarily by staff, the transport of radioactive and nuclear materials: in the event of an accident, the consequences would mostly be limited to an area, which would have to be decontaminated and / or entry or movement in a particular area would have to be restricted, nuclear accident at the Krško Nuclear Power Plant, which would cause radioactive substances to be released into the atmosphere, and a fall of a nuclear-powered satellite or a satellite carrying radioactive material on board.

Given the distance from the Krško NPP, the Police Directorate's area falls within the area of general preparedness, where protective measures are carried out based on the results of measurements.

There are 50 nuclear power plants operating in the radius of 1000 km from Slovenia, with 109 energy reactors, 32 of which are in the 500 km belt. The closest power stations are in Hungary, Slovakia, the Czech Republic and Germany (Bavaria), which are up to 300 km from the Slovenian border (17 nuclear power plants).

3.6. Threat assessment of the use of weapons or means of mass destruction for terrorist purposes or terrorist attack by conventional means

The area of the Police Directorate is not immune to terrorism or to cross-border effects of terrorist attacks in the neighbouring and other countries.

The risk of a terrorist attack with weapons of mass destruction or conventional means in the area of the Police Directorate is low but cannot be ruled out. The same is true of such attacks in the neighbouring countries.

Given the rhythm of everyday life in the area of the Police Directorate, there are never many people in one place. The only exceptions are commutes (traffic), larger companies with a high number of employees, schools, kindergartens and the Murska Sobota General Hospital.

Attacks during special events or public gatherings are a possibility.

The level of threat of terrorist attacks in the area of the Police Directorate is low. Nevertheless, such an attack cannot entirely be ruled out, either in the area or in a neighbouring country, which would affect the Pomurje region as well.

Use of radioactive and nuclear substance to cause harm and damage is not very likely. Conventional terrorist attacks are less unlikely, with the targets being different public, infrastructure and critical infrastructure buildings and facilities.

In case of a terrorist attack with weapons of mass destruction the effects on the health of people, animals and plants would be considerable. A terrorist attack by conventional means refers to blowing up a building or infrastructural facility with the aim of causing human casualties, material damage, disrupting traffic, cutting energy and water supply.
When weapons or means of mass destruction are used in a terrorist attack, humans, animals and plants are at risk; these risks include infectious diseases, radioactive contamination of humans, animals, plants and areas, the occurrence of radiation sickness, chemical contamination of humans, animals, plants and areas, the occurrence of deaths and adverse psychological effects in humans. A terrorist attack with conventional means in public places and in public buildings, causing an air, rail or other transport accident, explosions on roads and other facilities lead to a lot of dead and injured people and material damage.

Terrorist attacks by using weapons or means of mass destruction or terrorist attacks with conventional means cannot be anticipated; however, we need to make sure we are prepared for terrorism.

3.7. Major wild fire threat assessment

The population in the Police Directorate area is concentrated in settlements that have developed along the three largest rivers - Mura, Ščavnica and Ledava. Forests cover about 25% of the total area of the Police Directorate and mixed forests dominate.

Some forests on the hilly slopes of Pomurje are more difficult to access for firefighters. In most forest areas sources of water are provided in accessible locations; however, they are much more limited in hilly areas. The sources and possible causes of a forest fire are primarily human negligence, lightning strikes and damage to power lines. Major fires in the area of the Police Department might be started by careless burning of grass or by other negligence; however, they could only occur after an extremely long period of draught. The level of threat is higher during long periods of draught in spring and summer months.

Raising awareness of the population about the need to protect forests and the environment has helped to reduce the number of forest fires. In the last ten years, only a few small grassland and forest fires have been recorded in the area of the Police Directorate.

Forest and grassland areas are more at risk from wild fires than houses and outbuildings. The latter are more at risk of fire as a result of lighting, hay self-ignition, faults in electrical installations and human negligence.

Chain-reaction accidents are possible a fire approaches roads, train lines and farm buildings. Forest fires can spread to buildings, cause traffic accidents or put commercial facilities at risk.

There is a higher risk of an accident involving dangerous and flammable substance in the vicinity of natural gas, methanol and other flammable substance facilities and petroleum derivative storage facilities, where accidents, i.e. explosions or major fires, can occur due to leakages.

3.8. Epizooty threat assessment

Diseases caused by infectious germs (bacteria, spirochetes, Rickettsia, viruses and fungi) are called infectious diseases. According to the type of infection and the measures needed to prevent and eradicate them, the contagious diseases that require general and specific preventive and other measures under the Veterinary Practice Act are classified in four categories in accordance with the Terrestrial Code, namely Category A (highly contagious diseases), Category B (generally contagious diseases), Category C (generally not contagious diseases), zoonosis (diseases or infections which are naturally transmitted from vertebrate animals to humans and vice versa and which, depending on their characteristics and conditions, may be classified in Category A, B or C).

Some infectious diseases occur infrequently and to a lesser extent, while others occur often and rapidly spread to a larger area. They occur in various forms, but the basic ones are enzootic
(if an infectious disease in animals is constantly present in various intensity, in the same place, in a narrow area and has no tendency to spread), epizootic (if a disease breaks out on a large scale and rapidly spreads) and panzootic (if a disease spreads rapidly in a large area, for example, across the country).

Many farms in the Pomurje region engage in animal husbandry, mostly cattle and pig farming. There are no large cattle or pig farms, instead these animals are evenly distributed throughout the region.

In the past, some dangerous animal diseases have appeared in the vicinity of the Pomurje region, such as the outbreak of classical swine fever in 2007 in the area of Međimurje County in the Republic of Croatia, and avian influenza in 2006 in the area of Maribor and Pomurje. A risk factor is illegal transport of livestock across the border, particularly from the Republic of Austria, the Republic of Hungary and the Republic of Croatia.

There are several large poultry and pig farms in the region. In addition, there are a large number of horses in the Pomurje region.

In every instance of increased mortality of livestock the farmer must immediately inform the competent veterinary service, which is then obliged to determine the cause of mortality and take action in accordance with its professional instructions.

The removal of diseased and dead animals would pose a special problem if authorised organisations were not able to remove them.

The consequences of an epizootic would be especially economic as for many farms animal husbandry is the main source of income.

Other, follow-on risks include the spread of zoonoses in humans, environmental contamination as a result of dead animals, posing a threat to the health of people, economic losses due to mortality or slaughter of animals and decreased production and sale of meat, international transport congestions and negative consequences for tourism, reduced spending in shops by people from across the border and increased expenses for prevention and eradication of these diseases.

Current health situation in livestock is good. Public veterinary services can provide the basic and preventive healthcare of livestock.

An outbreak of infectious diseases in the area of the Police Directorate is not very likely; a more likely scenario is that an infection would be brought in across the border with cross-border transit, which is where the highest risk lies.

### 3.9. Threat assessment of motorway or tunnel accidents

When looking at accidents and mass accidents on motorways and expressways in the area of the Police Directorate, some specific aspects of road traffic need to be taken into account (very high speeds, high frequency of freight traffic, the monotony of long motorway journeys leads to more drivers’ errors, underestimation of speeding, etc.), as well as characteristics of the motorway (location of exits, rest areas, emergency crossings between directional carriages and motorway access, traffic signalisation, security devices, operation of communication devices, contingency plan of the Slovenian Motorways Company (DARS) for mass accidents, basic information on other units for protection and rescue, as well as domestic and foreign experiences with such accidents (there are some well-known tragic accidents on European motorways). On the motorway, the smallest obstacle greatly increases the chance of an accident. At the time of an accident, there is a very high possibility of a chain reaction (chain collisions, fire in vehicles, cargo and motorway facilities, explosions, accidents involving a
large number of injured and dead road users, accidents involving hazardous substances, pollution, etc.). Another problem with such accidents is that access of emergency services and their work at the scene is difficult.

Therefore the conditions for preventing such accidents (preventive activities and measures) must be ensured, and in the event of obstacles or accidents, it is crucial to ensure the shortest possible reaction time for intervention groups. All involved in police intervention must bear in mind that rapid arrival of patrols at the scene and the immediate implementation of activities and measures envisaged by the Police Directorate's plan are crucial. The plan is designed to ensure police action in the event of an emergency, such as a motorway mass accident in the Police Department area. In addition, other professional instructions, guidelines and principles of police work must be taken into account in such activities, which is a prerequisite for effective police intervention.

Due to a high number of various emergencies and accidents, the Police Directorate plan does not define all the activities and measures.

3.10. Epidemic/pandemic threat assessment

Infectious diseases are caused by pathogenic organisms such as bacteria, viruses, parasites, fungi and mould. They cause the onset and development of disease in animals and humans. Infectious diseases are transmitted by air, food and water and by direct contact, or indirectly, through objects and surfaces. They are transmitted from human to human or from animal to human.

Infectious diseases spread when conditions exist for the transmission of a microorganism and the infection can be transmitted to susceptible persons. Infections can occur massively in the form of outbreaks, accumulations, epidemics, or pandemics.

In the Pomurje region, the occurrence of infectious diseases in humans (outbreak or epidemic) can be expected as a result of a natural or other disaster. Since the basic living conditions may deteriorate very rapidly in the event of such disasters, there is a risk of the occurrence and spread of infectious diseases particularly after catastrophic floods, the outbreak of zoonoses, the use of weapons or means of mass destruction for terrorist purposes or terrorist attack by conventional means (use of biological weapons), accidents involving hazardous substances (in the Pomurje region there are three stationary sources of risk, two major risks and one source of lower risk), the occurrence of infectious diseases in humans (an epidemic or a pandemic) of a large extent: an epidemic or a pandemic of infectious diseases (e.g. flu, infection as a result of contaminated water, diseases that are transmitted by insects, etc.).

4. CONCLUSION

Natural and other disasters are among the most common threats to the security of the Republic of Slovenia and its citizens. The Resolution on the National Security Strategy of the Republic of Slovenia stipulates that Slovenia must pay the utmost attention to activities aimed at reducing the number of accidents and preventing or mitigating their consequences. The operation of the system of protection against natural and other disasters must be prevention-oriented. Not all hazards that cause accidents can be eliminated, and all forms of protection and preparedness that enable rapid and effective emergency response must be given equal prominence [2].

Due to constantly changing relationships between nature and society, and thus also the characteristics of natural, technical and technological disasters, the attitude of the Police, as a
body within the Ministry of the Interior of the Republic of Slovenia, to the hazards and disasters, must be based on constant study, recognition and consideration of these interactions.

The plan of activities developed by the Murska Sobota Police Directorate for the area it is responsible for covers the basis for work in case of natural and other disasters.

On the basis of the changes in the threat assessments, which are the basis for the plan, and by taking into account contact and other information, as well as the experience gained from concrete accidents and protection and rescue exercises, the Murska Sobota Police Directorate will regularly update and supplement them with the aim of preventing or reducing the consequences of natural and other disasters that may occur in its area.

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USE OF DRONS
IN OPERATIONS IN THE URBAN ENVIRONMENT

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Abstract: Accelerated development of arming and military equipment at the end of the 20th and the beginning of the 21st century caused development of unmanned aircraft vehicles which application had begun at the end of the 20th century. Unmanned aerial vehicles are used today for different purposes although their development was intended for system of defence and security. Drones have wide spectrum of possibilities therefore they have unlimited usage both commercial and country defence and security purposes. Drones have become unavoidable part in arming of police and military units in the world, and their versatile usage have classified them as the most important combat means without which modern operation is unthinkable. Possibilities of using drones in operations in the urban environment are presented and explained in this paper. The focus is on the analysis of the characteristics of drones in terms of their ability to be used in an urban environment with restrictions dictating urban space and the modern way of conducting combat operations.

Key words: drone, unmanned aircraft vehicle, multicopter, counterteroris operation

1. INTRODUCTION

The development of drones led to their various uses. In the beginning of development, most of those drones were intended for security forces, while today large number of drones is being used in commercial purposes for the sake of science, economy, sport, entertainment and smaller number for system of defence.

Term “drone” has broad meaning, which implies all drones – unmanned aircraft vehicle, whether they are controlled remotely RPAS (Remotely Piloted Aircraft System) or they have certain level of autonomy. The analysis of content concludes that term “drone” has identical meaning as abbreviation UAV (Unmanned Aircraft Vehicle) which means synthesis of drone and device necessary for control.

Until the end of the first decade of the 21st century the most common use of drones was for military purposes and with appearance of multicopter they became widely known and then became commercially available. Industry of drones had begun to develop rushly and created large number of innovations and drone adjustments to the needs of the common man. With the all advantages which new kind of drones possess, it is necessary to provide safe and ecologically acceptable development of new industry and protect people, their information and privacy. [20]

Multicopter (DRONE) represents kind of drone with very simple construction which they characterize: small dimensions and weight, small engines, control is realized with remote console, flight autonomy is from several hour.
The Fortune magazine has declared 2015 to be the year of increasing and widespread use of UAV aircraft in various fields of human activity. Needs for UAV have sudden increases both for civilian and military needs. Also there is significant interest for development of new drones which possess flight autonomy in different space and environment and can realize different missions and assignments. Wide spectrum of drone applications, have led to construction of different kinds of drones, various purposes, dimensions and weights. Technological development of drone system is very technicly and technologically advanced and revolutionary, with development of smart phones and internet, quickly opening up paths and possibilities for large number of users in defining new future of UAV implementation in different fields of use. The largest funding for development of combat drone program is invested by the U.S. Department of Defence. [9,10], while for the development of drones for civilian use, the largest financial resources are allocated by China.

2. DRONES CLASSIFICATION

The development of drones began in 1970s in Israel, using Firebea 1241 in the armed conflict between Israel, Egypt and Syria. After the development of drones for military needs, the development of drones for civilian needs began. Different types of drones are used for military purposes in many modern armed conflicts. Drones vary in their features depending on platform and purpose or practical use. When classifying drones it is necessary to look thoroughly all aspects which can have influence on different understandings of drones, in order to make their classification as accurate and precise as possible. So today there are many different classifications of drones, depending on the institution that classified them into different categories. In accordance with the design characteristics of drones, they can be divided into aircraft that provide the thrust required to fly at:

- Fixed aeroprophilic surfaces, ie wings (planes);
- Rotating aeroprophilic surfaces ie elisa (helicopters, gyroscopes, multirotors);

European Association for Unmanned Vehicels Systems (EUROUVS) has created categorization based on following characteristics: depending on purpose, flight altitude, speed, maximum take off weight (MOTW), aircraft dimensions, signal range and other. [2,18]

According to the model of control and management of UAV, they are divided into autonomous systems, self-control systems, radar or radio beam control systems, telecommunication control systems and combined systems (autonomous, not autonomous). Depending on flight altitude, takeoff weight and maximum range, drones are divided into 4 categories [1]:

- Category 1 (mass up to 1kg, flight altitude up to 50m above the ground level (AGL) range up to 500m)
- Category 2 (mass between 1kg and 5kg, flight altitude up to 150m AGL, range up to 500m)
- Category 3 (mass between 5kg and 20kg, flight altitude up to 300m AGL, range up to 2500m)
- Category 4 (mass greater than 20kg, flight altitude higher than 300m AGL, range wider than 2500m.)

Based on drones classification it is concluded that the characteristics of drones most often depend on their purpose. It is necessary to analyse tactical-techical characterisics of drones in order to consider their potential for use in urban operations.

3. SIGNIFICANCE OF DRONE CHARACTERISTICS FOR EXECUTING OPERATIONS IN URBAN ENVIRONMENT
When referring to the urban environment, it primarily refers to the cities and infrastructure that they own, which differ from other categories of settlements, most often by geographical, urban-architectural and other factors, which have an impact on the operation of urban areas.

Operation is defined as “set of combat and/or non-combat activities, movements or other actions which are taken with unique idea, either on its own or in cooperation with other defence forces, in order to accomplish general objective of different significance” [16].

Operacija je definisana kao “set borbenih i ili neborbenih aktivnosti, kretanja i drugih akcija koje su preuzete sa jedinstvenom idejom, bilo samostalno ili u kooperaciji sa drugim odbrambenim snagama, da bi postigli opšti cilj različitog značaja [12].

In order to successfully analyze the use of drones in operations in urban environments, it is necessary to consider the characteristics of the urban environment, reliefs and infrastructure, which directly or indirectly affect the use of drones in urban environments, as well as the legal regulations that condition their use.

For the purpose of conducting military operations, US Department of Defense has divided the infrastructure of the urban environment into five basic categories [20], similar to the one performed by Zoran Žegarac in the section Infrastructures [21]:

- Telecommunicational and IT infrastructure,
- Traffic infrastructure,
- Energy infrastructure,
- Economic infrastructure,
- Administrative and social infrastructure.

The original use of drones for military purposes was for the realization of observation missions, due to the ability to display the image in real time. Today, the use of drones is represented in various activities.

Features that influence the purpose and ability to use the drone in an urban environment are: wing type (fixed or rotating), level of autonomy, dimension and mass, source of power (kerosene, battery cells, fuel cells, solar sells), additional payload on the drone (cameras, microphones, different types of sensors, arming), range, flight altitude.

Depending on whether drone has fixed or rotating wings the maneuverability of the drone also depends. In urban environment, where space is limited and there are many obstacles, type of wings have direct influence on maneuver abilities of drones, and drones with rotating wings (most often with 4 rotors) are more efficient in urban environment cause of their flying-landing abilities and characteristics.

The level of autonomy can vary from full autonomous work to full control by remote pilot. The difference in concept of autonomy is difference between automatic and autonomous systems. Automatic system is fully programmed which can on its own execute pre-programmed task. Automatisation includes aspects such as automatic flight stabilization, and autonomous systems can confront unexpected situations using pre-programmed rules which allow them possibility of choice, while automatic systems can not use this “freedom of choice”.

Dimensions and mass also have direct impact on possibility of using drones in urban environment. Large-scale drones are impractical and inefficient for use in urban environment, which is characterized by limited space with obstacles that are limiting optical visibility of drone, as well as the use of the same.
An energy source is one very important feature. There is four sources of energy: traditional aircraft fuel (kerosene, battery cells, fuel cells and solar cells). Kerosene is mostly used for large drones with fixed wings, military drone *Predator* is an example of such drone. Battery cells are most commonly used in small multitofer drones. These drones are short and demand less working house than the ones using kerosene. These drones are mostly used for recreational purposes, and they are practical cause of their rechargeable battery cells. An example of such drone is *Phantom*. Fuel cells are electrochemical devices which directly convert chemical energy from fuel into electric energy. They are rarely used in drones cause of relatively high weight cells and their implementation is possible only on drones with fixed wings. The fact that drones can fly a lot longer without recharging is big advantage of using fuel cells. An example for this drone is *Stalker*, which can fly up to 8 hourse [6]. Drones with solar cells are rare, because of the low efficiency of current solar cells.

The additional payload of the drone is the drone-mounted accessories, which also characterize the purpose of the drone. Most often drones are equipped with different spectrum of cameras and sensors which can be used in various purposes. Additional payload of drone has direct impact on using drones in operations in urban environment cause of its characteristics. The biggest problem with the use of drones in operations in urban environment is inability to communicate with them at greater distances. In order to solve this problem, two new principles are under development:

- Communication with drones on fast-moving platforms,
- Communication with drones using drones as relay (mobile) stations.

### 4. THE ANALYSIS OF USING DRONES IN OPERATIONS IN URBAN ENVIRONMENT

Military use of drones can be classified into three groups namely: naval, land and air use, while for civilian use can be used in different areas of human activities such as: surveying (photogrammetry), agriculture, industrial production, civil protection, disaster management, critical infrastructure surveillance [17], environmental protection, police surveillance, protection and rescue of people [13], intelligence and security services, journalism, commercial activities and entertain.

Planning and organizing of any operation can not be executed well, without information about enemy, and which can be gathered using drones. The successful execution of operation in urban environment is supported by the use of drones. The possibility of using drones in urban operations is as follows: detection of nuclear, chemical and biological weapon; mines detection; electronic reconnaissance; anti-electron activity; relay for communication; hiperspectral scanning; making an image using radar; laser marking the target; jamming of the radar; carrying battle load. [19]

Drones can be most often used for gathering informations via scouting and recording from air. Gathered informations should be timely forwarded to the Operations Forces Command Center. Using drones in urban operations gives wide spectrum of possibilities to the units which are using them, adding variety of accessories. Drones give advantage during execution of combat operations, because they give support to managers fast decision making and possibility of controlling larger space of combat activities.

Using drones equipped with hi-tech devices (high resolution cameras, infrared and thermal cameras, microphones, different kind of sensors, and other accessories) increase efficiency of units engaged in urban operations. Using this sophisticated technology enables timely and accurate real-time event information to be obtained without exposing people to the risk of
injury. Drones can be used for delivering medical supplies and other needed equipment to the units in high risk zone.

Beside significant advantages that using drones in urban operation give, there is certain number of limitations and problems that occur during the use of drones such as: autonomy of flight, a large number of objects in a small space, different dimensions of objects, the possibility of interference.

Autonomy of flight represents one kind of limitation that directly influences on execution of operation, because maximal flight duration is between 15 and 60 minutes, and charging batteries and their replacement is difficult in combat and non-combat urban operations.

A large number of different objects in a small area also has a direct impact on operations in the operating environment, as it reduces maneuvering space and therefore makes drones with rotating wings more suitable for use. Different objects dimensions also are also limiting maneuver abilities and interfere equable drone flight.

Increasing the distance of the operator from the aircraft (drone), increases the safety of the operator who does not enter the high risk zone, but also increases the possibility of electronic interference with the drone.

Using drones in urban operations, regardless of limitations, increasing efficiency and effectivity of units engaged in operations and also increases the protection, reducing the risk to the personnel involved.

5. CONCLUSION

Drones nowadays represent aircraft that transform way of doing businesses, improve efficiency and find application in many industries. The future of the development of drones is yet to come, as the annual number of drones produced increases significantly from year to year and is becoming more accessible to everyone. They vary in shape, purpose and size, but basic aircraft components, from battery, motor to sensor are identical for all models. The price of drones has declined significantly over the last decade due to the simple components of the aircraft that are easily accessible and thus allow for the widespread availability of drones. Drone classification depending on certain number of criterions is shown in this paper, drone characteristics and their influence on executing urban operations is explained. Based on the content analysis, the following conclusion is reached:

- Rotary-wing drones are more efficient for use in urban environments than fixed-wing drones;
- Smaller drones are more suitable for use in urban operations;
- The most efficient source of energy for launching drones is fuel cells, but when used, there is a limitation that these drones must be larger in size;
- Depending on the type of additional payload, the efficiency of drone use in urban operations also depends.

In this paper are shown thoughts of using drones in urban operations with a focus on drone characteristics and abilities, as well as the limitations that occur during the use of drones in urban operations.

The biggest possibility for drone application in operations in urban areas is for recording, observation and tracking in order to get timely informations and provide to field manager to make timely and accurate decision. Beside advantages that drones provide during operation execution, there are certain limitations which reduce their efficiency. The paper presents an analysis and reflections on the limitations that occur when using drones in urban operations.
and how these limitations affect the course of the operation. Limitations such as flight autonomy, a large number of objects in a small space, different dimensions of objects, the possibility of interference are explained.

The advantage of drones is reflected in the increase of security, and the reduction of risk, better efficiency of work, which also causes the increase of economic aspects in business. Based on the characteristics of drones, it is possible to perform various high-risk tasks with minimal human risk, which justifies the use of the drone in operations.

It is assumed that in the forthcoming period, the drone industry will continue to develop due to its wide range of uses, both for military and civilian purposes. In the Republic of Serbia, further development of drones needs to be directed to the development of drones for military and police needs, in order to significantly increase the efficiency of military and police units.

LITERATURE


The Role and Importance of the State Military Security

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Abstract: Modern society is full of sharp contrasts economic, political, social and historical nature. This is especially true in countries that have a unique geographical position, natural resources, different cultural and scientific achievements and which are multinational.

Military potential is still considered one of the most effective factors in world politics. Demands placed ahead of a state military organization and its armed forces, can not be reduced. The countries national interests requires permanent directing attention to a very important sphere of national policy, and that the military security. Discussing the problems of military security, dominated approach is based on the principles of mutual cooperation in the field of security, reducing possible confrontation to a minimum level, with the armed forces of a state intended solely to protect its own borders. Term military security means such a state of inter-state relationship and defensive abilities of the state, in which the probability of conflict is minimized. From this point of view we consider the role and importance of military security as an element of national security.

Keywords: government, military security and national security.

1. INTRODUCTION

In order to prevent a global catastrophe (self-destruction), it is necessary to develop and implement a planetary strategy for preserving the civilizational achievements and entering a new era of development, when humankind will get the opportunity to intelligently manage its power for the purpose of further harmonious development.

It is a long and difficult process of forming new principles of human action and behavior, as well as of radical changes in the existence, standards, and ideals of humans. A positive completion of that process is possible only if the security of the existence and development of humanity and its social structures is ensured. All countries in the world create and implement their own security strategies, which provide protection of society from various threats. One of the key positions in each country’s national security system is military security.

Experience has shown that security problems cannot be solved by military means alone. A country may also be threatened by other, non-traditional forms of violence (like international terrorism), which is why it must constantly implement a whole array of measures in the most important areas of societal functioning, ensuring in the process that its potentials, including the military ones, are improved. The chief goal of every state is comprehensive military security.

Military security is one of the most important structural elements of a country’s national security and is in closely dialectically related to other elements.
2. NATIONAL SECURITY

Understanding the concept of national security has become widespread over the past decades. In most cases, national security is related to the activities of special services and is generally identified with country defense. Regardless of the fact that, according to modern conceptions, the armed forces of a country are a guarantee of its security, the economic, political, moral-ethical and other aspects of national security are also of great importance.

National security is the state of protection of the vital interests of citizens, society, and the country from internal and external threats. The vital interests are the rights and freedoms of citizens, who contribute to the normal functioning of society as a whole and to the sovereignty of the state. [1] The basic elements of a country’s national security are: political, economic, military, technical, technological, environmental, informational and humanitarian security.

The basic principles of the national security of a state are legality, respect for the security interests of the citizens and the state, a mutual security-related responsibility at the international level, the connection between national and international security, etc.

The elements, functions, and principles of national security, which form its content, have led to the development of a national security strategy at the state level, as a system of means and methods for managing external and internal threats. The responsibility for developing and implementing a national security strategy of the state lies with the President of the State, the Government, the National Assembly, the security services, the Ministry of Defense, the Ministry of Foreign Affairs, the Ministry of Internal Affairs, etc.

3. MILITARY SECURITY – ITS ROLE AND SIGNIFICANCE

Military security is an integral part and the most important component of national security, and it determines the state of a country’s defensive capability and its ability to provide the protection of national interests by armed means.

Military security is characterized by the ability of the state to counteract the outbreak of a conflict and to prevent being drawn into one, and, in the event of its occurrence, to minimize the damage and destructive consequences for national security. The basis of the military policy in all countries of the world is the desire to strengthen military security.

The basic content of each country’s military policy pertains to the implementation of the following activities: formation and implementation of a unified state policy in the field of military security; support for inner political stability; protection of the state constitution and the integrity and inviolability of the territory of the state; developing and strengthening of friendly relations with neighboring and other countries; creating and maintaining of the country’s defense system at the required level and a qualitative improvement of the situation in the armed forces and other defense system entities. [1] These measures are directed toward supporting and strengthening of the country’s military security.

In order to maintain the military security of a country, it is necessary to maintain the military capacities at a level required for defense in the event of a crisis. The required level of military security is achieved when all the structural components (military, political-diplomatic, economic, ideological and other) are present, directed and coordinated through the efforts of the state structures. [2]

The political-diplomatic component of military security is ensured by: an advanced level of the collective (international) security system; an integration of the state into the system of military-political alliances; an acceptable balance of military-political forces in the world; a guaranteed implementation of international treaties and agreements in which the state
participates, and by further improving the international arms control protocols and preventing the proliferation of weapons of mass destruction and their means of delivery.

The economic component of military security includes: the material and financial capacities that ensure a country’s defense capability; the qualitative and quantitative parameters of the armed forces; the country’s defense-industrial complex; the scientific and technical potential that enables the creation of new types of weaponry and military equipment and the mobilization capabilities of the military industry, which, if required, need to provide the armed forces with the necessary quantities of weapons and military equipment.

The military component includes the military organization of a state, created to ensure military security by relying on the military forces. The military component presupposes the presence of certain quantitative and qualitative indicators, including: the unit strength of the armed forces along with the command and control systems; the level of competence of the units on which the operational and functional capability depends; the technical equipment of the armed forces (military equipment, ammunition, military-technical assets); stockpiles of armaments and military equipment on the bases and in warehouses; the state of military infrastructure (stationary facilities) intended for training of the units and the strategic and operational development and management of military operations.

The moral-psychological component is closely related to the military component and includes: the spiritual abilities of the country’s population, which are determined by the degree of moral and psychological preparation; the soldiers’ status, as determined by a combination of rights and obligations, the position and prestige within society and the state; and the moral-psychological state of the members of the armed forces.

Military security is divided into three levels: global, regional, and national.

At the global level, military security is achieved by way of the non-proliferation of weapons of mass destruction control measures, the reduction of strategic offensive weapons, etc. At the regional level, a country’s military security is ensured by way of a participation in the collective security system (NATO, CSTO). At the national level, a country’s military security is basically ensured by way of creating the necessary military potential.

Legal factors are among those which play an important role in determining military security. These include the state of legal relations among countries in the field of military activity, the existence of accords and agreements on disarmament issues, an effective control pertaining to compliance with contractual obligations, and the existence of an effective mechanism for crisis prevention and resolution in the region. Military security has two aspects: internal and external.

The internal aspect of military security is manifested in the conditions of a country’s unstable development and is primarily related to the problems of protection of the existing constitutional system as well as of the relations between the state with its citizens (e.g. provinces, autonomous areas, autonomous regions).

The external aspect of military security pertains to the state of relations among entities of international law and is characterized by the ability of a state to counteract attempts by individual states or their alliances to use military force as a means of resolving the existing contradictions in different spheres. That includes the existence of modern armed forces, the formation of a unified security system, and an entry into military-political alliances. The internal and external aspects of military security are closely interrelated.

Guaranteeing the military security of the state requires a creation and functioning of a unified system for achieving military security.
The system of military security within a state has the following components: the leadership, including the president, the government, certain ministries and state bodies; the armed forces with systems of control and full support, as well as a military industrial complex; a system of mobilization resources and reserves; a military infrastructure; a system of a normative-legal support; a financial-economic system; and a foreign-policy support for military security.

In addition to handling security challenges, risks and threats, a military security system must also be able to anticipate them. An important requirement placed on a military security system is the combination of centralized and decentralized management of military security mechanisms in accordance with the constitution and laws of the state.

A special place in the establishment of military security should be given to the process of preparation and decision-making for the purpose of protecting national interests. Specific requirements for a military security system are determined by the nature of military threats.

4. THE METHOD OF ACHIEVING MILITARY SECURITY

The legal basis for the realization of a state’s military security are the following: the state constitution, state laws, a national security strategy, a military (defense) doctrine, normative-legal acts of state governmental bodies, and international agreements of the state.

The basic principles of ensuring the military security of a state are: a combination of firm centralized leadership of the military organization and the civilian control of its activities; the efficiency of anticipation, timely detection and classification of military threats and the adequacy of responses to them; sufficient forces, means and resources necessary to ensure military security, and their rational use; a harmonization of preparation, readiness and security of the country’s military organization with the military security requirements; refraining from causing harm to the international and national security of other countries; an employment of political, economic and other non-military measures for ensuring military security; worldwide efforts to counter acts of aggression and the use of military force in accordance with the United Nations Charter and international law in extreme cases, when the use of non-military means has not lead to the elimination of military threat. [2]

The legal regulation of the basic directions of state policy in the pursuit of military security includes the implementation of an effective military reform and the limitation of armament, based on the principle of equality.

The basic directions of the realization of military security of the state may include: a creation of suitable foreign policy conditions for defense; a determination of the priority national interests in the field of military security, as well as of the complex of political-diplomatic and other non-military measures and ways of their realization; intelligence and counter-intelligence activity; the organization of military-political and strategic management of state defense, armed forces and other particulars of the defense system; the passing of defense-related legal documents; the creation of a necessary economic, scientific and technical basis for reliable defense; the preparation of the country’s territory for defense; the maintenance of the armed forces and other security forces in charge of defense in situations of a high combat capability and mobilization readiness; the development of military science and military training; and the conservation and development of the military-industrial complex. [2]

Military security is the most important direction in which a state should act. The main objective in this area is to ensure an opportunity to respond adequately to threats that may arise in the 21st century, with rational defense expenditures.

There are several approaches to solving the problem of ensuring the military security of a state. The first approach is based on the concept of the primacy of international law in a state’s
military policy. The second approach involves ensuring the military security of a state by way of force, and requires the creation and maintenance of advanced military capacities. The third approach favors the legal, diplomatic and other non-military measures in preventing military conflicts, while maintaining the country’s defense potential at a required level. The concept of preventing military conflicts by non-military means is supported by the Republic of Serbia.

The aim of ensuring the military security of a state is to create and maintain a political, international and military position of the country that would exclude the possibility of any state or alliance diminishing its significance and role as a subject in international relations.

5. CONCLUSION

National security is an instrument for protecting the interests of citizens, society, and the country as a whole from external and internal threats, and it is part of global international security.

National security objectives are the constitutionally guaranteed rights and freedoms of citizens, the values of civil society, and the sovereignty of the state. A state’s legislative and executive bodies design and implement a national security strategy, delegating their authority to the security and non-security forces.

The military aspect is one of the key aspects of national security of any state, especially if the state is exposed to internal and external threats, geopolitical changes, terrorism, etc. A state’s military security is formed under the influence of many interdependent factors that affect its effectiveness, and it is ensured solely as a result of the complex and organized activity of all state governmental bodies. The mechanisms of this process are based on a set of coherent, logically constructed and interconnected mutually dependent elements.

Both in peacetime and in wartime, special measures may be employed to ensure military security. In peacetime, military security will be ensured by way of the implementation of military policy in the field of military security, as well as through the maintenance of the internal political stability.

The technological, economic, and defense-industrial base plays an important role, and so does the increasing of the national economy mobilization readiness. It is necessary to plan and continuously implement the measures related to territorial and civil defense, to develop the military infrastructure, and to protect the citizens of the state from military threats. In the event of an imminent threat of war and with the onset of an armed conflict, steps must be taken for the purpose of increasing the operational capabilities of the armed forces in order to repel the aggression.

It is necessary to ensure the following: a comprehensive support and quality development of the armed forces; a maintenance of their readiness for joint actions for the purpose of preventing and neutralizing external and internal threats; the development and improvement of a system of measures for transferring the armed forces and other defense-related forces from peacetime to wartime.

REFERENCES

THREAT AS AN ORGANIZATION SECURITY FACTOR

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Abstract: An organization or organizational system is made up of a number of factors that operate in a particular environment. The influence of factors and environment generates certain states, which have some influence on processes in the organization. The peak of development of a particular condition and its degree of influence on processes in an organization, in negative sense, is the threat. The relationship between condition of the event that causes the threat and degree of readiness of the organization to identify and respond to such conditions speaks of security of the organization degree.

Key words: challenge, threat, organization, security

1. INTRODUCTION - DESCRIPTION OF THE PROBLEM

Regardless of their size or type, organizations today face many challenges, risks and threats. Threats and risks are characterized by diversity, manifest diversity, concealment whereby forms of expression become more flexible and sophisticated. Thus, in recent years, a whole new range of threats and risks has been recorded, while on the other hand, the earlier forms have completely disappeared or taken on different contents and forms.

The range of events that are in the environment of an organization derives their diversity from the factors that make them. Each factor has its own characteristics, on which the way of acting on the value of the organization depends. Accordingly, the perception of events occurring in the environment depends on knowing the characteristics of the factors, that is, the new circumstances. In such an environment and condition, emerging events take the form of a challenge. Their appearance and the smallest perception, or information that they have appeared somewhere, is a challenge for management thinking. Whether the challenge will remain at the level of thinking or whether it will receive more attention depends on the degree of management's belief that it has negative potential.

2. ORGANIZATION SECURITY AND DANGER

The business of each organization is aimed at achieving business goals. The basic condition for achieving the goals is certainty of occurrence and impact of various events from internal and external context. The basic characteristic of all events is a certain degree of uncertainty about their occurrence and impact. A group of events about which an organization does not have sufficient information, is not sure how it will affect its values, or generally, does not have enough knowledge about them to perceive the impacts. In such circumstances, a situation arises where the values of the organization are threatened.

2.1. The concept, perception and sources of dangers to the organization

The term “danger” is directly related to the term “security”, that is, if security is by definition an absence of danger, then interdependence is evident. The connection of the adjective "dangerous" with the physical integrity of a person, as an individual or a member of a
collectivity, through “life-threatening condition, position, situation, ..., war, ..., exposure to great danger” undoubtedly results in the term "dangers" in very wide use in security theory.

As dangers are events or a set of events and conditions that can lead to or intensify, dangers are acute events that can cause damage or loss. We can talk about natural and social dangers. Over natural hazards such as earthquakes, hurricanes, volcanoes and the like humans have little control. Social dangers can be the cause of losses under the influence or control of people, such as wars, criminal activities, etc. In a commercial sense, these events cause economic damage and cannot be viewed in isolation as purely security, economic or other categories. An example of this are the strikes, the deliberate destruction for profit, and various other situations that cause economic losses[4].

The carrier of the danger (threatening activity) can be a member(s) of the security entity or from the security environment and the internal and external carriers can mutually attack the security object. According to the time of manifestation, the danger can be real (manifested, persisted, taking place) and possible (presumed its manifestation in the future). Depending on the means used by the subject of danger, two broadest groups of dangers are registered: unarmed and armed. According to the abundance (or distribution) there is a general, special and individual danger, and means endangering the safety of the facility in totality or only some of its components. Regarding this, there is a past, current and potential danger according to durability; according to disclosure - secret and public danger; according to the directness of action on the organization - immediate and indirect danger; according to time duration - continuous, long-term, short-term and immediate danger. Each of these groups represents a complex based on a specific criterion by which they are classified. Problems in their classification, and thus the explanation, arise from the fact that a single form can occur at multiple sources at different intensities. It would be ideal for organizations to be prepared for all types of dangers. However, this is practically not possible because some may never happen to it. Therefore, the first step is to identify, in preventative activities, what are the potential dangers that may affect the organization. A good way to assess future dangers is to look at the past (review of chronicles, files and documents ...) In order to identify new dangers, changes in the environment need to be constantly monitored [5].

2.2. Organization security - concept and substance

Organizations are an integral part of that environment and this is the key reason why organizations in modern conditions must have a developed and built security and safety component. Numerous statistics and empirical data show that organizations are exposed to various types of threats and numerous risks, for which even large powerful organizations do not have an ready adequate answer. For these reasons, organizations are not only constantly exposed but also become more vulnerable and more sensitive to different types and forms of threat. On the other hand, they have an obligation to their owners to protect their interests and competitiveness, this includes the protection of people, information, property and business itself, and therefore more and more attention is paid to security [1].

Organization security can be understood as measures and actions that are planned and undertaken to secure and protect employees, assets, business. The internal security dimension focuses on internal security issues, ie. to those threats and risks that come from the inside, while the external is aimed at identifying, assessing and eliminating external forms of threats (those that come from outside the organization) [3].

2.3. Vulnerability and endangering the values of the organization

When it comes to organization vulnerability, an essential assumption for vulnerability analysis is knowledge of protected values. The usual division of an organization's protected values is
on nominal and non-nominal. Business, security and financial performance are nominal. Regulatory legal and other norms, reputation and stakeholders are non-nominal [4].

Vulnerability can hardly be measured directly, but it can be assessed by applying specific, specially developed methodologies. Since vulnerability is an indicator of certain system deficiencies, it automatically implies the possibility of increasing negative capacity with increasing number and intensity of deficiencies. Namely, every system, by itself, tends to positively change existing state, regardless of its quality at that moment.

Endangerment, as a state of real danger, reflects one's actions aimed at causing change to the target value (man, property, business, state, society ...). Action on the protected values can be divided into: the action of natural forces - when man or society does not have many opportunities to influence their development and the action of technical and technological dangers and social dangers - when man has wide range of opportunities to influence their emergence and development. Endangering of protected values, by activities carried by man or the whole of human collective puts into the foreground a motive that drives him to commit acts with destructive character. If destructiveness is caused by hostile motives then man or collective is also the most destructive part of the process. On the other hand, a man can also be the carrier of activities that do not have a hostile character and have large destructive capacities, such as global warming, etc.

Therefore, the notion of protected values endangering is used in a security issue for the purpose of indicating the existence of a subject or source of danger that has capacity for destructive action on the protected value.

3. CHALLENGES

An event portfolio in an organization's environment implies a large number of events. In initial stage, there are at least two conditions: the first is lack of awareness in the organization of the existence of events that are potentially threatening, and the second is existence of awareness of such events. Both conditions imply the possibility of negative effects on the organization, regardless of the state of mind in the organization. Such events are the subject of thinking in the organization, that is, challenges for management of the organization.

3.1. Organization security challenges

Some of the challenges that all modern organizations face are: terrorism, high-tech crime and corruption as being particularly characteristic of our area.

Terrorism is one of the most complex security problems of modern society. No part of society and therefore organizations are not protected. Efforts by the security sector within organizations to protect persons, property and business of the company from potential terrorist attacks are reduced to institutional prevention of such occurrences. Also, on the operational plan, it is possible to improve the protection systems for preventive-repressive action. The effects of these measures are difficult to measure and often insufficient [1].

High-tech (or computer) crime is any criminal activity that is carried out using computers and computer systems and networks. The scope of these criminal activities is very wide and varied and involves various types of illicit activities, from unauthorized distribution of privatized copyright works to multimillion-dollar thefts and fraud committed through unauthorized online access to someone else's bank accounts. In addition to actions aimed at obtaining unlawful material gain, cybercrime also includes activities taken from other initiatives, such as creation and distribution of viruses and malicious software, publication of confidential business and personal information on the Internet and the like [1].
The fight against corruption is nowadays recognized as one of the most important social topics, and the effective fight against this, first of all, social problem, and then crime, is one of the most important social interests. In addition to statutory sanctions that vary from state to state, insisting on ethical norms and the principles of good business are often used mechanisms to combat corruption in the business environment. Business ethics and personal integrity are often critical to the (non) emergence of corruption. These two concepts characterize an environment where honesty, consistency, which are incorporated in an institutionalized manner into a valid pattern of behavior, are the prevailing values. In an organizational environment, integrity, as a human characteristic, is embodied in the form of a corporate culture that is governed by internal regulations and documents [1].

3.2. Organization security risks

Regardless of degree of orderliness, organizations face risks that may affect the achievement of their goals. These goals can relate to various organizational activities, from strategic initiatives to operations, processes and projects, and can be reflected in social, protective, security and environmental outcomes, then in the form of commercial, financial and economic measures, social, cultural, political as well as influences on reputation [2].

From the organizational aspect, three groups of "basic" risks stand out, which have been separated into categories by their specificity, manifestation and required treatment. These are: Natural risks - those risks that can arise from the effects of nature and relate to natural disasters such as floods, fires, earthquakes, extreme weather and the like; business risks - risks that arise primarily from the economic conditions in the market, but also from the political relations and legal provisions of the business that apply to companies in a particular area, i.e. in a particular country; business risks (organizational risks) - a type of risk that is conditioned by the activity of the organization and affects the persons, assets and business of the company. These are the risks arising from the field of business, essential characteristics of the activity, technical and technological processes, location, number and structure of employees and more [1].

It is also possible to divide by sources of origin, predictability and impact of technical factors. According to sources of occurrence, risks can be divided into internal and external. Internal include employee theft, various forms of property, economic or environmental crime, etc. External include attacks on property, persons and businesses from outside. According to predictability, we divide them into unpredictable or difficult to predict (impact of legal regulations in the field of security and protection, natural disasters ...) and predictable (competition activities, tax policy). From the influence of technical factors, the risks are divided into: technical (injuries at work, fires ...) and non-technical (human errors, work stoppages, etc.) [4].

4. THREATS

The risk state has its temporal, spatial, financial, psychological and physical framework. This framework determines the impact on the protected values of the organization. Approaching or crossing boundaries is an alarm to management to act or treat certain risks. A situation in which, based on the results of the assessment or on the basis of direct insight, management concluded that there was a certain negative impact on the protected values, has the characteristics of a threat.

4.2. Character and manifestations of threats to organization’s values

When considering security issues of an organization from the perspective of existing or potential threats to their resources and interests, changes in the manner of manifesting threatening dangers must be taken into account, especially their dynamics, coverage, breadth,
Organization security can be compromised by threats from the outside and from the inside and combined. The threats from the outside can be: 1) Natural disasters: a. earthquakes, b. floods, c. storms, d. fires. 2) Attacks: a. terrorism, b. arson, c. diversions, d. theft, e. fraud, f. robberies, g. industrial espionage, h. computer crime. 3) Action of competition. Threats from the inside where the bearers or direct executors of certain actions are self-employed workers within the company. They may, by their act or omission, that is, planned and conscious actions, or unknowingly due to negligence, ignorance, cause more or less damage to the company, which in turn may adversely affect its overall business, corporate image and reputation in the business world, through reducing the assets and profits of the organization. In today's conditions, employees through various forms of disposal and usurpation of assets, unauthorized distribution of business information, products and services, endanger the persons, property and business of the company [5]. Threats can also be combined, which can be divided into six categories of economic, social, legal, criminal, information and political.

4.3. Implications of the threat to structuring an organization's security

Unlike in the past, no organization, no matter how powerful, is immune to external or internal threats. Therefore, it is important for every organization to anticipate and evaluate all events and threats and their consequences that can occur and comply thereby defining appropriate answers. It is especially important that in conditions where the level of security risk is increased, to introduce a system of responsibilities, procedures, measures and actions through internal acts and of course consistently apply them.

The most important document that every organization should have is the Security Strategy (risk management strategy). The practice has confirmed that there are numerous benefits and benefits to organizations that enact and subsequently implement a security strategy: it assists the organization, and above all management, in the corporate governance process; provides a direction and a reference point for establishing priorities, being directly related to the business strategy, closely linked to the organization's risk management system, and creating defense mechanisms and capacities regarding the organization's vulnerability; provides assistance in business decision-making, ie. strategic or operational decision-making; serves as a practical guide to the work of managers and security services; enables all employees to better understand importance and role of safety; provides a working framework on how to integrate the security function into the business system; assists with a proactive approach to addressing security issues; enables measurement, performance of security activities, and warns of necessary corrections or modifications; assists in protecting the organizational profits, reputation, brand, assets, customers, suppliers and employees; enhances organizational sustainability and changeability.

In addition to adopting a Security Strategy, some organizations also have a security policy. Policy most often means a clearly defined and coherent program of measures and activities taken by an organization to preserve its values. It is very important for organizations to implement all that they have stated in the documents. It is often happens that everything is foreseen, however, when it is to be realized it is invested only “as much as it has to”.

The organization is obliged to take the necessary measures and actions for the purpose of adequate risk management in terms of preventive action, neutralization of risk, reduction of negative effects of risk depending on its appearance, duration and intensity of manifestation.
The primary role of risk management is to ensure a smooth continuity in case of manifestation of negative effects of particular risks. However, it is not enough for an organization to have only one manager capable and trained to deal with emergencies, but to have a formed and proven team characterized by high organizational performance and the ability to work under extreme pressure.

5. CONCLUSION

Modern organizations operate in an environment full of security challenges and risks with a wide range of threats. Even large organizations are exposed to different types of threats and risks, for which they often do not have an adequate response prepared. To prevent or counteract negative effects, an increasing number of organizations are paying greater attention to security. If an organization has mechanisms in place to prevent and eliminate the impact, consequences and effects of all threats and risks it faces, it has an increased chance of achieving its mission, vision or projected goals. Therefore, it can be concluded that security is one of the key prerequisites for the survival, normal functioning and development of the organization.

From the above it can be concluded that the „threat“ as form and condition has great importance for establishment of an integrated security system. The integrity of the security system is determined by the various elements of the system and their coordination and harmonization within the organization. Severity of the threat determines the steps of management directed to the need to form an organization security system. A threat as a form can never be an integral part of an organization's security system. It is always influential through the factors of organization as a system. Namely, the structure of the organization is that segment that must be able to support formation of a security system, which will be aligned with the structure of the organization. In the absence of compliance, the security system itself can be a source of threat. Function of the organization is crucial to the cost-effectiveness and functionality of the system. If a security system is created that is not aimed at supporting the core function of the organization, then the function will be at a constant „level of vulnerability“. This condition can cause a negative threat detection and poor response. The environment is the primary source of persistent threats. Surveillance of the environment and identification of threats, through challenges and risks, are the basic tasks of the security system.

In the future, technological advances will be aimed at simulating various threats in order to modeling effects and modes of action. More sophisticated decision support systems are needed, with strong risk assessment segments to identify early negative event signals.

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PROBLEM FROM PAST TO FIND SOLUTION TO PRESENT AND FUTURE - ASBESTOS

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Abstract: In most European countries, the use of asbestos and asbestos-containing materials is prohibited, and in many of them the process of replacing these materials has begun. During this process, there is the possibility of releasing asbestos fibers, which poses a risk to both employees and the environment. As a result, asbestos waste is considered a hazardous waste.

The paper gives an overview of the legislation in the Republic of Serbia related to asbestos, and the relevant European directives were adopted. These regulations cover both the environment and the workplace and there are related to the regulation of the flow of asbestos waste, its storage, but also the norms on permissible concentrations of employee exposure and methods of asbestos detection. In addition, methods of handling asbestos waste and the MID-MIX process for recycling asbestos-containing material (asbestos cement slabs) that do not produce a complete result are presented. Finally, the necessary process of recrystallization of asbestos was pointed out as the final solution to the problem.

Keywords: asbestos, recycling, MID MIX process

1. INTRODUCTION

Continuous advances in technology have introduced a large number of substances that differently affect humans and their environment. Besides positive characteristics that these substances have put into use, more often they come with negative properties such as toxicity, flammability and explosiveness. Therefore, contact with such substances can pose a risk to human health and life as well as to the environment. In order to create favorable conditions for the preservation of human health, material goods and the environment and also to make the work safe, it is necessary to carry out a series of activities aimed at eliminating the dangers in technological processes or their products. Of course, an important role is played by the state, which, by adopting appropriate legal acts and controlling compliance with them, through its inspection bodies, participates in the realization of protection of the population and employees.

One of the materials that has been extensively exploited in the past until its harmful effects were known is asbestos. Its unique and still unsurpassed physicochemical properties have influenced the widespread use of this material in many industries. Asbestos usage began in the early 20th century for the isolation of steam engines and later in World War II in shipbuilding, after which its usage began for a wide range of products such as refractory textiles, asbestos-cement ropes and pipes, roof and floor products, electrical and thermal insulation materials, etc. [1-3]. After learning about the harmful effects of asbestos (asbestos is classified as a category 1 carcinogen by the DSD / DPD system, that is, as a category 1A carcinogen by the CLP / GHS system [4,5]), bans on its use are introduced in many countries. The first ban was introduced by the Nordic countries between 1970 and 1980, followed by Germany in 1993, while upon its establishment, the European Union adopted a directive banning the use of
asbestos [1-3]. Subsequently, laws and regulations forbidding the use of asbestos were introduced in most European countries [2].

2. LEGAL REGULATION IN THE REPUBLIC OF SERBIA

Following the European directives, a set of legal regulations concerning asbestos has been adopted in the Republic of Serbia. These regulations cover both the environment and the workplace and they are related to regulating the flow of asbestos waste, its storage, as well as the norms on permitted exposure concentrations and detection methods. It first started from the environment with the enactment of the Law on Environmental Protection in 2004, and then with amendments in 2009 and 2011. This law regulates the integral system of environmental protection and ensures the realization of the human right to life and development in a healthy environment, as well as balanced the relationship between economic development and the environment in the Republic of Serbia [6]. In addition, the Law on Waste Management was adopted (“Official Gazette of RS”, Nos. 36/09 and 88/10) and the Law on Amendments to the Law on Waste Management, which stated that “hazardous waste from construction and demolition requiring special treatment, that is, having one or more hazardous characteristics that make it hazardous waste (waste containing asbestos, waste with a high content of heavy metals, etc.) to which special regulations apply. ” In the case of asbestos, special regulations refer to the Ordinance on the management of asbestos-containing waste (“Official Gazette of the RS”, No. 75/2010). This Ordinance lays down the packaging method, criteria, conditions and method of final disposal of asbestos-containing waste and other measures to prevent the asbestos fibers and dust from being distributed in the environment. While the list of wastes containing asbestos is given in the appendix, which is printed with the Regulations and forms an integral part thereof [7].

Regulations related to exposure to asbestos in the work environment include the Decree on Preventive Measures for Safe and Healthy Work on Asbestos Exposure (Official Gazette of the RS, No. 108/15). This regulation sets out the requirements that an employer is required to fulfill in order to ensure that preventive measures are implemented with the aim of eliminating or minimizing the risk of damage to the health of employees who are or may be exposed to asbestos. In addition, the regulation establishes a limit value for exposure to asbestos, recommends a method for determining the numerical concentration of fibers in the air and other specific requirements [8].

3. WASTE WHICH CONTAIN ASBESTOS

The process of removing asbestos and materials containing asbestos from the living and working environment and replacing them with non-asbestos ones, is a very expensive process, and so far only rich countries can do it. In addition, this process has led to new difficulties. Namely, there was a problem of its safe removal and storage. As a result of that, the Republic of Serbia adopted the Ordinance on the management of asbestos-containing waste [7], which, inter alia, listed activities where asbestos is encountered in excess of 100 kg per year. It is:

I. production of crude asbestos ore, except for processes directly related to the mining of ore,

II. production of products containing asbestos, as follows:
   - asbestos cement or asbestos cement products,
   - asbestos friction products,
   - asbestos filters,
   - asbestos textiles,
   - asbestos paper and paperboard,
   - asbestos seals,
- asbestos packaging materials,
- asbestos reinforcement material,
- asbestos floor coverings,
- asbestos fillers [9].

The process of safe handling and disposal of asbestos waste requires considerable material costs. These include the costs of handling and further use of asbestos waste, which include: rehabilitation of equipment or facilities, collection, packaging, storage, treatment, etc., and finally the cost of final disposal.

Asbestos waste landfill costs in Western European countries can be estimated at less than 140 € / t and asbestos cement disposal in the range of 50 to 60 € / t. It should be emphasized that the cost of permanent underground storage would be 400 € / t, while the cost of temporary storage (for 90 days) would be about 4 € / t (data from Austria and Germany). The cost of repairing asbestos-contaminated facilities varies depending on the size of the facility and the specific situation. Thus, e.g. for removal of asbestos-containing PVC floors, prices depending on the size of the building are 260 € / m² (for 10 m²) and 120 € / m² (for 40 m²) [10].

In addition, the estimated costs of a fully equipped hazardous waste storage facility and asbestos partitioning costs are as high as € 10,000 to € 15,000 per storage facility (Austrian experience). The cost of a truck equipped with asbestos-containing waste, which is € 150,000 to € 200,000, should also be added [10].

A very important item from the point of view of occupational safety and health is the procurement of equipment for employees (personal protective equipment and a system for extracting fibers from the air) to remove asbestos material, which would amount to approximately € 9,000 (measurement of asbestos fibers included). All costs of making an adequate landfill [7] can be divided into:

- landfill investment costs;
- investment costs for collection systems;
- investment costs of equipment.

3.1 Investment costs of landfills

In the case of a modern landfill, no additional costs are foreseen under the Landfill Regulation. No additional equipment is required to safely manage asbestos waste and waste containing asbestos. Dealing with best practice is just a management problem. On-site controls and specially trained on-site staff are a prerequisite for maintaining the landfill operation. However, as asbestos waste is disposed of in a separate part and in a certain landfill area, the investment costs for the construction of the landfill may be slightly higher because the return on investment for that particular part of the landfill may be much longer than for its other parts. According to data from Western European countries, investment costs range from a non-hazardous waste disposal site of € 10 / m³ - € 25 / m³ (excluding construction, permits, basic service costs) [10]

3.2 Investment costs for collection systems

The highest investment costs in collection systems can be incurred when setting up household hazardous waste collection systems. For the individual collection and storage of household equipment containing asbestos, an additional adequate space of approximately 10 m² to 15 m² seems sufficient to store approximately 20 t to 25 t. If there is proper documentation for this waste, this amount can be transferred from the point of collection directly to landfills with a permit for disposal. The estimated cost of a fully equipped hazardous waste storage facility is € 1,000 / m² additional costs for the asbestos compartment can be estimated at € 10,000 to € 15,000 per storage facility (Austrian experience). Therefore, it would be necessary to provide
more collection points close to households at the municipal level. This collection can be provided through mobile collection systems on trucks or through fixed collection points. The mobile system (truck) in a month (one day per municipality) can serve 25 to 28 municipalities. The cost of a fully equipped truck can be estimated in the range of € 150,000 to € 200,000. There are currently no specific costs for collecting asbestos-containing waste [10].

3.3 Investment costs of equipment

The investment costs for this necessary equipment to begin the rehabilitation of asbestos-containing facilities (vacuum protective equipment for three people, an air extraction system, etc.) can be estimated at around € 9,000 (data from Austria). The cost of laboratory asbestos analysis is not included in this price. However, these costs mainly depend on the volume of equipment required and the capacity of the disposal / cleaning area. During the process of dismantling and / or demolition of facilities, there must be coordination between waste management and occupational safety and health personnel to prevent illegal disposal. For the removal of asbestos cement parts, the additional cost is reduced to around € 1,500 (Vacuum Class H reader, protective mask / clothing) [10].

3.4 Safety procedures for working with asbestos

In all jobs where employees are or may be exposed to asbestos dust or dust containing asbestos-containing materials, the following safety precautions should be taken:

− All work areas and equipment should be regularly cleaned and maintained.
− Work clothes, personal protective equipment, all materials which have come into contact with asbestos or materials containing asbestos and asbestos waste should be stored in a properly sealed container and transported without emitting dust.
− All products containing asbestos, asbestos waste and their packaging must be labeled.
− The work process must be organized in such a way that no asbestos dust is generated. Asbestos concrete components should be completely removed if possible. Cutting the sander is prohibited.
− If workers are expected to exceed the limit values, each worker should wear personal respiratory protective equipment [10].

Entry and exit to / from this area must be through decontamination blocks:
− bloc 1 for personal decontamination - cleans protective clothing for example using pressurized air;
− block 2 - it removes and leaves protective clothing;
− block 3 - the whole body is showered and the respirators are removed;
− block 4 is the personal clothing of the worker ready.

4. RECYCLING MATERIALS CONTAINING ASBESTOS

Just storing asbestos-containing material may be the final solution, but it is a far better solution to find a good way to recycle. One way is solidification, with asbestos fibers being trapped. The recognized method for hazardous waste inertization is using MID-MIX technology. This technology treats a large number of waste materials: waste oils; oil emulsions; sediments of industrial and municipal water purifiers; different sludges; contaminated soil; various organic industrial wastes; refinery wastes; waste asbestos; oily waste; tar; waste fuel oil, etc. [11].

MID-MIX technology is a physicochemical process in which waste molecules react with calcium-based additives (calcium oxide CaO and calcium hydroxide Ca (OH) 2). During this reaction, the waste molecule is permanently transformed into a new product - NEUTRAL. The additives used in this process - the solidification process are: water, sand, zeolite, slaked lime (CaO) and slaked lime, Ca (OH) 2.
Water, sand and zeolite are the additives used to adjust the density of the hazardous waste mixture entering the MID-MIX reactor. Water plays the role of thinner, and sand and zeolite thickeners mix. In addition, water also acts as a calcium oxide activator, giving the mixture the necessary temperature and energy to start the reaction. The amount of sand can play an important role in the physical characteristics of the resulting solid. In combination with cement, solidification can also be a raw material for obtaining concrete elements [11,12].

When treating asbestos, the following operations are performed: grinding asbestos pieces or materials containing them, grinding, separating and dusting the asbestos-air mixture, mixing with water and distributing them to containers. After which solidification is performed by adding additives. The solidification is the result of a physicochemical reaction in which a waste containing mixtures of different hydrocarbons (bond C-H) reacts with the dissociated elements formed by the exothermic reaction of CaO and water when calcium hydroxide is formed and heat is released. The temperature of the final solidification is always above 100 °C, and usually around 120 °C [11,12].

However, the process described may not be the best solution when dealing with asbestos waste, as it is a process of trapping asbestos without altering the structure of the asbestos itself. According to some authors [13-15], the temperature required for asbestos restructuring is much higher than 120 °C, which is achieved in the MID-MIX reactor. According to their data, the temperature at which partial bonding (O-H) occurs must be 700 °C for 2 h, and for the complete destruction of the asbestos structure in forsterite to enstatite near 800 °C for 2 h. Treatment of asbestos materials that would surely lead to asbestos recrystallization is a method in which the asbestos structure is destroyed which requires enormous energy (thermal treatment [13,16], use of microwave radiation, etc.).

5. CONCLUSION

Highly exploited material in the past, in many industries, is asbestos. The widespread use of this material was influenced primarily by its still-unsurpassed physicochemical properties. After finding out about the harmful effects of asbestos on human health, in the 1970s and 1980s, it was banned in many countries. This prohibition affected the termination of its continued use, but many of the products in which it was incorporated remained in use. Thus, modern societies face the problems of safe removal, storage and recycling of asbestos-containing materials.

This paper presents a recognized procedure for the treatment of hazardous waste MID-MIX - procedure. This process involves a physicochemical process in which the waste molecule reacts with the additives to produce a solid that is chemically inert but develops a temperature of only 120 °C which is not sufficient to recrystallize the asbestos. In order to achieve a complete process of recrystallization of asbestos into forsterite and enstatite, thermal treatment at a temperature of at least 700 °C for 2 hours is required, and this temperature is not achieved by the MID-MIX procedure.

Treatment of asbestos materials that would surely lead to asbestos recrystallization is a method in which the asbestos structure is destroyed which requires enormous energy that can be obtained by heating (cheapest) or otherwise, e.g. with microwave radiation.

REFERENCES

TITIE OF THE ILLEGAL MIGRATIONS-SECURITY OR ECONOMICAL ISSUE FOR EUROPEAN COUNTRIES?

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Abstract: The article is based on the research of complex social phenomenon significantly affecting the security of all European Union countries and partner countries at their external borders. The main issues which have imposed themselves on the research are the structure of migrants, division into refugees and economic migrants, as well as the analysis of European Union documents that can contribute to the adequate solution of the greatest population movement in the 21st century. To what extent does the European Union have the mechanisms for responding to the migrant crisis, how much is it capable to strengthen the security of the continent and the Union itself at the borders are the questions for the EU Global Strategy on Foreign and Security Policy, as well as harmonization of EU member states and candidate countries through their strategic documents. By analyzing the existing EU documents, the authors responded to this question. As in most cases, the background of large migrant crises is the conflict of geopolitical interests of great world powers dictating the flows of international events. In such situations, victims are, as a rule, innocent civilians. In this paper, the authors attempt to scrutinize the greatest refugee crisis of the modern era in an objective and systematic way, especially from the aspect of real and possible consequences, as well as the activities of the European Union states on the Balkan migrant route.

Keywords: irregular migrations, European Union, Global Strategy, migrant crisis

1. INTRODUCTION

In accordance with the Council's adopted conclusions of 17 October 2016 relating to the implementation of the European Union Global Strategy for the Foreign and Security Policy, the High Representative/Vice-president of the Commission/Head of the European Defense Agency Federica Mogerini presented the Implementation Plan in the field of Security and Defense to the defense and foreign affairs ministers [1]. As it is known, strengthening of security and defense is just one of the five priorities in the implementation of the Global Strategy of the European Union. In addition to strengthening security and defense, priorities were defined related to: (1) investing in building resilience and sustainability of states and societies on the eastern and southern borders of the European Union; (2) the development of an integrated approach to conflict and crisis resolution; (3) promoting and supporting cooperative regional frameworks; and (4) strengthening the system of global governance based on international law, including the principles of the UN Charter and the Helsinki Final Act.
2. UNITED NATIONS, FACTS AND FIGURES ABOUT MIGRATIONS

The number of migrants increased by 41% in the 15 year period. The largest number of migrants found shelter in Europe - 76 million, followed by Asia and North America (with 75 and 54 million respectively) [2].

Only in the countries of Western Europe there are almost 28 million migrants, whose share in the total population of this region is 14.4%. When it comes to desirable migrants, they are always talented individuals, especially those with high achievements in the field of scientific research (electrical engineering, physics, etc.), medical doctors and nurses and students. The UN study also shows that 177 million migrants, or 72% of their total number in the world in 2015, were between the ages of 20 and 64, with an average of 39 years of age. The rapid increase in number of migrants in the world, as a result of globalization and better information on alternative opportunities, has multiple consequences. For employers in developed migration countries, especially in those where the domicile population is growing old rapidly and where the population growth is negative, it is a favorable opportunity. An increase of young labour at the labour market gives them a greater choice in employment, whereas the higher labor supply on the labor market leads to a reduction in wages and an increase in the profits of the employer. Of course, for societies and countries targeted by mass migration trends, a sharp increase in number of migrants has negative consequences, especially when it comes to the so-called unwanted migrants. The increase of migrant communities in some countries leads to an increase in xenophobia and growth of the extreme rightwing political organizations which are against migrants and which advocates for the strengthening of the national state. The worrying fact is that migration flows towards the EU in the last couple years have been intensified and according to the forecasts of the competent world organizations, they are still booming. Unlike the 1990s, current migrants have a predetermined target country in which they seek a „place under the sun” for a permanent life. Germany is most frequently mentioned as the preferred destination, which, in truth, does have a negative natural population growth rate for many years, but also the most intensive inflow of voluntary migrants, the largest number of asylum seekers, as well as certain problems with migrants whose total number exceeds 12 million, meaning that they make up more than 14.5% of the total population. According to the UNHCR International Refugee Agency, migration represents the biggest challenge the world is facing today. It is the result of armed conflicts, civil wars, ethnic and religious threats, poverty, corruption and climate change. The arrival of over one and a half million migrants from the region of the Middle East, Africa and Asia to the European continent is also a social and geopolitical process. It is safe to say that the European continent faces migration movements from two main geographic routes - the east and the south. The eastern route includes, in principle, the migrants arriving from the region encompassing parts from Afghanistan to the Middle East, who seek to reach Europe through Turkey [3]. The south route refers to the areas of Sahel and North Africa, that is the migrants who cross the Mediterranean Sea to reach the southern European coast. The main migrant flow starts from Yemen and moves over Somalia, Eritrea, Ethiopia and Sudan, the Nile Valley, towards Egypt and Libya. From there, the majority of refugees tries to illegally enter Greece or Italy by ferries from Alexandria. On the other hand, the migration route that passes through Libya (increasingly unstable due to the influence of radical Islamists) is also mainly directed towards Europe. Due to the closure of the „Balkan“ or the East-Mediterranean route, as well as the implementation of the EU and Turkey agreements, the focus of migration has been transferred to the North Africa route. However, this simultaneously led to the strengthening of the smuggling channels of migrants from Turkey. Due to the increase in the criminal groups activities on the smuggling of migrants at the external borders, the EU is attempting to intensify the anti-smuggling activities across the Mediterranean [4]. The mandate of EUNAVFOR MED operation SOPHIA has been
extended for another year in order to stop the flow of migrants from North Africa to Europe. The migrants trying to reach Europe through Italy are increasingly starting from Egypt, off the coast near Alexandria. A decision was also made to establish a new Border and Coast Guard Agency. The agency is developing from the existing FRONTEX and will consist of 1,000 active and around 1,500 reserve members and will have the possibility of engaging without the invitation and consent of the country in which it is engaged [5]. In response to the challenges of migration, the European Commission plans to build „migration partnerships“ with African and Middle Eastern countries and by 2020 use eight billion euros for that purpose. An example of "migration partnerships" is the cooperation and agreement of the EU and Turkey[6].

3. EUROPEAN UNION, FACTS AND FIGURES ABOUT MIGRATIONS

Besides the fact that the migrant crisis arises as a result of various causes it also creates the consequences which stem from conflicting interests of migrants and the countries which accept them. While migrants have a basic intention to find a better place to live running from war and poverty, the countries which receive them are in fear from security problems, changes of national and cultural identity and possible diseases that migrants carry with them. The hardest of all is the fact that the burden of the migrant crisis is predominantly borne by those states which are not in any way involved in the events in the war-torn areas of North Africa[7].

The modus operandi of European institutions and officials in response to the crisis caused by migration, as a culturally and ideologically defined form of cross-border interaction, proved to be inadequate. Also, involvement of EU institutions in peace processes in conflict affected areas remain unsuccessful. On the other hand, there are increasing number of advocates for the Union to take immediate steps to strengthen external borders as the only way to ensure freedom within the Schengen zone. At the same time, this also represents the victory of a political imperative in border control. However, it is necessary to achieve a higher level of political understanding with key transit countries, primarily with Turkey, as well as to ensure credible control of the external borders of the Union, but also to accelerate the deportation of rejected asylum seekers or economic migrants who are seeking asylum for purely opportunistic reasons [8]. A key event and a potential shift in resolving the problem with migrants overwhelming Europe is the agreement signed by the EU and Turkey, which entered into force on 20 March 2016. Under this agreement, all illegal immigrants found in Greece will automatically be transferred to Turkey, and Turkey will in turn send migrants to an EU country according to the Union's choice. According to the UNHCR data, Turkey received a total of 1,888,930 migrants in 2015, mainly from Syria (1,700,000) [9].

In addition, the European Union was primarily expected to establish a comprehensive migration policy, based on the consistent respect for human rights and fundamental values on which it rests. Such an approach implies recognizing international mobility as an advantage, since migration managed in a purposeful manner, taking into account the needs and priorities of all participants, can bring genuine benefits to all the parties involved. Understandably, the outcome of such planning depends largely on the dialogue and cooperation with states outside the EU and international organizations, without whose support and assistance it is difficult to deal with the negative side effects of migration, since the current migrant crisis is a global phenomenon and as such requires an engagement which exceeds European demographic contours. Among the European Union countries, Hungary has definitely demonstrated the greatest resistance to migrants. This country had the most restrictive approach out of all European countries to the migration crisis at the very beginning, openly saying that it is not ready to accept migrants according to the European quota. Even as back as 2011, the border crossings between Serbia and Hungary were mostly used for the entry of migrants and refugees
into the EU. During the first eight months of 2015, 155,480 migrants arrived from Serbia to Hungary (99% of asylum seekers entered over the Serbian border) [10]. Due to strict anti-migration policy in Hungary this number decreased over time to an immeasurable number.

4. EU GLOBAL STRATEGY ON FOREIGN AND SECURITY POLICY AND MIGRANT CRISIS

“The Global strategy for the foreign and security policy of the European Union was published in June 2016. Our Union will work to strengthen our partners: We will keep deepening the transatlantic bond and our partnership with NATO, while we will also connect to new players and explore new formats. We will invest in regional orders, and in cooperation among and within regions. And we will promote reformed global governance, one that can meet the challenges of this 21st century. We will engage in a practical and principled way, sharing global responsibilities with our partners and contributing to their strengths. We have learnt the lesson: my neighbour’s and my partner’s weaknesses are my own weaknesses. So we will invest in win-win solutions, and move beyond the illusion that international politics can be a zero-sum game. The European Union will promote peace and guarantee the security of its citizens and territory. Internal and external security is ever more intertwined: our security at home depends on peace beyond our borders” [11]. But, differences in approaches to resolving the migrant crisis and decisions on compulsory allocation quotas caused a rift among EU countries, which is why most countries decided to apply national measures. Among them, Hungary and Italy are the loudest in protection of their borders. However, according to all assessments and analyses, the problem of illegal migration (political, economical, security, humanitarian, etc.) exceeds state and regional limits. The security situation in Europe, due to the influx of migrants and terrorist threats, is becoming increasingly difficult every day. The European Union faces a dilemma whether to completely close its borders and create a refugee accommodation center out of Greece. The reason why migrants go to the countries of Western Europe in large numbers is the existence of strong local Muslim communities which can accept refugees and help them find their way and adapt to a new environment. Their final destination may be any country in Europe which can provide them with basic living conditions and employment opportunities. In Germany, the new „Law on Integration“ came into force on 2016 which defines the rights and obligations of asylum seekers upon their arrival to Germany and regulates their integration into German society. Aware that the process of integration of immigrants and migrants has not followed the desired course, the German government is also discussing the adoption of the „Immigrant Law“, which should fully regulate the integration process, not only refugees and asylum seekers, but also the “desirable” immigrants (medical doctors, programmers, engineers, etc.). The view that Germany needs the workforce constantly loses its justification, because most migrants from the Middle East are uneducated and unwilling to integrate into a new society. The new law applies only to legitimate asylum seekers, not to the hundreds of thousands of economic migrants from Africa, Asia and the Middle East who have entered Germany illegally by posing as asylum seekers. Of the more than 1.1 million migrants who arrived in Germany in 2015, only 476,649 have applied for asylum. Many of the rest have gone underground and are sustaining themselves through petty crime and drug dealing. Nearly half (49%) of the migrants in Germany whose asylum applications were rejected during the past two years have not left the country, according to leaked government data [12].

Austria continues to advocate the standpoint on the need for independent protection of the EU’s external borders, expressing skepticism about the agreement with Turkey and the expectation of a new wave of refugees. The Ministry of Foreign Affairs proposed the “Action Plan for Europe” which stipulates that migrants who come to Europe illegally must return to migrant centers and asylum centers. These centers should be established in third countries...
outside Europe, where asylum procedures would be conducted and from which the migrants would be relocated to EU countries, if they receive asylum. According to the data from the Austrian Ministry of Internal Affairs, the police apprehended between 400 and 500 illegal migrants per week in June and July and this is the reason for the continued implementation of comprehensive controls at border crossings and along the open border with Hungary and Slovenia. At the end of July 2018 Austria agreed with Hungary on the joint securing of the external border between Hungary and Serbia. Hungary, however, does not accept the return of migrants from Austria, since it would be required to implement the asylum procedure for them, according to the „Dublin Regulation“ [13].

The Hungarian government is opposed to accepting migrants allocated to it on its territory. At the same time, Hungary plans to, along with Poland and the Czech Republic, advocate for and impose its position on the need to protect the territory of the EU from uncontrolled inflow of refugees, regardless of which region and country they come from [14]. Hungary adopted a law allowing the police to send illegal migrants who are held within eight kilometers of the border back to the transit zones between Hungary and Serbia, outside their territory. The legal entry of migrants from Serbia to Hungary is possible through two transit zones on the Hungarian-Serbian border, and at the daily level it totals 30 persons. The number of migrants in Hungary is decreasing every day since most continue their way to Western Europe. The government of Hungary still does not accept migrants who have entered the EU through Greece, Bulgaria, Romania or Italy, but is ready to jointly solve the issue of migrants who chose Hungary as the country of entrance to the EU. The requests delivered to Hungary for readmission relate to 19,542 migrants mainly from Germany, Austria, France and Great Britain. According to long-term plans, Hungary needs to receive about 52,000 refugees in the coming period, which is deemed unacceptable, as they entered the territory of the EU through Greece. On the other hand, Vienna is warning of the possibility of forming refugee camps along Austria's border with Hungary because the Hungarian and Slovenian authorities refuse to take back migrants who came to Austria through these countries.

After the closure of the „Balkan Route“, there has been an increase in illegal migration channels, which grows in proportion particularly endangering the security and national interests of the Republic of Serbia. There are indications that some transit countries (Bulgaria and Macedonia) tolerate this phenomenon in order to reduce their presence and avoid the obligation to provide assistance. At the same time, the emergence of an increased number of illegal migrants on the borders of Hungary and Austria has provoked a response and a more rigid policy towards migrants turning into a „total blockade“ at the border with the Republic of Serbia. Similar measures are being prepared by the Republic of Croatia as well, in order to prevent the entry of migrants from our territory. After the engagement of the security forces of the Republic of Serbia, a redirection of illegal channels occurred, while in most of the region of the south and south-east Western Balkans, especially Bulgaria and Macedonia, the transport of migrants is tacitly tolerated. The smugglers in Bulgaria monitor activities of Serbian security forces along the border and seek a way for the migrants to be freely transferred to the territory of Serbia. Findings indicate that Bulgaria faces major challenges to the migrant crisis, as well as that there is no clear strategy for responding to the crisis. This is the consequence of ignoring the current situation with migrants, pronounced corruption and geographical location. Its reactions are mainly encouraged by international factors and their response measures to the migrant crisis can not be expected to have a long-term effect. At the time being, the Bulgarian authorities expect a gradual increase in the number of migrants due to the current situation in Turkey, which might lead to a violation of diplomatic relations with that country, if requested by Brussels. An enhanced security of the border was made, with the number of members of the Bulgarian Army increasing at the border with Turkey [15].
If there are no joint activities and measures at the EU level and single independent solutions of certain countries prevail, the transit countries could find themselves in a situation where they must confront a greater pressure of migrants at their borders by employing significant military and police capacities. At the regional level, the situation with migrants increases security risks, opens up new economic, social and health issues, as well as the possibility of violating the ethnic structure in certain environments. Short-term and mid-term security implications can be terrorist acts by infiltrated terrorists, the expansion of organized criminal groups in transport of migrants. The need to provide additional financial resources for transit countries, as well as divisions between EU member states in dealing with the crisis, are growing. A potential starting point for a new massive wave of migrants to Europe could be the countries of Africa and Asia including Afghanistan, Pakistan and Bangladesh. In the upcoming period, it may be expected that the current volume of illegal migration will continue, with the continued efforts of criminal groups to find new channels for transport of migrants. Particularly worrying is the situation in Bulgaria in which there is a possibility of further escalation of the migrant crisis, as well as non-implementation of the necessary measures for controlling the movement of migrants. Also, the intent of some countries to fight a more decisive fight against corruption and organized criminal groups involved with smuggling of migrants is not recognized. For a more complete understanding of the pattern of migration movements, it is necessary to observe the interaction of various social, economic and political relations on a certain space and at a certain historical moment. The reason for this is a fact that the migration is always in direct interaction with the prevailing social and economic realities in the countries of origin and destination. The largest number of migrants comes from areas characterized by high unemployment rates, low wages, low living standards, poverty, lack of arable land, hunger, but also a high crime rate, a sense of insecurity and other. Particular incentives to migration are various forms of social conflicts and confrontations, and in particular those of a wider scale on the religious, racial and national levels which escalated into armed conflicts. People tend to move to areas or environments that are, among other things, characterized by better ambient and infrastructural conditions for living, greater chances for employment and better earnings, better education, availability of various social services, and in particular a higher level of personal security [16].

CONCLUSION

Migrations are an inevitability of human society, it is important to examine all their aspects, but first of all make a valid classification which will help to better understand the newly emerging migrant crisis that began in 2015. Also, solving the newly emerging migrant crisis in accordance with international regulations, primarily the European Union regulations, as well as national legislation, as well as respecting the human rights of migrants are challenges that are, at this moment, deeply shaking the very foundations of the EU itself, but also the countries on transit routes. There is a special category of migration caused primarily by forced circumstances, which is why the literature refers to them as "forced migrations" although the boundary between „forced“ and others is often unclear. In international law, the status of this category of migration is basically linked to refugees as defined in the Convention Relating to the Status of Refugees (1951) with the 1967 Protocol, but numerous dilemmas remain in interpreting certain elements of the definition of the term „refugees“. A research done on migrants moving on the Balkan route has determined that some of them cannot have refugee status because their status is not the result of forced migrations or migrations due to conflicts. In that sense, they should be classified as illegal migrations. In this respect, the survey found that most of illegal migrants on the Balkan route belong precisely to the category of "labor migrants". Having in mind above mentioned, the solution of the migrant crisis lies in the need
to treat the causes and not the consequences, but in an appropriate way which obviously still haven’t been discovered in EU countries and beyond yet.

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[3] There is around 1.28 million Syrian refugees in Jordan (630,000 registered), around 1.1 million in Lebanon with additional 450,000 Palestinian refugees, 250,000 in Iraq (distributed in 10 refugee camps).
[4] Training of Libyan coast guard and navy was planned, as well as implementation of UN embargo on weapons at the open sea and near Libya.
[5] According to the EU road map, it should be operational since September 2016 and it should provide protection of external Schengen borders, in order to enable elimination of border checks within six countries of the Schengen Zone
[6] EU-Turkey Statement is agreed on 18.march 2016, to the end flow of irregular migration from Turkey to EU.
[14] In case six months passes from the date of entry of the asylum seeker who submitted his asylum request in another country, the authority over this issue is transferred to the country where the asylum seeker is currently.
[15] Viktor Orban hopes that the EU problems caused by Brexit will enable a more realistic planning, acceptance and respect of opinions of smaller states, such as Hungary.
[16] Number of soldiers is increased from 230 to around 500.
RISK EVALUATION WITH POSITIVE ACTION ON THE PROJECT PROCESS

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Abstract: Each project has specific risks that can negatively, but also and positively affect the project. Risk management is an essential element of successful project management. Positive project risk management aims to identify and analyze project risks prior to their occurrence and provide an action plan for activities during the project. After identifying, analyzing and defining project risks, activities need to be planned and formulated in advance to take advantage of potential opportunities. This process of preparing actions to encourage positive events is called risk response planning. The paper discusses the positive project risks with a specific project example applied to the preparation of planning documentation in the process of disaster risk reduction.

Key words: risk management, positive risk, project, opportunity

1. INTRODUCTION - DESCRIPTION OF THE PROBLEM

Project risk management begins with the project initiation process and is part of the day-to-day activities and documents that are created during project implementation. The success of project management can also be reflected in the success of project risk management: the success of project management can be measured by the number of risks that have occurred on the project and by the magnitude of the positive impact they have had on the project. If opportunities are missed (the so-called "lost benefit") then it can be said that the project was mismanaged. On the other hand, if the degree of opportunity using is high, then we can say that project risk management is adequate, that is, that the project is well managed.

In this paper, risk is considered in the context of an uncertain event or situation that, if it occurs, can have a positive impact on the project objectives. Management of positive project risks is based on a proactive approach and considering the positive risks and their consequences in advance. The goal of managing positive project risks is to increase the probability and positive impact of risk events on a project. By anticipating possible events and analyzing them, we come to knowledge what needs to be done to take advantage of positive impacts.

2. PROJECT RISK MANAGEMENT PROCESS

Project risk management is formal and very complex process, which must begin with development of a written and formal risk management plan. The objectives of project risk management are to develop a project risk management strategy, to decide how the risk management process will be carried out, and to integrate project risk management with all other project management activities. Since the risk management plan is incorporated into the project plan, these activities are performed within the project management, not independently of it.
Different authors define the risk management process in different ways - the number of steps in the process and their content varies, but once the whole is taken into consideration, the touch points are found. The project risk management process includes the following stages:

- **Identification of project risks** - includes all activities related to research and identification of possible risks with positive effects, as well as their definition and classification into specific groups. This process also includes making a list of risky events that may occur in the future.

- **Risk analysis** – positive risks are studied at this stage and some values are assigned, numerical or other, to the probability of positive risk events occurring. Qualitative analysis makes it possible to determine, by using methods and techniques in the analysis of identified risk events, the impacts and consequences that particular risk events may have on the project objectives. This analysis should provide data on the probability of risk events occurrence and the magnitude of their impact. Quantitative risk analysis uses many quantitative methods and techniques to determine the probability of risk events occurrence and its impact on the project. Quantitative risk analysis should enable making a list of priority risks.

- **Risk Response Planning** - Risk response planning involves the process of defining activities and actions that increase the probability of positive risk events occurring and responding to their occurrence in order to maximize the opportunity. Risk response planning is a very complex process, given the number and variety of possible risk events and the different strategies available to respond to positive risk.

- **Risk monitoring and control process** - it involves activation of responses to risk events when they occur, and also monitoring and controlling the occurrence of acceptable risk events and risk responses. Since new risks with positive effects may emerge during the project implementation, they need to be immediately considered and addressed in the manner presented above.

2. **STRATEGIES OF RESPONSE TO POSITIVE PROJECT RISKS**

Once the risks have been identified and gone through certain stages of the risk management process, it is very important to choose the right technique or combination of techniques that will be the best way to use it. In any case, the main benefit is that the decision was made on the basis of objective and comparable data, not on the basis of subjective conclusions and intuition.

Figure 1 shows the planning process for responding to positive risks. This process goes through each risk, and the process of defining the risk response is broken down into three levels. At the first level of defining a risk response, there are three options. The first option is about the degree of information we have about a particular risk. If it is determined that there is insufficient information to define an adequate risk response, there is a delay in the decision and re-analysis and/or collecting of information. Defining the answer is based on a comparison of the effectiveness of the alternatives, the degree of opportunity utilization, the time of implementation, the suitability of the project solution, and other criteria. In case the possible solutions are not acceptable for the project manager and the project team, additional information should be collected and then an answer that is adequate, cost-effective and reliable should be sought [8].
As second option on the first level of response is the development of an appropriate response plan for each risk that is active. Some of the strategies for responding to positive risks, or strategies for sing opportunities [8], are:

- **Using opportunities** – One possible answer to the identified and analyzed opportunities is to make the best use of them. Taking advantage of possibilities/opportunities is the opposite of avoiding risk because we try to ensure that the risk arises instead of trying to eliminate it.

- **Possibilities sharing** – Possibilities sharing involves a third party taking responsibility for the opportunity that a risky event brings. This kind of answer makes sense when without the involvement of a third party we would not be able to use the identified opportunity. Such a response also entails sharing some of the benefits of the opportunity used.

- **Providing redundancy** – Redundancy is a risk response strategy where we use parallel solution paths to improve the probability of using opportunities for a project. In case there is a opportunity that we can take advantage of, but we are not sure if with the results of a particular activity we will be able to use the opportunity, we will initiate another parallel activity and increase the probability of using the identified opportunity.

- **Opportunity enhancement** – In an opportunity enhancement strategy, we strive to maximize the probability of a favorable event occurring and to maximize its positive impact. Reinforcement comes down to trying to increase the expected value of the risk. This is, in fact, the opposite of mitigation, because we seek to increase rather than reduce the probability of a risky event or impact, or both. Opportunity enhancement strategy involves defining preventative actions, contingent actions and reserves that we will use to use opportunities for unknown risks and inactive risks.
Also, the project manager and the project team may decide not to take any action, that is, to accept the possible risk if it occurs. This is the third option on the first level of risk response planning.

4. EVALUATION OF RISK WITH THE POSITIVE ACTION OF THE PROJECT
A DISASTER RISK ASSESSMENT DESIGNING AT THE LEVEL OF A COMPANY

In general, it can be said that the concept of project risk management is also applicable to risk management at the company level. The main reason are in the fact that companies carry out their business activities and realize their strategic commitments mainly through the realization of a number of projects.

Some of the benefits of making the assessment of disaster risk at the level of the company are reflected in:
- the existence of compliance with disaster risk assessment at the level of local governments
- the existence of emergency services
- developed community resistance to negative risks
- preventing the occurrence of unwanted events which causes may be affected on
- reducing the effects of unwanted events which causes may not be affected on
- building an adequate basis for decision making
- raising the level of readiness to respond to changed circumstances
- opportunities using and more.

Consideration of these segments as benefits can only be accepted if positive effects are generated on the realization of the set goals. Namely, the process of monitoring and evaluating positive effects can be risky. Failure to identify positive actions or keep the responsible risk manager on accepting the existing situation represent a problem by itself, due to the undefined outcomes.

Disaster risk reduction is a project implemented by every entity in the protection and rescue system (state, province, local government, companies). The preparation of planning documentation is process of identifying dangers, analyzing and assessing risks, defining measures for the treatment of risks and developing a protection and rescue plan. The process itself depends on a large number of factors, the impact of which is achieved more or less permanently. A very important point is the identification of positive risks and their monitoring throughout the process of planning documentations. Particularly intersecting group is companies, which suffer the most damage in the territory of the local self-government unit.

Impact of some positive risks in the process of planning documentation preparation in the field of disaster risk reduction:

1. existence of compliance with disaster risk assessment at the level of local self-government units

Making a disaster risk assessment without reconciling with the assessment of a local government unit involves a disproportion in the process of emergency prevention and response. The law stipulates that the company makes an assessment based on the assessment of the local self-government unit, which is not the case in 99% of projects.

Conclusion: The positive risk of making company planning documents based on the assessment of the local self-government unit ensures using of the local self-government unit capacity, better prevention and faster response.

2. the existence of emergency services

Emergency services are usually formed by the state and are distributed throughout the territory. The existence of emergency services near a company means that there will be a faster response
in case of an emergency. On the other hand, it also means that it is not necessary to develop protection and rescue capacities in the segments covered by the emergency services. Conclusion: There is a positive risk of having an emergency service nearby, reducing the cost of building special protection and rescue facilities, without impairing response capacity.

3. **developed community resistance to negative risks**
The preparation of the planning documentation itself results in the development of risk analysis and assessment. The analysis and assessment refers to the risks with negative sign. By treating these risks, the effect of approaching the limit of acceptability is achieved. Acceptability means a condition in which risk can be controlled, but with constant care. Conclusion: Negative risks control creates opportunities for applying the potential for positive risks. The lower the negative risk is, the greater is possibility for positively influencing the goals by using existing and new opportunities.

4. **preventing the occurrence of unwanted events that may be affected on**
The environment in which company exists and operates is a dynamic complex of phenomena. A few phenomena are unknown or the occurrence is unknown, but the other part are phenomena which causes are known. By controlling these causes it is possible to prevent or reduce the effects of adverse actions. Conclusion: Effective control of phenomena that generate negative risks, reduces the possibility of damage occurrence, and planned resources are directed to improving the situation.

5. **reducing the effects of adverse events that may not be affected on**
Occurrences that occur by accident or due to unfamiliarity with the environment are among those that generate negative risks. Treating such risks, or influencing their causes, creates the preconditions for taking advantage of positive risks. Conclusion: By proactively responding to random occurrences in the environment, the possible consequences are minimized. The funds retained in this case can be used to improve existing measures.

6. **building an adequate basis for decision making**
The decision-making platform is represented by crisis teams. A properly formed and trained crisis team will make rational and timely decisions. In most cases, crisis teams are formed to fulfill legal obligations, without adequate references. Conclusion: An adequate crisis team will have positive effects in the prevention process and will create optimal conditions for response. In such conditions, more resources will be devoted to developing and supporting the execution of the objectives.

7. **raising the level of readiness to respond to changed circumstances**
The overall capabilities of a company are based on human, technical and organizational factors. Adequate risk assessment identifies the real dangers for the company and develops capabilities for protection and rescue on these basis. Conclusion: a company that has complied with legal requirements, prepared planning documentation in accordance with regulations and professional principles, creates conditions for prevention and damages reduction. In such circumstances, a company can be devoted to identifying positive risks and improving the quality of business processes.

8. **opportunity using**
The overall risk management process should be focused on identifying opportunities and directing them towards the quality of business processes improving. The team of risk managers must be set and organized in such a way that they constantly and completely monitor all risks. This approach creates conditions for the crisis team to work, to develop a system of prevention and adequate response. Conclusion: By recognizing the opportunities, the crisis team prevents negative events and directs power to the business processes.
Given this, it is evident that the range of positive risks is wide. It is very difficult to monitor all risks and adequately assess them in real time. This is why systems are used to support decision making and prioritize risk treatment.

5. CONCLUSION

Risk is an uncertain event that, if it occurs, has a positive or negative impact on the project objectives. In everyday life, when we talk about risk, we usually mean on negative consequences. However, the risk has dual nature - on the one hand, it carries danger, and on the other hand it offers some opportunity, in one situation it can be an opponent and in the other an ally.

Investigating the area of project risk assessment reveals that equal attention must be paid to both negative and positive risks. Positive risk management increases the likelihood of positive events occurring and the potential benefit to the project. Positive risk response strategies should influence the drivers of risk (drivers of risk event and impact) and thus increase the chances or provide benefits for the project. This means that effective risk management focuses on the drivers of risk. In the event that risk drivers are eliminated, the chance for positive risk increases.

The need to manage positive risks is particularly important in the field of disaster risk reduction. As a rule, the effects of disasters have major consequences for people, material resources and the environment. In such circumstances, it is very important to recognize both types of circumstances, positive and negative, on time. By reducing the potential impact on negative events, the volume of positive circumstances increases and conditions for progress are created.

This paper recognizes the connection and need for research in the field of risk management and finds application in the field of disaster risk reduction. Future research should be focused on exploring the relationship between environmental influencing factors and finding optimal ways to monitor risks, treat existing ones, and identify new risks.

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EDUCATION IN THE CONTEXT OF SECURITY

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Abstract: Despite the fact that scientific and professional public deems that security has never been deliberated more than it has been in the 21st century, every period of time is marked by specific or yet same security issues that are addressed in accordance with the present achievements of a society. Security permeates all areas of social life, so it is necessary to consider the extent to which it is important to educate citizens about security and the type of knowledge that would be sufficient to make an individual feel safe in time he/she lives. Spreading knowledge on security and acknowledging the needs of a society becomes one of primary tasks of any country. However, developing and fostering security culture depends on available mechanisms that encourage broader population to accept education in the context of security as part of general culture. There are different ways to transfer knowledge of certain aspects of security to target groups and that is the reason why this paper analyzes different approaches and levels of education, i.e. teaching and training individuals to recognize security challenges, risks and threats in their environment and to address them appropriately.

Keywords: education, school system, learning, knowledge, security lecturers

1. INTRODUCTION

Learning process is a continuous and integral part of every person’s life. Starting from an early age, people imitate everyday elements in their environment, thus making their first steps toward accommodation. After mastering a primary stage of development, an individual continues to acquire formal knowledge through the process of education and gradually becomes prepared to enter the world of adults. Acquiring knowledge and skills at different levels of education is definitely not the end of the learning process. The quality of a person's future existence depends not only on formal knowledge, but also on informal knowledge acquired due to various work, national, social or other needs.

In the history of development of human society, first examples of security education involved defence of the territory and people living there, and acquisition of necessary war skills. Over time, the sphere of ensuring the survival and enabling stable living conditions has moved from the battlefield to other areas of social life. Today, the issue of peace, stability and sustainable development of humanity goes beyond doctrinal, strategic and tactical knowledge and skills, clearly emphasizing the necessity of a complex and interdisciplinary approach to providing response.

Traditional bearers of defense and public security are fully aware of the fact that security cannot be divided, and for this reason they are devoting their efforts not only to fulfilling their daily tasks, but also to cooperation and coordination with other relevant factors of society. On the way to creating an optimal level of well-being, the first step is related to education, and bearers of this activity usually do not belong to security structures. However, social stratification requires inclusion of certain types of education in all areas and at all levels. Placement of information, theoretical and practical teaching or training in establishing, maintaining and enhancing the stability of the social community involves many actors. This
may be a consequence of justified presence of different educational and upbringing models at a given time or insufficiently systematic approach in achieving a desired outcome.

All areas of human activity have a context of security, which means that it is necessary to find a way of spreading and acquiring that kind of knowledge in a modern society. Based on theoretical and empirical evidence presented in scientific literature, there is a clear correlation between education and security, especially in the field of prevention. This paper further shows a study of interdependence of two variables - education and security, traditional ways and contemporary trends regarding education in the context of security.

2. CORRELATION BETWEEN THE CONCEPT OF EDUCATION AND CONCEPT OF SECURITY

Historical retrospective shows that, if we neglect time when education was a privilege of the rich, we can notice a steadiness in learning and upbringing. People are always learning, particularly in a modern society. Owing to the mechanism of sanctioning, elementary levels of education and upbringing cannot be evaded. The question is not whether or not learning takes place - learning always takes place [10]. Upbringing is not something that may or may not happen, it is not a gift that the elder give to the younger, and may choose not to do it – it is a form of human existence [4]. Upbringing as differentia specifica of a man, is a biological necessity and is integrated in the society and culture that a man creates [4]. The fact that upbringing cannot be understood outside the context of culture is substantiated by the contents present in the educational systems, primarily in some social sciences, which are based on key transformations at the national and global level, embedding religious, political or ideological elements. Education in a wider cultural context is clearly reflected in the security sphere.

During the 19th century, unlike during the Age of Enlightenment when certain achievements were accessible only to certain classes, elements of learning about security and defense in particular were present at all social levels. Back at that time, main focus was on defending territory by military forces, which engaged all able-bodied male citizens. However, revolutions shifted the focus of existence towards the national, in an effort to raise the awareness of environment and all dangers therein. The period of predominantly national upbringing was aimed at developing a sense of belonging to a particular national community and establishing the attitude toward other nations, where „the sense of belonging to a national community implies awareness thereof, an emotional attachment to that community, and willingness to work on accomplishing national goals” [3]. The field of security has expanded and now, in addition to national upbringing occasionally confronted with cosmopolitan advocacy of life, education and training for the prevention of security challenges is present in all areas: from schools and city areas inhabited by groups with risky behavior (drug addiction, different types of crime, street robbery), over business environments, to the cyber space.

Schoenebeck's statement that educational thinking should be grounded in moral demands of the present, the demands of objective reality, and give the correct answer to the question of who stands on the side of life and who does not [10], can be applied to the purpose of education in the context of security. Unlike authors who believe that efforts should be directed to the acquisition of theoretical knowledge, because there is nothing more practical than good theory [11], others seek to focus on the real, actual practice of the school itself, on what people really do, on what really „is”, without which there can be no pedagogically effective "should" [4]. With theory being transferred into practice and practice pervading theory, security must inevitably integrate both types of knowledge.

Although the relationship between education and security may seem insufficiently strong, they are very much interrelated. Education should be a pivot of security because, according to some
authors, the education system contributes “not only to educating a required number of profiled experts, but also to spreading knowledge and attitudes, increasing interest, creating new capacities in a society” [8]. The relation between education and security is reflected primarily in: a) the preventive effect of education on the establishment, maintenance and promotion of security, and b) the effect of compromised security on the need to broaden and upgrade the knowledge acquired through various models of education. The two-way link is just another in a series of indicators that education and security are unavoidable aspects of human existence.

3. LEVELS OF SECURITY EDUCATION

“Knowledge is power” wrote Bacon in the New Organon at the beginning of the Modern period, and officially opened a large chapter of modern history in which science became a central force in community development - a main direction of its entire existence [1]. It may also be appropriate to recall Socrates' speech about “reliable knowledge which is knowledge for everyone” [12]. In the process of transferring knowledge to people, school is a basic instrument. However, according to some authors, certain notions like those conservative or cybernetic “cannot address the challenges of a modern school, as it is quite certain that the school of today cannot survive because it is already late enough in its own modernity.” [8].

Considering the fact that the education system is a main source of knowledge distribution, according to the criterion of acquiring formal security knowledge, there are following levels of education:
- elementary education, depending on strategic and national needs, elementary security knowledge is: a) addressed through related scientific disciplines depending on the content to which it relates; b) presented through optional teaching modules and/or c) contained by a separate subject;
- secondary education, depending on social and security needs, provides knowledge through: a) secondary school curricula aimed entirely at creating professional staff for the national security and/or defense system; b) secondary school curricula in which some courses relate to studying security in the process of production or provision of services, c) curricula of related scientific disciplines, d) optional teaching modules, and e) curriculum of a specific mandatory or optional course; and
- higher education, aimed at creating: a) profiled security experts with a particular level of academic studies, i.e. basic, vocational, master, specialist and doctoral; and b) highly educated staff in different scientific fields with elementary security knowledge acquired through studying of existing curriculum offered by higher educational institutions, studying of content of a required/elective course or optional teaching modules

Formal learning is learning with intention that takes place in educational institutions with lecturers qualified for a specific field [6]. What is required is that the institutional context of teaching, recognized in the education system, and learning, delivered through education, together make a real life context. However, some authors have realized that the school system provides “learning in didactic situations, which are most often based on the assumption that the school's task is to convey facts, principles and rules of action that must be learned, memorized and then applied. Teaching is not a two-way communication but one-way transmission of information” [4]. National education policy makers, when developing strategies for improving the quality of work of educational institutions, should take into account the broader global experience, especially that of developed countries with long tradition in developing this area [7].
In addition to the formal aspects of security knowledge, informal knowledge is also present in society. Informal knowledge is acquired through various workshops, courses and training curricula, which, according to expected outcomes, are classified as follows:

a) personal development, in order to acquire applicable knowledge and/or to fulfill the prescribed preconditions for work,

b) realization and preservation of national interests, where certain types of training cover the target population; and

c) training for situational response, in everyday life or work environment.

As with the acquisition of knowledge in other scientific fields, in the field of security, as a field of social sciences, there is an informal knowledge based on the spontaneous and unconscious experience of an individual gained while taking care of personal safety, protection of the lives of loved ones, their property and other.

Cvetković makes a distinction based on security science/studies differentiation: e.g. functionality-based security (industrial or energy security, information or cyber security, etc.) or context-based security (security at school, business, local community, etc.) [2]. Believing that “security science/studies are not only impracticable (pointless), but also meaningless if one does not know who, what and why is being protected or secured,” it could be concluded that “only through that knowledge, it is possible to reach the practical: how is someone/something protected (secured, safeguarded)” [2]. Therefore, “those who wish to become “professional security officers” must have knowledge of formerly established scientific disciplines, as well as knowledge and skills of newly established hybrid security science/studies that are combined with the skills of management studies”, i.e. “diverse knowledge in the interdisciplinary field of security science/study can be applied, or taken advantage of, through security planning (risk assessments), organizing and coordinating (risk analysis) and finally - managing (risk management) ”[2]. Security studies at higher educational institutions must meet certain criteria that security, as a field of research, places before educational institutions.

4. BEARERS OF EDUCATION IN THE CONTEXT OF SECURITY

Contrary to the traditional knowledge and skills that have survived to the present time due to social need and confirmation of their indispensability, scientific and technological findings produced new scientific disciplines which consequently produced modern age professions. What characterizes certain emerging professions is that they quickly replace one another, which can be explained by dynamic living conditions and a competitive environment or by a need for overcoming certain weaknesses. To set a profession on solid ground, it is necessary to consider its scientific justification, needs of the population at the local or global level and its final contribution, i.e. the work results.

So, the first step is acquirement of applicable knowledge in the field of security. It is important to note in advance that “there is no universal upbringing philosophy, policy, or educational program that suits all cultures and periods” [5]. The practice of constant learning and upgrading of knowledge has become deep-rooted, due to the need for personal development, nature of the workplace, struggling for survival in the business environment or ensuring existence. Therefore, it is important to identify and outline the ways of acquiring knowledge in the field of security. The basic way of acquiring knowledge certainly concerns the school system, while the business environment can at the same time be an environment in which to acquire new experiences and skills, but also to test and improve the knowledge acquired through the education system. Also, modern technologies enable independent access to a wide range of information and data. However, there is a question which educational model is optimal for creating necessary prerequisites for a more secure future.
First of all, it is necessary to take into account the objectives of education and upbringing, which should be future-oriented. The objectives of education and learning represent, first of all, the reference frameworks against which all educational activities are compared, evaluated and assessed [5]. Researches have shown that the value orientation of the society had decisive influence and effect on overall changes in the field of education [5]. Education, subject to the influence of value orientation, reflects not only national interests, but accepted global trends as well. However, it is also important that “educational goals are set with experience and serve as a means of directing that experience and dealing with practical life situations” [13].

Bearers of education in the field of security may also be considered in relation to educational goals which may be academic, professional and social. Security knowledge comes from educational institutions, state institutions, private agencies, humanitarian organizations and voluntary associations. The role of educational institutions, as key actors in transferring security knowledge, is reflected in:

a) providing epistemological responses to the establishment, maintenance and improvement of the optimal security status;

b) developing human resources capable of using the acquired knowledge for the benefit of humanity; and

c) raising awareness of the importance of safe living, in accordance with national strategic views and the level of social development.

State institutions responsible for preserving and promoting peace and stability, independently or in cooperation with other government authorities, influence the education of population on security with the aim of:

a) preventive acting based on the evaluation of knowledge of one's own profession;

b) responding to the needs of society due to the evident lack and absence of elementary knowledge about a particular security aspect;

c) fulfilling legal and technical conditions necessary for the functioning of any field of the social life; and

d) a reactive response to the consequences of security risks.

Private agencies that focus their work on teaching and training for implementation of practical knowledge in the field of security, supplements the work of educational institutions and state institutions by:

e) transferring experience acquired through work and

f) providing the level and type of knowledge necessary to satisfy basic, professional or business requirements.

Humanitarian organizations and voluntary associations have equal importance in educating population in the context of security, because they establish direct connection with citizens in a free, independent and active way. They contribute to spreading knowledge in the context of security by:

a) implementing different expertise and skills to the field of security and encouraging other members of the community to engage in humanitarian and voluntary work by giving a good example and proactive work,

b) joint activities with population to provide assistance to the vulnerable.

The family, as the primary nucleus of social structure, which is the first stage of adopting habits, attitudes and consciousness of safe living, must not be left out.

Which segment of acquiring security knowledge will the social community pay more attention to depends primarily on the risks it faces: natural disasters (floods, earthquakes, snow drifts and avalanches, storms, landslides and more), technical and technological disasters, armed
conflicts and the like. On the other hand, which bearer of security education will the community give priority depends on the level of development, social stability, current level of security and presence of security culture.

This characteristic of learning, as a lifelong process, is best reflected to the field of security. The interpretation that “education is by nature future-oriented, because it does not prepare a man so much for the existing society as for the emerging one” [5], must be viewed through its reflection to all areas of social life, because reality confronts us with the fact that learning about security arises from the risks whose reappearance should be prevented and the consequences that need to be remedied.

5. CONCLUSION

Many of conducted researches have found that the process of learning contributes to a person’s development on an intellectual, emotional and physical level. However, the adoption, sharing and fulfilment of scientific achievements takes a broader, i.e. global dimension. Contemporary states, well aware of the importance of education for their population, due to the lack of expected progress, are redesigning their educational curricula and modernising alternative education processes to respond to dynamic living conditions.

Learning is a human need, which an individual may or may not be aware of. Nevertheless, knowledge needs renewing and upgrading, which is a quality of every successful person and a necessity of the modern world. Therefore, apart from some secondary and higher educational institutions dedicated to preparing personnel for professions of importance for security and defense of the country, there are secondary vocational schools and colleges which have developed curricula dealing with establishment, maintenance and improvement of security aspects in carrying out production or service processes. In this overall process of transferring and acquiring knowledge, the formal concept must be shifted into everyday living conditions in order to become applicable.

Teaching trends in the field of security, including quick and short-term learning modalities are based on: a) a justified need and an acceptable initial solution, b) a need to establish and maintain standards in this area following the example of other countries, and/or c) a need to comply with strategic and normative-legal documents on the way of fulfilling the conditions for international integrations. The quick learning trends developed in different seminars, courses, modules or workshops must be continuous in terms of acquiring, applying, refreshing and upgrading knowledge by the trainees and/or listeners. Otherwise, all education processes in the context of security, with the exception of knowledge contained in education system, will be reduced to an alternative solution typical of a certain period of time.

Thus, it is quite reasonable to ask whether any response in the context of security is complete and conclusive and whether it can be, at all. Bearing in mind all the above arguments, it could be concluded that contemporary approaches should entail integrated and applicable knowledge from many social spheres responsible for giving response to both traditional and contemporary forms of security threats. Security knowledge contents that individuals acquire or will acquire are diverse and ask for a wide range of lecturers. By applying many different productive and useful forms of lectures in the course of education and fulfillment of prerequisites for security development, different lecturers contribute to a clearer observation of the correlation between the two variables analyzed in this paper.
REFERENCES

INCREASING RESILIENCE TO EMERGENCIES THROUGH THE STAFF TRAINING

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Abstract: Emergency staff training is one of the essential segments of emergency management preparation. Making quick decisions in a short timeframe and implementing them requires a certain degree of staffing and training. We believe that this can only be achieved through quality and systematic training of staff members. Through this paper, we will outline the possible structure of staff training, with the results of research conducted in a case study, the process of raising the level of training of municipalities emergency staff in the Vrbas River Basin.

Keywords: training, staff, management, structure

1. INTRODUCTION

Increasing resilience to emergencies is a complex and challenging work and requires a systematic approach to implementation. Decisions that must be made are made in adverse circumstances while, at the same time, an emergency generates obstacles to the quality of decision-making process. The functioning of the emergency management and command system has a number of specificities compared to the operation of traditional management systems. This requires a certain degree of readiness, competence and training of the management structure. The readiness of emergency staff is one of the essential segments of emergency management preparation, and this is where the training comes to the fore. Emergency preparedness of the staff can only be achieved through qualitative, pragmatic and, above all, systematic training. Designing, planning and delivering of training is a responsible process and must be pursued on a continuous basis. The choice of training methods and techniques depends on the goals and objectives and their effect can only be measured by reacting in a real situation.

2. TERMINOLOGICAL DETERMINATION OF THE TRAINING

In the theoretical and practical consideration of the term training, terminological confusion is sometimes present in the use of similar terms such as training, education, development and learning, and these terms are sometimes used synonymously. In terms of human resources management, as an extremely important segment of the management of the protection and rescue system, it is necessary to terminologically define these terms.

The importance of training has been extensively elaborated and documented [1] in terms of influencing the development of abilities, skills, knowledge, attitudes and behavior, which results in increased staff efficiency. Training is defined in various ways, starting with it being a “planned process of modifying attitudes, knowledge and skills through learning to increase efficiency” [2] to Sloman, who believes that training is “… an intervention to change the desired behavior employees through a process driven by the instructor and based on the content.” [3] McLeod and King consider the training to be "... activities, formal or informal, that help gain the knowledge and ability to perform the assigned work." [4] Basically, training produces the best results through hands-on experience because "what is heard is forgotten,
what is seen is remembered and what is done is understood. Because of this training must include a segment of the practical in itself. Training represents the process of acquiring specific knowledge, skills and competences to perform the current job and duties.

On the other hand, education is a broadly defined and generalized approach to knowledge dissemination. Therefore, education is most often defined as “an activity aimed at developing the abilities, knowledge, moral values and understanding required in all segments of life and not in specific areas”. [5] Unlike training, education, especially formal, refers to general knowledge and skills and is a basis for expanding competencies.

Some scholars consider learning holistically to include both education and training, and it is a process that leads to an increase in adaptability (Jensen, Shloman). [6] This is an ongoing process, not necessarily always planned, and can be understood as the core of human development.

The term development covers a wide range of activities that include both learning and training. This term emerges in the 1950s and although the term development is most commonly used in terms of training, it is not. The difference is that the training refers to the current activity or job and applies immediately while the development is designed and planned for future use, for the job or role in the future.

Garavan sees the distinction in the fact that the notion of learning is an umbrella term under which formal education and training go, while development is the result of the whole process. [7] Education is a formal form of knowledge acquisition, while training is the acquisition of knowledge through the performance of practical actions and procedures, and thus the acquisition of specific knowledge and skills.

3. SYSTEMATIC APPROACH TO TRAINING

Given that training is a systematic approach to enhancing knowledge and skills in order to increase workplace efficiency and perform the intended functions, in order to increase performance, training must aim at raising the level of competence, both individually and collectively has to be managed by plan.[8] It prepares the staff to respond properly in emergencies and situations that are not regular. Training also influences attitudinal change so that it must strive to create a synthesis between individual advancement and enhancement of competencies and promotion of organizational or system goals.

Training is a planning process and seeks to develop the individual's ability to successfully meet the requirements of the organization and, thus, implicitly, the overall performance of the organization. A systematic approach to training involves certain stages and processes and their integration. (Picture 1).

The first step is to identify the needs, that is, to identify both the deficiencies of the system and the target group, and assess the degree of their training. Training needs may be defined on the basis of the results of the evaluation of previous training programs, on the basis of the results of regular work, on the basis of needs due to the introduction of some new methods, systems or means into use, or on the basis of deficiencies observed in the actual situation.

Based on identified needs, training objectives and training tasks are defined. The objectives define what are the expected competencies upon training completion, within the training standards and training conditions, while the training tasks define the specific areas to be completed. The implementation of training tasks must be measurable in order to qualitatively evaluate training.
Planning and designing of the training is following. The training is planned in such a way that the training objectives are achieved through the training tasks and the training methods are selected on the basis of this. The training method is defined as a set of systematic procedures, activities, and techniques that are designed to have a direct impact on enhancing the capabilities of the training participants. Training methods include the following:

- individual training: mentoring, lectures, seminars, conferences, round tables, on-the-job training, independent training (e-learning),
- group / team training - syndicate work, project assignment, case studies, study trips,
- collective training (exercises): table top exercises, map exercises, command post exercises, computer assisted exercises, field training exercises.

Training methods selection depends on the training objectives and tasks and the resources available (material and human). This applies primarily to the following: learning modalities, the environment in which the training is conducted, the presence of the instructor, the proximity of the instructor, the degree of interaction, the cost of training and the time available.

Upon trainin completion, the quantitative and qualitative evaluation is carried out, with an assessment of the achievement of the training objectives and tasks. The results of the evaluation are taken into account when redefining and identifying the future training need.
4. EMERGENCY STAFF TRAINING

Successful emergency response and reduction of negative effects of emergencies on society as well as the development of resilience of society are realized, inter alia, through the development and raising of the emergency staff readiness level as an essential element of the protection and rescue system. Human resources are the most important capacity available to society and although technology and material resources have an impact on the functioning of the system, nothing is achieved without people. Training is a systematic approach to raising the capacity of emergency staffs through the development of both individual knowledge, abilities and attitudes, and through collective training and the development of team spirit, confidence and knowledge of internal procedures. Therefore, the effectiveness of the staff rests on the capabilities of its members. Personnel training is viewed through the human resource management process, which must have a clear and separate role and place in the protection and rescue system. The development of a protection and rescue system depends on the development of the individual capabilities of its members and those two processes are interdependent. Human nature is dynamic and therefore relevance and competence are imposed as a necessity.

The main objective of emergency staff training is to enhance capabilities, both individual and collective, by setting adequate goals and achieving them. [9] Approach to training must be systematic and holistic, and thus there is a need to design and plan training on that way. The training we are talking about is formal training and is aimed at achieving the goals of the protection and rescue system.

Below we will give a brief overview of the results of the survey, for some important issues related to the training of emergency staffs, conducted on a sample of 9 (nine) municipalities with the participation of 75 members of emergency staffs and representatives of first responders in the Vrbas River valley in the Republic of Srpska from November 2017 to December 2018. The survey was carried out as part of the project "Technical Assistance to Municipalities in the Vrbas River Valley to Improve Local Flood Defense Planning and Implementation”. The project involved enhancing the capacity and capability of emergency staffs and first responders through the training of their members and the evaluation and testing of flood response plans. The training methods used were individual through two seminars and practical collective through the implementation of a table top exercise. The objective of table top exercise, as the lowest and cheapest form of staff exercise, was to raise the level of the staff’s ability to respond in the event of a flood.

The achievement of this goal was envisaged through the realization of several tasks: introducing the staff members to their roles at the staff, creating synergies inside the staff, testing the elements of the flood response plans that the staffs, in the meantime, with the assistance of engaged consultants, realized during the project and finally providing complete documentation of the exercise plan to the staff as a useful tool for continuing their training. The exercises were carried out in the premises used by the staffs in their local communities with appropriate material resources.

The question “Have you participated in this type of exercise so far” (Chart 1) is answered as follows:
According to the respondents, very few staff members encountered this type of exercise, which is a relatively effective and inexpensive tool for staff training. Unfortunately, the situation is probably even worse, since exercises in smaller local communities are probably not planned or performed at all due to the lack of adequate personnel and lack of awareness of the need for them. In relation to this question, the question was asked "Are you familiar with the Flood Response Plan in your local community" (Chart 2) the participants' response was that almost a half of staff member was aware of the plan and that the other half was not even aware with a Flood Response Plan. With this in mind, the realization of the project has significantly helped to raise awareness of staff members, get acquainted with plans and participate in the exercise for the first time.

The following question was "Exercise made it possible to adequately test the elements of the Response and Evacuation Plan" (Chart 3). Based on the response, 77% of the participants stated that the exercise helped them to become familiar with the response plan, 19% partially agreed, which makes up the vast majority and indicated that the training greatly helped improve the headquarters situation. The answer to the following question “Exercise has improved understanding of my role and function in an emergency” (Chart 4) only confirmed the previous question where 66% of participants said they fully agree and 32% partially agree, which again makes up the absolute majority of participants in the exercise.

Finally, the answer to the question "Upon realization of the exercise I think that we are better prepared for the real situation" (Chart 5) the answer showed:
which means that 68% of participants completely agree with the statement that they now feel more prepared for the real situation both as individuals and as a staff, while 30% partially agree with this statement, which again makes the absolute majority. There was no disagreement with any of the previous statements, which means that the goal and tasks of the exercise of completeness have been achieved.

5. CONCLUSION

The organization of every country for the protection of citizens and property is a primary security and political issue, especially in emergencies. In order to increase the resilience of society to the impact of emergencies, complex and comprehensive measures are being taken. One of them is training of management and command structure which is a crucial element of the effectiveness of the protection and rescue system.

The results of the survey indicate progress in terms of the preparedness of emergency staffs to respond to the real situation upon training execution. In addition to getting acquainted with the plans, the realization of staff members interaction, in the future it is necessary to work on the development of awareness of the necessity of training, not only the staff, but also of the entire society in terms of preparation for emergency situations.

This process must be centrally managed and decentralized in execution for greater efficiency but flexibility too. The approach has to be systematic and the elements for creating the programme are offered in this paper.

With this in mind, the protection and rescue system should be encouraged to train and raise level of preparedness of its staffs in order to increase their efficiency and competence. Training increases efficiency, raises initiative and quality of job performance, and for a complete protection and rescue system to be improved, a systematic approach to training and ongoing training must be made obligatory.

REFERENCES


DOMINANCE OF THE NATO ALLIANCE AFTER THE COLD WAR

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Abstract: The practical application of post-war council arrangement (in favor of which declared main leaders of the anti-Hitler party during the common battle against the Axis powers and their allies) did not come to life in the period after the World War II. Instead of stability, peace and collaboration between the allies, the ideological division of the world came to light. There were no open battles so the conflict was called the cold war. The war about ideals, harsh politics and interests, created a new era-the world divided into blocks due to contradictory beliefs and different political goals when it comes to international issues. The rise of distrust between the dominant forces the USA and the USSR gives birth to confronted military alliances. NATO, as the winning side of the cold war, instead of dissolution, keeps on to tailor the destiny of many nations, takes the power over the world military-political scene, and consequences are still felt, even 30 years after the cold war.

Keywords: NATO, USSR, Cold war, dominance.

1. INTRODUCTION

Consequences of the NATO (North Atlantic Treaty Organization) domination after the Cold war and bipolar climate, which reigned almost half a century on the world scene, are felt even today. From this “war” NATO came out as a winner with the USA as the head of the alliance, which had military, political, and strategic dominance over the Warsaw pact, whose representative was the Union of Soviet Socialist Republics (USSR). By studying the history of these relations and the disruption of the balance which occurred after the dissolution of USSR, we can better understand the relations today. The current attempts these days, to shift the center of power are the exact consequences of the NATO dominance after the Cold war. Today, countries such as China and Russia are equal match to the USA along with the NATO alliance. These countries are tremendous opponents to the USA’s hegemony which leads to conflict situations and crises in places where interests confront.

Justification of the NATO dominance in the post-cold war period will be further explained through these arguments: First of all, the expansion of the NATO alliance outside its current boundaries, especially over the countries which were members of the Warsaw pact, creating the “arc” around the USSR, with special emphasis on introducing the American democracy into the countries of the former Warsaw pact; Second, causing wars and crisis in the world, starting with the aggression on Federal Republic Yugoslavia, by which, Washington showed
his allies and potential opponents its ability to legislate or violate laws without the approval of the Security Council of UN in any measure it takes to achieve its political goals. Finally, as the last argument of this paper, is the unbreakable bond between the Europe and NATO which is based on dependence of European community to the North Atlantic alliance. Dependence is noticed as early as in the 90s, when Europe was not able to prevent and to stop the civil war in the former Socialist Federal Republic of Yugoslavia, instead the help was asked from NATO alliance with the dominant influence of the American diplomacy.

2. NATO EXPANSION

Expansion of NATO "scope" into two cycles marked the second half of the 90s. The NATO expansion, beside the wars it waged against terrorism and extremism, was a process that marked NATO as a military force in the first years of the 21st century. Expansion is reflected, to a lesser extent, after the second round of expansion, which was expected, because the NATO expanded for seven members: Bulgaria, Estonia, Latvia, Lithuania, Romania, Slovakia, and Slovenia. Countries invited to NATO on the summit in Bucharest in April 2008, Croatia and Albania became the 27th and 28th members of NATO. The result of NATO expansion in the western Balkan region, apart from gaining new members, got NATO closer to east and southeast and gave the Allies larger strategic capabilities. The fact is that the expansion shifted the balance inside NATO itself, if such balance ever existed, between the USA and the "New Europe" in favor of the "Old Europe", which are the names that two separate groups in Europe started to use. Former members of the Warsaw pact are, today, new members of NATO alliance, and have a much more positive attitude towards the USA and are open to cooperation in many aspects.

The expansion of NATO alliance is considered successful if we assume that the bases of NATO reach further then the defensive reasons and using that, ensures its further survival. Current members and candidates use the wellbeing of the hegemonic camp, which is also known in the literature as the "Bandwagoning for the profit". Besides that, another benefit of the NATO expansion for the building of the unique European security is that the high level of institutionalization brings stability to the European continent, prevents conflicts, manages the crises, and the coordination of the international security politics. These benefits reach further beyond the geo-political reasons. Admitting the countries of middle Europe into NATO helped establish the democracy and the rule of law in said countries, especially through the reform of the civilian-military relations. Aspiration towards the membership of the Baltic countries and countries of southeast Europe accelerated and helped its stabilization. Indirectly, though significantly, membership in NATO offers a certain political security and investment into the member, helping their development. Capital that was brought to the new members feels safer, which is one of the reasons why the investment in said countries increased. Process of admitting new members into NATO and EU went almost parallel, but, EU required much bigger reforms in all aspects of society and economy were, so the EU membership would be acquired much later. None of the new candidates were made members of NATO without being admitted into the EU as well, so the membership of NATO was considered a test of capabilities before entering the EU. This was important evidence of the complementarity between the processes of NATO and EU expansion. NATO, apart from everything stated, shows the existence of the community of nations that share democratic values, act through consulting, make decisions together and want to expand the influence on other countries. The best illustration of the unbreakable bond between the EU and NATO is seen in the dependence of
Europe to NATO to solve the conflicts in western Balkan, which will be spoken of more in the following paragraphs.

When it comes to the third cycle of the NATO expansion, which was meant to be an evolutionary, logical continuation of the past two rounds of the expansion, being more of a technical process, whose strategic value wouldn’t be as vast, nor would it have any real geo-strategic implications. Area of the Western Balkan, which should have been targeted by the third cycle of the expansion, is surrounded by the NATO members. However, the geopolitical role of the NATO expansion into the region of the Western Balkan is not negligible. NATO, as an organization that tends to the security and stability of its members, and Europe as a whole, cannot allow the region of permanent instability in an area surrounded by its members. Geopolitical effects of this cycle of expansion would be of greater use to NATO, its members, and countries which won’t become the members in the future cycle of expansion, but are members of Partnership for the peace and must go through a long way of reforms and fulfilling the demands so that they can one day attempt to access NATO alliance. Membership of their neighbors in NATO would be an incentive on that road.

Apart from European countries, as an important base for NATO operations, partner countries who aren’t members of the Alliance, such as South Korea, Japan, Australia, and New Zealand were also included. The Euro-Atlantic web of security was, in the beginning, during the 90s, was based on developing through politics of partnership. NATO succeeded in securing a democratic transition for countries of east Europe by the western standards. At the beginning of the Partnership for the peace, Euro-Atlantic alliance for cooperation, later the Mediterranean dialog, and the Istanbul initiative for the cooperation programs, certain conditions were created for the regional, but expanded security cooperation. As an organization of collective security, NATO succeeded in establishing a thick web, which was capable to respond to the changing nature of the security threats, which suffered a lot of changes during the last century. With great efforts and investments, NATO remained as an alliance, adjusted to the newly found geopolitical situation and continues its growth. In the change goals, key role played the bombing of the Federal Republic of Yugoslavia, which was the basis for the legitimacy of acting without the support of the UN, and simultaneously, justified the need for the existence and demonstrated the vastly dominant power of the NATO alliance comparing to the all other potential military forces.

About the increase of the engagement of the NATO forces for the operations, which were unpredictable towards the end of the 20th century, testifies the help to the host of the Olympic Games in Athens in 2004, the transport of humanitarian aid to Pakistan and Louisiana in the middle of natural disasters crisis. Amongst these "ad hoc" missions should be mentioned the three Anti-Arab operations in the waters around the Horn of Africa and Aden's Bay (2008.) as well the operation ”Ocean Shield” in 2009. These anti-pirate missions were performed, and are now exercised as a support to the resolutions of the Council of security of the United Nations.

The expansion of the Alliance after the cold war, by finishing its third cycle, increased the membership of this military-political alliance, simultaneously leading NATO into regions in which it was never present before. NATO, in its first cycle, expanded its membership with 3 new members: Czech Republic, Hungary, and Poland, while in its second cycle with seven new members: Bulgaria, Estonia, Latvia, Lithuania, Romania, Slovakia, and Slovenia. After the third cycle of the expansion, Croatia joined the alliance, which helped NATO fortify its
position on the east coast of the Adriatic. That encompassed the growing unstable region of the Western Balkan, while the membership of Albania became an even more significant in the region of the Western Balkan. If Northern Macedonia was to be admitted to the alliance, the capabilities to solve the great security threats which marked the region to this day like Kosovo and Bosnia and Herzegovina would be even greater. Withal, we can claim that the membership of the countries with unstable political structures, like Northern Macedonia, has a great effect on the cohesion of the countries and in that way it secures peace. That illustrates the advantages of belonging to the dominant alliance like NATO and explains the desire of the small and unstable countries to be under the wing of the NATO alliance and at the same time, to expand the scope of their influence.

3. CAUSING WARS IN THE WORLD

The executive cadre of the NATO alliance towards the end of the 1960s and the beginning of 1970s, didn't question the priority of territorial defense, but from the documents and appearances of the members' officials and the representatives of the alliance itself, could be deducted that the strategic evaluation and idea are being adjusted to the current challenges and threats to security. During the 1980s and 1990s, the general idea of security would change, and the strategic concept of the Alliance from 1991 would make a significant change from the cold war role of NATO and direct it primarily towards the crisis management, peace operations, and humanitarian interventions. Even though the strategic concept of NATO from 1991 symbolized the biggest turn from the beginning of the Cold war, still in that document is emphasized that "No weapon of the alliance will ever be used except for the cause of self-defense". The next year, the "Wars of the Third Kind", on Balkan will require the engagement of the NATO forces beyond the scope of section 5 of Washington charter, without the preference of how would that be called: "crisis management", "respond to a crisis", "operation of the stabilization and peacekeeping operation" etc.

In the region of the Western Balkan, instead of the former Social Federal Republic of Yugoslavia, acting outside of the territory of the member countries of the alliance towards the conflict and bloodshed prevention, and later, in the establishment and preserving the peace in internal conflicts which followed the Yugoslavian Civil war, NATO found its new mission and identity. By changing its policy from the times of the Cold war, with the strategy focus on territorial defense, during the last decade of 20th century NATO grew into the political-security organization which adjusts its actions, resources and capabilities to the changing nature of security threats, facing all the new challenges, risks and threats, both global and regional.

Strategic concept of NATO, from 1999, going through a long period of transformations during the 90s, as a result had the decisions that will permanently change the geopolitical situation in the world. NATO officials had intentions to assert the dominance of the alliance in the European security boundaries 50 years after its creation in 1949 and to find new directions and goals for further development. The new strategic concept of the Alliance which was adopted in March of 1999, symbolized the continuation of the ongoing process of NATO transformation from 1991. North Atlantic alliance is still faced with unpredictable challenges that constantly threaten the members, or are occurring in the proximity of the Euro Atlantic region. According to the concept, there is no singular threat to the security of the members, instead, it speaks of an entire opus, primarily terrorism, sabotage, organized criminal and interruption of the vital resources or uncontrolled movement of a large number of people.
These challenges require a wider approach and a combination of military and civilian resources to be solved.

Strategic concept from 1999 made the ability of Alliance to act outside the frame of section 5 of the NATO treaty official. Apart from collective defense, guaranteed by section 5, NATO confirmed its readiness to carry out the activities unregulated by the said section. The decision to make the ability to act out of its original self-defensive scope official affected the bombing of the Federal Republic of Yugoslavia, in which members of NATO took part in, as well as the former activities that NATO carried out during the efforts to solve the conflict in Bosnia. Considering that NATO was now ready to act outside its primary scope, it was necessary to make plans that would help carry out the improvement of the military resources and capacities of the NATO members and members of the Partnership for Peace. It is noted earlier, also, during the conflicts in Bosnia and Herzegovina and Federal Republic of Yugoslavia, that Europe as a community, failed during the peace establishment on Balkan. European allies were secondary participants in the intervention because of numerous deficiencies in the equipment and technology and poor internal communication. A new and special initiative was foreseen for the defensive capacities development of the NATO members and for the candidates, a Plan of activities was created to help the countries gain membership in the alliance. During the meeting in Washington, NATO expanded its membership outside Western Europe for the first time. Three new countries, former members of the Warsaw pact were admitted into NATO - Hungary, Poland and Czech Republic. Alliance expanded towards the east and ultimately erased the boundaries that existed in Europe during the Cold war, which split the European continent into Eastern and Western Europe.

Aggression towards FR Yugoslavia presents the turning point in NATO’s strategy and politics. If we exclude the Alliance's aspirations for that part of Europe and the Balkan territory, as well as the wish to demonstrate to Russians how powerless they are while their fraternal country from Balkan is under attack, we can see an entire new political making era of NATO behind the aggression. The US, whose air force carried out 90 percent of the attacks on Yugoslavia and financed 90 percent of the cost of NATO aggression against Yugoslavia, entered the conflict with the intention to strengthen NATO and the leading role of the United States, not only among their allies but also with their main partners and potential rivals as such as China and Russia. The Washington Treaty, which is still a valid NATO document to this day, rests on the Seventh Chapter of the United Nations Charter and the Right of States to Collective Self-Defense. In this document’s preamble, the signatories to the Treaty reaffirm their belief in the objectives and principles of the United Nations Charter and they oblige to resolve all international disputes involving them, peacefully and in such a manner that will not endanger international peace and security while refraining from threatening and using force. The real goals of NATO at the time, in the early 1950s, were concisely defined by Churchill's military advisor and NATO's first secretary general, Lord Lionel Ismay, saying that NATO served to keep Americans in Europe, Russians out of Europe and Germans under control. [3]

The tendency of both domestic and foreign researchers to interpret NATO's war against the Federal Republic of Yugoslavia in 1999 as being waged solely by geopolitical motives nevertheless predicts the fact that for US administration, this war will mean much more than NATO's attempt to consolidate its military presence on the periphery of Russia, the Mediterranean, and The Middle East. The bombing of FR Yugoslavia was supposed to be a demonstration of Washington's ability to legislate or violate laws. Yugoslavia was declared a
criminal state, even though it did not violate international law. The old Kenan doctrine of deterrence gave way to the interventionism of American neo-conservatives. As early as 1992, the Carnegie Foundation published a report entitled "Change Our Way: America’s Role in the New World", which called for the introduction of a new principle in international relations, by which destroying or relocating groups of people within countries could be cause for international intervention, and both US and OSCE has been advised to adapt to this type of problem. Washington and Moscow, as well as other world capitals, were equally surprised by NATO's attack on Yugoslavia, as the attack was a warning that the US and NATO are ready to use force. As a result, these countries have revised their military doctrines and started modernizing their armed forces. Since Vladimir Putin came to power in Russia, this country has become a protector of the existing international order, counting on the support of its friends from Asia. Such as China, and all other countries that have felt threatened by the new American interventionism, and this, among other things, will lead to the creation of the so-called Shanghai groups as an attempt to counter US policy in Asia. The bombing of Yugoslavia caused Europe to doubt the intentions of the US. Those doubts were later confirmed in the attack on Iraq, and both Germany and France strongly condemned the process, creating a division into "old" and "new" Europe. In other words: between opponents and supporters of American neo-interventionism. Time will soon show that even after 1999, Kosovo has not lost its importance for the US in these disputes. [3]

In addition to the unlawful war against FR Yugoslavia, NATO has had a series of military interventions to demonstrate its superiority and dominance in the world. The aggression against Yugoslavia was followed by interventions in Afghanistan in 2001, Iraq in 2003, interventions against Libya in 2011, Ukraine in 2014, Yemen (2015) as well as Syria, which is still ongoing.

4. THE DEPENDENCE OF EUROPE – UNBREAKABLE LINK BETWEEN EUROPE AND NATO

One of the most adequate examples of European dependence on NATO is Europe's failure to maintain peace and resolve the crisis that has hit the countries of the Balkans. The Dayton Agreement comprehensively and vividly illustrates what the European Community's capabilities were at that moment, what are the failings and weaknesses of Europe and that it was not able to solve the challenges in the Balkans on its own. The Dayton Agreement is an act of the international system, and therefore a result of the circumstances and the spirit of the time in which it was created. The broader lessons and consequences of this act are that the European Union cannot fulfill its self-proclaimed task, which is to guarantee peace and stability throughout European soil. During the first international intervention in the post-Yugoslav wars, first of all, the war in Slovenia, the EU stated that "This is the moment of Europe, not America". It is Dayton that has become a symbol with quite the opposite message. It was, however, a moment for America, not Europe. It is true that the European intervention in the war between Yugoslavia and Slovenia in the summer 1991. was successful, it marked the war and enabled the subsequent peaceful transition of power in the newly independent state of Slovenia. Still, the failure is experienced in Croatia and then in Bosnia and Herzegovina. In the case of Bosnia and Herzegovina, it could be said to have aroused hostilities and contributed to its dissolution. Since the Dayton Agreement itself was signed in Paris and included prominent European representatives, it has failed to change the substance of the message about
US security and political domination. "Dayton is the pinnacle of unipolar moment politics". [4]

In addition, Dayton presents a slap in the face for Europe's ambitions to assume the leading role of a security guarantor in Europe. Instead of American and Soviet hegemony, which had previously cast a shadow over European institutions, Europe now saw itself as both the creator and the framework of collective security in this new order. Europe lived in the hope that America would leave them everything, including security functions, so that Europe could integrate in that sense. The post-Yugoslav wars, and especially the one in Bosnia and Herzegovina, showed all the shortcomings of then overly optimistic Europe and how truly dependent it was on NATO. The American return to Europe, or rather, the decision not to leave it, was further reinforced by Srebrenica, a tragedy in which the United Nations, or the Dutch soldiers, played an important role. After Srebrenica, it is difficult to challenge the need for additional and increased US security engagement. Dayton also shows that the issue of security, including wars, is still high on the agenda of international politics, despite the liberal optimism that considered security a de facto solved issue, due to the ideological dominance of liberal-democratic models and the proliferation of the European Union and NATO throughout Central and Eastern Europe. The democratization of countries in the region does not solve the problem of security. Moreover, in the case of the countries of the former SFRY, it could be argued that the very introduction of democracy, in the form in which it was carried out, led to instability which subsequently led to war. Such a democracy was not liberal and reformist, but conservative and sometimes revolutionary. The Dayton agreement, which was only possible because of the US decision to intervene in various ways, including through supporting Croatia in its implementation of the ‘Flash’ and ‘Storm’ actions, sent a message: when it comes to internal conflicts, and in particular those interethnic, which include emotions and threaten to turn a state into a field of chaos and violence, it is justified to intervene. The sovereignty of States, in this case, is of secondary importance, and can (if necessary) be neglected. [4]

5. CONCLUSION

NATO has repeatedly demonstrated its dominance on the political and strategic scene after the end of the Cold War, partly through diplomacy, and largely through the use of military and economic dominance over the former Warsaw Pact and non-Alliance countries. By its expansion, NATO has been able to strengthen its influence over a much larger territory since its inception. The democracy is inducted into the former socialist states and thus permanently removed those countries from their original center of power - the USSR, now Russia. By causing crises, as well as wars, by NATO, with or without the approval of the United Nations, the American sphere of influence enters the policies of crisis countries through military, economic, cultural and technical influence. Europe, as a pillar of history, culture and economy, has come closer to NATO in its doctrines and strategy, so much so that Europe is inseparable, and can be said to be a dependent alliance with the United States-led NATO. Through these three arguments, it is clear that NATO's dominance is not just a phrase used in political and geopolitical debates, but it really does exist. Although NATO, in co-operation with the European Union, is trying to maintain global hegemony, the growing military and economic power of Russia, China, and India, which are the biggest opponents of US hegemony, is a major obstacle. By opposing American hegemony, the world has entered a new phase with no clear tendencies in the division of interest zones, but certainly with the multipolar structure of international relations.
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Abstract: The article presents a necessity for the risk assessment based approach for new regulations and a set of controls for variety of services and drone usage in today’s uncontrolled part of class G urban airspace. The main subject is the consideration of risk factors related to human health and property damage during the usage of urban airspace areas for the purposes of various fields like logistics, search and rescue activities, photography, filming, recreational acts, and police and private security sector areas. Accordingly, we propose different regulatory and technical solutions for the modification of regulations as known today.

Future urban air traffic management with risk based route calculation considering a drone class, payload and the route is the foundation for safe usage of unmanned and autonomously flown aircrafts in urban areas. The market of unmanned aircraft vehicles together with humanly controlled aircraft vehicles is expanding drastically leading towards the need for reconsideration of existing regulations with the aim of providing feasible solutions to frame the small unmanned aircraft vehicles in the urban airspace safely.

Existing class G airspace definition is not supporting the unmanned aircraft vehicles traffic, due to classification of being an uncontrolled airspace. Furthermore, the unmanned aircraft vehicle traffic is not compatible with the existing features of a Visual flight rules (VFR).

As provided before, the class G airspace is not controlled. The implementation of surveillance radar systems in urban areas for the class G airspace is not a feasible proposal. The investigation of potential aviation accidents and incidents are challenging since the majority of aircrafts in class G airspace traffic does not offer the appropriate equipment onboard to record the flight data (FDR). The existing flight data recorders used in regular aircrafts are not suitable for small-unmanned aircraft systems (SUAS). Furthermore, the implementation of drone countermeasures is challenging due to the lack of basic flight information, like time and the route of a flight together with the identity of a UAS’s controller.

Since the presented issue is crucial for establishment of an effective Air Traffic Management System in urban areas, the postponements in reconsideration of existing regulations will result in delays of implementation of higher safety standard and effective drone countermeasures.

Keywords: national security, police and private security industry, search and rescue, urban air traffic management, small unmanned aircraft systems
1. INTRODUCTION

The Drones and unmanned aircrafts vehicles caught us unprepared. Increasing number of close calls and incidents related to the use of drones resulted in applied regulations, that are difficult to follow. In addition, those regulations are obstructing the development of new services based on unmanned aircraft vehicles or drones, autonomous flying and development of drones and drone based services for civil usage and the technology itself.

The latest EU achievement with regulations [1] applied, is similar to the FAA [2] approach and the error they made with the self-certification in process, which contributed to the 737 Max disasters.

It appears that the EASA is losing the confidence in FAA and demands additional validation and “self” testing of the aircrafts. This is especially valid in the case of grounded 737 max. We consider, this is the correct approach, which should be extended to a drone regulation, certification and classification as for the complete change of a class G airspace regulation. In the uncontrolled airspace, there are, instead of automated traffic control service, the air traffic advisory, that provide the required information to the pilots in control about other aircrafts nearby in the sense of recommendations and advise [3]. Any regulation also needs to be consolidated with national plans for emergency situations [4], [5].

This paper deals with some proposed challenges related to the use of class G air space in the cities and urban areas. It is not, by intention, the full implementation guide. It should raise the awareness for the forthcoming and rising problems.

2. OVERVIEW OF AUTONOMOUS FLIGHT REGULATION ISSUES

2.1 The need for efficient route calculation, execution and control

One of today’s challenges is the efficient usage of energy. This means to fly as short as needed, where, and when allowed. This can be disrupted in case of need and execution of avoidance manoeuvres as a result of using crowded and unregulated air space. Longer flight time means more energy wasted, more noise, risk generated, and less commodity. Time means money. Avoiding and recalculating routes away from preferred corridors results in greater risk because flying over manned terrain or other riskier areas that are away from predesigned and approved routes.

Route calculation should be performed based on various parameters:
- drone category,
- cargo list,
- vulnerability of the area below flown corridor and
- no-fly zones.

Effective controls could and should be implemented to allow a wide number of possibilities for energy consumption optimisation and safe flying below acceptable risk thresholds with adequate protection of life, nature, properties, assets, belongings and today’s very important asset - personal data.

2.2 Continuous auditing

The future system should enable collecting all relevant flight data including automatic and systematic checking against the flight plan and rules, aircraft, class limits, etc. We see continuous auditing as one of the best possible way of controlling the execution of defined set of controls to ensure the detection of deviations from flight plan and the acceptance of the risks related to the flight itself. Through collection of remote black box data, also continuous auditing of the aircraft’s state and maintenance is possible. This should lower the risks related
to the inappropriate aircraft usage and maintenance. Automatic messaging and alerting of the chosen recipients (i.e. state authorities) is possible and needed.

2.3 Airworthiness with according standardization and certification
Faulty and unapproved parts at aircraft risk mitigation. In connection with advanced motor and battery testing the UATM back office should trigger inventory data collection procedure before take-off. Collected log file should contain all relevant and demanded aircraft data. The collected data is to be compared against the back office stored data in the UATM.

Maintenance, maintenance log with actual aircraft data, reconciliation messaging, alerting and flight allowance retrieval should be possible.

2.4 Standards for aircraft part/components marking
Standardization of unmanned aircraft’s and drone’s parts and components such as batteries, motors, bearings, screws, electronics/controllers, blades/propellers, and frames is needed immediately. To markings for pure mechanical parts, where is needed and possible, only the visual marking standard is applied. For important parts which are more complex and important for the drones and smaller unmanned aircrafts in the class G airspace such as motors/electro motors, controllers, radio links, remote controllers, frame, propellers.

2.5 Electronic parts “marking”
An electronic serial number is provided for the aircraft inventory procedure and suitable visible markings such as laser imprint/laser engraving, QR or other readable markings. For the flight/flying most important elements/building blocks and components such as for example battery and motor not only electronic inventory but a set of current data and status should be provided together with the location of the aircraft back to the UATM back office. For non-electronic related parts of great importance for the flight and the flight safety such as aircraft frame or propeller, the marking procedure through RFID, laser imprint should to be considered. Additionally, a standard should be defined for which components are suitable to certain aircraft type or class.

2.6 Sensors vs predefined route flying - Time slot, route direction and height reservation
In the area of autonomous driving and flying, a big portion of existing traffic relies on aircraft sensors and collision avoidance through aircraft support systems - software routines. This should, for the purpose of the air traffic in the urban areas, shift to predesigned, predicted and calculated route allocation. It should transfer to the dedicated airspace and time, alerting all affected airspace users in the region in case of flight plan breaches. The sensor driven action step in only in case of increased detected risk for an incident or by Air Traffic Management (ATM) commandment for avoidance or commanded landing action. This will be the case especially in the urban areas - cities and if demanded in other regions.

2.7 Prerequisites
Prerequisites for construction of flight planning, safe flying, obstacle avoidance and planned or unplanned landing is a 3D cartography of urban terrain and sensors as a substitute for safer flying need to be established. In the urban area, a detailed 3D cartography (as vector cartography new/additional development) with all required data is needed, which is today mostly not available. Cartography should incorporate suitable safe landing zones and already known obstacle cartography. To achieve suitable quality of vectorised 3D cartography a development of simpler scanning and lightweight stereo vision for drones is demanded. Furthermore, appropriate back office support is needed together with a system and
infrastructure to control and follow the aircraft’s position with all relevant flight data. This type of a system will enable the communication between aircraft and infrastructure (and back office, ATM…) and aircraft to aircraft communication.

2.8 Landing sites development (classification and standardization)

Common to all types is development and classification of suitable technology setup and charted landing sites with suitable power supply, safety and security features including from and against domestic and wild animals.

One of the potential development direction is a video surveillance CCTV/TCP-IP camera system for the landing site with video detection and integration into the back office. For safety concerns, the automatic fire suppression system in terms of water and foam availability or connection to water or sand supply subproject with fire brigade for the development of effective unmanned or manned aircraft fire suppression in the urban areas can be proposed.

Among the potential threats in this area, two are pointed out:
- burning LiPo or similar chemistry batteries, fuel or cargo and
- Landing goes wrong, due to various reasons like strong wind, abrupt weather change, heavy rain, battery cell’s abrupt failing etc.

Another potential development direction is the possibility for mounting hazard sirens on each landing site as well as using general or inventing a new sound warning for potential emergency or crash landings of a drone.

2.9 Landing site ETA calculation

The back office function providing out of flight log data and the current situation (ETA) for the recipient to collect cargo at the chosen or redirected and confirmed landing site. ETA is (re)calculated on the basis of:
- Flight plan execution,
- Previous deliveries (if any),
- Known limitations for the class G airspace such as weather conditions, airspace status etc.

According to this proposal, the same technology (module) can be adopted for the 2D traffic movement (streets).

2.10 Landing and take-off sites

Under this section, we understand the development of emergency and normal landing sites. Development of suitable technology setup and charted landing sites with suitable power supply; safety and security including from domestic and wild animals, video surveillance and the ease of accessibility and noise acceptance. Developing classification standard for landing site categorization.

2.11 Visual marking of landing sites development

Development of suitable technology setup and setting the standard for landing sites (i.e. visual markings according to the landing site categorization with suitable QR code setup) for safe landing of multiple smaller or at least one bigger aircraft in accordance to presumably vertical take-off and landing. Visual marking should locate the aircraft to the free landing micro location using video detection/recognition and using back office data.

2.12 Crash landing sites in addition to emergency landing sites

Development of suitable technology setup (and carto graphed) crash landing sites (for example with crash falling/collection “fish” net, automatic fire extinguisher, alarming). Development
and testing of the technologies and procedures, incorporating the chosen procedures in to a back office covered process.

2.13. Weather stations network

Part of the infrastructure will be network of weather stations providing detailed and on line data about weather conditions (as part of a Smart City infrastructure). This data will be available to the ATM and the service providers using unmanned aircrafts. Since weather, especially wind (shear, crosswinds, updraft and downdraft) is very important factor for safe flying of unmanned or manned aircrafts near to the ground. Out of the weather stations network generated warning, some classes of aircrafts will receive warning or command to land including the information about take of options, that can be delayed or cancelled.

2.14. Entering no fly zones (flight oversight)

In case of breaching predesigned and confirmed route – flight plan and entering a no fly zone or protected air space, not following the predesigned flight route, an automated alarm will be generated. The alarm will be sent to a (pre)defined list of recipients. Ignoring (U)ATM (manual or automated) commanded avoidance or commanded landing action, will provide all needed data of the aircraft/drone, cargo, and at need trigger the use of drone countermeasures systems (water cannons, electronic countermeasures – jamming devices…) or (usually – more common) enabling the possibility for issuing warnings, penalties, retrieving flight allowance, etc.

2.16. Using class G airspace in cities

Unlicensed and rules noncompliant use, that being the usage without being licensed and equipped with suitable beacon/transponder/ (ADS-B+) as one of the options) and/or alternative send out of relevant data of class G urban airspace should be prohibited. Similar to the long range radar purpose, the challenges for the coverage of the urban area (and the class G airspace) are similar and influenced with flying at low altitudes (i.e. airspace between ground terrain and the set limit for the class G airspace, aircrafts flying between obstacles and not only over them) with many obstacles like buildings, trees, terrain etc. in the urban area the reasons that the microwave radar is not suitable tool for unmanned aircraft flight control and oversight to cover the urban area with classic ground radar surveillance systems. It is more appropriate to request a mandatory communication of the current aircraft location to the back office (similar to the long range radar based on beacon – transponder).

Even in a distant future, we cannot expect that the usage of airspace unmanned aircrafts will be taken out completely without accidents. It is to be expected that the number of incidents as the accidents will rise with the number of flights and registered/used unmanned aircrafts). These type of aircrafts are not suitable to be equipped with flight data recorders as known today and widely used in the aircraft industry. For example, the usage of LiPo batteries rises the risk of fire and the terminal destruction of complete avionics and the electronics in case of malfunction and/or crash. A mandatory send-out of the required set of the data to the back office remote black box is needed. The remote black box or remote flight recorder is essential to provide all needed data for the flight accident investigations. The option to keep parallel the data in the aircraft in the agreed format and medium is decision of the aircraft designer), business decision.

2.17. Maintenance support

Through flight tracking system and log book many relevant flight data and through the remote black box functionality for maintenance of the aircraft will be collected. Using flight data such as hours under recorded conditions, hours for specific components of the aircraft and some
additional special and innovative internal controls built into the aircraft, we can influence and/or trigger predictive and proactive maintenance instead preventive and especial breakdown maintenance. We can also control whether the maintenance was performed according to the scheduled or triggered task. These controls are intended to lower the risks on all important aircrafts with suggestion to demand smart and controllable batteries to avoid flying with bad or unsuitable batteries (this also could be the case as at the Garuda Indonesia Flight 421). Batteries for example should record number of charge/discharge cycles – the conditions of use, special battery test before take-off should detect bad cells, worn out batteries, rising internal resistance and/or falling capacity. Similar procedures are usable also on other transportation vehicles powered by electricity/batteries, for example maritime, land transport and other mission critical applications.

2.18. Connected class G airspace aircraft (and flight tracking system)

Development of new services can lead to crowded skies in urban areas in the near or distant future. Only “connected” aircraft can send out on one side all relevant data to the back office and the flight tracking system and receive the responsible person/company - service provider and/or other message(s) during the commanded or autonomic flight. Only through connected networks such as 3G, 4G, 5G, Wi-Fi, and/or DMR for the aircraft a true interaction is possible and feasible. To ensure complete communication possibilities such as aircraft to aircraft and aircraft to infrastructure a unified infrastructure and standardisation is demanded.

Only supervised and controlled environment ensure acceptable risk and with the same rules for all ensures equal possibilities, fair competition and, if decided, reimbursement for occupying the sky and generating noise (or other pollution) in urban areas.

Similar is applicable for autonomous vehicles on the ground. Storing vehicle and possible accident data at service provider back-office can lead to hiding relevant data in front of officials/official investigation etc., no unified set of data defined and/or ensured for incident/accident investigation.

2.19. Commanded grounding to predefined emergency landing zone vs remote controlled flight

During the flight allowance request the process should implement exchanging of digital signatures (for example X509 certificates). During receiving flight (take off) allowance all possible landing points (zones) and their approach along the flight route should be predefined and stored in the aircraft flight plan. In case of emergency triggered around the status of the unmanned aircraft, abrupt weather changes or received NOTAM message from flight control thru the back office or even direct, unmanned aircraft chooses nearest predefined emergency landing zone and notifies the air traffic control through the back office or air traffic control commands the unmanned or manned aircraft to land on one of the landing zones. The aircraft confirms and replies with the chosen landing zone and successful landing. In addition, the process should cover new take-off in case of extended take off allowance from emergency landing zone or collection from the service provider. Unsupervised/uncontrolled flight rises a risk in case of other class G airspace priorities. Shifting responsibility away from ATM to the unmanned aircraft operators and not providing better (less riskier) procedures, banning or overcomplicating the flight allowance procedures is not helping anyone (not the industry, development of new services etc.

2.20. Remote controlled flight

During the procedure of announcing flight (flight allowance request) digital signatures (for example X509 certificates) are exchanged. This allows as mechanism (opens) the possibility
(if needed and allowed) to take over the flight controls. Additional controls should be implemented for risk mitigation!

2.21. Pay as you fly

Using the class G air space in the urban areas and the cities can be free of charge or charged. Charged flight can be flat fee and the fairest solution would be pay as you fly. Service providers which use class G airspace and the infrastructure of the city should pay for using it. Part of the fee can be fixed such as annual registration, part of it can be related to the pollution and engine type used in the aircraft, purpose/cargo/classification of the aircraft and some for the infrastructure using/supporting the operations.

Pay as you fly can and should be important factor for insurance companies. Not only data of location and duration the aircraft, but also the complete history from the black box can be used as input for insurance calculation.

Using the class G air space in the urban areas and the cities and in some special case should be additional oversight and the data collected thru other system such as automatic audio and video detection, data compared with the data from the UATM. In case of rising risk systems such as automatic drone countermeasures should be triggered.

Using the class G air space in the urban areas and the cities should be controlled and supervised. In to the UATM build controls should be extended with additional controls (i.e. systems) to detect as much flying (in the urban area) without sending out the wrong flight data or flight data at all. Data collected thru other (enforcement) systems such as automatic audio and video detection, thermal vision, microwave radar etc. will being send-out to the UATM and compared with the data from the UATM. In case of risk being detected over the set threshold an alerting, alarming and/or automatic drone countermeasures should be triggered.

CONCLUSIONS

On us is to act now, and to act wisely. It will be easier to guide in suitable regulations and solutions’ as soon as possible (now). Otherwise, we will have to take later a longer and more painful process followed by intermediate period with drones and autonomy aircrafts flown by todays (unsuitable) rules generating unnecessary risks in class G airspace over urban areas.

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1. It is now an established fact that the phenomenon of uncontrolled and massive mass immigration of illegal immigrants (not identifiable because they are intentionally devoid of identity documents) coming largely from the African continent - more from West Africa than from East Africa - through Libya, without every "title" to ask for political asylum or any other form of "international protection" is aimed at politically, socially and economically destabilizing the European continent and in particular Italy, given its geographical location with respect to Libya.

This phenomenon wanted and sponsored above all by Germany and France (it is the latter that favours the entry and crossing of Libya to its Mediterranean coast of people of West Africa), who demand a now unrealistic and blackmailing fulfilment of the Regulation of the European Union "Dublin III", finds its operational "ways" in criminal agreements between the so-called "smugglers" and NGOs.

These criminal agreements have been confirmed in police investigations and in legal proceedings. All incidents of prohibited, and therefore illegitimate, landings in Italy have confirmed two fundamental aspects: they are not shipwrecked persons for whom there is an obligation to rescue independently of international conventions or provisions of national law; moreover, the criminal agreements between "smugglers" and NGOs are in the sense that landings must take place only in Italy.

The recent case of the "Sea Watch 3" is emblematic: the ship flying the Dutch flag and owned by a German NGO, first remained 13 days at sea (and therefore being able to reach any other port in Malta, Tunisia, France, Spain, Algeria and of the same Netherlands and Germany), and then entered the Italian port of Lampedusa by force, ramming a military patrol boat of the Italian Guardia di Finanza and endangering the lives of the crew members.

2. What was briefly described above as an introduction, makes it clear that the phenomenon of the current mass immigration - which claims to be unlimited and uncontrolled - in violation of any norm of general and conventional international law, as well as in violation of the internal laws of the State, is clearly representative of a general and preordained criminal project aimed at the destabilization and destruction of the destination States of illegal immigrants (the so-called "migrants").

A project that if not preordained aimed at a result of partial “ethnic substitution”, is deliberately aimed at compromising the public order of the State: the growing and exponential increase in the crimes (even particularly fierce) committed by the so-called “migrants” finds confirmation in the surveys statistics of different destination States and especially in Italy.

3. On the level of alteration of the internal public order of the State there is an even more serious aspect which compromises the security of all the States of destination of illegal immigrants.

In the mass of uncontrolled and uncontrollable "migrants", because their generality, the places of actual origin and every other cognitive element is ignored, there are many with a past made
up of terrorist activities in the Middle East or in other States of the European Union, or others who are potential terrorists for religious or other radicalism.

The threat that these elements represent for the security of each State and of the entire European Region, from East to West, from South to North, is therefore evident.

And this without speaking of the inevitable inter-ethnic conflicts that are increasingly, and always with greater violence and gravity, exploding within States with a greater presence of immigrants; ethnic conflicts that testify to the impossibility of their effective integration and, on the contrary, the claim that host societies must adapt to totally different and extraneous "cultures", customs, traditions, religions, etc.

4. No less devastating are the effects, also desired and preordained, of mass immigration on the economy and on the "welfare State": the "chinesization" of the labour "market" will see an unstoppable process of precarization of labour relations and of lowering of wages to which even citizens of the State, of any State of settlement of irregular immigrants, will be forced to adapt to the inevitable offer (and acceptance) of lower wages.

All this for the benefit of robbery capitalism and faceless finance, which are the final beneficiaries of the pre-ordained phenomenon of mass migration, in addition to the "intermediate" beneficiaries: smugglers, NGOs, managers of the so-called "reception centers", etc.

The consequence on the social level will be the progressive loss of rights, providences and providence hard-won by the working classes, as has already largely happened.

The final and conclusive outcome will be the dismantling of the "welfare state", of every measure of defense and social protection in terms of social security and welfare, and above all, as regards health care, destined to become the privilege of those few who will be able to access it by facing the high costs.

5. These are the brief, essential considerations (and warnings, if one is still in time to put an end to the phenomenon in question) that can be carried out on the subject and which must be explained clearly and without any pretence or justification of fake "do-goodism" or respect to religious precepts of "Western" expression as non-existent as falsely (and deliberately) represented also by the highest religious offices of Catholic Christianity.

Any silence or hypocrisy is complicity.

The State and the social community that lives in it must be defended.

Beyond the necessary and preliminary assessment whether the persons who are obliged to be rescued at sea are truly or not "shipwrecked" (or "shipwrecked on payment"), there is that the international conventions on which we speak, that is the United Nations Convention on the right of the sea signed in Montego Bay in 1982, the Convention of the International Maritime Organization for the safety of life at sea, and the Convention on the search and rescue maritime of Hamburg of 1974, are Conventions that are no longer pertinent since, in addition to being very dating back over time, they have regard to situations of "normality" with regard to the obligation, procedures, times and methods of rescuing at sea.

Today there are situations of exceptional emergency, radically different and preordained, of mass immigration which certainly cannot cope with the provisions of the aforementioned international conventions.
DIGITAL FOOTPRINT OF USERS ON REGIONAL WEBSITES

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Abstract: The average web browser user on average stays for 6 minutes and 58 seconds per website in the top 50 most popular websites in Serbia. In this research we found out about how much average users share their information when they load a regional website with companies that are not affiliated with the company that is offering the website. The purpose of this research is to raise awareness of the average user that, when they load a homepage, they share a certain amount of information with companies that are not from our region. One of the key aspects of this research paper is suggested measures to protect the privacy of users on the internet. The research used the normative method, the legally logical method of induction and deduction, as well as the statistical method. This paper is the part of research project No. 47009 (European integrations and social-economic changes of the economy of Serbia on the road towards the EU), financed by the Ministry of Education, Science and Technology of the Republic of Serbia.

Keywords: Privacy, tracking, law, “cookies”, security

1. INTRODUCTION

The Internet has recently become very interesting for collecting large amounts of data. A new trend has emerged in the business that focuses on gathering as much user information as possible, selling that same information to other companies as well as predicting customer interest.

1.1. Data and their importance

Data is a set of facts such as words, numbers, measurements, observations, etc. which are forwarded to the computer in that form so that the computer can process that information. In the areas of business and informatics, data refers to the information that a computer can process instead of the data the user uses.

User information, also called non-structured information, is information that only a person can understand and process, such as images or the importance of text. If the data requires a person to process the data in part, then it represents the data for the users.

Computer data, also called structured data, refers to information that a computer program can process. The term program is a computer set of instructions for processing data. Using the aforementioned set of instructions over the data, we get software. [6]
a. **Personal data**

Personal information is information that pertains specifically to one user. This information includes various things such as user location, IP address, e-mail address, and various other factors that affect user identification.

The vast majority of companies that have websites collect personal information about visitors i.e. site users. If users want more features when using the site, they must register by filling out an application form that is asking for personal information. It often happens that when companies receive such information, that information is later used to personalize the content of the site.

Another way of using personal data is to group all the data and then sell it to other companies [9] for further processing of the data or for targeted advertising to the user [6]. This is especially important in terms of legal protection of personal data. In this regard, there is a significant affair with Facebook and Cambridge analytics, where there has been a drastic misuse of personal data. Given the scandal surrounding Cambridge Analytics and the great scandal surrounding the misuse of personal data from citizens around the world, there is a need for a more thorough analysis of EU data protection regulations. This is quite justified, given the extremely negative consequences that have arisen or may arise from the misuse of personal data of citizens. With the advent of social networks (Facebook, Twitter, Myspace, etc.), there was a large concentration of vast amounts of personal data in one place and thus opened the door to possible abuse. This is also due to the rather high degree of trust that social network users have shown to companies, believing that the security of their personal information is fully ensured. Thanks to this attitude (which was not entirely without foundation), users were leaving different types of information and posting (often) photos of "sensitive" content on social networks, all with the aim of obtaining as many friends and increasing their own attractiveness on the Internet. In that endeavor, they often forget about the danger of having their personal information available to a large number of users. Social networks are tempting especially because users are able to manage the type of content that they post themselves, with the ability to remove information that might diminish their projected social representation. The fact that data on networks are often stored for an indefinite period of time should not be overlooked, which opens up room for manipulation. [3] Therefore, when analyzing the digital footprint of users on domestic and foreign sites, the application of regulations (both domestic and European) is inevitable. However, practice has shown that the application of these regulations, in particular the General Regulation on the protection of individuals with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (General Data Protection Regulation) -GDPR Regulation-, sometimes problematic, especially since the said Regulation applies outside the Union. In the future, further development of regulations regarding the protection of personal data can certainly be expected.

b. **Transactional data**

Transactional data is data that requires a user to take some action to be able to collect such data. For example, a user can make an online purchase, at which point a transaction table is created. This table contains customer and product information as well as the date of purchase that is stored in the database. [2]
Table 1: An example of a transaction table

<table>
<thead>
<tr>
<th>Sale ID</th>
<th>Product ID</th>
<th>Customer ID</th>
<th>Sale price</th>
<th>Sale time</th>
</tr>
</thead>
<tbody>
<tr>
<td>0001</td>
<td>1982SP</td>
<td>67</td>
<td>56.99</td>
<td>2/1/2019 16:36:55</td>
</tr>
<tr>
<td>0002</td>
<td>454YH</td>
<td>67</td>
<td>65.99</td>
<td>2/1/2019 16:37:08</td>
</tr>
<tr>
<td>0003</td>
<td>454YH</td>
<td>68</td>
<td>70.99</td>
<td>8/7/2019 13:22:43</td>
</tr>
</tbody>
</table>

Transactional data is very important for the company for the reason that such information helps them in making decisions in order to provide better services. Processing such data can lead to some correlation that was not previously apparent. [6]

c. Internet data

Internet data consists of all data that is publicly available on sites. [6] Overall, such data is delivered to the user via the site by some predefined standards. For a particular type of data set, different types of organizations set those standards. This data is very important for several reasons, such as: better understanding of the user for a given dataset, automatic processing and manipulation of a dataset by a computer, easier retrieval of data in a given dataset, greater chances of reusing the dataset, trust: consumer confidence have in a given dataset will be improved, the link between the dataset, users and computers have access to an up-to-date dataset in various forms and presenting the dataset in an agreed manner for better management. [13]

2. „COOKIES“

To make the term "Cookies" clearer, we first need to clarify how websites work.

2.1 HTTP protocol

HTTP (The Hypertext Transfer Protocol) is a protocol that allows resources to be collected, such as HTML documents (Figure 1).
In this way, when a user wants to load a website, he sends a request through an internet browser, also called a client, and receives all the necessary information from the server to view the website. The client and server communicate by sending "messages". Messages sent by the client are called requests, while messages sent by the server are called responses. Since every new request from the same connection has no connection to the previous request, the HTTP protocol can be considered as a stateless protocol without being able to remember previously requested information. [10] This protocol facilitates the construction and management of internet browsers and servers.

However, there is one problem here. Namely, if a user wants to buy a product from a site, without some additional mechanisms this will not be possible, because, as already mentioned, the HTTP protocol does not have the ability to remember previous requests. One solution is to use “Cookies”.

2.2 Definition “Cookies”

The cookies were first mentioned in 1994 and made by twenty-four-year-old programmer Lou Montulli. [8] The name "Cookie" derives from the term "Magic cookie" used in Unix operating systems to transmit small amounts of information between programs and thus enable the operation to be performed. [12] Today, cookies represent a small amount of information packed into small files stored on a user's computer (Figure 2). They can be accessed by the client and the server. [14]

Figure 2: Chrome DevTools – list of cookies when you visit the site blic.rs

By using cookies, it is possible for websites to recognize whether a user has previously visited the site, what page settings have been saved, what products the user has placed in the cart, whether the user has previously logged in to the site, and more. [10] This was the original purpose of cookies, where they were intended to make it easier for the user to use the website. They were tasked with restoring the user to the previous state of the website after their browsing session ends.

However, cookies have long gone beyond their original purpose by being used for many more things today. Cookies are used today by companies that collect large amounts of data. Specifically, companies collect various user information. Some of this information may be user retention time on the site and which pages the user visits all in order to display information that is customized for that user. [11]
2.3 The types of cookies

Generally, cookies are split into session cookies and persistent cookies. Session cookies are stored on your computer only for as long as the active session, as long as the user has been using that website. Permanent cookies are kept much longer than session cookies, i.e. they have the exact date for how long they are valid. [7]

2.3.1 Session cookies

This type of cookie helps the website remember the user when he wants to add the product to a cart or perform any other action on the site as well as share the user's IP address.[7]

2.3.2 Permanent cookies

The life span of these cookies is very long. They even remain when the session is over. Permanent cookies are used by websites to save settings during the next visit. [7]

3. TOOLS FOR BLOCKING UNWANTED COOKIES

uBlock Origin is an "Open-source" add-on for the internet browsers, which in the default configuration, is used to block ads, domains for tracking users and malicious websites by using an "Open-source" filter lists. [5]

Privacy Badger is also an "Open-source" add-on for the internet browsers that blocks domain tracking for users by placing a "Do Not Track" signal in the HTTP header. If this request is ignored, then it switches to another mechanism whose domain will be blocked if same tracking domain is seen on three different sites. [4]

Table 2: Effectiveness of stopping unwanted cookies

<table>
<thead>
<tr>
<th>Site name</th>
<th>„Alexa rank“ [1]</th>
<th>The number of cookies after the third load of the site</th>
<th>The number of cookies with „Privacy Badger“</th>
<th>%</th>
<th>The number of cookies with „uBlock Origin“ and „Privacy Badger“</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blic.rs</td>
<td>5</td>
<td>63</td>
<td>30</td>
<td>52.38</td>
<td>21</td>
<td>66.67</td>
</tr>
<tr>
<td>Kurir.rs</td>
<td>6</td>
<td>33</td>
<td>19</td>
<td>42.42</td>
<td>16</td>
<td>51.52</td>
</tr>
<tr>
<td>Kupujemprodajem.com</td>
<td>10</td>
<td>28</td>
<td>6</td>
<td>78.57</td>
<td>5</td>
<td>82.14</td>
</tr>
<tr>
<td>B92.net</td>
<td>12</td>
<td>42</td>
<td>32</td>
<td>23.81</td>
<td>13</td>
<td>69.05</td>
</tr>
<tr>
<td>Polovniautomobili.com</td>
<td>13</td>
<td>43</td>
<td>26</td>
<td>39.53</td>
<td>12</td>
<td>72.09</td>
</tr>
<tr>
<td>Alo.rs</td>
<td>19</td>
<td>81</td>
<td>29</td>
<td>64.20</td>
<td>14</td>
<td>82.72</td>
</tr>
<tr>
<td>Telegraf.rs</td>
<td>20</td>
<td>37</td>
<td>24</td>
<td>35.14</td>
<td>16</td>
<td>56.76</td>
</tr>
<tr>
<td>Oktopod.rs</td>
<td>22</td>
<td>29</td>
<td>18</td>
<td>37.93</td>
<td>14</td>
<td>51.72</td>
</tr>
<tr>
<td>Srbijadanas.com</td>
<td>23</td>
<td>34</td>
<td>20</td>
<td>41.18</td>
<td>14</td>
<td>58.82</td>
</tr>
<tr>
<td>N1info.com</td>
<td>26</td>
<td>30</td>
<td>24</td>
<td>20.00</td>
<td>21</td>
<td>30.00</td>
</tr>
<tr>
<td>Espreso.rs</td>
<td>28</td>
<td>36</td>
<td>31</td>
<td>13.89</td>
<td>26</td>
<td>27.78</td>
</tr>
<tr>
<td>Novosti.rs</td>
<td>31</td>
<td>108</td>
<td>15</td>
<td>86.11</td>
<td>8</td>
<td>92.59</td>
</tr>
<tr>
<td>Halooglasni.com</td>
<td>32</td>
<td>52</td>
<td>45</td>
<td>13.46</td>
<td>16</td>
<td>69.23</td>
</tr>
<tr>
<td>Informer.rs</td>
<td>34</td>
<td>42</td>
<td>8</td>
<td>80.95</td>
<td>5</td>
<td>88.10</td>
</tr>
<tr>
<td>Gledalica.com</td>
<td>36</td>
<td>6</td>
<td>6</td>
<td>0.00</td>
<td>6</td>
<td>0.00</td>
</tr>
<tr>
<td>Titlovi.com</td>
<td>37</td>
<td>43</td>
<td>17</td>
<td>60.47</td>
<td>17</td>
<td>60.47</td>
</tr>
<tr>
<td>Navidiku.rs</td>
<td>40</td>
<td>20</td>
<td>14</td>
<td>30.00</td>
<td>12</td>
<td>40.00</td>
</tr>
<tr>
<td>Mondo.rs</td>
<td>43</td>
<td>74</td>
<td>35</td>
<td>52.70</td>
<td>18</td>
<td>75.68</td>
</tr>
<tr>
<td>Rts.rs</td>
<td>44</td>
<td>36</td>
<td>20</td>
<td>44.44</td>
<td>15</td>
<td>58.33</td>
</tr>
</tbody>
</table>
4. CONCLUSION

Based on the results of the analysis of the effectiveness of stopping unwanted cookies, it is concluded that the use of "Open-source" add-ons can significantly reduce unwanted domains for tracking users on the Internet. This also implies that the use of the aforementioned add-ons will reduce the collection of customer information by companies which are not from our region. Significant is the existence of effective legal regulation to prevent multiple abuses on the Internet. A good landmark is the GDPR Regulation, whose solutions, although subject to some degree of criticism by the scientific and professional public, make a contribution to the protection of personal data.

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Engineering
Ekology
-ICMNEE-
MULTIPLE-CRITERIA MODEL FOR OPTIMAL OFF ROAD VEHICLE SELECTION FOR PASSENGER TRANSPORTATION: BWM-COPRAS MODEL

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Abstract: Adequate evaluation and choice of off road vehicles used in performing various types of assignments is a very important factor which affects user mobility through quality of transportation activities in the Serbian Armed Forces (SAF), safety, as well as efficiency in carrying out transportation activities. Therefore, this paper proposes a model for optimal off-road vehicle selection for the needs of SAF through the implementation of BWM (Best Worst Method) and COPRAS (Compressed Proportional Assessment) models. Establishing the relative weight of criteria used to assess potential off-road vehicles was done by using the BWM method. In addition to the COPRAS method which is a component of the basic decision making model, in this paper, the MABAC (MultiAttributive Border Approximation Area Comparison) and MAIRCA (MultiAttributive Ideal-Real Comparative Analysis) methods were also applied through result validation. By testing the BWM-COPRAS model on the example of optimal off road vehicle selection in SAF, a high rank correlation was achieved. Validation of results was done through statistical processing of the results obtained through the implementation of various multi-criteria techniques by applying the Spearman’s rank correlation coefficient.

Key words: BWM, COPRAS, MABAC, MAIRCA, vehicle selection, multi-criteria decision making

1. INTRODUCTION

When observing the efficiency of units in off-road conditions in both peace and war, it is impossible to miss its high dependence on adequate vehicle selection for carrying out a mission, for it is precisely this process that represents an important factor which directly influences the lowering of risk and time involved in performing their activities. Proper assessment and selection of the right vehicle provides the proper conditions for efficient performance of tasks set before the units of the Serbian Armed Forces (SAF). Taking into consideration the aforementioned, the optimal off-road vehicle selection process is of great importance for successful and safe transport of units. Identifying actions that have the biggest impact on the efficiency of vehicles during task performance enables the users (units) to modify the operation accordingly and reduce the time needed to perform their activities. This research paper presents the multi-criteria BWM-COPRAS model for evaluation and optimal off-road vehicle selection for units of the Serbian Armed Forces. The hybrid BWM-COPRAS model is carried out in three phases. The first phase of the model includes calculating the optimal values of weight coefficients by applying the non-linear model in BWM. The second phase is where the COPRAS model is applied. Input values into the COPRAS model represent the values of the BWM weight coefficients, and elements of the basic Decision matrix. The third phase includes the validation of obtained results through: (1) comparing results with other
multi-criteria (MCDM) models, (2) analysis of result stability in a dynamic environment and (3) analysis of result stability when weight coefficients of the criteria are changed.

Through research and development of the models, several goals have been set in this paper. The first goal pertains to the advancement and enhancement of the optimal vehicle selection methodology in the area of multi-criteria decision making through development and introduction of the new FUCOM-COPRAS approach. The second goal of this paper is to bridge the gap that currently exists in the evaluation and adequate vehicle selection methodology within the military as a whole. The third goal of the paper is the possibility of enhancing the efficiency and lowering the risks of performing SAF assignments by defining models for adequate vehicle selection. And the fourth goal of this paper is the popularization and affirmation of the idea of multi-criteria decision making in reaching complex decisions in SAF through presentation of the BWM-COPRAS model.

The authors of this paper have opted for the use of the hybrid BWM-COPRAS model due to its following advantages: (1) Use of the BWM and COPRAS models enables a successful simulation of the decision-making processes, starting from defining the goal, criteria and alternatives, to comparison of the criteria, i.e. establishing the priority of each of the alternatives over the set goal; (2) Application of the BWM-COPRAS model breaks down the concrete decision making process by taking apart the problem into a hierarchy of its elements. Hierarchical examination of the decision making process allows for easier control over the consistency of estimates while paying attention to the entirety of the problem and functional interactions between criteria and alternatives; (3) By using the BWM-COPRAS model the qualitative and quantitative factors are integrated into the decision-making, because the most real problems most often occur as a combination of qualitative and quantitative elements; (4) The BWM-COPRAS model successfully identifies and points to the inconsistency of the decision-maker by tracking the inconsistencies of estimates during the entire process, and calculating the index and ratio of consistency; (5) Redundancy of pair comparison makes the BWM-COPRAS model less sensitive to estimation errors; (6) Implementation of the BWM-COPRAS model in group decision-making significantly improves communication between group members. In case of a discussion, a group must agree on every joint estimate that is to be entered into the matrix. This helps in structuring the discussion and coming to a consensus. The BWM-COPRAS model also has certain limitations which the users might encounter while using it, among these are: (1) Insufficiently large scale (Saaty scale of relative importance) for comparison of elements in pairs, related to some decision making problems; (2) The number of necessary pair comparisons is not negligible in most problems; (3) Achieving an acceptable consistency ratio is often difficult, and (4) the complexity of the mathematical algorithm can be a limiting factor for widespread use of the model.

This paper contains a total of six sections, the first of which refers to introducing the problem of adequate vehicle selection for SAF. The second, containing the literature review, takes a closer look at already existing research on similar topics in which multi-criteria decision making models were applied. The third section briefly introduces the previously used models and lays out the algorithm of the hybrid BWM-COPRAS model. The fourth section displays a study of the case in which vehicle evaluation was performed by using the BWM-COPRAS model. The fifth section is a discussion of the results which includes a result stability check through the change of weight coefficients of the criteria in BWM, and the validation of the obtained results through comparison with other MCDM models. The sixth section shows key contributions of the developed model and the performed research, as well as suggestions for future research.
2. LITERATURE REVIEW

Based on research from the most important indexes of international science magazines (SCOPUS and Web of Science) a literature analysis has been performed which deliberates the implementation of MCDM models in transport and logistics optimization. It analyses the period between 2008 and 2018. During this period only two papers on the topic of vehicle selection in the military were published (Pamučar, et. al., 2013; Starčević, et. al., 2019). Starčević et. al. (2019) have presented the selection of a military vehicle for use in multinational operations by using the hybrid AHP-DEA (Analytic Hierarchy Process – Data Envelopment Analysis) models, while Pamučar et. al. (2013) have shown the application of the neuro-fuzzy system for the selection of a military motor vehicle used for performing transportation assignments in SAF. Due to scarcity of papers on the topic of application of the MCDM models for military off-road vehicle selection, this paper analyses papers from the domain of transport and logistics which deal with similar topics. For example, Jeon et. al. (2010) showed the application of the MCDM methods in the sustainable transport plan selection based on the sustainability index. In the research the authors used the Weighted Sum Model. Cadena & Magro (2015) presented a new methodology for assigning weight coefficients of sustainability criteria in transport projects. In order to solve the problem of imprecision and subjectivity, the authors applied the MCDM models in fuzzy environment.

Given that the traffic system is the life force of every country and one of the bases for its economic development, Barić et. al. (2016) suggest that the AHP method be applied when choosing the best project in the realization of city traffic projects. The model has been tested on a real system and has yielded reliable results. Barić et al (2016) have also pointed out the main drawback of applying the AHP model which is a large number of inputs making the validation of the obtained results more difficult. In order to solve this problem, Inti and Tandon (2017) presented a modified AHP method characterized by additive transitivity of fuzzy relations. The model was tested in choosing a contractor for the construction of transportation infrastructure.

In order to improve sustainability in transport, one of the solutions is to use various alternative fuels and vehicle propulsion systems. In this way, with the help of the sustainability index, Mitropoulos & Prevedouros, (2016) make estimates of vehicle characteristics. The identified indicators are grouped into five categories of sustainability: Environment, Technology, Energy, Economy and Users, and then they were aggregated using the WSM method. Also Mohamadabadi et. al. (2009) have selected the types of propulsion fuel for vehicles based on three basic sustainability aspects. For ranking the alternatives based on the five criteria the PROMETHEE method was used. Intermodal transportation can greatly improve the sustainability of a transportation system. It is necessary to choose the optimal location of the terminals based on the different requirements of different partakers in the transportation process. With that aim Zečević et. al., (2017) have suggested a new hybrid MCDM model for selecting locations. Sustainable transport systems have today become a necessity, especially in large cities because of various harmful effects on the environment. An approach for choosing the best alternative of transport systems based on 24 criteria grouped in three categories was defined in Awasthi et. al. (2011). The abovementioned approach contains three steps, and the TOPSIS method is applied in combination with fuzzy theory with the aim to assess the criteria and choose an alternative. Castillo and Pitfield (2010) suggest the Evaluative and Logical Approach to Sustainable Transport Indicator Compilation (ELASTIC) framework
for choosing a sustainable transport system indicator with the help of AHP and SAW methods. Although the improvements of transport planning methods over the past few years are visible, according to López & Monzón (2010) in order to improve the sustainability level in transport it is necessary to apply a multidisciplinary approach based on GIS. In addition to that it is necessary to integrate methods of multi-criteria decision making within the suggested approach.

An estimate of transport system sustainability in individual European countries based on selected economic, ecological and social indicators was presented in Bojković et al., (2010). The ELECTRE (ELimination and Choice Expressing Reality) method was used together with its modification based on Absolute Significance Threshold (AST). The framework for selecting sustainable transport projects in urban areas of developing countries was proposed in Jones et al., (2013). The choice of alternatives is performed based on Localized Sustainability Score index whereby the AHP method is used. In addition to the AHP method, assessing the sustainability of different transport solutions such as mode sharing, multimodal transport, intelligent transportation systems, Awasthi & Chauhan (2011) use the Dempster-Shafer theory in the proposed hybrid approach. While the AHP method is primarily used for ranking criteria based on their weight, the Dempster-Shafer theory enables synthesis of multiple information sources. Dimić et al., (2016) have developed a model for strategic transport steering based on SWOT analysis, fuzzy Delphi and DEMATEL – ANP method.

There are a certain number of studies which contemplate the application of different theories of uncertainty in multi-criteria models for solving numerous logistical and transportation problems. For example Sremac et al., (2018) have shown the ranking of logistical providers by using Rough SWARA (Step-Wise Weight Assessment Ratio Analysis) and Rough WASPAS (Weighted Aggregated Sum Product Assessment) models, while Badi et al., (2018) demonstrated the use of the CODAS model. Later Badi and Ballem and Stević et al., (2017a) demonstrated the application of rough numbers in multi-criteria models for vehicle rationalization within the inner transport of logistical companies. The paper puts forward a new approach based on the combination of Simple Additive Weighing (SAW) method and rough BWM. Radović et al., (2018) showed the use of rough numbers for valuating performance indicators which was applied in three different countries: Bosnia and Herzegovina, Libya and Serbia. The multi-criteria model includes the use of rough ARAS (Additive Ratio Assessment) approach for performance indicator valuation in nine transportation companies from the three countries. Pamučar et al., (2019) have shown the possibilities of applying the multi-criteria models based on Linguistic Neutrosophic Numbers (LNN) in managing human resources in the process of transporting hazardous substances. The application of LNN-WASPAS model for the evaluation of security advisors when transporting hazardous substances on Serbian soil was demonstrated. Pamučar et al., (2016) showed a green p-median problem combined with fuzzy multi-criteria model which processes environmental parameters, sociological parameters and the expenses of logistical distributors and applies their influence on the planning of the city logistical terminal location on a discrete traffic network.

Sustainability is a very important concept in logistics, and reverse logistics as one of its sub-branches can greatly improve the efficiency and the ecological aspect of doing business. Wang et al., (2018) have presented a method for choosing returnable product collectors. The hybrid approach based on AHP and Entropy Weight (AHP-EW) methods is used in order to estimate the weight of certain criteria, while the Multi-Attributive Border Approximation area Comparison (MABAC) method is used for ranking the alternatives. Different initiatives for
city logistics (e.g. proper location of distribution centers) can significantly contribute to improving the degree of sustainability in a city. This is precisely the research topic in Awasthi & Chauhan, (2012). Out of the MCDM methods, the aforementioned paper uses AHP and Fuzzy TOPSIS. With the help of the Fuzzy Step-wise Weight Assessment Ratio Analysis (SWARA) and Fuzzy MOORA Mavi & Zarbakhshnia, (2017) perform a selection of the third-person provider of reverse logistics services in the plastic industry. Later Badi and Ballem, (2018) showed the possibilities of applying BWM and MAIRCA models for selecting third-person provider for reverse logistics services in the pharmaceutical industry. Pamučar and Ćirović, (2015) demonstrated the application of the hybrid DEMATEL-MABAC model in the process of making investment decisions about the acquisition of manipulative vehicles in logistics centers. The DEMATEL method was used for obtaining the weight coefficient of criteria, while the valuation and selection of forklifts was done by using the MABAC model. The following table (Table 1) shows an overview of fields which most frequently employ the MCDM models.

### Table 1. MCDM methods in the transport and logistics subfield

<table>
<thead>
<tr>
<th>Field of application for the MCDM method</th>
<th>MCDM method</th>
<th>Literature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Determining the impacts of ecological transport measures on city sustainability</td>
<td>AHP; AHP-EW; MABAC</td>
<td>Awasthi et al (2011); Zečević et al (2017)</td>
</tr>
<tr>
<td>Logistical provider assessment with acknowledging the risks and sustainability</td>
<td>Fuzzy SWARA, Fuzzy MOORA</td>
<td>Mavi et al (2017)</td>
</tr>
<tr>
<td>Transport management</td>
<td>WSM; REMBRANDT; Delphi; Fuzzy TOPSIS; AHP; SAW; PROMETHEE; ELECTRE I; Modified ELECTRE I; Fuzzy Delphi; DEMATEL – ANP</td>
<td>Jeon et al (2010); Bueno Cadena &amp; Vassallo Magro (2015); Awasthi &amp; Chauhan (2011); Castillo &amp; Pitfield (2010); Simongáti (2010); Bojković et al (2010); Dimic et al (2016); Awasthi &amp; Chauhan (2012)</td>
</tr>
<tr>
<td>Vehicle evaluation</td>
<td>WSM; PROMETHEE</td>
<td>Mitropoulos &amp; Prevedouros (2016); Mohamadabadi et al. (2009)</td>
</tr>
<tr>
<td>Location Evaluation Problem for Logistical Center Construction</td>
<td>Fuzzy Delphi; Fuzzy Delphi ANP; Fuzzy Delphi VIKOR; Fuzzy MAGDM; Fuzzy ARAS; AHP;</td>
<td>Zečević et al (2017); Rao et al. (2015); Turskis &amp; Zavadskas, (2010); Pamučar et al. (2018)</td>
</tr>
</tbody>
</table>
Based on the presented literature analysis we can conclude that the most frequently used method for solving problems in the field of transport and logistics in the past ten years was the AHP method. However, the AHP method requires the use of \( \frac{n(n-1)}{2} \) comparison of criteria pairs. A large number of comparisons makes the application of the model more complicated, especially in cases with a larger number of criteria. For this reason the use of this method is not advised in cases with a larger number of criteria. The model which eliminates the abovementioned drawback of the AHP method is the BWM method. But even with this fact, and the numerous advantages of BWM over the AHP method we can see that the BWM has not been used in the field in question. Therefore a logical need arises for the development of MCDM models which imply the implementation of all BWM advantages. In addition to the BWM method, by analyzing the literature we can see that the COPRAS (COmpressed PRoportional ASsessment) method hasn’t been used either, even though it falls into models which yield stable results. Considering that in the presented literature there are no examples of either BWM or COPRAS models for off-road vehicle assessment in either civilian or military organizations the need for their application is imposed. The application of the BWM-COPRAS model fills the gap that exists in the literature which deals with this field.

3. **BWM-COPRAS MULTI-CRITERIA MODEL**

As was previously emphasized, BWM-COPRAS implies the use of two methods, the BWM method for determining weight coefficients of criteria, and the COPRAS method for assessing, i.e. ranking alternatives (Image 1)
The model contains three phases. Phase one calculates the optimal values of weight coefficients of criteria through the application of BWM. The end results of the BWM method are the values of weight coefficients of criteria. Output results of the BWM, weight coefficients, are further processed through the COPRAS method algorithm. In phase two the COPRAS method is used to rank the alternatives. Phase three is the validation of results. The next section shows the algorithms of the BWM and COPRAS methods.

**a. Best-Worst method**

The following section contains the algorithm of the BWM method for determining weight coefficients of evaluation criteria (Stević et. al., 2018)
Algorithm: BWM

**Input:** Expert pairwise comparison of criteria

**Output:** Optimal values of the weight coefficients of criteria/sub-criteria

**Step 1:** The identification of the selected criteria as a set of the criteria related to the topic. The set of the criteria can be evaluated as $C_1, C_2, C_3, \ldots, C_n$.

**Step 2:** Finding the best and the worst criteria. As is mentioned above, it should be done by experts and the involved decision-makers.

**Step 3:** The creation of a matrix of the preference of the best criterion over all the other criteria (BO vector) by applying numbers between 1 and 9:

$$A_b = (a_{b1}, a_{b2}, a_{b3}, \ldots, a_{bn})$$

**Step 4:** The creation of a matrix of the preference of the worst criterion over all the other criteria (OW vector) by applying numbers between 1 and 9.

$$A_w = (a_{w1}, a_{w2}, a_{w3}, \ldots, a_{wn})$$

**Step 5:** Generating the relative importance of the criteria through calculating the final and optimal weights for the criteria. The weights will show the same as:

$$\begin{align*}
\min \xi \\
\text{s.t.} \\
\frac{w_a}{w_j} - a_{ab} \leq \xi, \forall j \\
\frac{w_j}{w_a} - a_{wb} \leq \xi, \forall j \\
\sum_{j=1}^{n} w_j = 1 \\
w_j \geq 0, \forall j
\end{align*}$$

**Step 6:** The same as with the AHP, there is a consistency index shown in Table 2. The consistency ratio should be calculated as follows:

$$\text{Consistency ratio} = \frac{\xi}{\text{Consistency index}}$$

For different values $a_{bw} \in \{1, 2, \ldots, 9\}$ we get maximum values $\xi$ (max $\xi$). Table 2 contains maximum values of $\xi$ for different values of $a_{bw} \in \{1, 2, \ldots, 9\}$.

**Table 2.** Consistency Index values (CI)

<table>
<thead>
<tr>
<th>$a_{bw}$</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>CI</td>
<td>0.00</td>
<td>0.44</td>
<td>1.00</td>
<td>1.63</td>
<td>2.30</td>
<td>3.00</td>
<td>3.73</td>
<td>4.47</td>
<td>5.23</td>
</tr>
</tbody>
</table>

Based on CI we get the consistency ratio (CR) which takes the values of interval [0, 1], where the values closer to zero indicate a high consistency, and CR values closer to one indicate a low consistency.

**b. Copras method**

Within the decision-making theory there is a large number of multi-criteria decision making methods (MCDM) which support us in solving different problems. The COPRAS method is one of the newer methods which is increasingly used in literature (Chaterjee et al., 2018; Pamučar et al., 2018a; Mukhamezhanov and Pamučar, 2018b). Each MCDM method is characterized by a specific mathematical apparatus. The COPRAS method is partly
characterized by a more complicated procedure of criteria function value aggregation, and the simplified procedure of data normalization (the nature of the criteria is irrelevant – min/max). The following section succinctly displays the mathematical apparatus of the COPRAS method. The problem is formally presented by choosing one of the $m$ options (alternatives), $A_i, i = 1, 2, ..., m$ which are assessed and compared among each other based on the $n$ criterion $(X_j, j = 1, 2, ..., n)$ whose values are familiar. The alternatives are presented as vectors $x_j$ where $x_j$ is the value of $i$ alternative according to $j$ criteria. Seeing as the criteria have varying impacts on the final assessment of alternatives, each criteria is assigned a weight coefficient $w_j, j = 1, 2, ..., n$ (where $\sum_{j=1}^{n} w_j = 1$) which reflects its relative value in assessing the alternatives.

**Step 1.** Normalization of the basic matrix. The first step of the COPRAS method includes the normalization of the elements of the basic decision-making matrix ($X$).

$$
X = \begin{bmatrix}
A_1 & [x_{11} & x_{12} & \cdots & x_{1n}] \\
A_2 & [x_{21} & x_{22} & \cdots & x_{2n}] \\
\vdots & \vdots & \ddots & \vdots \\
A_m & [x_{m1} & x_{m2} & \cdots & x_{mn}] \\
\end{bmatrix}
$$

(1)

The main goal of criteria value normalization is the transformation of different values of criteria (“benefit” or “cost”) into values which allow mutual comparison. The normalization values are shown in matrix $D$.

$$
D = \begin{bmatrix}
A_1 & [x_{11} & x_{12} & \cdots & x_{1n}] \\
A_2 & [x_{21} & x_{22} & \cdots & x_{2n}] \\
\vdots & \vdots & \ddots & \vdots \\
A_m & [x_{m1} & x_{m2} & \cdots & x_{mn}] \\
\end{bmatrix}
$$

(2)

Elements of the normalized matrix ($x_{ij}$) are obtained by applying additive normalization:

$$
x_{ij} = \frac{x_{ij}}{\sum_{i=1}^{m} x_{ij}}
$$

(3)

where $x_{ij}$ represents the elements of the basic decision-making matrix ($X$), $x_{ij}$ represents the normalized values of elements from the basic decision-making matrix, $m$ represents the total number of alternatives.

**Step 2.** Forming of the weighted normalized matrix. In the second step a weighted normalized matrix ($Z$), gained by multiplying the elements of the normalized matrix ($D$) with the weight coefficients of criteria ($w_j$), is constructed.
\[
Z = \begin{bmatrix}
z_{11} & z_{12} & \cdots & z_{1n} \\
z_{21} & z_{22} & \cdots & z_{2n} \\
\vdots & \vdots & \ddots & \vdots \\
z_{m1} & z_{m2} & \cdots & z_{mn}
\end{bmatrix}
= \begin{bmatrix}
W_1 \cdot x_{11} & W_2 \cdot x_{12} & \cdots & W_n \cdot x_{1n} \\
W_1 \cdot x_{21} & W_2 \cdot x_{22} & \cdots & W_n \cdot x_{2n} \\
\vdots & \vdots & \ddots & \vdots \\
W_1 \cdot x_{m1} & W_2 \cdot x_{m2} & \cdots & W_n \cdot x_{mn}
\end{bmatrix}
\]

(4)

where \(n\) is the total number of criteria, and \(m\) is the total number of alternatives.

Step 3. In the following, third step the values of the \(Z\) matrix are summed up in columns. The values are summed up depending on which criteria group they belong to ("benefit" \(\rightarrow\) max or “cost” \(\rightarrow\) min). The values of the benefit criterion (higher criterion value is desirable) are obtained by applying formula (5) or formula (6):

\[
S_i^+ = \sum_{z_i = +} z_{ij}
\]

(5)

where \(z_i = +\) is the sum of the benefit criteria, or:

\[
S_i^+ = \sum_{k=1}^{k} x_{ij} \cdot q_j
\]

(6)

where \(k\) is the total number of the benefit criteria.

The values of the cost criterion (lower criterion value is desirable) is obtained by applying formula (7) or formula (8):

\[
S_i^- = \sum_{z_i = -} z_{ij}
\]

(7)

where \(z_i = -\) is the aggregate of the cost criteria, or:

\[
S_i^- = \sum_{p=1}^{p} x_{ij} \cdot q_j
\]

(8)

where \(p\) is the total number of the cost criteria.

Step 4. Aggregation of criteria function values. In step four, by applying the formula (9) we determine the significance (influence) of each of the given alternatives from the set of compared alternatives:

\[
Q_i = S_i^+ + \frac{S_{min}^+}{S_i^+} \sum_{i=1}^{m} S_i^- = S_i^+ + \frac{S_{min}^-}{S_i^-} \sum_{i=1}^{m} \frac{1}{S_i^-}
\]

(9)

Step 5. Ranking of alternatives. In the final, fifth, step the ranking of alternatives is performed based on the values of the criterion function which is assigned to each alternative. The end-values of criteria functions of alternatives are gained by applying the formula (10):

\[
N_i = \frac{Q_i}{Q_{max}} \cdot 100\%
\]

(10)

4. APPLICATION OF BWM-COPRAS MODEL TO OFF-ROAD VEHICLE SELECTION IN SAF

Military cargo motor vehicles for passenger transport are only one of the vehicles categories used in SAF. Seeing as this paper deals only with this vehicle category, the following section
will briefly introduce the classification of vehicles in SAF and types of vehicles used in SAF as well as in other militaries across the world.

a. Classification of vehicles

The classification of motor vehicles and other means of transportation that use liquid fuels in MoD and SAF (except waterborne vessels, aircrafts, stationary aggregates and boiler rooms), aims to group the encompassed vehicles according to the criterion of purpose or according to similar technical characteristics.

The classification includes the division of vehicles into classes, types, groups and the assignment of numbers for marking them: I – classes of vehicles are marked with numbers 1-9; II – types of vehicles within classes are marked with numbers 01-99 and III – groups of vehicles within types are marked with numbers 01-99. This paper deals with vehicles that belong to the first group of the aforementioned classification as shown in Table 3.

<table>
<thead>
<tr>
<th>Mark</th>
<th>Vehicle description</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>Off road vehicle for passenger transport, up to 5 seats;</td>
</tr>
<tr>
<td>02</td>
<td>Off road vehicle for passenger transport, 6 to 8 seats;</td>
</tr>
<tr>
<td>03</td>
<td>Off road vehicle for passenger transport, more than 8 seats;</td>
</tr>
<tr>
<td>04</td>
<td>Off road vehicle for passenger transport, with protection.</td>
</tr>
</tbody>
</table>

The supply of this vehicle category from the SAF fleet is low and amounts to approximately 43%, while the total number (of vehicles from the prescript fleet) is 92%. The structure of vehicles from this category in SAF is also inhomogeneous, that is, they are of different brands and types, mostly obtained more than 30 years ago. The most prominent brands of manufacturers are: PUCH (around 33%), PINZGAUER (around 27%), LADA (around 14%) and LANDROVER (around 10%). The inhomogeneity of the fleet vehicles complicates the maintenance process of these vehicles. The average functionality of off road vehicles for passenger transport in SAF is approximately 66%. The average age of off-road vehicles for passenger transport in SAF units is 26.9 years. It is especially important to stress that approximately 80% of this category is older than 12 years, which is also the designed lifespan of these vehicles. In addition to the abovementioned statistical data, it is necessary to point out that an average off-road vehicle for passenger transport in SAF has crossed approximately 141,000 kilometers, where the vehicles older than 12 years have on average crossed 162,728 km, and vehicles less than 12 years old 56,000 km.

Defining the criteria for off road vehicle selection and characteristics of alternatives

Given than in the publicly available literature there are not a large number of papers dealing with the topic of military off-road vehicle selection, the criteria have been defined based on the available literature, internal regulations and requirements of the SAF. The chosen criteria are shown in Image 2. In addition to the abovementioned criteria, excluding criteria such as equipment with the AC, GPS, traction-control system, etc. were applied.
Selection of off-road motor vehicle for passenger transport

Image 2. Hierarchical model for vehicle selection

The first level represents a goal which is a choice between the given vehicle types, while the second level includes 7 criteria for vehicle selection: obstacle clearing capability (C1), equipped soldier transportation capacity (C2), characteristics of the motor (C3), price (C4), maintenance (C5), safety (C6), warranty provisions (C7). The third level consists of seven sub-criteria that are sorted within the group of main criteria, while the potential vehicle types are shown on the fourth level.

By comparing the characteristics of vehicles used by SAF and modern vehicles used for the same purpose, a conclusion is drawn that a modernization of SAF’s fleet vehicles is needed. Modern vehicles have significantly improved characteristics when looking at maneuverability, tank capacity and horsepower. Seeing as there is no consensus among manufacturers concerning the evaluation of the abovementioned vehicle types, as well as because of data confidentiality policies, this paper won’t talk about specific types of vehicles, instead the vehicles will be marked as vehicle 1 – vehicle 4.

Vehicle 1 (A1) has the following technical characteristics: the ability to clear obstacles is higher than vehicle 2 and lower than vehicle 4. The vehicle can simultaneously carry four persons; the level of passenger and cargo security is higher compared to other given types of vehicles; it has 190 HP, and fuel consumption is 23.75 l/km; the price of the vehicle is 15,785,100 RSD with the possibility of payment in 18 installments without interest; the shipment deadline is 6 months and it has a 24 month guarantee; widespread availability of the service network and availability of spare parts is poorer than for other given vehicle types.

Vehicle 2 (A2) has the following technical characteristics: the ability to clear obstacles is the lowest with this vehicle; the vehicle can simultaneously carry 6 persons, and the security of the passengers and cargo is on a high level; the engine has 122 HP, and consumes fuel at the rate of 10.1 l/km; the price of the vehicle is 13,702,500 RSD with the possibility of payment
in 18 installments without interest; the shipment deadline is 4 months and it has a 24-month
guarantee; the widespread availability of the service network and availability of spare parts is
better than with vehicle 1, but worse than other given types of vehicles.

Vehicle 3 (A3) has the following technical characteristics: this vehicle’s ability to clear
obstacles is the same as with vehicle 1; the vehicle can simultaneously carry 4 persons, the
security of passengers and cargo is lower compared to vehicle 1 and vehicle 2; the engine has
177 HP, and consumes fuel at the rate of 10.4 l/km; the price of the vehicle is 14,210,000 RSD
with the possibility of payment in 12 installments without interest; the shipment deadline is 4
months, and it has a 12-month guarantee; the widespread availability of the service network
and the availability of spare parts is better than with all other given vehicles.

Vehicle 4 (A4) has the following characteristics: the ability to clear obstacles is on a higher
level than with other vehicles; the vehicle can simultaneously carry 6 persons; the level of
passenger and cargo security is the lowest compared to all other vehicle types; the engine has
268 HP and consumes power at the rate of 9.5 l/km; the price of the vehicle is 10,380,000 RSD
with the possibility of payment in 24 installments without interest; the shipment deadline is 6
months, and it has a 60-month guarantee; the widespread availability of the service network
and the availability of spare parts is better than with vehicle 1 and vehicle 2, but worse than
vehicle 3.

Vehicle assessment through the application of the BWM-COPRAS model

This research includes three groups of experts. Within every criteria/sub-criteria group experts
have defined the best (B) and worst (W) criterion/sub-criterion. Based on this, the BO and OW
vectors were defined for B and W criteria/sub-criteria. Criteria/sub-criteria assessment was
performed through the application of [1,9] scale: 1 – very low influence; 2 – low influence;...;
8 – high influence; 9 – very high influence. The values of BO and OW vectors within the
groups of criteria/sub-criteria are shown in table 4.

Table 4. BO and OW vectors

<table>
<thead>
<tr>
<th>Criteria</th>
<th>BO evaluation</th>
<th>The best: C4 (Price)</th>
<th>Expert evaluation</th>
<th>The worst: C3 (Characteristics of the motor)</th>
<th>Expert evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1 (Obstacle clearing capability)</td>
<td>5; 6; 6</td>
<td>C1 (Obstacle clearing capability)</td>
<td>4; 4; 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C2 (Equipped soldier transportation capacity)</td>
<td>7; 7; 8</td>
<td>C2 (Equipped soldier transportation capacity)</td>
<td>3; 2; 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C3 (Characteristics of the motor)</td>
<td>9; 9; 9</td>
<td>C4 (Price)</td>
<td>9; 9; 9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C5 (Maintenance)</td>
<td>2; 2; 2</td>
<td>C5 (Maintenance)</td>
<td>7; 7; 7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C6 (Safety)</td>
<td>3; 5; 2</td>
<td>C6 (Safety)</td>
<td>5; 5; 7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C7 (Warranty provisions)</td>
<td>3; 4; 4</td>
<td>C7 (Warranty provisions)</td>
<td>5; 6; 6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C3 (Characteristics of the motor)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The best: C31 (Fuel consumption)</td>
<td>BO evaluation</td>
<td>The best: C32 (horsepower)</td>
<td>Expert evaluation</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
C32 (horsepower) 4; 3; 2 C31 (Fuel consumption) 2; 4; 3

C4 (price)

The best: C41 (Price) Expert evaluation The best: C42 (shipment time) Expert evaluation
C42 (shipment time) 6; 5; 5 C41 (price) 6; 5; 7
C43 (payment conditions) 3; 3; 2 C43 (payment conditions) 4; 2; 6

C5 (maintenance)

The best: C51 (widespread availability of the service network) Expert evaluation The best: C52 (availability of spare parts) Expert evaluation
C52 (availability of spare parts) 2; 3; 3 C51 (widespread availability of the service network) 2; 3; 5

Medium values of expert evaluations are shown in table 5.

Table 5. Medium values of BO and OW vectors

<table>
<thead>
<tr>
<th>Criteria</th>
<th>The best: C4 (Price)</th>
<th>Medium value</th>
<th>The worst: C3 (Characteristics of the motor)</th>
<th>Medium value</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1 (Obstacle clearing capability)</td>
<td>5.7</td>
<td>C1 (Obstacle clearing capability)</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>C2 (Equipped soldier transportation capacity)</td>
<td>7.33</td>
<td>C2 (Equipped soldier transportation capacity)</td>
<td>2.33</td>
<td></td>
</tr>
<tr>
<td>C3 (Characteristics of the motor)</td>
<td>9</td>
<td>C4 (Price)</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>C5 (Maintenance)</td>
<td>2</td>
<td>C5 (Maintenance)</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>C6 (Safety)</td>
<td>3.33</td>
<td>C6 (Safety)</td>
<td>5.67</td>
<td></td>
</tr>
<tr>
<td>C7 (Warranty provisions)</td>
<td>3.67</td>
<td>C7 (Warranty provisions)</td>
<td>5.67</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Criteria</th>
<th>The best: C31 (fuel consumption)</th>
<th>Medium value</th>
<th>The worst: C32 (horsepower)</th>
<th>Medium value</th>
</tr>
</thead>
<tbody>
<tr>
<td>C32 (horsepower)</td>
<td>3</td>
<td>C31 (fuel consumption)</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Criteria</th>
<th>The best: C41 (price)</th>
<th>Medium value</th>
<th>The worst: C42 (shipment time)</th>
<th>Medium value</th>
</tr>
</thead>
<tbody>
<tr>
<td>C42 (shipment time)</td>
<td>5.33</td>
<td>C41 (price)</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>C43 (payment conditions)</td>
<td>6.67</td>
<td>C43 (payment conditions)</td>
<td>4</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Criteria</th>
<th>The best: C51 (widespread availability of the service network)</th>
<th>Medium value</th>
<th>The worst: C52 (availability of spare parts)</th>
<th>Medium value</th>
</tr>
</thead>
</table>
Optimal values of weight coefficients of the criteria/sub-criteria vectors are calculated based on the defined ratios from Table 5. This is how the four non-linear models for calculating the optimal values of the criteria/sub-criteria weight coefficients were formed.

Model 1 (Criterion)
\[
\text{min } \xi \\
\text{s.t.} \\
\left| \frac{w_1}{w_4} - 5.67 \right| \leq \xi; \\n\left| \frac{w_4}{w_5} - 7.33 \right| \leq \xi; \\n\left| \frac{w_5}{w_6} - 9 \right| \leq \xi; \\n\left| \frac{w_6}{w_7} - 2 \right| \leq \xi; \\n\left| \frac{w_7}{w_8} - 3.33 \right| \leq \xi; \\n\left| \frac{w_8}{w_9} - 3.66 \right| \leq \xi; \\
\sum_{j=1}^{7} w_j = 1 \\
w_j \geq 0, \forall j = 1, 2, \ldots, 7
\]

Model 2 (Characteristics of the motor)
\[
\text{min } \xi \\
\text{s.t.} \\
\left| \frac{w_{31}}{w_{32}} - 3 \right| \leq \xi; \\n\left| \frac{w_{32}}{w_{33}} - 3 \right| \leq \xi; \\n\sum_{j=1}^{2} w_j = 1 \\
w_j \geq 0, \forall j = 1, 2
\]

Model 3 (Price)
\[
\text{min } \xi \\
\text{s.t.} \\
\left| \frac{w_{41}}{w_{42}} - 5.33 \right| \leq \xi; \\n\left| \frac{w_{42}}{w_{43}} - 6 \right| \leq \xi; \\n\left| \frac{w_{43}}{w_{44}} - 4 \right| \leq \xi; \\
\sum_{j=1}^{3} w_j = 1 \\
w_j \geq 0, \forall j = 1, 2, 3
\]

Model 4 (Maintenance)
\[
\text{min } \xi \\
\text{s.t.} \\
\left| \frac{w_{51}}{w_{52}} - 2.67 \right| \leq \xi; \\n\left| \frac{w_{52}}{w_{53}} - 3.33 \right| \leq \xi; \\n\sum_{j=1}^{2} w_j = 1 \\
w_j \geq 0, \forall j = 1, 2
\]

The optimal values of weight coefficients were obtained based on the aforementioned models, Table 6.
Table 6. Optimal values of the sub-criteria

<table>
<thead>
<tr>
<th>Criteria/Sub-criteria</th>
<th>Local weights</th>
<th>Global weights</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>0.077</td>
<td>0.077</td>
<td>5</td>
</tr>
<tr>
<td>C2</td>
<td>0.059</td>
<td>0.059</td>
<td>6</td>
</tr>
<tr>
<td>C3</td>
<td>0.033</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>C31</td>
<td>0.750</td>
<td>0.025</td>
<td>10</td>
</tr>
<tr>
<td>C32</td>
<td>0.250</td>
<td>0.008</td>
<td>11</td>
</tr>
<tr>
<td>C4</td>
<td>0.365</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>C41</td>
<td>0.754</td>
<td>0.276</td>
<td>1</td>
</tr>
<tr>
<td>C42</td>
<td>0.097</td>
<td>0.035</td>
<td>9</td>
</tr>
<tr>
<td>C43</td>
<td>0.149</td>
<td>0.054</td>
<td>7</td>
</tr>
<tr>
<td>C5</td>
<td>0.217</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>C51</td>
<td>0.750</td>
<td>0.163</td>
<td>2</td>
</tr>
<tr>
<td>C52</td>
<td>0.250</td>
<td>0.054</td>
<td>8</td>
</tr>
<tr>
<td>C6</td>
<td>0.130</td>
<td>0.130</td>
<td>3</td>
</tr>
<tr>
<td>C7</td>
<td>0.118</td>
<td>0.118</td>
<td>4</td>
</tr>
</tbody>
</table>

Table 6 shows the global and local values of criteria/sub-criteria weight coefficients. The global values were obtained through multiplication of the weight criteria coefficients and weight sub-criteria coefficients. The global weight values are further used to assess the alternatives in the multi-criteria model.

By solving the non-linear models the values $\xi^{*}$ Критерijума = 0.06868, $\xi^{*}$ Качества мотора = 0, $\xi^{*}$ Цена = 0.238385 and $\xi^{*}$ Одржавање = 0.33 are obtained. The $\xi^{*}$ values are used for defining the consistency coefficients. Using the obtained values of $\xi^{*}$ values of the consistency index and consistency ratio were defined, Table 7.

Table 7. Values of the Consistency index and Consistency ratio

<table>
<thead>
<tr>
<th>Sub-criteria level</th>
<th>$C_{\text{criteria}}$</th>
<th>$C_{\text{characteristics of the motor}}$</th>
<th>$C_{\text{price}}$</th>
<th>$C_{\text{maintenance}}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$a_{BW}$</td>
<td>9</td>
<td>3</td>
<td>6.67</td>
<td>3.33</td>
</tr>
<tr>
<td>CI</td>
<td>5.23</td>
<td>1.00</td>
<td>3.335</td>
<td>1.11</td>
</tr>
<tr>
<td>CR</td>
<td>0.013</td>
<td>0.000</td>
<td>0.071</td>
<td>0.297</td>
</tr>
</tbody>
</table>

After obtaining the weight coefficient values the COPRAS method is used for choosing the best alternative. The first step is to form the basic matrix (X)

$$
\begin{bmatrix}
C1 & C2 & C3 & C4 & C5 & C6 & C7 & C8 & C9 & C10 & C11 \\
A1  & 6 & 4 & 23.75 & 190 & 15785100 & 6 & 18 & 2 & 2 & 8 & 24 \\
X = A2 & 4 & 6 & 10.1 & 122 & 13702500 & 4 & 18 & 4 & 4 & 6 & 24 \\
A3  & 6 & 4 & 10.4 & 177 & 14210000 & 4 & 12 & 8 & 8 & 4 & 12 \\
A4  & 8 & 6 & 9.5 & 268 & 10380000 & 6 & 24 & 6 & 6 & 2 & 60
\end{bmatrix}
$$

In the first phase, by applying formula (3), the normalization of the basic decision making matrix (X) is performed. This is how we get the normalized matrix (D).
In the second phase we perform the multiplication of the value of the matrix \(D\) with the weight coefficients by applying formula (4) and form a weight-normalized matrix \(Z\).

\[
\begin{bmatrix}
    \text{A1} & 0.250 & 0.200 & 0.442 & 0.008 & 0.292 & 0.300 & 0.25 & 0.1 & 0.1 & 0.4 & 0.2 \\
    \text{A2} & 0.167 & 0.300 & 0.188 & 0.005 & 0.253 & 0.200 & 0.25 & 0.2 & 0.2 & 0.3 & 0.2 \\
    \text{A3} & 0.250 & 0.200 & 0.193 & 0.005 & 0.263 & 0.200 & 0.167 & 0.4 & 0.4 & 0.2 & 0.1 \\
    \text{A4} & 0.333 & 0.300 & 0.177 & 0.008 & 0.192 & 0.300 & 0.333 & 0.3 & 0.3 & 0.1 & 0.5 \\
\end{bmatrix}
\]

\[
\text{Z} = \begin{bmatrix}
    \text{A1} & 0.019 & 0.012 & 0.011 & 0.000 & 0.081 & 0.011 & 0.014 & 0.016 & 0.005 & 0.052 & 0.024 \\
    \text{A2} & 0.013 & 0.018 & 0.005 & 0.000 & 0.070 & 0.007 & 0.014 & 0.033 & 0.011 & 0.039 & 0.024 \\
    \text{A3} & 0.019 & 0.012 & 0.005 & 0.000 & 0.073 & 0.007 & 0.009 & 0.065 & 0.022 & 0.026 & 0.012 \\
    \text{A4} & 0.026 & 0.018 & 0.004 & 0.000 & 0.053 & 0.011 & 0.018 & 0.049 & 0.016 & 0.013 & 0.059 \\
\end{bmatrix}
\]

In the third phase we sum up the values of the \(Z\) matrix by columns. The values are summed up based on which criterion group they belong to (max or min). The total values of the max and min criteria are shown in the following matrix.

\[
\begin{bmatrix}
   \text{Si} & \text{Si} \\
    \text{A1} & 0.2037 & 0.0403 \\
    \text{A2} & 0.1786 & 0.0531 \\
    \text{A3} & 0.1679 & 0.0812 \\
    \text{A4} & 0.1890 & 0.0774 \\
\end{bmatrix}
\]

In the fourth phase we apply formula (9) to define the significance of each of the considered alternatives from the set of alternatives that are being compared. In the end the ranking of alternatives is performed based on the value of the criterion function that is assigned to every alternative. The final values of the COPRAS method and the alternative ranks are shown in the \(Q\) matrix.

\[
\begin{bmatrix}
   \text{Qi} & \text{Pi} & \text{P\text{max}} \\
    \text{A1} & 0.294504 & 100.00 & 1 \\
    \text{A2} & 0.247505 & 84.04 & 2 \\
    \text{A3} & 0.212909 & 72.29 & 4 \\
    \text{A4} & 0.236293 & 80.23 & 3 \\
\end{bmatrix}
\]

Based on the criteria function values the final rank of alternatives is defined: \(\text{A1} > \text{A2} > \text{A4} > \text{A3}\).

\section*{5. VALIDATION OF RESULTS}

Before coming to a decision it is necessary to perform a validation of the obtained results. In this paper the validation of results is performed in three phases. In phase one the initial rank of the alternatives gained by applying the BWM-COPRAS model is compared to the ranks
obtained through MIRCA (Chaterjee et. al., 2018) and MABAC (Pamučar and Ćirović, 2015) methods (*Image 3*).

**Image 4.** Ranks of alternatives

Compared to other methods the rank of the alternatives A1 and A2 remained unchanged. Results obtained through the COPRAS method differ from those obtained through the MABAC and MAIRCA methods only in the position of the A3 and A4 alternatives. In order to determine the statistical significance between ranks obtained through the BWM-COPRAS model and though other approaches, the Spearman’s rank correlation coefficient was used (SRCC). SRCC is the coefficient of the basic linear correlation between ranks. Spearman’s rank correlation coefficient is a non-parametrical method for ascertaining the strength of the correlation applied when (Pamučar et. al., 2018b); (1) the data for at least one of the variables is displayed as ordinal data or in ranks; (2) at least one of the variables doesn’t have a normal distribution and (3) the ratio among variables is not linear. The value of rank correlation coefficients is obtained through formula (11):

$$R = 1 - \frac{6 \sum_{i=1}^{n} D_{i}^{2}}{n(n^2 - 1)} \in [-1, 1]$$

where $D$ represents the variance in ranks and $n$ the number of units of analysis. The results of the rank comparison though the application of SRCC are shown in *table 8*.

**Table 8.** Rank correlation of the tested methods.

<table>
<thead>
<tr>
<th>MCDM method</th>
<th>COPRAS</th>
<th>MAIRCA</th>
<th>MABAC</th>
</tr>
</thead>
<tbody>
<tr>
<td>SRC</td>
<td>0.800</td>
<td>1.000</td>
<td>1.000</td>
</tr>
</tbody>
</table>

From *table 8* we see that the results of MABAC and MAIRCA methods are in complete correlation, while the results of the COPRAS method have also shown a high level of correlation when compared to other methods. Since the lowest level of correlation is 0.8 and the middle value is 0.9, we can conclude that the suggested rank is confirmed and credible.

The second phase of result validation is performance analysis of the proposed model in the dynamic basic matrix environment. In the dynamic basic matrix for every scenario a change in number of alternatives was performed and the obtained ranks were analyzed. The matrices are formed by removing the lowest-ranking alternative, and then ranking the remaining based on the newly-obtained basic decision-making matrix. By applying the BWM-COPRAS model the solution $A1 > A2 > A4 > A3$ was obtained. Given that the A3 alternative is the worst in the modified matrix, A3 is eliminated from the set of alternatives. The new decision-making
matrix is solved again and we get a new rank $A_1 > A_2 > A_4$. After this the worst alternative ($A_4$) is once again eliminated, and with the application of the BWM-COPRAS model the final rank $A_1 > A_2$ is obtained.

Based on the obtained results we can conclude that by eliminating the worst method the rank of the remaining alternatives stays the same through all three scenarios. Alternative $A_1$ has stayed the best ranked through all scenarios which has confirmed the robustness of the ranks obtained in a dynamic environment.

The third phase of result validation is performed by changing the weight criteria. The goal of this phase of result validation is to estimate the influence of the most influential criterion on the performances of ranking the proposed model. After determining the weight coefficients of criteria by applying the BWM-COPRAS method for the purposes of sensitivity analysis, the “most important criterion” is identified. By applying formula (12) the weight proportionality is defined during the sensitivity analysis.

$$w_c = (1 - w_c) \times \left( \frac{w^o_c}{W^o_c} \right) = w^o_c - \Delta \alpha_c$$  
(12)

where $w_c$ is the shift in weight criteria within the sensitivity analysis, $w_c$ represents the weight of the most important criterion, $w^o_c$ represents the original values of weight criteria and $W^o_c$ represents the sum of original weight criteria values that are changing. The $\alpha_c$ parameter is defined as the weight coefficient of elasticity that expresses a relative compensation of other weight coefficient values compared to the given changes in the weight of the most important criterion. The $\alpha_c$ value is obtained through formula (13) (Kahraman, 2002).

$$\alpha_c = \frac{w^o_c}{W^o_c}$$  
(13)

The assumptions during the performance of sensitivity analysis are as follows: (1) the value of the weight coefficient of elasticity for the most significant criterion is defined as one; (2) the ratio of the variable weights stays constant during the entirety of the sensitivity analysis (Kirkwood, 1997). The $\Delta x$ parameter (formula (12)) represents the amount of change applied to the set of weight coefficients depending on their weight coefficients of elasticity. The change of weights of the most important criteria should be limited. Otherwise the weights can take on negative values which would lead to a disturbance in limiting the weight proportionality. The $\Delta x$ parameter can be (1) positive, which is indicated by the increase of relative significance or (2) negative, as indicated by the decrease of the relative significance. The limits of $\Delta x$ are defined as the greatest change in weight of the most important criterion in the negative and positive direction. The boundary values of $\Delta x$ are defined by applying formula (14).

$$-w^o_c \leq \Delta x \leq \min \left\{ \frac{w^o_c}{\alpha_c} \right\}$$  
(14)

After defining the boundary values of $\Delta x$, new criteria weights are calculated according to the previously established parameters for sensitivity analysis. The set of these new weight coefficient values is calculated using formulas (15) and (16).

$$w^o_c = w^o_c + \alpha_c \Delta x$$  
(15)

$$w^o_c = w^o_c - \alpha_c \Delta x$$  
(16)

where $w^o_c$ is the initial weight of criteria subjected to sensitivity analysis, $w^o_c$ is the original value of the variable weights. This new set of criteria always satisfies the universal state of
weigh coefficient proportionality that \( \sum w_s + \sum w_c = 1 \). Based on the newly-obtained criteria values new ranks of alternatives for the given scenario are calculated.

In this research the C5 criterion is identified as the most influential one because it has the highest weight coefficient value \( w_5 = 0.276 \). In the next step the coefficient of weight elasticity of the most important criterion is determined \( (\alpha_s) \) (Table 9) and the boundary values for the weight coefficient change of the most important criterion \( (\Delta x) \) are defined.

**Table 9. Elasticity coefficient for changing weights**

<table>
<thead>
<tr>
<th>Criteria labels</th>
<th>( \alpha_s )</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>0.1070</td>
</tr>
<tr>
<td>C2</td>
<td>0.0820</td>
</tr>
<tr>
<td>C3</td>
<td>0.0350</td>
</tr>
<tr>
<td>C4</td>
<td>0.0110</td>
</tr>
<tr>
<td>C5</td>
<td>1.0000</td>
</tr>
<tr>
<td>C6</td>
<td>0.0480</td>
</tr>
<tr>
<td>C7</td>
<td>0.0747</td>
</tr>
<tr>
<td>C8</td>
<td>0.2254</td>
</tr>
<tr>
<td>C9</td>
<td>0.0747</td>
</tr>
<tr>
<td>C10</td>
<td>0.1798</td>
</tr>
<tr>
<td>C11</td>
<td>0.1632</td>
</tr>
</tbody>
</table>

That is how the boundary values of the C5 criterion were obtained and they are \(-0.2760 \leq \Delta x \leq 0.723\). Based on the defined boundaries of the weight coefficient change for the most important criterion the scenarios for sensitivity analysis were determined. The \(-0.2760 \leq \Delta x \leq 0.723\) interval was divided into a total of 21 scenarios. After defining the boundary values of the most influential criterion, new weight coefficient values were defined for the 21 scenarios, Table 10.

**Table 10. Weights of the new criteria**

<table>
<thead>
<tr>
<th>Scenario</th>
<th>C1</th>
<th>C2</th>
<th>C3</th>
<th>C4</th>
<th>C5</th>
<th>C6</th>
<th>C7</th>
<th>C8</th>
<th>C9</th>
<th>C10</th>
<th>C11</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1</td>
<td>0.107</td>
<td>0.082</td>
<td>0.035</td>
<td>0.011</td>
<td>0.000</td>
<td>0.048</td>
<td>0.075</td>
<td>0.225</td>
<td>0.075</td>
<td>0.180</td>
<td>0.163</td>
</tr>
<tr>
<td>S2</td>
<td>0.101</td>
<td>0.078</td>
<td>0.033</td>
<td>0.011</td>
<td>0.050</td>
<td>0.046</td>
<td>0.071</td>
<td>0.214</td>
<td>0.171</td>
<td>0.155</td>
<td></td>
</tr>
<tr>
<td>S3</td>
<td>0.096</td>
<td>0.073</td>
<td>0.031</td>
<td>0.010</td>
<td>0.100</td>
<td>0.044</td>
<td>0.067</td>
<td>0.203</td>
<td>0.162</td>
<td>0.147</td>
<td></td>
</tr>
<tr>
<td>S4</td>
<td>0.091</td>
<td>0.069</td>
<td>0.029</td>
<td>0.009</td>
<td>0.150</td>
<td>0.041</td>
<td>0.063</td>
<td>0.192</td>
<td>0.063</td>
<td>0.153</td>
<td>0.139</td>
</tr>
<tr>
<td>S5</td>
<td>0.085</td>
<td>0.065</td>
<td>0.028</td>
<td>0.009</td>
<td>0.200</td>
<td>0.039</td>
<td>0.060</td>
<td>0.180</td>
<td>0.144</td>
<td>0.131</td>
<td></td>
</tr>
<tr>
<td>S6</td>
<td>0.080</td>
<td>0.061</td>
<td>0.026</td>
<td>0.008</td>
<td>0.250</td>
<td>0.036</td>
<td>0.056</td>
<td>0.169</td>
<td>0.056</td>
<td>0.135</td>
<td>0.122</td>
</tr>
<tr>
<td>S7</td>
<td>0.075</td>
<td>0.057</td>
<td>0.024</td>
<td>0.008</td>
<td>0.300</td>
<td>0.034</td>
<td>0.052</td>
<td>0.158</td>
<td>0.052</td>
<td>0.126</td>
<td>0.114</td>
</tr>
<tr>
<td>S8</td>
<td>0.069</td>
<td>0.053</td>
<td>0.022</td>
<td>0.007</td>
<td>0.350</td>
<td>0.031</td>
<td>0.049</td>
<td>0.147</td>
<td>0.149</td>
<td>0.117</td>
<td>0.106</td>
</tr>
<tr>
<td>S9</td>
<td>0.064</td>
<td>0.049</td>
<td>0.021</td>
<td>0.007</td>
<td>0.400</td>
<td>0.029</td>
<td>0.045</td>
<td>0.135</td>
<td>0.145</td>
<td>0.108</td>
<td>0.098</td>
</tr>
<tr>
<td>S10</td>
<td>0.059</td>
<td>0.045</td>
<td>0.019</td>
<td>0.006</td>
<td>0.450</td>
<td>0.027</td>
<td>0.041</td>
<td>0.124</td>
<td>0.041</td>
<td>0.099</td>
<td>0.090</td>
</tr>
<tr>
<td>S11</td>
<td>0.053</td>
<td>0.041</td>
<td>0.017</td>
<td>0.006</td>
<td>0.500</td>
<td>0.024</td>
<td>0.037</td>
<td>0.113</td>
<td>0.037</td>
<td>0.090</td>
<td>0.082</td>
</tr>
<tr>
<td>S12</td>
<td>0.048</td>
<td>0.037</td>
<td>0.016</td>
<td>0.005</td>
<td>0.550</td>
<td>0.022</td>
<td>0.034</td>
<td>0.101</td>
<td>0.034</td>
<td>0.081</td>
<td>0.073</td>
</tr>
<tr>
<td>S13</td>
<td>0.043</td>
<td>0.033</td>
<td>0.014</td>
<td>0.004</td>
<td>0.600</td>
<td>0.019</td>
<td>0.030</td>
<td>0.090</td>
<td>0.030</td>
<td>0.072</td>
<td>0.065</td>
</tr>
<tr>
<td>S14</td>
<td>0.037</td>
<td>0.029</td>
<td>0.012</td>
<td>0.004</td>
<td>0.650</td>
<td>0.017</td>
<td>0.026</td>
<td>0.079</td>
<td>0.026</td>
<td>0.063</td>
<td>0.057</td>
</tr>
</tbody>
</table>

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The influence of the new weight coefficient values on the change of ranks of alternatives are shown in *image 4*.

<table>
<thead>
<tr>
<th>Scenario</th>
<th>C1</th>
<th>C2</th>
<th>C3</th>
<th>C4</th>
<th>C5</th>
<th>C6</th>
<th>C7</th>
<th>C8</th>
<th>C9</th>
<th>C10</th>
<th>C11</th>
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<tbody>
<tr>
<td>S15</td>
<td>0.032</td>
<td>0.024</td>
<td>0.010</td>
<td>0.003</td>
<td>0.700</td>
<td>0.015</td>
<td>0.022</td>
<td>0.068</td>
<td>0.022</td>
<td>0.054</td>
<td>0.049</td>
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<tr>
<td>S16</td>
<td>0.027</td>
<td>0.020</td>
<td>0.009</td>
<td>0.003</td>
<td>0.750</td>
<td>0.012</td>
<td>0.019</td>
<td>0.056</td>
<td>0.019</td>
<td>0.045</td>
<td>0.041</td>
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<tr>
<td>S17</td>
<td>0.021</td>
<td>0.016</td>
<td>0.007</td>
<td>0.002</td>
<td>0.800</td>
<td>0.010</td>
<td>0.015</td>
<td>0.045</td>
<td>0.015</td>
<td>0.036</td>
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<tr>
<td>S18</td>
<td>0.016</td>
<td>0.012</td>
<td>0.005</td>
<td>0.002</td>
<td>0.850</td>
<td>0.007</td>
<td>0.011</td>
<td>0.034</td>
<td>0.011</td>
<td>0.027</td>
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</tr>
<tr>
<td>S19</td>
<td>0.011</td>
<td>0.008</td>
<td>0.003</td>
<td>0.001</td>
<td>0.900</td>
<td>0.005</td>
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<td>0.007</td>
<td>0.018</td>
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<tr>
<td>S20</td>
<td>0.005</td>
<td>0.004</td>
<td>0.002</td>
<td>0.001</td>
<td>0.950</td>
<td>0.002</td>
<td>0.004</td>
<td>0.011</td>
<td>0.004</td>
<td>0.009</td>
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<tr>
<td>S21</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.999</td>
<td>0.000</td>
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</table>

*Image 4. Sensitivity analysis of alternative ranks through 21 scenarios*

The final step is the review of SRCC for all scenarios (*Image 5*) by using formula (21).
The medium value of the correlation coefficient for all scenarios is 0.752, with this we conclude that the scenarios show a high degree of correlation. Given that through all three phases of result validation of alternatives A1 remained the highest ranked we can conclude that the proposed rank is confirmed and credible.

6. CONCLUSION

This research created the hybrid BWM-COPRAS model for the assessment of off-road vehicles for the units of SAF. For the evaluation of alternatives seven criteria in the first hierarchical level were used which were broken down into seven additional sub-criteria on the second hierarchical level. The key contribution of this paper is the new BWM-COPRAS model for the assessment of vehicles in SAF, as well as the original BWM-MABAC and BWM-MAIRCA models which were created for the needs of result verification. The presented model enables the inclusion of subjectivities which arise in the process of group decision-making through linguistic validation of evaluation criteria. In addition to this though the model presented in this paper new methodological bases for SAF vehicle evaluation were introduced which simultaneously contribute to the betterment of theoretical bases of multi-criteria decision-making as a whole. The developed approach enables the bridging of the gap that currently exists within the methodology for off-road vehicle assessment for the units of SAF. By choosing the optimal off-road vehicle the risk of performing tasks for the units of SAF is significantly lowered and their efficiency is greatly enhanced.

The hybrid BWM-COPRAS model has been applied for the assessment of the four vehicles that are considered for use in the units of SAF. The obtained results were checked though the discussion of results where different scenarios were formed in which a dynamic environment was simulated through the application of weight criteria values. The stability of the model was verified through the statistical coefficient of correlation which showed a high correlation of ranks in all scenarios. The research presented in this paper can serve as a methodology for decision-making when choosing the optimal off-road vehicle. Also, the results can be used in the analysis of the certain criteria influence on the selection of the military vehicle that is systematical approach to path defining in model of the authority’s decision-making, in the process of vehicle selection, in the army as well as in other complex systems.
REFERENCES


NOVEL INTEGRATED MULTI-CRITERIA MODEL FOR SUPPLIER SELECTION: FUCOM-MABAC MODEL

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University of Defence in Belgrade, Military Academy, Department of Logistics, Serbia

Abstract: Supply chain is a very complex area that aims to find the optimum from the point of view of all participants. In order to achieve the overall optimum and satisfaction of all participants, it is necessary at its initial stage to make an adequate evaluation and selection of suppliers. In this paper, the selection of suppliers is based on a new approach in the field of multicriteria decision making. Weight coefficients were determined using the Full Consistency Method (FUCOM), while supplier evaluation and selection was performed using the Multi-Attributive Border Approximation Area Comparison (MABAC) method, which is one of the more recent methods in this field. In order to determine the stability of the model and the applicability of the proposed hybrid FUCOM-MABAC model, the results were compared with MAIRCA and VIKOR models and the results of the comparative analysis are presented. In addition, a total of 18 different scenarios were formed in the sensitivity analysis in which the criteria change their original value. At the end of the sensitivity analysis, the statistical dependence of the results was determined using Spearman's correlation coefficient, which confirmed the applicability of the proposed multicriteria approaches.

Key words: Multicriteria decision making; FUCOM; MABAC; MAIRCA; VIKOR; Supply chain.

1. INTRODUCTION

When looking at the efficiency of the entire supply chain, it is impossible not to notice that it largely depends on the adequate selection of suppliers, because this process is one of the most important factors that directly affect the performance of the company. With proper valuation and selection of the right supplier, this logistics subsystem can efficiently carry out tasks related to the supply of the company, since the right suppliers can meet the requirements and needs posed in the procurement subsystem, which relate to quality, price, quantity of goods, delivery times and other deadlines, flexibility, reliability, etc. The search for suppliers to fulfill this is a permanent and primary task. In order to enable the former, it is necessary to continuously collect and process suppliers' data, establish and maintain adequate links with them.

Supplier selection according to Soheilirad et al. (2017) is an important item when it comes to management decisions that considers several qualitative and quantitative criteria. The importance of this process in organizations is reflected in the formation of the final product price, since the price of raw materials plays a significant role in the price of the final product (Bai and Sarkis 2010; Ramanathan 2007). Supplier selection is one of the more important items in supply chain management (Zhong and Yao, 2017), while managing and developing supplier relationships is a critical issue for achieving competitive advantage (Bai and Sarkis, 2011).
Considering that supplier selection in the supply chain is multi-criteria group decision making, according to Zolfani et al., (2012) it is necessary for managers to know the most appropriate method to use to choose the right supplier. This is especially true when we know that modern supply chains require stringent requirements to be met, so managers are faced with the difficult task of properly evaluating potential suppliers that rarely price products that affect a company's competitiveness in the market (Cox and Ireland, 2002).

Every day a large number of decisions are made on the basis of certain criteria, so it can be safely said that multi-criteria decision making (MCDM) plays a significant role in real life problems, including logistical problems. Particularly important is the role that multi-criteria decision-making plays in the decision-making process that affects the business system or the environment. Therefore, MCDM is an efficient systematic and quantitative way to solve vital logistical problems, including supply chain management. The increasing use of multi-criteria decision-making methods has contributed to the increasing popularity of this field on a daily basis (Zavadskas et al., 2014a).

This paper presents a hybrid MCDM vendor evaluation model, which is based on the application of two models: The Full Consistency Method (FUCOM) and the Multi-Attributive Border Approximation Area Comparision (MABAC) model. The FUCOM model was used to determine criterion weights, while the MABAC model was used to evaluate suppliers. The FUCOM and MABAC models were chosen because of the many advantages that recommend them for use in this area. In addition, the application of the hybrid FUCOM-MABAC model has not been reported in the literature, thus enriching the methodology for supplier evaluation and selection.

The paper is structured through several chapters. In the second section of the paper, a literature analysis was performed through an overview of existing multi-criteria decision-making methods in the field of supply chains. The analysis of the applied methods, as well as the criteria in the works in the field of selection of transport service providers was carried out. Based on the data obtained from the analysis of the works, a new model of multicriteria decision making was proposed, as well as the criteria that will be used to select the transport service provider. In the third section, the mathematical foundations of the hybrid FUCOM-MABAC model are presented. In the fourth section, the testing of the proposed model was performed on a real-life example, in which the evaluation of suppliers at the Ministry of Defense of the Republic of Serbia was carried out. The composition of the fourth section of the paper validated the results through three phases. The first phase involves comparing the results of the FUCOM-MABAC model with those obtained by applying other multicriteria decision-making methods. In the second stage, the validation was performed in a dynamic environment by applying dynamic initial decision matrices. The third phase of validation included a sensitivity analysis of the change in the weights of the coefficients of the criteria. The fifth section of the paper covers concluding considerations, where the presented conclusions are derived from the conducted research and suggestions for further research.

2. LITERATURE REVIEW
The selection of providers, by many authors, is one of the most challenging management problems in logistics (Stojicic et al., 2019). As a result, a number of methods for evaluating transport service providers have been developed to date. In the literature (Fallahpour et al., 2017), the author uses Fuzzy modifications of the Analytic Network Process (ANP) method and the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS). Govindan et al (2013) used the fuzzy TOPSIS method to rank the sustainable performance of a transport service provider. In order to make the choice of a logistics provider from a sustainability perspective while keeping an eye on the company's goals, Dai & Blackhurst (2012) introduced a new integrated approach based on the AHP and Quality Function Deployment (QFD) method, with four hierarchical stages. Rezaei et al (2016) introduced a new approach for selecting a transport service provider consisting of three phases, where the essence attaches to the phase in which the implementation of the Best-Worst Method (BWM) is demonstrated. This approach can benefit companies looking for new markets. Azadnia et al (2013) propose an integrated approach for choosing a logistics provider, which, in addition to applying the fuzzy AHP method, is also based on multi-objective mathematical programming, as well as a rule-based weighted fuzzy method. Luthra et al (2017) introduced an integrated approach for selecting a transport service provider from a sustainability perspective. The approach was implemented through a combination of AHP and VIKOR methods based on 22 criteria. Barata et al (2014) demonstrated the application of MCDM methods in evaluating the degree of organizational sustainability of a company.

Hsu et al (2014) presented an approach based on several MCDM methods in order to select a transport service provider from an environmental point of view, i.e. with respect to carbon emissions. Also, Validi et al (2014) ranked logistics providers and traffic routes based on CO2 emissions using the TOPSIS method. Performance evaluation of logistics providers in the electronics industry, and from an environmental point of view, is a topic of research in the paper (Chatterjee et al., 2018). In this paper, the authors use the rough Decision making trial and evaluation laboratory (DEMATEL) model in combination with the rough Multi-Attribute Ideal Real Comparative Analysis (MAIRCA) method. A quantitative assessment of the performance of transport service providers, from the perspective of sustainability, is presented in the paper (Erol et al., 2011). In addition to MCDM methods, the authors used fuzzy techniques in this paper due to the presence of indeterminacy. More specifically, the fuzzy Entropy and fuzzy Multi-Attribute Utility Theory (MAUT) methods were used. Kusi-Sarpong et al (2018) presented a framework for the ranking and selection of sustainable innovation in logistics, given that innovation plays a very significant role in sustainability. This framework is based on the BWM method, which has been tested and applied by several companies in India. Managing the evaluation of providers from a sustainability perspective is significant for many industries, and therefore for logistics. Therefore, it is an increasingly common topic of research. Table 1 presents an analysis of papers on this topic that have been published in the last few years.
Table 1. Application of MCDM methods in supply chains

<table>
<thead>
<tr>
<th>Problem solved by applying MCDM methods</th>
<th>Applied Methods</th>
<th>Literature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supplier evaluation from an environmental point of view</td>
<td>Fuzzy Entropy-TOPSIS, ELECTRE TRI</td>
<td>Barata et al (2014); Zhao et al (2014)</td>
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<tr>
<td>An integrated approach for identifying and analyzing criteria and alternatives under uncertain conditions</td>
<td>Grey-DEMATEL, FAHP</td>
<td>Azadnia et al (2015); Su et al (2016)</td>
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</table>

Also, MCDM methods have found application in solving a wide range of problems in the field of logistics. Depending on the specific problem in the field of logistics, various MCDM methods were used, such as: AHP, TOPSIS, VIKOR, MAIRCA, ELECTRE, fuzzy AHP, fuzzy TOPSIS and DEMATEL (Alikhani et al., 2019; Ahmadi et al., 2019; Buyukozkan & Gocer, 2017). In the field of logistics, based on the table, we can see that the AHP, TOPSIS and fuzzy TOPSIS methods have the greatest application. The BWM and Fuzzy Preferences Programming (FPP) methods were most commonly used to determine the weight coefficients.
From this literature review we can see that so far, FICOM and MABAC models have not been applied in the supply chain of suppliers. Due to the aforementioned fact, as well as the numerous advantages of the FUCOM and MABAC model (Pamucar and Cirovic, 2015; Gigovic et al., 2017; Pamucar et al., 2018a, 2018b), a hybrid FUCOM-MABAC model is proposed in this paper. Based on the search of the most important index databases of international journals, table 2 presents an analysis of the criteria that have been applied in MCDM methods in optimizing the selection of suppliers in supply chains.

**Table 2.** Applied criteria in MCDM methods in the field of transport service provider selection:

<table>
<thead>
<tr>
<th>Area</th>
<th>Literature</th>
<th>C1</th>
<th>C2</th>
<th>C3</th>
<th>C4</th>
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<tr>
<td>Sustainable supplier selection in supply chains</td>
<td>Alikhani et al (2019)</td>
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<td>Fallahpour et al (2017)</td>
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<td>Memari et al (2019)</td>
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<td>Yu et al (2019)</td>
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<td>Fashoto et al (2016)</td>
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<tr>
<td>Supplier evaluation from an environmental point of view</td>
<td>Razaei and Haeri (2019)</td>
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<td>Parkouhi et al (2019)</td>
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<td>Dobos and Vorossmarty (2019)</td>
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<td>Lin et al (2011)</td>
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<tr>
<td>An integrated supplier evaluation approach</td>
<td>Fu et al (2019)</td>
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<td>Ahmadi and Amin (2019)</td>
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<td>Rouyendegh and Saputro (2014)</td>
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<td>Wu et al (2019)</td>
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<td>Supplier Selection - Application of Fuzzy Theory in MCDM models</td>
<td>Buyukozkan and Gocer (2017)</td>
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<td>Sarkar et al (2017)</td>
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<td>Zhang et al (2015)</td>
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<td>Lima-Junior and Carpinetti (2016)</td>
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<tr>
<td>Supplier Selection - ANP approach</td>
<td>Dargi et al (2014)</td>
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Based on the literature review presented, the following criteria are identified to address supplier evaluation issues in supply chains: C1 - Price (min), C2 - Quality (max), C3 - Service and Delivery (max), C4 - Flexibility (max), C5 - Technological capabilities (max), C6 - Trust (max), C7 - Relationship (max), C8 - Risk (min) and C9 - Innovation (max).

Based on table 2, it can be concluded that C1, C2 and C3, i.e. price, quality and service and delivery, are indispensable criteria when choosing a supplier, regardless of the specific
situation. Another important criterion is C5, i.e., technological capabilities, which was applied in 8 papers, then C6 and C8, respectively, trust and risk, which were applied in six papers, then C4 and C7, respectively, flexibility and relationship (trust), which were applied in five papers. Innovation as a criterion (C9) is the least used in solving the problem of choosing a transport service provider, in only two papers. In this paper, for the purpose of comprehensive consideration of the problem, all the analyzed criteria will be included.

3. FUCOM-MABAC HYBRID SUPPLIER EVALUATION MODEL

This paper presents a new hybrid FUCOM-MABAC model (Figure 1) for supplier evaluation. The model involves the application of two methods: (1) the FUCOM method for determining weight criteria and (2) the MABAC method for evaluating, respectively, ranking alternatives.

![Figure 1. FUCOM-MABAC model](image)

The model is realized through three phases. In the first phase, the criteria are evaluated using the FUCOM method. Based on the questionnaire and expert evaluation, the ranking of criteria and the comparison of ranking criteria are made. The values of the weight coefficients of the criteria are obtained as an output from the FUCOM method. The output data from FUCOM is further processed through the MABAC method algorithm. In the second phase, alternatives are ranked through the application of the MABAC method. In the third phase, the results are validated.
3.1. FUCOM Algorithm

One of the more recent models that, like AHP and BWM, is based on comparison principles in criterion pairs and validation of results through deviation from maximum consistency is FUCOM (Pamucar et al., 2018). FUCOM is a model that eliminates the drawbacks of both the BWM and AHP models to some extent. Advantages of FUCOM implementation are the low number of comparisons in the pairs of criteria, the ability to validate the results by defining the maximum consistency deviation (OMK) of the comparisons, and the consideration of transitivity during comparisons in the criterion pairs. Also, the FUCOM methodological procedure eliminates the problem of comparison redundancy in criterion pairs, which is present in some subjective models for determining criterion weights. Suppose that there are n evaluation criteria in the multicriteria model that are denoted as w_j, j = 1, 2, ..., n and that their weight coefficients need to be determined. Subjective weighting models based on comparisons in criterion pairs require the decision maker to determine the degree of influence of the criterion and on criterion j. In accordance with the defined settings, the following section introduces the FUCOM algorithm (Pamucar et al., 2018).

Algorithm: FUCOM

Input: Expert comparison in criterion pairs
Output: Optimal values of criterion / sub criterion weight coefficients

Step 1: Expert ranking of criteria / sub-criteria.
Step 2: Determination of vector of comparative significance of evaluation criteria.
Step 3: Defining the constraints of a non-linear optimization model.
Constraint 1: The ratio of the weight coefficients of the criteria is equal to the comparative significance between the observed criteria, respectively \( \frac{w_i}{w_{k+1}} = \varphi_{k/(k+1)} \).
Constraint 2: The values of the weighting coefficients should satisfy the condition of mathematical transitivity, that is \( \varphi_{k/(k+1)} \otimes \varphi_{(k+1)/(k+2)} = \varphi_{k/(k+2)} \).
Step 4: Defining a model for determining the final values of the weighting coefficients of the evaluation criteria:

\[
\begin{align*}
\min_{\chi} & \\
\text{s.t.} & \\
\left| \frac{w_{j(k)}}{w_{j(k+1)}} - \varphi_{k/(k+1)} \right| & \leq \chi, \ \forall j \\
\left| \frac{w_{j(k)}}{w_{j(k+2)}} - \varphi_{k/(k+1)} \otimes \varphi_{(k+1)/(k+2)} \right| & \leq \chi, \ \forall j \\
\sum_{j=1}^{n} w_j & = 1, \ \forall j \\
w_j & \geq 0, \ \forall j
\end{align*}
\]

Step 5: Calculation of the final values of the evaluation criteria / sub-criteria \( (w_1, w_2, ..., w_n)^T \)

3.2. MABAC model algorithm

The MABAC method is one of the more recent methods (Pamucar and Cirovic, 2015). To date, it has found wide application in solving numerous problems in the field of multicriteria...
decision making. The basic assumption of the MABAC method is to define the distance of the criterion function of the observed alternative from the boundary approximate area. The following section introduces the MABAC method algorithm (Pamucar and Cirovic, 2015).

**Algorithm: MABAC method**

**Input:** FUCOM weights and initial decision matrix  
**Output:** Rank alternatives

**Step 1:** Formation of initial decision matrix (X).

**Step 2:** Normalization of elements of the initial matrix.

**Step 3:** Calculation of elements of a difficult matrix (V).

**Step 4:** Determination of the matrix of boundary approximate regions (G). Matrix of boundary approximation domains G (12) format $n \times 1$:

$$G = \begin{bmatrix} C_1 & C_2 & \ldots & C_n \end{bmatrix}, \quad g_i = \left( \prod_{j=1}^{m} v_{ij} \right)^{1/m}$$

($v_{ij}$ represent elements of a difficult matrix).

**Step 5:** Calculation of the elements of the distance matrix of alternatives from the boundary approximation region (Q). The distance of the alternatives from the boundary approximation region ($q_{ij}$) is determined as the difference between the elements of the constrained matrix (V) and the value of the boundary approximation regions (G).

$$Q = \begin{bmatrix} v_{11} - g_1 & v_{12} - g_2 & \ldots & v_{1n} - g_n \\ v_{21} - g_1 & v_{22} - g_2 & \ldots & v_{2n} - g_n \\ \vdots & \vdots & \ddots & \vdots \\ v_{m1} - g_1 & v_{m2} - g_2 & \ldots & v_{mn} - g_n \end{bmatrix} = \begin{bmatrix} q_{11} & q_{12} & \ldots & q_{1n} \\ q_{21} & q_{22} & \ldots & q_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ q_{m1} & q_{m2} & \ldots & q_{mn} \end{bmatrix}$$

**Step 6:** Ranking alternatives. The calculation of the values of the criterion functions is obtained as the sum of the distances of the alternatives from the boundary approximation regions ($q_{ij}$).

4. **APPLICATION OF THE FUCOM-MABAC MODEL**

The model has been tested on a real issue that involves the evaluation of suppliers of spare parts for transport vehicles in the Ministry of Defense of the Republic of Serbia. A total of eight suppliers were considered whose names were not included in this survey because of the confidentiality of the tender documents. The study involved four experts with at least 10 years of experience in supply chain evaluation.

In the first phase of implementation of the FUCOM-MABAC model, it is necessary to define the weight coefficients of the criteria using FUCOM. The first phase of FUCOM involves expert ranking of criteria. In table 3 you can see the significance of the criteria, which were determined on the basis of previously defined criteria ranks.
Table 3. Criteria ranking and significance determination

<table>
<thead>
<tr>
<th>Experts</th>
<th>C1</th>
<th>C2</th>
<th>C3</th>
<th>C4</th>
<th>C5</th>
<th>C6</th>
<th>C7</th>
<th>C8</th>
<th>C9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Significance of the criteria</td>
<td>1.5</td>
<td>3.0</td>
<td>3.6</td>
<td>4.1</td>
<td>4.8</td>
<td>5.2</td>
<td>6.0</td>
<td>8.0</td>
<td>8.0</td>
</tr>
<tr>
<td></td>
<td>C2</td>
<td>2.0</td>
<td>C6</td>
<td>3.5</td>
<td>C8</td>
<td>4.0</td>
<td>C9</td>
<td>5.5</td>
<td>6.0</td>
</tr>
<tr>
<td></td>
<td>C3</td>
<td>2.1</td>
<td>C4</td>
<td>2.8</td>
<td>C7</td>
<td>3.5</td>
<td>C1</td>
<td>2.3</td>
<td>8.0</td>
</tr>
<tr>
<td></td>
<td>C4</td>
<td>1.5</td>
<td>C8</td>
<td>2.1</td>
<td>C5</td>
<td>1.5</td>
<td>C7</td>
<td>1.0</td>
<td>2.0</td>
</tr>
<tr>
<td></td>
<td>C5</td>
<td>1.1</td>
<td>C6</td>
<td>2.5</td>
<td>C9</td>
<td>3.5</td>
<td>C8</td>
<td>1.2</td>
<td>1.1</td>
</tr>
<tr>
<td></td>
<td>C6</td>
<td>1.0</td>
<td>C7</td>
<td>3.0</td>
<td>C9</td>
<td>1.5</td>
<td>C1</td>
<td>4.5</td>
<td>4.0</td>
</tr>
<tr>
<td></td>
<td>C7</td>
<td>1.1</td>
<td>C8</td>
<td>3.0</td>
<td>C6</td>
<td>2.0</td>
<td>C5</td>
<td>2.0</td>
<td>3.0</td>
</tr>
<tr>
<td></td>
<td>C8</td>
<td>1.2</td>
<td>C5</td>
<td>2.0</td>
<td>C7</td>
<td>1.5</td>
<td>C4</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td></td>
<td>C9</td>
<td>1.3</td>
<td>C4</td>
<td>1.0</td>
<td>C6</td>
<td>1.5</td>
<td>C1</td>
<td>1.0</td>
<td>1.0</td>
</tr>
</tbody>
</table>
| Based on the significance of the criteria (Table 3) a nonlinear model was formed for the calculation of the optimal values of the weight coefficients. A total of four models have been formed, one for each expert. The following section provides a model for calculating the optimal values of the weighting coefficients for the first expert.

**Expert 1**

1. \( \frac{w_1}{w_2} - 1.5 \leq \chi \)
2. \( \frac{w_2}{w_4} - 2 \leq \chi \)
3. \( \frac{w_4}{w_8} - 1.2 \leq \chi \)
4. \( \frac{w_8}{w_3} - 1.139 \leq \chi \)
5. \( \frac{w_1}{w_6} - 1.17 \leq \chi \)
6. \( \frac{w_6}{w_5} - 1.083 \leq \chi \)
7. \( \frac{w_5}{w_7} - 1.53 \leq \chi \)
8. \( \frac{w_7}{w_9} - 1.3 \leq \chi \)
9. \( \frac{w_1}{w_4} - 3 \leq \chi \)
10. \( \frac{w_2}{w_8} - 2.4 \leq \chi \)
11. \( \frac{w_4}{w_7} - 1.367 \leq \chi \)
12. \( \frac{w_8}{w_6} - 1.33 \leq \chi \)
13. \( \frac{w_1}{w_5} - 1.267 \leq \chi \)
14. \( \frac{w_6}{w_7} - 1.657 \leq \chi \)
15. \( \frac{w_5}{w_9} - 2.035 \leq \chi \)

By solving nonlinear models, the optimal values of the weight coefficients for each expert are defined, Table 4.

Table 4. Criteria weight coefficients

<table>
<thead>
<tr>
<th>Experts</th>
<th>E1</th>
<th>E2</th>
<th>E3</th>
<th>E4</th>
<th>Medium</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>0.311</td>
<td>0.100</td>
<td>0.117</td>
<td>0.030</td>
<td>0.1395</td>
</tr>
<tr>
<td>C2</td>
<td>0.207</td>
<td>0.120</td>
<td>0.180</td>
<td>0.149</td>
<td>0.1640</td>
</tr>
<tr>
<td>C3</td>
<td>0.076</td>
<td>0.299</td>
<td>0.269</td>
<td>0.149</td>
<td>0.1982</td>
</tr>
<tr>
<td>C4</td>
<td>0.104</td>
<td>0.067</td>
<td>0.096</td>
<td>0.149</td>
<td>0.1040</td>
</tr>
<tr>
<td>C5</td>
<td>0.060</td>
<td>0.086</td>
<td>0.054</td>
<td>0.075</td>
<td>0.0687</td>
</tr>
<tr>
<td>C6</td>
<td>0.065</td>
<td>0.120</td>
<td>0.077</td>
<td>0.075</td>
<td>0.0842</td>
</tr>
<tr>
<td>C7</td>
<td>0.052</td>
<td>0.050</td>
<td>0.045</td>
<td>0.149</td>
<td>0.0740</td>
</tr>
<tr>
<td>C8</td>
<td>0.086</td>
<td>0.075</td>
<td>0.128</td>
<td>0.149</td>
<td>0.1095</td>
</tr>
<tr>
<td>C9</td>
<td>0.039</td>
<td>0.054</td>
<td>0.034</td>
<td>0.075</td>
<td>0.0505</td>
</tr>
</tbody>
</table>
By averaging the values obtained, the optimal values of the weight coefficients of the criteria were defined, which were further used for supplier evaluation using the MABAC method. The paper evaluates eight suppliers, designated A1 through A8. Based on the supplier data, the MABAC model was implemented through the following six steps:

**Step 1.** In the MABAC model we start from the initial decision matrix (X):

\[
X = \begin{bmatrix}
65 & 23 & 56 & 53 & 54 & 95 & 53 & 59 & 62 \\
45 & 29 & 50 & 49 & 49 & 87 & 63 & 73 & \\
56 & 43 & 70 & 57 & 41 & 59 & 41 & \\
70 & 35 & 82 & 43 & 91 & 93 & 38 & 66 & \\
82 & 68 & 63 & 95 & 35 & 81 & 79 & 39 & 49 \\
90 & 56 & 71 & 80 & 62 & 71 & 91 & 23 & 81 \\
48 & 39 & 63 & 74 & 25 & 66 & 66 & 72 & 52 \\
76 & 56 & 59 & 61 & 53 & 6 & \\
\end{bmatrix}
\]

**Step 2.** Using linear normalization, the elements of the matrix X are normalized, thus obtaining the normalized matrix N:

\[
N = \begin{bmatrix}
0.556 & 0 & 0.188 & 0.192 & 0.439 & 1 & 0.283 & 0.265 & 0.406 \\
0.133 & 0 & 0.115 & 0.364 & 0 & 0.925 & 0.184 & 0.750 & \\
0.756 & 0.444 & 0.625 & 0.269 & 0.252 & 0.294 & 0.057 & 0.408 & 0.313 \\
0.444 & 0.267 & 1 & 0 & 1 & 0.961 & 0 & 0.633 & 0.531 \\
0.111 & 1 & 0.406 & 1 & 0.152 & 0.725 & 0.774 & 0.673 & 0 \\
0 & 0.733 & 0.656 & 0.712 & 0.561 & 0.529 & 1 & 1 & 1 \\
0.933 & 0.356 & 0.406 & 0.596 & 0 & 0.431 & 0.528 & 0 & 0.094 \\
0.311 & 0.733 & 0.281 & 0.346 & 0.424 & 0.451 & 0.396 & 0.531 & 0.875 \\
\end{bmatrix}
\]

**Step 3.** By multiplying the optimal values of the weighting coefficients obtained by applying FUCOM, with the elements of the normalized matrix N, we obtain a difficult normalized matrix V:

\[
V = \begin{bmatrix}
0.217 & 0.164 & 0.235 & 0.124 & 0.099 & 0.168 & 0.095 & 0.139 & 0.071 \\
0.279 & 0.186 & 0.198 & 0.116 & 0.094 & 0.084 & 0.142 & 0.130 & 0.088 \\
0.245 & 0.237 & 0.322 & 0.132 & 0.085 & 0.109 & 0.078 & 0.154 & 0.066 \\
0.202 & 0.208 & 0.396 & 0.104 & 0.137 & 0.165 & 0.074 & 0.179 & 0.077 \\
0.155 & 0.328 & 0.279 & 0.208 & 0.079 & 0.145 & 0.131 & 0.183 & 0.051 \\
0.140 & 0.284 & 0.328 & 0.178 & 0.107 & 0.129 & 0.148 & 0.219 & 0.101 \\
0.270 & 0.222 & 0.279 & 0.166 & 0.069 & 0.121 & 0.113 & 0.110 & 0.055 \\
0.183 & 0.284 & 0.254 & 0.140 & 0.098 & 0.122 & 0.103 & 0.168 & 0.095 \\
\end{bmatrix}
\]
Step 4. In Step 4, we approach the defined matrix of boundary approximate regions (G). The boundary approximation area (GAO) for each criterion is determined by geometrically averaging the values of the matrix V.

\[
G = \begin{bmatrix}
C_1 & C_2 & C_3 & C_4 & C_5 & C_6 & C_7 & C_8 & C_9 \\
0.2055 & 0.2335 & 0.2807 & 0.1425 & 0.0942 & 0.1276 & 0.1074 & 0.1568 & 0.0736
\end{bmatrix}
\]

Step 5. In this step, the distance of the elements \(V\) of the matrix from the matrix \(G\) is calculated. Thus, we obtain the matrix \(Q\), which represents the distance of the alternatives from GAO.

\[
Q = \begin{bmatrix}
\min f_1 & \max f_2 & \max f_3 & \max f_4 & \max f_5 & \max f_6 & \max f_7 & \min f_8 & \max f_9 \\
A1 & 0.011 & -0.070 & -0.045 & -0.018 & 0.005 & 0.041 & -0.012 & -0.018 & -0.003 \\
A2 & 0.073 & -0.048 & -0.083 & -0.026 & -0.001 & -0.043 & 0.035 & -0.027 & 0.015 \\
A3 & 0.039 & 0.003 & 0.041 & -0.010 & -0.009 & -0.019 & -0.029 & -0.003 & -0.007 \\
A4 & -0.004 & -0.026 & 0.116 & -0.038 & 0.043 & 0.037 & -0.033 & 0.022 & 0.004 \\
A5 & -0.051 & 0.094 & -0.002 & 0.066 & -0.015 & 0.018 & 0.024 & 0.026 & -0.023 \\
A6 & -0.066 & 0.051 & 0.048 & 0.036 & 0.013 & 0.001 & 0.041 & 0.062 & 0.027 \\
A7 & 0.064 & -0.011 & -0.002 & 0.024 & -0.025 & -0.007 & 0.006 & -0.047 & -0.018 \\
A8 & -0.023 & 0.051 & -0.027 & -0.0020 & 0.004 & -0.005 & -0.004 & 0.011 & 0.021 \\
\end{bmatrix}
\]

Step 6. The ranking of alternatives is done based on the value of the alternative criteria functions. The criteria functions of the alternatives are obtained by summing the elements of the matrix \(Q\) by rows. Thus, we obtain the values of the alternative criteria functions for each supplier:

\[
S_2 = -0.104 \quad S_3 = 0.007 \quad S_4 = 0.120 \quad S_5 = 0.137 \quad S_6 = 0.212 \quad S_7 = -0.018 \quad S_8 = 0.025
\]

Based on the values of the criteria functions, a final ranking of alternatives is defined: \(A6 > A5 > A4 > A8 > A3 > A7 > A2 > A1\).

Before making a decision, it is necessary to evaluate the reliability of the results obtained. Validation of the results of the FUCOM-MABAC model performed through three phases. In the first phase, the initial ranking of the alternatives was compared with that of other MCDM models, Figure 2. Since the MABAC method uses linear normalization, the Multi Attributive Ideal-Real Comparative Analysis (MAIRCA) method and the Multicriteria Compromise Ranking (VIKOR) method also have linear normalization.
The alternative rankings according to the methods shown show that the A6 alternative remained the first rank by all methods. The MAIRCA method obtained the same rank as the MABAC method, while the VIKOR method changed the rank (alternative A1 replaced the rank with alternative A2 and alternative A3 replaced the rank with alternative A8). To determine the statistical significance between the rankings obtained by the FUCOM-MABAC model and other approaches, Spearman's correlation coefficient (SKK) was used. This correlation coefficient is the simple linear correlation coefficient between ranks. Spearman's rank correlation coefficient is a non-parametric method for estimating the strength of an association that applies when data for at least one variable is given as ordinal data or rank, at least one variable has no normal distribution and the relationship between the variables is not linear. The results of ranking comparisons using SKK are shown in table 5.

Table 5. Rank correlation of tested methods

<table>
<thead>
<tr>
<th>Method MCDM</th>
<th>MABAC</th>
<th>MAIRCA</th>
<th>VIKOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>SKK</td>
<td>1.000</td>
<td>1.000</td>
<td>0.952</td>
</tr>
</tbody>
</table>

From table 5 we can see that the MABAC and MAIRCA methods are in complete correlation. Also, the VIKOR method shows a high correlation compared to the MABAC method. Since in this case all the values of SKK are significantly higher than 0.9 (exceptional correlation) and the mean value is 0.976, we can conclude that there is a very large correlation (closeness) between the proposed model and other methods of MCDM. In doing so, we can conclude that the proposed ranking is validated and credible.

In the second stage of result validation, the performance analysis of the proposed model was performed under the conditions of the dynamic initial matrix. In the dynamic starting matrix, for each scenario, the number of alternatives was changed and the ranks obtained were analyzed. Scenarios are formed for situations where one inferior alternative is removed from subsequent considerations, while the remaining dominant alternatives are ranked according to the newly acquired initial decision matrix. In this study, the initial solution A6> A5> A4> A8> A3> A7> A2> A1 was obtained. Clearly, alternative A1 is the worst option. In the first
scenario, we eliminate alternative A1 from the list of alternatives and obtain a new decision matrix with a total of seven alternatives. The new decision matrix is re-solved using the FUCom-MABAC model. In the following scenario, the next worst alternative was eliminated and the remaining alternatives were ranked. Thus, a total of seven scenarios were formed, which are shown in table 6.

**Table 6. Ranks of alternatives within a dynamic decision matrix**

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Rang</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1</td>
<td>A6&gt;A5&gt;A4&gt;A8&gt;A3&gt;A7&gt;A2&gt;A1</td>
</tr>
<tr>
<td>S2</td>
<td>A6&gt;A5&gt;A4&gt;A8&gt;A3&gt;A7&gt;A2</td>
</tr>
<tr>
<td>S3</td>
<td>A6&gt;A5&gt;A4&gt;A8&gt;A3&gt;A7</td>
</tr>
<tr>
<td>S4</td>
<td>A6&gt;A5&gt;A4&gt;A8&gt;A3</td>
</tr>
<tr>
<td>S5</td>
<td>A6&gt;A5&gt;A4&gt;A8</td>
</tr>
<tr>
<td>S6</td>
<td>A6&gt;A5&gt;A4</td>
</tr>
<tr>
<td>S7</td>
<td>A6&gt;A5</td>
</tr>
</tbody>
</table>

It is clear from table 6 that when the worst-case alternative is eliminated, there is no change in the best-ranked alternative in the rearranged matrix. Based on this, we can conclude that the FUCom-MABAC model does not lead to a rank reversal among alternatives. The A6 alternative remained the best ranked across all scenarios, confirming the robustness and accuracy of the resulting alternative rankings in a dynamic environment.

Since the results of multicriteria decision making depend on the values of the weighting coefficients of the evaluation criteria, in the third phase, an analysis of the sensitivity of the results to the change in the weights of the criteria was performed. The sensitivity analysis of the rankings of the alternatives to changes in the weight coefficients of the criteria was conducted through the eighteen scenarios given in table 7.

**Table 7. Sensitivity analysis scenarios**

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Criterion weights</th>
<th>Scenario</th>
<th>Criterion weights</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1</td>
<td>( w_{c1}=1.25 \times w_{c11(SV)}; ) ( w_{c2}=0.25 \times w_{c21(SV)}; )</td>
<td>S10</td>
<td>( w_{c2}=1.55 \times w_{c11(SV)}; ) ( w_{c2}=0.55 \times w_{c21(SV)}; )</td>
</tr>
<tr>
<td>S2</td>
<td>( w_{c2}=1.25 \times w_{c21(SV)}; ) ( w_{c2}=0.25 \times w_{c2(SV)}; )</td>
<td>S11</td>
<td>( w_{c2}=0.55 \times w_{c21(SV)}; ) ( w_{c2}=1.55 \times w_{c2(SV)}; )</td>
</tr>
<tr>
<td>S3</td>
<td>( w_{c2}=1.25 \times w_{c21(SV)}; ) ( w_{c2}=0.25 \times w_{c2(SV)}; )</td>
<td>S12</td>
<td>( w_{c2}=0.55 \times w_{c2(SV)}; ) ( w_{c2}=1.55 \times w_{c21(SV)}; )</td>
</tr>
<tr>
<td>S4</td>
<td>( w_{c2}=0.25 \times w_{c21(SV)}; ) ( w_{c2}=1.25 \times w_{c2(SV)}; )</td>
<td>S13</td>
<td>( w_{c2}=0.55 \times w_{c2(SV)}; ) ( w_{c2}=1.55 \times w_{c21(SV)}; )</td>
</tr>
<tr>
<td>S5</td>
<td>( w_{c2}=0.25 \times w_{c21(SV)}; ) ( w_{c2}=1.25 \times w_{c2(SV)}; )</td>
<td>S14</td>
<td>( w_{c2}=0.55 \times w_{c2(SV)}; ) ( w_{c2}=1.55 \times w_{c21(SV)}; )</td>
</tr>
<tr>
<td>S6</td>
<td>( w_{c2}=0.25 \times w_{c21(SV)}; ) ( w_{c2}=1.25 \times w_{c2(SV)}; )</td>
<td>S15</td>
<td>( w_{c2}=1.55 \times w_{c21(SV)}; ) ( w_{c2}=0.55 \times w_{c2(SV)}; )</td>
</tr>
<tr>
<td>S7</td>
<td>( w_{c2}=1.25 \times w_{c21(SV)}; ) ( w_{c2}=0.25 \times w_{c2(SV)}; )</td>
<td>S16</td>
<td>( w_{c2}=1.55 \times w_{c2(SV)}; ) ( w_{c2}=0.55 \times w_{c21(SV)}; )</td>
</tr>
<tr>
<td>S8</td>
<td>( w_{c2}=0.25 \times w_{c21(SV)}; ) ( w_{c2}=1.25 \times w_{c2(SV)}; )</td>
<td>S17</td>
<td>( w_{c2}=0.55 \times w_{c2(SV)}; ) ( w_{c2}=1.55 \times w_{c21(SV)}; )</td>
</tr>
<tr>
<td>S9</td>
<td>( w_{c2}=1.25 \times w_{c21(SV)}; ) ( w_{c2}=0.25 \times w_{c2(SV)}; )</td>
<td>S18</td>
<td>( w_{c2}=0.55 \times w_{c2(SV)}; ) ( w_{c2}=1.55 \times w_{c21(SV)}; )</td>
</tr>
</tbody>
</table>

*SV (old value)*
The sensitivity analysis scenarios for the change in criteria weights are grouped into two groups. Within each group, the weighting coefficients of the criteria were respectively increased by 25% and 55%, respectively. In each of the 18 scenarios, one criterion is favored within the two groups, by which the weight coefficient is increased by the indicated values. In the same scenario, the weighting coefficients are reduced by 75% (S1-S9) and 45% (S10-S18) respectively. Changes in the ranking of alternatives over the 18 scenarios are shown in Table 8.

Table 8. Rank changes due to changes in criteria weights

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Rang</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1</td>
<td>A7&gt;A2&gt;A3&gt;A4&gt;A6&gt;A1&gt;A5&gt;A8</td>
</tr>
<tr>
<td>S2</td>
<td>A5&gt;A6&gt;A8&gt;A3&gt;A4&gt;A7&gt;A2&gt;A1</td>
</tr>
<tr>
<td>S3</td>
<td>A4&gt;A6&gt;A3&gt;A5&gt;A7&gt;A8&gt;A1&gt;A2</td>
</tr>
<tr>
<td>S4</td>
<td>A5&gt;A6&gt;A7&gt;A8&gt;A4&gt;A3&gt;A1&gt;A2</td>
</tr>
<tr>
<td>S5</td>
<td>A4&gt;A6&gt;A5&gt;A8&gt;A3&gt;A1&gt;A2&gt;A7</td>
</tr>
<tr>
<td>S6</td>
<td>A4&gt;A6&gt;A5&gt;A1&gt;A8&gt;A7&gt;A3&gt;A2</td>
</tr>
<tr>
<td>S7</td>
<td>A6&gt;A5&gt;A2&gt;A8&gt;A7&gt;A4&gt;A3&gt;A1</td>
</tr>
<tr>
<td>S8</td>
<td>A6&gt;A5&gt;A4&gt;A8&gt;A3&gt;A1&gt;A7&gt;A2</td>
</tr>
<tr>
<td>S9</td>
<td>A6&gt;A4&gt;A8&gt;A5&gt;A3&gt;A2&gt;A7&gt;A1</td>
</tr>
<tr>
<td>S10</td>
<td>A4&gt;A7&gt;A6&gt;A3&gt;A5&gt;A2&gt;A8&gt;A1</td>
</tr>
<tr>
<td>S11</td>
<td>A5&gt;A6&gt;A8&gt;A4&gt;A3&gt;A7&gt;A2&gt;A1</td>
</tr>
<tr>
<td>S12</td>
<td>A4&gt;A6&gt;A5&gt;A3&gt;A7&gt;A8&gt;A1&gt;A2</td>
</tr>
<tr>
<td>S13</td>
<td>A6&gt;A5&gt;A4&gt;A7&gt;A8&gt;A3&gt;A1&gt;A2</td>
</tr>
<tr>
<td>S14</td>
<td>A6&gt;A4&gt;A5&gt;A8&gt;A3&gt;A7&gt;A1&gt;A2</td>
</tr>
<tr>
<td>S15</td>
<td>A6&gt;A4&gt;A5&gt;A8&gt;A3&gt;A7&gt;A1&gt;A2</td>
</tr>
<tr>
<td>S16</td>
<td>A6&gt;A5&gt;A4&gt;A8&gt;A7&gt;A2&gt;A3&gt;A1</td>
</tr>
<tr>
<td>S17</td>
<td>A6&gt;A5&gt;A4&gt;A8&gt;A3&gt;A7&gt;A1&gt;A2</td>
</tr>
<tr>
<td>S18</td>
<td>A6&gt;A4&gt;A5&gt;A8&gt;A3&gt;A7&gt;A2&gt;A1</td>
</tr>
</tbody>
</table>

The results show that assigning different criteria weights across the 18 scenarios presented does not lead to a significant change in the rankings of the alternatives. In scenarios S2-S9 and S11-S18, we notice that alternative A6 has a first or second rank. In scenarios S1 and S10, alternative A6 is not among the top two alternatives due to the high value of the A6 supplier engagement price, and in scenarios S1 and S10, the impact of the weighting factor on the final decision has just been increased.

The results (Table 8) show that assigning different weights to the criteria across scenarios leads to a change in the rank of alternatives, thus confirming that the model is sensitive to changes in weight coefficients. The following section compares the ranks in Table 8 with the initial ranks. SKK values are shown in Figure 3.
Based on figure 3 we can conclude that in 12 scenarios there is a high rank correlation, since the SKK value is greater than 0.80, while in four scenarios the correlation is satisfactory, ie greater than 0.50. In two scenarios, the SKK value is less than 0.50. However, the mean SKK across all scenarios is 0.778, which shows a satisfactory average correlation. Based on this, we can conclude that there is a satisfactory closeness of ranks and that the proposed ranking is validated and credible.

5. CONCLUSION

The multicriteria model presented in this paper is an integration of the FUCOM and MABAC methods, where FUCOM is used to calculate the criterion weight values, while the MABAC method is applied for supplier evaluation and selection. The model was verified through the process of selecting suppliers in a real system based on nine criteria. The results show that supplier six represents the best solution in all scenarios involving different criteria values, except in two scenarios when the price criterion is favored. The analysis of the results showed that the obtained ranks of alternatives of the FUCOM-MABAC model were in complete correlation with the ranks of other multicriteria models with which the comparison was made. One of the contributions of this paper is the FUCOM-MABAC model, which provides an objective aggregation of expert decisions. In addition, another contribution of the paper is to improve the methodology of supplier evaluation and selection through a new hybrid multicriteria model. The use of this or similar approach in the selection of suppliers through literature analysis has not been observed.

By applying the developed approach, it is possible to approach multicriteria decision-making in an easy way and to evaluate and select suppliers that have a significant impact on achieving the efficiency of the complete supply chain. The four-stage model can also be applied to make
other decisions. It is applicable in the supplier evaluation process in all areas, and may be particularly suitable for manufacturing companies. The flexibility of the model is reflected in the fact that its verification can be implemented by the integration of any multicriteria decision-making methods. Further research related to this paper is related to the application of theories of uncertainty (fuzzy, rough, neutrosophic etc.) with this and other multicriteria methods in this field.

REFERENCES


LINEAR PROGRAMMING FORMULATION FOR VEHICLE ROUTING PROBLEM WHICH IS MINIMIZED IDLE TIME

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\textsuperscript{2} Altınbaş University Prof.(PhD), School of Applied Sciences, kemal.sezen@altinbas.edu.tr

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Abstract: The paper is related to “What is a Vehicle Routing Problem Which Is Minimized Idle Time and how to model as Linear Programming”. In this study, a Linear Programming (LP) model has been developed for a Vehicle Routing Problem (VRP) to minimize total idle time (MIT). This problem has been realized according to manage the route operations of a company carrying long-distance passengers by bus in Turkey. The differences of this problem from the other VRP firstly comes from its objective function. It suggests vehicles should work more because they make profit if they work. So its objective function should be defined as to minimize the sum of idle time of those vehicles. To the contrary of VRP problems which are examined so far, vehicles should work more and sometimes they should prefer long distance route also. Other two differences are related with constraints: Some locations should be visited more than once for different time periods and sub-tours could be allowed to occur in some situations. For solving this kind of problems, it is very important using exact methods such as Mathematical Programming or Branch and Bound.

Keywords: Vehicle routing problem; Minimizing idle time; Linear Programming; Location & time point

1. INTRODUCTION

Vehicle Routing Problem (VRP) is a NP-Hard problem and encountered in logistics management which constitutes about 20% of product-service costs [1]. The research on VRP problems grows an average of 6% every year [2].

The main components of the VRP are geographical route network, customer, warehouse, vehicles and drivers. Different VRPs are distinguished on these basic components by different constraints or types of routes. According to those components, basic VRP problems are divided into subcategories as capacity limited, distance constrained, time restricted, pick and delivery, open, mixed vehicles, partly carried, periodic, stochastic, fuzzy.

It is generally seen that the objective functions of all problems are minimizing the costs of linking geographical resources to target points in previous researches [3,4]. VRP problems are grouped in the most general sense as above, but there are also sub-problem definitions for the hybrid or these basic categories [2].

In this study a new kind of objective function, is presented and modelled, which will gain a different view on the aforementioned problems. The problem that is addressed is that it is different from other problems in terms of targeting the minimization of idle time for geographical points while offering to use vehicle more in their route. For this reason, the name of the problem is proposed as VRPMIT (Vehicle Routing Problem Which Is Minimized Idle Time).
In the literature, when looking at time-targeted or limited problems for VRP, there are short-term goals such as minimum driving salary and minimum CO2 emissions [4]. It evaluates the issues such as time-related work, traffic conditions, vehicle maintenance, and presents sub-solutions with certain or indeterminate time of arrival. Outputs of these aims may give similar results, but this study has a different perspective. The objective function addressed is a timed objective, which is ultimately aimed at having at minimum idle time of the vehicle, device or equipment. From this point of view, vehicles should/may work for longer. As a result, the number of cars operated will be reduced, resulting in less waste in resource use and increased operating efficiency.

When we look at the previous researches, proposed solutions to VRP problems are exact, heuristic and meta-heuristic methods [1]. These are many solutions that uses heuristic algorithms due to easiness of finding a suitable solution. [3]. The solutions to be developed for LPVRP MIT will be effected to the direct and indirect costs such as number of vehicles, fleet management, service-maintenance, ticket prices, carbon emissions, wastage reduction both land and airway operations.

2. DEFINITION OF PROBLEM

A company that provides passenger transportation by bus on the highway has operation centers that coordinate and carry out passenger transport operations in different settlement locations. These centers independently give their trip decisions related to their operations, can put in new trips and can cancel or take out an existing trip. A trip is the name of the bus passenger transport from a settlement point (location, we call it the source) that will travel at a certain time (departure time) to another settlement point (destination) at a certain time. When the bus completes this process, it waits until the most suitable time of departure to move to the target settlement point at this settlement point. This waiting period is called idle time. Figure 1 shows the route charts of one of the operation centers of the company during the research period on the map. The idle times between trips are given in Table 1 in minutes. Table 3 shows how these values are calculated.

![Figure 1: Destination points (locations)](image)

There can be multiple trips from a given geographical point of departure, or more than one trips at different times. Each vehicle must complete a tour included the whole trips has to take place once in the related sub operation group. This tour is called a Mevlana tour by transport professionals.
In this problem company has five sub groups and we have only interested in one of them. Thus we build a tour for one decision center included 34 trip. If we want to put all that sub groups together we build a tour include about 500 trips. This kind of long run tours was called Attila tours by historian. Hence it could be found out more lower cost and could be possible more effective decision making.

Figure 2 shows the trips managed by one of the company’s operation centers during the research period. Each bow on the figure represents one trip. Sp9 arc corresponds to sp9 (trip) in Table 2, which represents an expedition from Balıkesir at 8:00 am to the arrival time of 22:00 in Alanya, the journey lasting approximately 14:00 hours. When Figure 2 is examined, it is seen that there is only two way reciprocal trip to the both sides, but between Antalya and İzmir, and between Fethiye and İzmir there are 6 two way trip to the both sides reciprocal.

**Figure 2:** An operation center’s trips

**Figure 3:** As a TSP

In the problem, the objective is to minimize the sum of the idle time (waiting time) between trips due to time-dimension geographical point connections, taking into account the geographic boundaries as well as the time dimension. The vehicles must make these trips as soon as possible and return to the starting point as they do in Traveling Salesman Problem. The shortest time of all trips will ensure that the total duration of the tour is the smallest if there is no idle time. In this view the problem seems like Jobshop scheduling problem also. However, our problem may have sub routes and some other VRP constraints.

**Table 1:** Idle time between trips, trimmed table for easy viewing. (In minutes)

<table>
<thead>
<tr>
<th>Trip No</th>
<th>sp1-9</th>
<th>sp10</th>
<th>sp11</th>
<th>sp12</th>
<th>sp13</th>
<th>sp14</th>
<th>sp15</th>
<th>sp16</th>
<th>sp17</th>
<th>sp18-34</th>
</tr>
</thead>
<tbody>
<tr>
<td>sp1-9</td>
<td></td>
<td>X</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>...</td>
</tr>
<tr>
<td>sp10</td>
<td>X</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>...</td>
</tr>
<tr>
<td>sp11</td>
<td>-</td>
<td>X</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>...</td>
</tr>
<tr>
<td>sp12</td>
<td>-</td>
<td>-</td>
<td>X</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>...</td>
</tr>
<tr>
<td>sp13</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>X</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>...</td>
</tr>
<tr>
<td>sp14</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>X</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>...</td>
</tr>
<tr>
<td>sp15</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>X</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>...</td>
</tr>
<tr>
<td>sp16</td>
<td>1090</td>
<td>760</td>
<td>100</td>
<td>1300</td>
<td>1420</td>
<td>280</td>
<td>X</td>
<td>-</td>
<td>-</td>
<td>...</td>
</tr>
<tr>
<td>sp17</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>X</td>
<td>-</td>
<td>...</td>
</tr>
<tr>
<td>sp18-34</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>X</td>
<td>...</td>
</tr>
</tbody>
</table>

Data structure of this problem can be seen in Table 2. One data can be defined as five column or by five field. To make sure returning to the start point, every trip needs to be reciprocal.

**Table 2:** Data about trips

<table>
<thead>
<tr>
<th>Trip Number</th>
<th>City Departure</th>
<th>City Destination</th>
<th>Departure Time</th>
<th>Duration</th>
<th>Arrival Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>sp9</td>
<td>Balıkesir</td>
<td>Alanya</td>
<td>8:00</td>
<td>14:00</td>
<td>22:00</td>
</tr>
</tbody>
</table>
For the sake of clarity, the calculation of the VRPMIT is shown in Table 3. To provide one route, The Tour I has been randomly created from Table 2 as; sp23 – sp11 – sp9 – sp15 – sp23

**Table 3:** Traveling and idle time for the Tour I.

<table>
<thead>
<tr>
<th>Tour I</th>
<th>Journey Number</th>
<th>Arrival Time (A)</th>
<th>Next Departure Time(D)</th>
<th>Spare Time(D-A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>sp23</td>
<td>9:00</td>
<td>23:00</td>
<td>14:00</td>
</tr>
<tr>
<td>2</td>
<td>sp11</td>
<td>13:00</td>
<td>8:00</td>
<td>19:00</td>
</tr>
<tr>
<td>3</td>
<td>sp9</td>
<td>22:00</td>
<td>17:00</td>
<td>19:00</td>
</tr>
<tr>
<td>4</td>
<td>sp15</td>
<td>7:00</td>
<td>19:00</td>
<td>12:00</td>
</tr>
</tbody>
</table>

Total Idle Time (B) 64:00

Efficiency Ratio : T / (T+B) 56/120=0.47

Efficient ratio is about 47%. If we change routing sequence like sp23–sp15–sp9–sp11–sp23 we create Tour II in Table 4.

**Table 4:** Traveling and idle time for Tour II.

<table>
<thead>
<tr>
<th>Tour II</th>
<th>Journey Number</th>
<th>Arrival Time (A)</th>
<th>Next Departure Time(D)</th>
<th>Spare Time(A-D)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>sp23</td>
<td>9:00</td>
<td>17:00</td>
<td>8:00</td>
</tr>
<tr>
<td>2</td>
<td>sp15</td>
<td>7:00</td>
<td>8:00</td>
<td>1:00</td>
</tr>
<tr>
<td>3</td>
<td>sp9</td>
<td>22:00</td>
<td>23:00</td>
<td>1:00</td>
</tr>
<tr>
<td>4</td>
<td>sp11</td>
<td>13:00</td>
<td>19:00</td>
<td>6:00</td>
</tr>
</tbody>
</table>

Total Idle Time (B) 16:00

Efficiency Ratio : T / (T+B) 56/72=0.78

As shown from Table 3 and 4, efficiency ratio has raised to 78%. In the Tour I (first route) total time was 120 hours but second route (Tour 2) takes only 72 hours. It is gained 48 hours or minimum two buses are saved by means of purchasing. The differences between performance ratios shows that it is very important to find the solution by an exact method such as LP, DP, Branch and Bound Technique… This sample problem is too small and there were not too many alternatives. But real size problems can be more complex and it could not be possible to find a solution by using exact methods

**2.1 Solution Methods**

The discussed problem is a NP hard, combinatorial type problem. Different methods have been proposed in the literature to solve such problems. Heuristic, meta heuristic methods, Simulation gives some might be appropriate solutions. Moreover Simulation allows us to consider and adding more different pillars to the model.

<table>
<thead>
<tr>
<th>sp23</th>
<th>Balıkesir</th>
<th>Alanya</th>
<th>19:00</th>
<th>14:00</th>
<th>9:00</th>
</tr>
</thead>
<tbody>
<tr>
<td>sp15</td>
<td>Alanya</td>
<td>Balıkesir</td>
<td>17:00</td>
<td>14:00</td>
<td>7:00</td>
</tr>
<tr>
<td>sp11</td>
<td>Alanya</td>
<td>Balıkesir</td>
<td>23:00</td>
<td>14:00</td>
<td>13:00</td>
</tr>
</tbody>
</table>

Total Time (T) 56:00
We have emphasized above how important using exact methods to get a solution. Using Mathematical Programming methods such as Linear, Dynamic programming could be found out an optimal solution. Also Backtracking and Jumptracking two versions of the Branch and Bound technique could be very attractive to go over the problems. However, when the problem grows in size, the effectiveness of the method used and the ability to reach an optimal solution are rapidly diminishing.

2.2 Linear Programming Model

As known VRP is different from Travelling Salesman Problem (TSP) or Hamilton tours especially on having more routes. Standard objective function for TSP is;

\[
\text{Min} \sum_{i=0}^{n} \sum_{j \neq i, j=0}^{n} c_{ij} x_{ij}
\]

(1)

Here; \(c\); cost; \(x\); binary variables to show trip is done.

The objective function for purposed VRPMT aimed to find minimum idle time is;

\[
\text{Min} \sum_{i=0}^{n} \sum_{j \neq i, j=0}^{n} t_{ij} x_{ij}
\]

(2)

Where \(t\); idle time on \(i\) to \(j\) departure time;

Constraints:

Every trip is to be taken place one time:

\[
\sum_{i}^{n} X_{i, j} = 1
\]

(3)

\[
\sum_{j}^{n} X_{i, j} = 1
\]

(4)

Preventing from sub tours(optional):

\[
\sum_{i}^{n} X_{i, i} = 0
\]

(5)

\[
X_{i, j} + x_{j, i} \leq 1
\]

(6)

\[
X_{i,j} + x_{j,k} + x_{k,i} \leq 2
\]

(7)

\[
X_{i,j} + x_{j,k} + \ldots + x_{z,i} \leq (n-1)
\]

(8)

and

\[
X_{i, j} = 0 \text{ or } 1
\]

(9)

\(i, j = 1, 2, \ldots, n\)

(10)

Sometimes it could be allowed becoming sub tours due to keep cost lower. In this way the problem is getting further away from TSP.

3. DISCUSSION

We have found out some solutions for the problem using some heuristics and Backtracking method. Some researchers are working on solving the problem by Mathematical Programming, different Branch and Bound method applications, some Heuristic methods and Simulation.
Moreover, the use of these solutions as a core part of some operational software related with transport companies, autonomous unmanned vehicles, automatic controlled vehicles is a matter of future work. Another paper will be related to solve the LP model and discuss the results of the problem.

REFERENCES


AHP APPROACH TO CHOOSING A TRAINING MODEL FOR DANGEROUS GOODS TRANSPORT SAFETY ADVISERS

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Abstract: The paper presents an approach to the selection of a course model for dangerous goods transport consultants employed in Serbian Ministry of Defense and Serbian Armed Forces. The well-known decision support method, the Analytical Hierarchical Process, has been individually used by ten decision makers. Synthesis of individual evaluations of decision makers was performed by aggregating individual priorities using arithmetic weighting averaging. Decision makers were assigned weights that were obtained by normalizing the values of their competence coefficients.

Keywords: AHP; model; training; transport safety advisor; dangerous goods.

1. INTRODUCTION

Technological advancement, as a major feature of the modern age, has contributed to the development of the chemical industry and the discovery of more and more substances necessary for the functioning of modern society. Although industrial development has made progress as time goes on, it is less and less controversial that this type of development makes modern society increasingly vulnerable. Among the substances essential to modern society are substances that seriously impair human health and the environment.

The increasing presence of goods containing dangerous substances has caused traffic to increase in the number of vehicles transporting these types of goods. The transport of dangerous goods by road in every organization carries enormous risks because of the high elasticity of this mode of transport and the more pronounced possibility of accidents. When transporting these types of goods, staff directly handling the goods are at risk (packaging, storage, loading, unloading, unpacking,), as well as all other persons near by.

The handling of dangerous goods is particularly highlighted in the military mostly because of its purpose and the environment where military perform tasks and actions. The use of a wide variety of dangerous goods is a function of the normal functioning of the military as a complex organizational system and the performance of its regular and extraordinary tasks. Accordingly, a military organization must constantly take actions to prevent accidents in procedures of handling this type of goods.

The transport of dangerous goods is regulated by various regulations at the international and national level, as well as at local community or organization level. It is necessary for all these regulations to be harmonized with each other, while respecting the hierarchy and level of competence. In order to provide continuity of dangerous goods transport, there was a need for include dangerous goods transport adviser, as a person who knows the obligations of all
participants in this process. Dangerous Goods Transport Advisor is a person who performs activities in a company, another legal entity or an entrepreneur to ensure the application of regulations in the transport of dangerous goods, which has a certificate of professional competence and which the employer has designated by act to perform these tasks, in accordance with with ADR (European Agreement concerning the International Carriage of Dangerous Goods by Road) / RID (Regulations concerning the International Carriage of Dangerous Goods by Rail) / ADN (European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways) [1].

The transport of dangerous goods in the Ministry of Defense (MoD) and the Serbian Armed Forces (SAF) is regulated by the "Law on the transport of dangerous goods in the MoD and SAF" [2], which is in accordance with the "Law on the Transport of Dangerous Goods" in the Republic of Serbia. The MoD and SAF train drivers for the transport of dangerous goods, while the training of safety consultants for the transport of dangerous goods is carried out in civilians.

The aim of this paper was to select a training model for dangerous goods transport consultants in the MoD and SAF. The problem under consideration was approached with the help of the Analytical Hierarchical Process (AHP) at the group level. The expert group consisted of ten decision-makers - members of the MoD and the SAF, who carry out duties in the field of transport dangerous goods as an obligation arising from the functional duty they perform on a daily basis.

The paper consists of five sections with introduction and conclusion. The second section of the paper, entitled "AHP Decision Making", describes the process of implementing AHP at the individual and group level. The third section of the paper, entitled "Setting up and Implementing AHPs for Choosing a Training Model for dangerous goods transport consultants" describes the problem and presents the AHP's hierarchy of decision problems.

"The results of the AHP conducted for the selection of a training model for the dangerous goods transport adviser" are presented in the fourth section of the paper. In the "Conclusion" - the fifth section of the paper, the key contributions of the conducted research are highlighted.

2. AHP DECISION MAKING

The analytical hierarchical process [3] is a multicriteria analysis method that is the most used as an help in individual and group decision making [4-10]. The method is "analytical" and "hierarchical" because the decision maker decomposes a complex decision problem into several decision elements between which he establishes a hierarchy. The word "process" in the name of the method suggests that once the initial hierarchy of decision problems has been formed, its interactive modifications are allowed [11]. The hierarchy of decision problems has several levels, with the goal at the top of the hierarchy, the next level containing criteria while the bottom has alternatives. Such a hierarchical setting refers to a standard decision problem, but there are also cases where the hierarchy has four or more levels, when there is a sub-criterion level between the criteria and alternatives. Also, there are decision problems when the hierarchy has two levels and then only alternatives are below the goal.

After the hierarchy is formed, the decision maker compares in pairs the elements at given level of the hierarchy with respect to all (upper) elements at the higher level, in order to determine their mutual importance. In standard AHP, the elements are compared by giving linguistic (semantic) ratings of mutual significance relative to the higher-level element of the hierarchy using the basic scale in Table 1.
Table 1. Saaty scale of relative importance

<table>
<thead>
<tr>
<th>Definition</th>
<th>The numerical value ((a_{ij}))</th>
</tr>
</thead>
<tbody>
<tr>
<td>The absolute dominance of the element (i) over element (j)</td>
<td>9</td>
</tr>
<tr>
<td>Very strong element dominance (i) over element (j)</td>
<td>7</td>
</tr>
<tr>
<td>Strong element dominance (i) over element (j)</td>
<td>5</td>
</tr>
<tr>
<td>Poor element dominance (i) over element (j)</td>
<td>3</td>
</tr>
<tr>
<td>The same importance of element (i) and element (j)</td>
<td>1</td>
</tr>
<tr>
<td>Poor element dominance (j) over element (i)</td>
<td>(1/3)</td>
</tr>
<tr>
<td>Strong element dominance (j) over element (i)</td>
<td>(1/5)</td>
</tr>
<tr>
<td>Very strong element dominance (j) over element (i)</td>
<td>(1/7)</td>
</tr>
<tr>
<td>Absolute dominance of the element (j) over element (i) (Intermediates)</td>
<td>(1/9)</td>
</tr>
</tbody>
</table>

In addition to Saaty scale, other scales can be used, e.g. Lootsma [12-14], Ma & Zheng scale [15], balanced scale, etc., but the Saaty scale is most commonly applied. The linear part of the Saaty scale consists of integer values \((1.9)\) and non-linear reciprocal values \((1.1 / 9)\).

When a decision maker at a given level of the hierarchy values the decision elements with respect to the parent element according to the scale in Table 1, his semantic ratings according to the definitions in the left column are numerically represented by values from the right column and entered in the square matrix \(A\). The matrix is positive and reciprocal (symmetric with respect to the main diagonal). In other words, the elements in the upper are reciprocal of the elements in the lower triangle of the matrix, and the elements on the main diagonal are equal to 1 \(a_{ii} = 1/ja_{ij}\), for every value of \(i\) and \(j\); \(a_{ii} = 1\) and every value of \(i\), equation 1.

\[
A = \begin{bmatrix}
a_{11} & a_{12} & \ldots & a_{1n} \\
 a_{21} & a_{22} & \ldots & a_{2n} \\
 \vdots & \vdots & \ddots & \vdots \\
 a_{n1} & a_{n2} & \ldots & a_{nn}
\end{bmatrix}
\]

If the standard Saaty scale is used, then each of \(a_{ij}\) can have one of 17 values from discrete interval \([1 / 9.9]\). Determining the weights of the compared elements based on the numerical values from the matrix is called prioritization. Prioritization is the process of determining the priority vector \(w = (w_1, \ldots, w_n)^T\) from matrix \(A\), where every \(w_i > 0\) implicates \(\sum_{i=1}^{n} w_i = 1\).

There are several matrix and optimization methods of prioritization (Table 2), and the most commonly used are the eigenvalue method, the logarithmic least squares method, and the additive method [16].

\[
11 12 1 \\
21 22 2 \\
12
\begin{bmatrix}
= 31 32 3 \\
21 22 2 \\
12
\end{bmatrix}
\]

(1)
Table 2. Prioritization methods and their authors

<table>
<thead>
<tr>
<th>Priority methods</th>
<th>Method authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>eigenvector method – EV</td>
<td>Saaty (1980)</td>
</tr>
<tr>
<td>additive normalization method – AN</td>
<td>Saaty (1980)</td>
</tr>
<tr>
<td>weighted least squares method – WLS</td>
<td>Chu and sar. (1979)</td>
</tr>
<tr>
<td>logarithmic least squares method – LLS</td>
<td>Crawford and Williams (1985)</td>
</tr>
<tr>
<td>logarithmic goal programming method – LGP</td>
<td>Bryson (1995)</td>
</tr>
</tbody>
</table>

Because of it simplicity and frequency of use, the additive normalization method was used in this paper (additive normalization method – AN) In order to determine a vector of priorities $w$, it is sufficient to divide each element from a given column of the matrix $A$ by the sum of the elements of that column (normalization), then to compile the elements in each type, and finally to divide each resulting sum by the rank of the matrix $n$. This procedure is described by relations 2 and 3:

$$a_{ij} = \sum_{i=1}^{n} a_{ij}, ij = 1,2,\ldots,n$$

(2)

$$w_i = \frac{\sum_{j=1}^{n} a_{ij}}{n}, i = 1,2,\ldots,n$$

(3)

Based on the evaluation, the chosen method of prioritization determines the local weights of the decision elements, and synthesis, that is, the additive synthesis, ultimately determines the weights of the alternatives at the lowest level relative to the element at the highest level (goal), which determine ending individual decision making by AHP. The additive synthesis is given by relation 4:

$$u_i = \sum_j w_j d_{ij}$$

(4)

- $u_i$ – the final (global) priority of the alternative $i$;
- $w_j$ – weight of the alternative $j$;
- $d_{ij}$ – the local weight of the alternative $i$ relative to the criterion $j$;

In addition to prioritization methods, one of the important features of AHP is that it checks the consistency of decision makers evaluations at all levels of the hierarchy. For consistency checking, Saaty [17] suggested a consistency ratio (CR) that is used in AN prioritization methods. Calculating the consistency ratio includes two steps. First step, the consistency index (CI) is calculated using relation 5:

$$CI = \frac{\lambda_{\text{max}} - n}{n - 1}$$

(5)

- $n$ – rank of the matrix;
- $\lambda_{\text{max}}$ – the maximum eigenvalue of the comparison matrix.
Second step, the consistency ratio (CR) is calculated as the ratio of the consistency index (CI) and the random index (RI), relation 6:

\[
CR = \frac{CI}{RI}
\]

The random index (RI) depends on the rank of the matrix and its values are obtained by random (random) generation of 500 matrices (Table 3).

**Table 3.** The values of the random index depending on the rank of the matrix

<table>
<thead>
<tr>
<th>n</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>RI</td>
<td>0.00</td>
<td>0.00</td>
<td>0.52</td>
<td>0.89</td>
<td>1.11</td>
<td>1.25</td>
<td>1.35</td>
<td>1.40</td>
<td>1.45</td>
<td>1.49</td>
</tr>
</tbody>
</table>

If the consistency ratio (CR) is less than or equal to 0.10, the result indicates that the decision maker was consistent and there is no need to repeat the evaluation [18]. If the CR is greater than 0.10, the decision maker should repeat (or modify) its valuations to improve its consistency.

Numerous authors in scientific papers have suggested that making decisions on the basis of a self thinking or intuition is almost impossible. More recently, when there are opportunities for this, it is about making decisions within groups, through the so-called group sessions during which they exchange views and improve the knowledge of individual participants, exploit different experiences of the participants, trace the path to consensus and achieve an important psychological effect of common interest in the success of the decision.

There are many ways to combine individual decisions and grades into group equivalents. The two basic and most commonly used ways to get a group decision in AHP are [19 - 20]:

- Aggregation of Individual Priorities – AIP
- Aggregation of Individual Judgments – AIJ

To integrate individual decisions into group decisions, this paper uses the AIP method, characterized by two aggregations:

1) **Weight Arithmetic Mean Method – WAMM.** The alternative \( A_i \) and its weight value \( w_i^{(k)} \) (priority) for the K-th decision maker are given. If all the members of the group (\( g \)) are assigned appropriate weight values \( \alpha_k \), the weight arithmetic mean is:

\[
w_i^{(g)} = \frac{1}{m} \sum_{k=1}^{m} w_i^{(k)} \alpha_k
\]

- \( w_i^{(g)} \) - final (composite) priority of the alternative \( A_i \);
- \( m \) - number of decision makers (group members);

By assumption, the individual weights of group members \( \alpha_k \) are previously additively normalized \( \sum_{k=1}^{m} \alpha_k = 1 \).

2) **Geometric Mean Method – GMM.** At this method, the aggregation consists in applying the following expression:
The weights $\alpha_i$ of the group members were also previously additively normalized.

Both methods require a final additive normalization of the priorities of all alternatives.

An essential feature of AHP is the sensitivity analysis of the final solution. Sensitivity analysis is conducted to see the extent which changes in input data reflect changes in the results obtained. In order to determine whether the ranking of alternatives is sufficiently stable with respect to acceptable changes to the input data, it is recommended to check the priority of alternatives for different combinations of input data. This analysis is very easy to do with decision support software. One of the most commonly used is Expert Choice, which offers five sensitivity analysis options: Dynamic, Performance, Gradient, Head to head and 2D.

Dynamic sensitivity analysis (Dynamic option) checks the stability of the results. If the ranking of the alternatives remains unchanged by varying the importance of the main criteria by 5% in all combinations, the result is considered to be stable [21].

3. SETTING UP AND IMPLEMENTING AN AHP TO SELECT A TRAINING MODEL FOR THE DANGEROUS GOODS TRANSPORT CONSULTANTS

The hierarchy of AHP decision problems for selecting a training model for dangerous goods transport consultants in this paper consists of three levels, Figure 1.

The goal is to "select a training model for the dangerous goods transport consultant" and he is at the top of the hierarchy. The criteria are at the next-medium level, which are:

- K1 - Certificate acquisition speed;
- K2 - Adaptation to own needs;
- K3 - Training mobility;
- K4 - Cost price;
- K5 - Transparency;

The alternatives are the subject of choice (the model by which the training dangerous goods transport consultants should be conducted) and they are at the lowest level of the hierarchy:

- A1 - Model A (civilian training and placement);
- A2 - Model B (training is implemented in the MoD and VS units, and civilian test);
A3 - Model C (training and placement are raelaised in MO and SAF units);

The expert group consisted of ten decision makers - members of the MoD and the Armed Forces, who, within the framework of their functional duties, perform daily tasks related to the transport of dangerous goods. Expert competence assessment was performed according to the model recommended for assessing the competence of experts in the field of traffic support (Dorović, 2003). Competence coefficient values experts (decision makers - DM) according to the implemented model, Table 4, confirm the competence of the group.

<table>
<thead>
<tr>
<th>Decision makers</th>
<th>Competence coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>DM 1</td>
<td>0.67</td>
</tr>
<tr>
<td>DM 2</td>
<td>0.67</td>
</tr>
<tr>
<td>DM3</td>
<td>0.54</td>
</tr>
<tr>
<td>DM 4</td>
<td>0.69</td>
</tr>
<tr>
<td>DM 5</td>
<td>0.50</td>
</tr>
<tr>
<td>DM 6</td>
<td>0.53</td>
</tr>
<tr>
<td>DM 7</td>
<td>0.48</td>
</tr>
<tr>
<td>DM 8</td>
<td>0.51</td>
</tr>
<tr>
<td>DM 9</td>
<td>0.64</td>
</tr>
<tr>
<td>DM 10</td>
<td>0.57</td>
</tr>
</tbody>
</table>

Group Competency Coefficient 0.58

The implementation of AHP was realized by completing with each decision maker a complete, personalized AHP stage which consisted of 5 following steps:
1) The hierarchy from Figure 1 is shown and the elements of the hierarchy are explained in a short conversation;
2) The AHP evaluation procedure is explained, that is, instructions are given on how to evaluate the elements of the hierarchy using the Saaty scale in Table 1.
3) A form with comparison matrices for AHP comparison in pairs of elements of the hierarchy using the Saaty scale was presented, Figure 2;

Figure 2. Form for AHP comparison of hierarchy elements
4) It is already concluded that the results from the comparison matrix will be processed using Expert Choice 2000 software (EC 2000), which automatically calculates reciprocal values, and accordingly only the elements in the so-called upper triangles of the comparison matrix should be evaluated (unshaded fields above the main diagonal);

5) It is also concluded that upon completion of the AHP evaluation, the decision maker will be informed of the final result of its decision-making on the problem and the consistency ratio he / she demonstrated, which is also automatically calculated by EC 2000 software.

4. RESULTS OF THE AHP CONDUCTED TO SELECT A TRAINING MODEL FOR DANGEROUS GOODS TRANSPORT ADVISER.

According to the methodology described above for the implementation of AHP, Table 5 shows the results of the individual evaluation of decision makers (members of the expert group), obtained by processing data from the AHP form for comparing hierarchy elements with EC 2000.

<table>
<thead>
<tr>
<th>Decision makers</th>
<th>Model A</th>
<th>Model B</th>
<th>Model C</th>
</tr>
</thead>
<tbody>
<tr>
<td>DM 1</td>
<td>0,123</td>
<td>0,416</td>
<td>0,460</td>
</tr>
<tr>
<td>DM 2</td>
<td>0,123</td>
<td>0,416</td>
<td>0,460</td>
</tr>
<tr>
<td>DM 3</td>
<td>0,176</td>
<td>0,173</td>
<td>0,650</td>
</tr>
<tr>
<td>DM 4</td>
<td>0,524</td>
<td>0,349</td>
<td>0,128</td>
</tr>
<tr>
<td>DM 5</td>
<td>0,518</td>
<td>0,309</td>
<td>0,173</td>
</tr>
<tr>
<td>DM 6</td>
<td>0,665</td>
<td>0,125</td>
<td>0,21</td>
</tr>
<tr>
<td>DM 7</td>
<td>0,272</td>
<td>0,366</td>
<td>0,362</td>
</tr>
<tr>
<td>DM 8</td>
<td>0,176</td>
<td>0,173</td>
<td>0,650</td>
</tr>
<tr>
<td>DM 9</td>
<td>0,123</td>
<td>0,416</td>
<td>0,460</td>
</tr>
<tr>
<td>DM 10</td>
<td>0,272</td>
<td>0,366</td>
<td>0,362</td>
</tr>
</tbody>
</table>

After all the decision makers performed all the evaluations, the information base is complete and the group synthesis of individual weight vectors from Table 5 was performed by the AIP WAMM method according to relation 7. The experts were assigned the weights obtained by normalizing the values of their coefficients of competence, and the group AIP WAMM decision is shown in Table 6.

<table>
<thead>
<tr>
<th>Alternative</th>
<th>importance</th>
<th>Rang</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model A</td>
<td>0,291</td>
<td>3</td>
</tr>
<tr>
<td>Model B</td>
<td>0,318</td>
<td>2</td>
</tr>
<tr>
<td>Model C</td>
<td>0,391</td>
<td>1</td>
</tr>
</tbody>
</table>

A graphic presentation of the group AHP decision from Table 6 is shown in Figure 3.
The results of the group AHP conducted indicate that most experts favor Model C. As no dynamic ranking of alternatives occurred when conducting a dynamic sensitivity analysis (Dynamic EC 2000 software option) and varying the importance of all criteria by 5% in all combinations, the final results of the AHP to select a training model for the dangerous goods transport consultant may be considered stable. Accordingly, it can be concluded that the training of dangerous goods transport consultant, as well as the examination for obtaining a relevant certificate, should be conducted in one's own organization, in one of the MoD and SAF units.

5. CONCLUSIONS

Multiple criteria must be considered when selecting a training model for the training of dangerous goods transport consultant. This paper demonstrates how the well-known multicriteria analysis method AHP can be used for this purpose. Because group decision-making allows for numerous variants of process handling, one of the more important is that decision-makers are assigned relative weights and thus may be favored over one another when forming a group decision. In doing so, it is necessary to emphasize the difference between the terms "joint" and "group" decision. When making a joint decision, the focus is on consensus, and not with group decision. The group context treated in this paper corresponds to a whole other case (group decision), that is, no harmonization and consultation were made among decision-makers, and individual decisions were subsequently consolidated. In order to maximize objectification of the group context, in the process of synthesis of individual decisions, decision makers are assigned weights that are consistent with the manifest coefficients of their competence. The results of the conducted group AHP procedure indicate that the training of dangerous goods transport consultant for the MoD and the SAF, as well as the examinations for obtaining the relevant certificate, should be conducted within the MoD and the SAF.

REFERENCES

[2] Pravilnik o transportu opasne robe u MO i VS, Službeni vojni list, br. 8/18.


APPLICATION OF PROCESS FUNCTION METHOD FOR ESTIMATING THE LEVEL OF ORGANIZATION IN TRANSPORTING DANGEROUS GOODS

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* Correspondence: lukovacvesko@yahoo.com; Tel.: +381113603817

Abstract: The process function method, as one of the most well-known methods for assessing the level of organization, represents a very effective tool for diagnosing the existing conditions and identifying what needs to be improved. The process function method can be used to evaluate the organization of business functions, organizational units, areas of work, business elements, work places, etc. In this project, the process function method is applied to evaluate the level of organization in the process of transporting dangerous goods in one of the units of the Serbian Armed Forces.

Keywords: process function; estimation, organization; transporting dangerous goods.

1. INTRODUCTION

Development of technologies, urbanization of cities and towns, development of infrastructure and industry as a whole, in addition to everything positive in terms of the development of society, carry a greater danger to safety, and health of people, and the environment. The increasing presence of goods containing dangerous substances causes in traffic greater use of vehicles for transporting them. The transport of dangerous goods is particularly pronounced in the military because the day-to-day handling of this type of goods is normal in that type of environment. This fact requires that, in addition to the development of the economy, infrastructure, the introduction of various technologies and systems, the construction of facilities in which a large number of people live or work, appropriate measures must be taken to protect against accidents caused by the transport of dangerous goods.

The aim of this project is to assess the level of organization of work performed by the person in charge of organizing the process of transport of dangerous goods in one of the units of the Serbian Armed Forces. The process of solving the considered problem was accessed with the process function method.

This project, containing introduction and conclusion, has three sections. The second section of this project, which name is „Use of the process function method” describe process function method and its use on the considered problem. In the conclusion-third section of the project, the results are analyzed and suggestions to improve the current condition are made.
2. USE OF THE PROCESS FUNCTION METHOD

The process function method can be used to evaluate the organizational level of an entire organization or only certain organizational units, functions, etc. The term *process functions* according to [1] means the activities necessary for the successful completion of the entire task at all levels of workplaces in the organization. Ten basic phases of process functions [2–6] appear in the work process, Table 1.

Table 1. Overview of process functions with tags and meaning

<table>
<thead>
<tr>
<th>Name of the function</th>
<th>Index</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recording</td>
<td>Rec</td>
<td>Covering all business developments in an organization</td>
</tr>
<tr>
<td>Informing</td>
<td>Inf</td>
<td>Delivering data and information to all workplaces in the organization</td>
</tr>
<tr>
<td>Controlling</td>
<td>Con</td>
<td>Comparison of activities performed with pre-set benchmarks, standards and guidelines</td>
</tr>
<tr>
<td>Analysis</td>
<td>An</td>
<td>Disassembling, comparing and concluding on the causes of deviations</td>
</tr>
<tr>
<td>Deciding</td>
<td>De</td>
<td>Re-intervening on developments in existing processes and shaping future processes</td>
</tr>
<tr>
<td>Planning</td>
<td>Pl</td>
<td>Providing the necessary elements to execute decisions</td>
</tr>
<tr>
<td>Synchronization</td>
<td>Sy</td>
<td>Combining and directing individual efforts into total effort</td>
</tr>
<tr>
<td>Organizing</td>
<td>Org</td>
<td>Finding and designing appropriate organizational procedures and performing work tasks</td>
</tr>
<tr>
<td>Performance</td>
<td>Per</td>
<td>Concrete execution of tasks in all workplaces in the organization</td>
</tr>
<tr>
<td>Command</td>
<td>Co</td>
<td>Assigning tasks to subordinate units and organs.</td>
</tr>
</tbody>
</table>

This project analyzes the activities performed by the person in charge of organizing the process of transport of dangerous goods in one of the units of the Serbian Armed Forces, Table 2.

Table 2. Jobs analyzed

<table>
<thead>
<tr>
<th>Index</th>
<th>Jobs</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>Determining the availability of drivers capable of transporting dangerous goods</td>
</tr>
<tr>
<td>02</td>
<td>Determining the availability of vehicles intended for the transport of dangerous goods</td>
</tr>
<tr>
<td>03</td>
<td>Consultation of the safety advisor on the transport of dangerous goods</td>
</tr>
<tr>
<td>04</td>
<td>Develop an engagement plan</td>
</tr>
<tr>
<td>05</td>
<td>Preparing the driver to complete the task</td>
</tr>
<tr>
<td>06</td>
<td>Control of the equipment that a dangerous goods transport vehicle must possess</td>
</tr>
<tr>
<td>07</td>
<td>Control of driver and vehicle documentation</td>
</tr>
<tr>
<td>08</td>
<td>Checking the knowledge of the procedure in the event of a failure or a traffic accident</td>
</tr>
<tr>
<td>09</td>
<td>Communication of occupational safety and health, environmental and fire safety measures when performing the task</td>
</tr>
<tr>
<td>10</td>
<td>Tracking the completion of a task</td>
</tr>
<tr>
<td>11</td>
<td>Submission of reports within the prescribed deadlines</td>
</tr>
</tbody>
</table>
The listed tasks are performed within individual areas of work by process functions. As every job does not have to contain all process functions, it is necessary to determine their connection. The connection of jobs with process functions is determined by entering in the table "the connection between jobs and process functions" (Table 3), for a job containing one of the process functions, the sign „+“ where the sum of „+“ signs represents the sum of frequencies (F). If the job does not contain any of the process functions, a „-“ is entered in the table.

Table 3. Connection between jobs and process functions

<table>
<thead>
<tr>
<th>Jobs</th>
<th>Process function</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rec</td>
<td>Inf</td>
</tr>
<tr>
<td>01</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>02</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>03</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>04</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>05</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>06</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>07</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>08</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>09</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>10</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>11</td>
<td>+</td>
<td>+</td>
</tr>
</tbody>
</table>

Not all jobs have the same importance. Some are more significant and the other less significant, it is necessary to carry out their weighting. Weighting is done by selecting one of the weights on a scale from 0 to 5, according to the criteria shown in Table 4.

Table 4. Weighting Criteria

<table>
<thead>
<tr>
<th>Weight</th>
<th>Criterion</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Execution of jobs is necessary, business would not be possible</td>
</tr>
<tr>
<td>4</td>
<td>Execution of jobs has a big impact on the overall business</td>
</tr>
<tr>
<td>3</td>
<td>Execution of jobs affects the economy of the business</td>
</tr>
<tr>
<td>2</td>
<td>Failure to do the job causes a deficiency in the business, but the business is nonetheless possible</td>
</tr>
<tr>
<td>1</td>
<td>Execution of jobs affects the integrity of the business</td>
</tr>
<tr>
<td>0</td>
<td>Execution of jobs is not necessary</td>
</tr>
</tbody>
</table>

According to the same criteria, process functions are weighted because they do not all have the same importance for the job. Selected job weights, as well as process function weights, are the result of a survey conducted with a person performing these tasks in the Serbian Military Unit which was the subject of this analysis. The weighting of jobs and process functions is done by multiplying the selected job weights with the selected process function weights and the resulting products are theoretical weights for jobs by process function, that is, for process functions by the job, Table 5.
The next step is to evaluate jobs by process functions with a rating from 1 to 5, according to the criteria for determining ratings based on the observed organizational attitude in the observed workplace, which are shown in Table 6.

### Table 5. The theoretical weighting of jobs by the process function

<table>
<thead>
<tr>
<th>Jobs Index</th>
<th>Weight</th>
<th>Process function</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Rec  Inf Con  An  De  Pl  Sy  Org  Per  Co  ∑</td>
<td></td>
</tr>
<tr>
<td>02</td>
<td>5</td>
<td>15   15   25   25   25   25   25   25   25   25  225</td>
<td></td>
</tr>
<tr>
<td>03</td>
<td>5</td>
<td>15   15   25   25   25   25   25   25   25   25  225</td>
<td></td>
</tr>
<tr>
<td>05</td>
<td>4</td>
<td>12   12   20   20   20   20   16   20   20   20  180</td>
<td></td>
</tr>
<tr>
<td>06</td>
<td>4</td>
<td>12   12   20   20   20   20   16   20   20   20  180</td>
<td></td>
</tr>
<tr>
<td>08</td>
<td>4</td>
<td>12   12   20   20   20   20   16   20   20   20  180</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>4</td>
<td>12   12   20   20   20   20   16   20   20   20  180</td>
<td></td>
</tr>
<tr>
<td>∑</td>
<td></td>
<td>153  153  255  255  255  255  255  255  255  255  2295</td>
<td></td>
</tr>
</tbody>
</table>

The ratings are calculated by summing the weights of each process function. The total sum is 2295.

### Table 6. Jobs evaluation criteria

<table>
<thead>
<tr>
<th>Rating</th>
<th>Criterion</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The jobs are not done</td>
</tr>
<tr>
<td>2</td>
<td>The jobs are done occasionally</td>
</tr>
<tr>
<td>3</td>
<td>The jobs are done on their own initiative, but by appointment</td>
</tr>
<tr>
<td>4</td>
<td>The jobs are done according to the instructions of the superiors</td>
</tr>
<tr>
<td>5</td>
<td>The jobs are done according to organizational regulations</td>
</tr>
</tbody>
</table>

Ratings of jobs by process function are shown in Table 7 and they are also the result of a survey conducted with the person performing the tasks that are the subject of this analysis.
After evaluating jobs by process functions, the calculation of the actual job weights \( P_s \) is performed by using the relation 1:

\[
P_s = \frac{P_p \times O}{S_o}
\]  

(1)

\( P_p \) — required (theoretical) weighting of the job,

\( O \) — job evaluation by process functions,

\( S_o \) — rating scale (5).

The actual jobs weights are shown in Table 8.

Table 8. The actual jobs weights

<table>
<thead>
<tr>
<th>Jobs</th>
<th>Process function</th>
<th>( \Sigma )</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rec</td>
<td>Inf</td>
</tr>
<tr>
<td>01</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>02</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>03</td>
<td>12</td>
<td>9</td>
</tr>
<tr>
<td>04</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>05</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>06</td>
<td>7.2</td>
<td>7.2</td>
</tr>
<tr>
<td>07</td>
<td>7.2</td>
<td>7.2</td>
</tr>
<tr>
<td>08</td>
<td>7.2</td>
<td>7.2</td>
</tr>
<tr>
<td>11</td>
<td>7.2</td>
<td>12</td>
</tr>
<tr>
<td>( \Sigma )</td>
<td>123.6</td>
<td>113.4</td>
</tr>
</tbody>
</table>

The next stage in applying this method is to calculate average job ratings \( O \) using the relation 2:

\[
O = \frac{\sum P_s \times S_o}{\sum P_p}
\]

(2)
Average jobs ratings are shown in Table 9.

Table 9. Average jobs ratings

<table>
<thead>
<tr>
<th>Jobs</th>
<th>$\sum P_s$</th>
<th>$\sum P_p$</th>
<th>$O$</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>189</td>
<td>225</td>
<td>4.20</td>
</tr>
<tr>
<td>02</td>
<td>189</td>
<td>225</td>
<td>4.20</td>
</tr>
<tr>
<td>03</td>
<td>202</td>
<td>225</td>
<td>4.49</td>
</tr>
<tr>
<td>04</td>
<td>201</td>
<td>225</td>
<td>4.47</td>
</tr>
<tr>
<td>05</td>
<td>168.8</td>
<td>180</td>
<td>4.69</td>
</tr>
<tr>
<td>06</td>
<td>155.2</td>
<td>180</td>
<td>4.31</td>
</tr>
<tr>
<td>07</td>
<td>205</td>
<td>225</td>
<td>4.56</td>
</tr>
<tr>
<td>08</td>
<td>159.2</td>
<td>180</td>
<td>4.42</td>
</tr>
<tr>
<td>09</td>
<td>225</td>
<td>225</td>
<td>5.00</td>
</tr>
<tr>
<td>10</td>
<td>219</td>
<td>225</td>
<td>4.87</td>
</tr>
<tr>
<td>11</td>
<td>171.2</td>
<td>180</td>
<td>4.76</td>
</tr>
<tr>
<td>Total</td>
<td>2084.4</td>
<td>2295</td>
<td>4.54</td>
</tr>
</tbody>
</table>

Analogous to relation 2, the average ratings of process functions ($O_{pf}$), which are shown in Table 10, are calculated using the weights in Tables 5 and 8.

Table 10. Average ratings of process functions

<table>
<thead>
<tr>
<th>Process function</th>
<th>$\sum P_s$</th>
<th>$\sum P_p$</th>
<th>$O_{pf}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recording</td>
<td>123.6</td>
<td>153</td>
<td>4.04</td>
</tr>
<tr>
<td>Informing</td>
<td>113.4</td>
<td>153</td>
<td>3.71</td>
</tr>
<tr>
<td>Controlling</td>
<td>213</td>
<td>255</td>
<td>4.18</td>
</tr>
<tr>
<td>Analysis</td>
<td>190</td>
<td>255</td>
<td>3.73</td>
</tr>
<tr>
<td>Deciding</td>
<td>255</td>
<td>255</td>
<td>5.00</td>
</tr>
<tr>
<td>Planning</td>
<td>250</td>
<td>255</td>
<td>4.90</td>
</tr>
<tr>
<td>Synchronization</td>
<td>174.4</td>
<td>204</td>
<td>4.27</td>
</tr>
<tr>
<td>Organizing</td>
<td>255</td>
<td>255</td>
<td>5.00</td>
</tr>
<tr>
<td>Performance</td>
<td>255</td>
<td>255</td>
<td>5.00</td>
</tr>
<tr>
<td>Command</td>
<td>255</td>
<td>255</td>
<td>5.00</td>
</tr>
<tr>
<td>Total</td>
<td>2084.4</td>
<td>2295</td>
<td>4.54</td>
</tr>
</tbody>
</table>

Based on average job ratings and process functions, jobs (Table 11) and process functions are ranked (Table 12).

Table 11. Jobs rank

<table>
<thead>
<tr>
<th>Rank</th>
<th>Job index</th>
<th>Weights</th>
<th>$O$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>09</td>
<td>5</td>
<td>5.00</td>
</tr>
<tr>
<td>2.</td>
<td>10</td>
<td>5</td>
<td>4.87</td>
</tr>
<tr>
<td>3.</td>
<td>11</td>
<td>4</td>
<td>4.76</td>
</tr>
<tr>
<td>4.</td>
<td>05</td>
<td>4</td>
<td>4.69</td>
</tr>
<tr>
<td>5.</td>
<td>07</td>
<td>5</td>
<td>4.56</td>
</tr>
<tr>
<td>6.</td>
<td>03</td>
<td>5</td>
<td>4.49</td>
</tr>
<tr>
<td>7.</td>
<td>04</td>
<td>5</td>
<td>4.47</td>
</tr>
<tr>
<td>8.</td>
<td>08</td>
<td>4</td>
<td>4.42</td>
</tr>
<tr>
<td>9.</td>
<td>06</td>
<td>4</td>
<td>4.31</td>
</tr>
<tr>
<td>10.</td>
<td>01</td>
<td>5</td>
<td>4.20</td>
</tr>
<tr>
<td>10.</td>
<td>02</td>
<td>5</td>
<td>4.20</td>
</tr>
</tbody>
</table>
Table 12. Rank of process functions

<table>
<thead>
<tr>
<th>Rank</th>
<th>Process function</th>
<th>Weights</th>
<th>( O_{pf} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Deciding</td>
<td>5</td>
<td>5.00</td>
</tr>
<tr>
<td>1.</td>
<td>Organizing</td>
<td>5</td>
<td>5.00</td>
</tr>
<tr>
<td>1.</td>
<td>Performance</td>
<td>5</td>
<td>5.00</td>
</tr>
<tr>
<td>1.</td>
<td>Command</td>
<td>5</td>
<td>5.00</td>
</tr>
<tr>
<td>2.</td>
<td>Planning</td>
<td>5</td>
<td>4.90</td>
</tr>
<tr>
<td>3.</td>
<td>Synchronization</td>
<td>4</td>
<td>4.27</td>
</tr>
<tr>
<td>4.</td>
<td>Controlling</td>
<td>5</td>
<td>4.18</td>
</tr>
<tr>
<td>5.</td>
<td>Recording</td>
<td>3</td>
<td>4.04</td>
</tr>
<tr>
<td>6.</td>
<td>Analysis</td>
<td>5</td>
<td>3.73</td>
</tr>
<tr>
<td>7.</td>
<td>Informing</td>
<td>3</td>
<td>3.71</td>
</tr>
</tbody>
</table>

3. CONCLUSIONS

Average jobs evaluation is an assessment of the level of organization in a particular workplace. Accordingly, in this research, based on the obtained value of the average job rating (4.54), it can be concluded that this is a level of organization that is characteristic that the execution of jobs is not based entirely on organizational regulations, but also on the instructions of superiors. This especially applies for jobs that are rated lower than the average job rating, in this case, these are jobs:

- 01 – Determining the availability of drivers capable of transporting dangerous goods,
- 02 – Determining the availability of vehicles intended for the transport of dangerous goods,
- 06 – Control of the equipment that a dangerous goods transport vehicle must possess
- 08 – Checking the knowledge of the procedure in the event of a failure or a traffic accident,
- 04 – Develop an engagement plan,
- 03 – Consultation of the safety advisor on the transport of dangerous goods.

Based on the average process function rating, an image is obtained about which process functions need to be upgraded. This applies primarily to those process functions that are rated lower than average (4.54), so in the specific case, improvement measures should focus on process functions:

Synchronization, Controlling, Recording, Analysis, Informing.

The good and the bad sides of the level of organization can also be seen from the analysis of the relationship of the assigned weights and the calculated ratings. From that analysis, we can also see which process functions and jobs need to be given greater attention, and this applies primarily to those process functions and jobs that are assigned high weights and have low average ratings. From this point of view, jobs with the labels "01", "02", "03" and "04" are interesting, as well as the process functions "controlling" and "analyzing".

As in both cases, the jobs marked "01", "02", "03" and "04", as well as the process functions "controlling" and "analyzing", were identified as weaknesses, the measures for improvement of the existing situation should be first focused on improving these jobs and process functions. However, it's necessary to accentuate that the results of this analysis should be viewed critically for a more appropriate analysis of the observed problem, and the opinion of a larger number of persons (or group of experts) involved in the subject problem must be considered.
REFERENCES

FOOD SECURITY CONCEPT

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Abstract: Security in food supply is an existential need and a global challenge. The possible instability or discontinuity in the nutrition of the population threatens the national security of the state, creates the conditions for the outbreak of conflict and poses an equal threat to regional and global security. The state, through its national policy, should provide every resident with permanent access to the optimal amount of healthy and wholesome food from long-term sustainable sources. The paradigm of access to food through the exchange of goods on the world market in a multi-polar world is becoming a limiting factor in preserving the sovereignty of the state and an instrument for directing political decisions that do not reflect their own national interests. In these circumstances, the causal link between population nutrition and national security needs to be revised and legally articulated in order to meet the challenges of modern times.

Keywords: food security, national security, food sovereignty, population nutrition.

1. INTRODUCTION

Food security as a vital prerequisite for the physical, spiritual and cultural reproduction of a nation has always entailed the ability to provide the majority of its own production to meet the needs of the population. The processes of globalization and market liberalization have accelerated the flow of people, goods and information and have influenced the change in the perception and implementation of food security.

The modern agri-food system from the second half of the nineteenth century to the present was developed under the influence of Great Britain and in a political environment that stimulated the development of commodity markets, labor markets, the eradication of planet hunger, fair trade and prevented any form of state protectionism in achieving the proclaimed humane goals, which favors national food security and nutrition culture.

The dominant view promoted the “matrix” that the market is the best guarantor of food security and that individual food insecurity issues should be addressed outside the market by targeted policy measures, humanitarian work and philanthropy [1]. This view has enabled global growth in food production and made food available to countries with nutritional deficits through free international trade. Access to food has become dependent on the country’s solvency power rather than the ability to produce food on its own, making the financial security of the country a priority over food security. Economists have equated food with other commodities and, under the influence of market principles in the economic portfolio, completely neglected its vital importance for the survival and reproduction of the human potential of the state [2].

Food is not a commodity but a human right, while the production and distribution of food are a matter of human survival, as well as a matter of social and national sovereignty [3].
2. THE BASIS OF THE FOOD SECURITY CONCEPT

There are about two hundred individual definitions of food security [4]. The comprehensive definition of food security due to its complexity is not conclusive and is complementary to the constant changes in the social perception of this phenomenon. The term food security had a variable meaning depending on the temporal discourse from which it originated and the socio-political system in which it was used, e.g. Russian terms for self-sufficiency (самообеспеченность) and food security (продовольственная безопасность) are often mixed and do not coincide with common usage in Western literature [5].

In relation to the determinative idea, there are five approaches to ensuring food security that have changed chronologically so far [6]:
(I) „availability of food“- to strike a balance between needs and possibilities through own agricultural production
(II) „income“- to enable the market economy to import sufficient quantities of food, regardless of the agro-sector's development;
(III) „basic needs“- the focus is again on food as a basic need rather than the income needed to buy it;
(IV) „right to food“- the accessibility of food to each individual is primary in relation to the availability of food at the national level, therefore it is necessary to maintain parity between labor and food prices, and
(V) „sustainable level of livelihoods“- as a kind of synthesis of (III) and (IV) approaches, it is part of the overall strategy for development and poverty reduction, especially in rural areas.

In the period up to the 1980s, food security was viewed through a balance between population and quantity of produced food, and implied self-sufficiency, i.e. ability to meet nutritional needs from own production. Self-production has been a key component of self-sufficiency and is defined as "the availability of current world essential food supplies in the face of a steady increase in food consumption through the moderation of constant fluctuations in production and market prices."

With the acceleration of globalization in the 1980s, self-sufficiency was seen as useless, because excess of produced food could not be exported and sold overseas, and producers were left without higher earnings and thus endangered [7].

In 1983, the Food and Agriculture Organization of the United Nations (FAO) redefined the concept of food security so that "all people have, on a permanent basis, the basic and physically available essential food they need" to promote the idea of a balance between demand and food security and the concept of access to food for all. Following the 1986 World Bank report, the new wording "constantly available food for all people needed for an active and healthy life" included a quantitative and qualitative aspect of food in the definition.

At the World Food Summit, 1996, the importance of safety and nutritional value of food and eating habits was emphasized and the following more complex definition was adopted: “Food security, at the individual, family, national, regional and global levels, is reached when all people are constantly have access, physically and paidly, to sufficient, safe and nutritious foods that meet their nutritional needs and habits and enable an active and healthy life”. In the Nutrition Insecurity Statement, 2001., the definition was supplemented by the addition of the social dimension to the right of everyone to food and thus took the final form: safe and nutritious foods that meet their nutritional needs and habits and allow for an active and healthy life.
3. MEASURING FOOD SECURITY

Particular foundation of the concept of food security, which develops the comparative advantages of international trade and contributes to prosperity and poverty reduction, has been advocated by neoliberal economists, international agencies including the World Bank and other advocates of globalization [8] [9] [10].

Determining the level of food security is based on the Global Food Security Index (GFSI) which comprehensively examines food security through internationally determined dimensions: Availability, Access, Quality and Safety, including a factor called "Natural Resources and Resilience" to evaluate Stability, i.e. country exposure to climate change impacts, sensitivity and adaptability of natural resources and the state to risks.

The index ranks 113 developing and developed countries around the world in terms of food security and is a dynamic quantitative and qualitative model of comparison, built from 28 unique indicators including: mortality rate, malnutrition, access to food, dietary diversity, access to water, coping strategies risks and livelihoods.

The index provides a common framework for understanding the causes of food insecurity by examining the dynamics of food systems around the world.

Food security goals can only be realized if they simultaneously cover the following aspects: availability on the market, economic and physical access to food, food usability, and stability which links the other three aspects temporally [11], Figure 1.

Figure 1. Dimensions of food security
Adapted from https://academicjournals.org/journal/JDAE/article-full-text/5C3ACD759442

Global Food Security Index [12], was created by The Economist Intelligence Unit, an english research company supported financially by Corteva Agriscience™, agricultural division of DowDuPont, which favors the use of genetically modified organisms to increase crop yields per unit area of land [13].
Despite all the combined efforts, the number of malnourished and hungry people in the world is on the rise; e.g. in developed regions it does not exceed 5%, in developing regions it reaches 13%, in Asian countries it is 13% while in African countries it is up to 20%.

According to FAO data in 2016, malnutrition is represented in 11% of the world population (around 815 million people), and the 2017 World Bank data shows that 83 million people, in 45 countries, are starving. The main reasons for this are: natural disasters, armed conflicts, population growth and poverty.

In 2017, there is a decline in indexes in countries where there are war conflicts but also in peaceful regions where food security has fallen due to the global financial crisis.

The value of the GFSI countries' total score by region of the world is shown in Figure 2.

![Figure 2. Food security index of countries in the regions of the world](https://foodsecurityindex.eiu.com/Country/Details)

The picture shows the correlation between the index and the level of development of the economy, so the highest index of food security is in the USA (85), U.K. (85), followed by France (82.9), Japan (79.9), Israel (78.6), Italy (76.3) and Chile (75.1). Behind them are developing countries: Brazil (68.4), Russian Federation (67), Mexico (66.4), China (65.1), Botswana (60.8), while Serbia (59.8), Peru (57.7) and India (50.1) have less than sixty index units. In the last place are the underdeveloped countries Haiti (33), Yemen (28.5) and Burundi (23.9). Comparative advantages in food production have been sidelined by political and military power and influence.

3. FOOD SECURITY TRENDS
The global economic crisis has contributed to the rise of world poverty and hunger. The United Nations projected an increase of the world population to 10.9 billion by 2050, which will require a 50% increase in food supplies and 75% according to some forecasts [14]. Modern food production technologies allow increase of soil fertility, use of marine and ocean resources, solar energy, the benefits of growing hybrid plant varieties and animal breeds, but
at the same time there is a real chance that the use of these technologies will cause a planetary ecological disaster.

Population decline is only expected in developed European and Orthodox developing countries, Figure 3.

![Figure 3. World population growth in millions](https://en.wikipedia.org/wiki/Projections_of_population_growth)

Existing predictions indicate an increase in the number of malnourished and hungry people, Figure 4.

![Figure 4. Trends of the 1. overall population and 2. number of malnourished people in billions](image)

A particular increase in food demand (The needs of the organism so far have been examined through a quantitative indicator, ie. the number of calories but not the structure of the nutrients that make it, e.g. for the average person living in a temperate climate and not engaged in heavy physical work, daily calorie intake should come from protein foods, 13%, fat-rich foods, 33% and carbohydrate sources, 54%) is expected in developing especially those consuming rice as
the main source of calories (60%) and Sub-Saharan Africa (250%). Some scientists see the solution in the cultivation and large-scale use of high-protein insects as a substitute for pork and beef. Although only one-third of scientists favor the use of genetically modified organisms (GMOs), there is an opinion that the goal is not to feed the broad population of the planet, but to increase the income of a limited group of individuals and the corporations that promote them [16].

Totally food security of the state is established when food reserves are 30% higher than the needs of the population. According to the FAO's recommendations, the state's food security is established when the state produces 80% of the vital products of the population's total needs, while Russian legislation identifies eight types of food and the level of its own food production that needs to be achieved to ensure food self-sufficiency, for example: cereals 95%, meat and products of meat 85%, milk and milk products 90%, fish products 80%, potatoes 95%, salted food 85%.

In 2018, FAO declared the motto: "No food waste and no food lose". They arise as a consequence of inadequately developed infrastructure, most notably in the manufacturing process and in storage, e.g. storing food in inadequate warehouses generates about 40% of food losses [2]. About 1/3 of edible food products in the world were lost, in Europe and North America 95-115 kg/per capita, and in Africa and Asia 6-11 kg/per capita [17].

Although current global food production allows the diet of residents with food containing an average (the food balance is a comprehensive picture of food supply in the selected country (area) over a given reference period) of 2884 calories per day, or 81.23 grams of protein and 82.76 grams of fat [17], hunger is not eradicated. The global problem of hunger cannot be solved by simply increasing productivity without the scientific and intensive development of biotechnologies that enable the preservation of manufactured products, the development of logistical scheme theory and the rational development of agricultural production [18]. Food production is not evenly distributed so that the increase in food production productivity in developed countries (USA, EU) does not contribute to the reduction of world hunger, on the contrary, it deliberately generates a gap to politically influence food importing countries, under the motto of "establishing democracy".

The emergence of a civilization paradox, i. that about one billion people in the world's total population are obese and at risk of health, while as many are malnourished or starving, it supports the thesis that there is no good mechanism or political will to eliminate hunger.

In most developing countries, hunger does not occur because of a shortage of grain stocks in the world, but because of low incomes of the population, where food products are inaccessible to more people, Table 1.

### Table 1. The share of the malnourished in the population [2]

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>World</td>
<td>18,1</td>
<td>13,8</td>
<td>12,9</td>
<td>12,5</td>
</tr>
<tr>
<td>Developed countries</td>
<td>1,9</td>
<td>1,2</td>
<td>1,3</td>
<td>1,4</td>
</tr>
<tr>
<td>Developing countries</td>
<td>23,2</td>
<td>16,8</td>
<td>15,5</td>
<td>14,9</td>
</tr>
<tr>
<td>Asia</td>
<td>23,7</td>
<td>16,3</td>
<td>14,8</td>
<td>13,9</td>
</tr>
<tr>
<td>Africa</td>
<td>27,3</td>
<td>23,1</td>
<td>22,6</td>
<td>22,9</td>
</tr>
<tr>
<td>Latin America</td>
<td>14,6</td>
<td>9,7</td>
<td>8,7</td>
<td>8,3</td>
</tr>
</tbody>
</table>
Obesity is associated with lifestyle changes (sedentary lifestyle, inadequate eating habits, low physical activity, stress), but also with rising food prices and its correlation with nutritional value and production costs [19].

4. CONCLUSIONS

Modern conflicts are inspired by the profits from arms sales and the exploitation of the resources of destabilized countries. In the conditions of a unipolar world and political instability in which the regimes of states change overnight, it is impossible to establish food security. It is necessary to establish economic and political counterbalancing to the US and EU by a group of developed countries organized to direct global processes into international legal and humane development frameworks [16]. The way in which the concept of food security is implemented is a necessary but not sufficient condition for ensuring adequate nutrition for the population [20].

The World Economic Crisis 2007/2008 has relaunched debates on the justification of access to food security so far, and sanctions on food imports introduced in the Russian Federation in 2014 have indicated a political instrumentalization of the same. Countries that have anticipated the strategic importance of food in the context of contemporary geopolitical circumstances at all levels, redefine the political, security, economic and ethical aspects of food security in the top-level strategy documents and refocus on the concept of food sovereignty and food self-sufficiency.

Food sovereignty allows people the freedom to choose how to produce, distribute and consume food and is based on a social, economic, environmental and cultural principle whose synergy enables sustainable agriculture and quality and dignified life for people in rural areas. The peasant model enables social and economic justice, respects the identity and knowledge of local communities, gives priority to local markets and strengthens the autonomy of people and communities.

REFERENCES


SELECTION OF THE LOCATION FOR CONSTRUCTION, RECONSTRUCTION AND REPAIR OF FLOOD DEFENSE FACILITIES BY IR-MAIRCA MODEL APPLICATION

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Abstract: The paper presents the application of a model for the selection of the location for construction, reconstruction and repair of flood defence facilities. The model consists of three parts. The first part of the model defines the criteria which influence the selection, and within the second part their weight coefficients are determined. The weight coefficients are defined using ranking methods. The selection of the best alternative is described in the third part of the model. This selection is presented by applying a hybrid model based on interval rough numbers and multi-criteria decision making method MAIRCA.

Keywords: decision making, interval rough numbers, MAIRCA, floods.

1. INTRODUCTION

For centuries, man has been struggling with natural phenomena which had negative effects on people's lives trying to control the nature. Although new technology has greatly advanced the predictions and defense against force majeure events and natural disasters, nature still remains unconquered and constantly shows that it can surprise. Out of all natural risks, floods are the most frequent, the most widespread and with the most severe consequences [1]. The extent of the flood consequences varies from very small to enormous, in human casualties and material damage [8]. Current predictions indicate that "it is very likely that humanity will be under the increasing risk of these phenomena in the future" [13].

Serbia and the region of Southeastern Europe are significantly exposed to floods. Floods account for approximately 55% of all natural disasters in Serbia [13]. More and more often, historical maximum values of water levels on rivers are shifting, and even larger cities in the Republic of Serbia, such as Belgrade, Sabac, Smederevo, Cuprija, Leskovac and other, are threatened. [9].

The Law on Waters [16] prescribes flood protection and it is implemented through preventive actions, flood management and flood relief. Optimal decision making is important at all stages of flood protection [2]. Large number of papers which discuss the decision making issue in situation of floods are related to the evaluation of the risk of vulnerability of particular areas or facilities or the evaluation of the possibility of flood occurrence itself and its consequences [5, 7, 14, 17]. The focus of this paper is the development of decision-making models in the phase of preventive actions, respectively, in the part related to the planning of the construction of new flood protection facilities, the improvement of the characteristics of the already constructed ones and the repair of the damaged facilities (selection of the location for reconstruction and repair of flood defence facilities). In circumstances where flood defense funds are not limited, such a model would be redundant. Unfortunately, most countries have limited funds to invest in this area, and are forced to invest in only a certain number of facilities. This model defines which objects are the priorities for investment with the available funds. The methodology up to date for solving this problem is presented in [9], where it is
emphasized that the selection is made according to certain priorities (importance of protected area and value of protected goods, available funds and possibilities of the participation of local government in financing works, the role of the facility in flood defense system and the possibility of construction in terms of the resolution of property relations and the degree of preparation of project documentation), but these are not elaborated with more detail. This leaves room for freer interpretation of this issue, but also for the application of multi-criteria decision-making methods.

The model is conceptualized through three phases: Phase I - defining the criteria, Phase II - calculating the weight coefficients of the criteria and Phase III - selecting the best alternative.

2. DEFINING THE CRITERIA AND ITS WEIGHT COEFFICIENTS

This part of the paper presents the first two phases of the model development, respectively, defining the criteria influencing the selection, and in the second part defining the methods for calculating weight coefficients and calculating the weight coefficients itself.

2.1. Description of the criteria influencing the selection

The analysis of available literature identifies eight criteria that influence the selection of the location for construction, reconstruction and repair of flood defense facilities. The criteria are defined in terms of their importance and influence to the final selection, from the most important/influential (C1) to the one with the smallest impact (C8).

The first criterion (C1) presents the level of flood risk. In this paper, it is used the methodology to calculate the risk level which is provided in [15]. Other available methodologies can also be used. The risk level obtained ranges from 1 to 25 and it is ranked as follows: very low - 1 and 2, low - 3, 4 and 5, moderate - 6, 8 and 9, high - 10, 12, 15 and 16 and very high- 20 and 25.

The second criterion (C2) is the cost of construction of planned facility or a part of the facility which may have the characteristics of a whole. This criterion is emphasized considering Serbia's economic situation and current investments in flood defense. The cost of project realization includes also, in addition to the cost of the facility, solving property relations, as well as all other foreseeable costs following the construction of the facility from the beginning to the end. The criterion is numerical, and it is described by the cost of constructing the facility.

The third criterion (C3) is the interest of other participants in financing the construction of the facility. Depending on the area in which the facilities could be constructed, in addition to the state, other participants (local governments, companies, non-governmental organizations, local population, etc.) have interest. As interested parties, these could reduce the construction costs of the facility by a certain percentage. The criterion is numerical, and it is described through the percentage of participation of other participants in the cost of construction of the facility.

The fourth criterion (C4) presents the importance of the facility in the flood defense system. This criterion observes the position and the role of the facility the construction of which is planned in the overall flood defense system. The criterion is linguistic.

The fifth criterion (C5) is population density. This criterion determines the population density of the territory which is protected by the construction of the facility. The criterion is numerical and it is described by the number of inhabitants per square kilometer.

The sixth criterion (C6) presents the level and importance of economic activities. This criterion assesses which economic activities exist in the territory protected by the construction of the facility and their importance to the wider community. The criterion is linguistic.
The seventh criterion (C7) presents **cultural and spiritual goods.** This criterion assesses the importance of cultural and spiritual heritage sites in the territory protected by the construction of the facility. The criterion is linguistic.

The eighth criterion (C8) presents **negative impacts generated by the construction of the facility.** When considering this criterion, it is primarily considered social acceptability and ecological sustainability of the construction of the facility because of possible impairment of the existing state, respectively, its compatibility with the processes in the environment [6]. This criterion is of linguistic character.

A ten-point scale is used to define the values of the linguistic criteria, where the value of ten represents the highest significance and the value of one the smallest (for the criteria C4, C6, and C7), respectively, for the criterion C8, the value of ten represents the highest influences, and the value of one the lowest.

### 2.1. Calculation of the weight coefficients of the criteria

The calculation of the weight coefficients of the criteria is performed by applying the methods for determining weights of criteria based on their rank [10], on the basis of: inverse weight method, rank sum method and geometric weight method.

**Inverse weight method:**

\[
W_j = \frac{1}{n} \sum_{j=1}^{n} \frac{1}{j}
\]

Where: \(r\) - range, and \(j=1,2,...,n\) present the criteria.

**Method of rank centroids:**

\[
W_j = \frac{1}{n} \sum_{j=1}^{n} \frac{1}{j}
\]

Where: \(r\) - rang, and \(j=1,2,...,n\) present the criteria.

**Method of the sum of ranks is linear function:**

\[
W_j = \frac{2(n+1-r)}{n(n+1)}
\]

Where: \(r\) - rang, and \(n\) present total number of the criteria.

After calculating the weights of criteria using the above methods, their mathematical unification is performed using the method of arithmetic weighting. Aggregated weights are obtained by averaging individual weights of criteria using the following expression:

\[
W_j = \frac{1}{m} \sum_{i=1}^{m} W_{ij}
\]

Where: \(m\) – number of the methods applied, and \(j=1,2,...,n\) present the criteria.

Using the expressions one to four, the values of the weight coefficients of criteria are obtained (Table 1).
Table 1: Calculation of the weight coefficients of criteria

<table>
<thead>
<tr>
<th>Method</th>
<th>C1</th>
<th>C2</th>
<th>C3</th>
<th>C4</th>
<th>C5</th>
<th>C6</th>
<th>C7</th>
<th>C8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Method of the inverse weights</td>
<td>0.37</td>
<td>0.18</td>
<td>0.12</td>
<td>0.09</td>
<td>0.07</td>
<td>0.06</td>
<td>0.05</td>
<td>0.05</td>
</tr>
<tr>
<td>Method of the sum of ranks</td>
<td>0.22</td>
<td>0.19</td>
<td>0.17</td>
<td>0.14</td>
<td>0.11</td>
<td>0.08</td>
<td>0.06</td>
<td>0.03</td>
</tr>
<tr>
<td>Method of the centroids of</td>
<td>0.34</td>
<td>0.21</td>
<td>0.15</td>
<td>0.11</td>
<td>0.08</td>
<td>0.05</td>
<td>0.03</td>
<td>0.02</td>
</tr>
<tr>
<td>ranks</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aggregated weights of the</td>
<td>0.31</td>
<td>0.20</td>
<td>0.15</td>
<td>0.11</td>
<td>0.09</td>
<td>0.07</td>
<td>0.05</td>
<td>0.03</td>
</tr>
<tr>
<td>criteria</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3. PRESENTATION OF THE SELECTION OF THE BEST ALTERNATIVE

The selection of the best alternative is carried out by applying the modified MAIRCA (Multi Attributive Ideal-Real Comparative Analysis) method and the interval rough numbers (IRN). The hybrid IR - MAIRCA model and its application are presented in the following two subsections. More about interval rough numbers can be seen in [3, 4, 12].

3.1. Description of the IR - MAIRCA method

The MAIRCA method was first presented in [11]. This method is based on determining the gap between ideal and empirical estimates. The uncertainties that accompany almost all types of decision making have influenced classical methods to be modified through the application of various mathematical fields which successfully present uncertainties. Interval rough numbers are used in this paper. The steps of the IR - MAIRCA method are presented below [4].

Step 1. Forming initial decision-making matrix \( (Y) \). The first step is used to evaluate \( l \) alternatives by \( n \) criteria, thus defining initial decision-making matrix.

\[
Y = \begin{bmatrix}
A_1 & IRN(y_{11}) & IRN(y_{12}) & \cdots & IRN(y_{1n}) \\
A_2 & IRN(y_{21}) & IRN(y_{22}) & \cdots & IRN(y_{2n}) \\
\vdots & \vdots & \ddots & \cdots & \vdots \\
A_l & IRN(y_{l1}) & IRN(y_{l2}) & \cdots & IRN(y_{ln})
\end{bmatrix}_{l \times n}
\]

where \( l \) presents the number of alternatives, and \( n \) presents total number of criteria.

Interval rough vector \( A_i = \left( IRN(y_{i1}), IRN(y_{i2}), \ldots, IRN(y_{in}) \right) \), where \( IRN(y_{ij}) = \left[ RN(y_{ij}^L), RN(y_{ij}^U) \right] = [y_{ij}^L, y_{ij}^U] \), present the value of the \( i\)-th alternative by \( j\)-th criterion \( (i=1,2,\ldots,l; j=1,2,\ldots,n) \). The values of \( RN(y_{ij}^L) \) present the lower class of the objects of IRN defined by lower \( y_{ij}^L \) and upper limit \( y_{ij}^U \), where \( y_{ij}^L \leq y_{ij}^U \). The value \( RN(y_{ij}^U) \) present the upper class of the objects of IRN, defined by lower \( y_{ij}^L \) and upper limit \( y_{ij}^U \), where \( y_{ij}^L \leq y_{ij}^U \).

Step 2. Determining preference in the selection of alternatives \( P_A \). When selecting the alternatives, a decision maker may be neutral in the selection of alternatives, and may have a preference for one of the alternatives offered. When the decision maker is neutral in the selection of alternatives, the preference for selection one of \( l \) alternatives is
where \( l \) presents total number of alternatives being selected.

**Step 3.** Calculation of the elements of theoretical estimation matrix \((T_p)\). The elements of theoretical estimation matrix \((\text{IRN}(t_{pj}))\) are interval rough numbers and are calculated as the product of the preferences towards the selection of alternatives \(P_A\) and the weights of criteria \((\text{IRN}(w_i), i = 1,2,\ldots,n)\) obtained by applying the methods shown in the preceding section:

\[
P_A = \frac{1}{l}; \quad \sum_{i=1}^{l} P_A = 1, \quad i = 1,2,\ldots,l
\]

(6)

\[
T_p = \begin{bmatrix}
P_A \text{IRN}(w_1) & \text{IRN}(w_2) & \ldots & \text{IRN}(w_n) \\
\text{IRN}(t_{p11}) & \text{IRN}(t_{p12}) & \ldots & \text{IRN}(t_{p1n}) \\
\text{IRN}(t_{p21}) & \text{IRN}(t_{p22}) & \ldots & \text{IRN}(t_{p2n}) \\
\vdots & \vdots & \ddots & \vdots \\
P_A \text{IRN}(t_{pl1}) & \text{IRN}(t_{pl2}) & \ldots & \text{IRN}(t_{pln}) 
\end{bmatrix}
\]

(7)

where \( P_A \) presents the preferences in the selection of the alternatives, \( \text{IRN}(w_i) \) weight coefficients of the evaluation criteria, and \( \text{IRN}(t_{pj}) \) theoretical estimation of the alternative for the observed evaluation criterion. The elements of the matrix \( T_p \) are determined by applying the expression:

\[
t_{pj} = P_A \cdot \text{IRN}(w_i) = P_A \cdot \left[ \text{IRN}(w_i^L), \text{IRN}(w_i^U) \right]
\]

(8)

**Step 4.** Determining the elements of real estimation matrix \((T_r)\). Calculation of the elements of real estimation matrix \((T_r)\) is performed by multiplying the elements of theoretical estimation matrix \((T_p)\) and the elements of initial decision making matrix \((X)\) according to the expression:

\[
\text{IRN}(t_{rj}) = \text{IRN}(t_{pj}) \cdot \text{IRN}(x_{ij}) = \left( \left[ t_{pj}^L, t_{pj}^U \right], \left[ t_{pj}^L, t_{pj}^U \right] \right) \cdot \left( \left[ y_{ij}^L, y_{ij}^U \right], \left[ y_{ij}^L, y_{ij}^U \right] \right)
\]

(9)

where \( \text{IRN}(t_{pj}) \) presents the elements of theoretical estimation matrix, and \( \text{IRN}(y_{ij}) \) presents the elements of normalized matrix \( Y = \left[ \text{IRN}(y_{ij}) \right]_{i,n} \). Normalization of elements of initial decision making matrix is performed by applying the expression:

a) For „benefit“ type criteria (higher value of the criteria is preferable)

\[
\text{IRN}(y_{ij}) = \left[ y_{ij}^L, y_{ij}^U \right] = \left[ \frac{y_{ij}^L - y_{ij}^U}{y_{ij}^U - y_{ij}^L}, \frac{y_{ij}^U - y_{ij}^L}{y_{ij}^U - y_{ij}^L} \right] = \left[ \frac{y_{ij}^L}{y_{ij}^L - y_{ij}^U}, \frac{y_{ij}^U}{y_{ij}^L - y_{ij}^U} \right]
\]

(10)

b) For „cost“ type criteria (lower value of the criteria is preferable)

\[
\text{IRN}(y_{ij}) = \left[ y_{ij}^L, y_{ij}^U \right] = \left[ \frac{y_{ij}^L - y_{ij}^U}{y_{ij}^L - y_{ij}^U}, \frac{y_{ij}^U - y_{ij}^L}{y_{ij}^L - y_{ij}^U} \right] = \left[ \frac{y_{ij}^L}{y_{ij}^L - y_{ij}^U}, \frac{y_{ij}^U}{y_{ij}^L - y_{ij}^U} \right]
\]

(11)

where \( y_{ij}^L \) and \( y_{ij}^U \) present minimal and maximal values of the border intervals of the observed criterion, respectively:

\[
y_{ij}^L = \min_j \{y_{ij}^L, y_{ij}^L\}
\]

(12)

\[
y_{ij}^U = \max_j \{y_{ij}^L, y_{ij}^U\}
\]

(13)
Step 5. Calculation of the total gap matrix \((G)\). The elements of the matrix \(G\) are obtained as the difference (gap) between theoretical \((t_{ij})\) and real estimations \((r_{ij})\), respectively, subtracting the elements of the matrix of theoretical weights \((T_p)\) and the elements of the matrix of real weights \((T_r)\):

\[
G = T_p - T_r = \begin{bmatrix}
IRN(g_{11}) & IRN(g_{12}) & \cdots & IRN(g_{1n}) \\
IRN(g_{21}) & IRN(g_{22}) & \cdots & \cdots & IRN(g_{2n}) \\
\vdots & \vdots & \ddots & \vdots & \vdots \\
IRN(g_{n1}) & IRN(g_{n2}) & \cdots & IRN(g_{nn})
\end{bmatrix}_{n \times n}
\]

(14)

where \(n\) presents total number of criteria, \(l\) presents total number of alternatives being selected, and \(g_{ij}\) presents the gap obtained of the alternative \(i\) by the criterion \(j\). The gap \(g_{ij}\) presents interval rough number and it is obtained by applying the expression:

\[
IRN(g_{ij}) = IRN(t_{ij}) - IRN(t_{ij}) = \left(\left[t_{ij}^L, t_{ij}^U\right], \left[t_{ij}^L, t_{ij}^U\right]\right) - \left(\left[t_{ij}^L, t_{ij}^U\right], \left[t_{ij}^L, t_{ij}^U\right]\right)
\]

(15)

Step 6. Calculation of the values of the criteria functions \((Q_i)\) by alternatives. The values of the criteria functions are obtained by summing the gap, respectively, summing the elements of the matrix \((G)\) by columns:

\[
IRN(Q_i) = \sum_{j=1}^{n} IRN(g_{ij}), \quad i = 1, 2, \ldots, m
\]

(16)

where \(n\) presents total number of criteria, \(m\) presents total number of the alternatives being selected.

Ranking alternatives is performed by transferring interval rough numbers into the real numbers. Transferring interval rough number \(IRN(Q_i) = [Q_i^L, Q_i^U], [Q_i^L, Q_i^U]\) into the real number \(Q_i\) is performed by applying the expression:

\[
\mu_i = \frac{RB(Q_i^L)}{RB(Q_i^L) + RB(Q_i^U)}; \quad RB(Q_i^L) = Q_i^U - Q_i^L; \quad RB(Q_i^U) = Q_i^U - Q_i^L
\]

\[
Q_i = \mu_i \cdot Q_i^L + (1 - \mu_i) \cdot Q_i^U
\]

(17)

(18)

Step 7. Determining dominance index of the first-ranked alternative \((A_{D,1-j})\) and final rank of alternatives. The dominance index of the first-ranked alternative defines its advantage compared to other alternatives. Dominance index is determined by applying the expression:

\[
A_{D,1-j} = \frac{|Q_i| - |Q_j|}{|Q_i|}, \quad j = 2, 3, \ldots, m
\]

(19)

where \(Q_i\) presents the criteria function of the first-ranked alternative, \(Q_n\) presents the criteria function of the last-ranked alternative, \(Q_j\) presents the criteria function of the alternative to which the first-ranked alternative is compared to, \(m\) presents total number of alternatives.

After determining the dominance index, it is determined the dominance threshold \(I_D\) according to the expression:

\[
I_D = \frac{m - 1}{m^2}
\]

(20)

where \(m\) presents total number of alternatives.
If the condition is met where the dominance index \( A_{D,j} \) is higher or equal to the dominance threshold \( I_D \) \( (A_{D,j} \geq I_D) \), then the obtained rank is kept. If the dominance index \( A_{D,j} \) is lower than the dominance threshold \( I_D \) \( (A_{D,j} < I_D) \), it cannot be concluded with certainty that the first-ranked alternative has sufficient advantage over the observed alternative.

### 3.2. Selection of the best alternative – application of the IR - MAIRCA method

For the purpose of demonstrating the implementation of created model, ten fictitious alternatives have been defined. The values for every alternative are shown in initial decision-making matrix (Y), as in the Table 2.

**Table 2: Initial decision-making matrix (Y)**

<table>
<thead>
<tr>
<th></th>
<th>C1</th>
<th>C2</th>
<th>C3</th>
<th>...</th>
<th>C8</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>(1,2),(3,4)</td>
<td>(5.63,7.41),(7.45,8.06)</td>
<td>(25.30),(31.35)</td>
<td>...</td>
<td>(3,5),(6,7)</td>
</tr>
<tr>
<td>A2</td>
<td>(2,3),(4,5)</td>
<td>(7.58,8.63),(8.7,8.89)</td>
<td>(15,18),(24,27)</td>
<td>...</td>
<td>(8,9),(9,10)</td>
</tr>
<tr>
<td>A3</td>
<td>(9,10),(12,15)</td>
<td>(4.36,7.38),(7.9,9)</td>
<td>(10,12),(20,22)</td>
<td>...</td>
<td>(4,5),(7,9)</td>
</tr>
<tr>
<td>A4</td>
<td>(8,9),(10,12)</td>
<td>(5.81,8.38),(11,14)</td>
<td>(5,10),(11,14)</td>
<td>...</td>
<td>(3,4),(6,7)</td>
</tr>
<tr>
<td>A5</td>
<td>(20,20),(20,25)</td>
<td>(5.86,7.67),(12,13)</td>
<td>(5,5),(8,8)</td>
<td>...</td>
<td>(7,7),(8,8)</td>
</tr>
<tr>
<td>A6</td>
<td>(15,16),(20,25)</td>
<td>(3.86,6.33),(8,11)</td>
<td>(20,22),(24,26)</td>
<td>...</td>
<td>(2,3),(4,5)</td>
</tr>
<tr>
<td>A7</td>
<td>(10,12),(15,16)</td>
<td>(5.9,7.67),(9,10)</td>
<td>(30,35),(35,45)</td>
<td>...</td>
<td>(2,3),(4,5)</td>
</tr>
<tr>
<td>A8</td>
<td>(4,5),(6,8)</td>
<td>(5.78,8.11),(24,26)</td>
<td>(18,20),(22,24)</td>
<td>...</td>
<td>(6,7),(7,8)</td>
</tr>
<tr>
<td>A9</td>
<td>(15,16),(20,20)</td>
<td>(2.38,5.04),(13,15)</td>
<td>(35,40),(45,50)</td>
<td>...</td>
<td>(5,6),(7,8)</td>
</tr>
<tr>
<td>A10</td>
<td>(6,8),(9,10)</td>
<td>(5.87,7.26),(15,17)</td>
<td>(28,30),(32,35)</td>
<td>...</td>
<td>(1,2),(3,4)</td>
</tr>
</tbody>
</table>

In the second step it is determined the preference to the selection of alternatives \( P_A \) by applying the expression (6). Considering that there has been no preference to any of the alternatives \( P_A = 0.1 \). Next, by applying the expression (8) it is calculated the matrix of theoretical estimation (\( T_p \)), as in the Table 3.

**Table 3: Matrix of theoretical estimation (\( T_p \))**

<table>
<thead>
<tr>
<th></th>
<th>C1</th>
<th>C2</th>
<th>...</th>
<th>C8</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1-A10</td>
<td>(0.031,0.031),(0.031,0.031)</td>
<td>(0.02,0.02),(0.02,0.02)</td>
<td>...</td>
<td>(0.003,0.003),(0.003,0.003)</td>
</tr>
</tbody>
</table>

In the fourth step are calculated the elements of the matrix of real estimations (\( T_r \)) by applying the expressions (9) to (13), as in the Table 4.

**Table 4: Matrix of real estimations (\( T_r \))**

<table>
<thead>
<tr>
<th></th>
<th>C1</th>
<th>C2</th>
<th>...</th>
<th>C8</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>(0.001),(0.003,0.004)</td>
<td>(0.015,0.016),(0.016,0.017)</td>
<td>...</td>
<td>(0.001,0.001),(0.002,0.002)</td>
</tr>
<tr>
<td>A2</td>
<td>(0.001,0.003),(0.004,0.005)</td>
<td>(0.014,0.015),(0.015,0.016)</td>
<td>...</td>
<td>(0,0),(0,0.001)</td>
</tr>
<tr>
<td>A3</td>
<td>(0.01,0.012),(0.014,0.018)</td>
<td>(0.015,0.016),(0.016,0.018)</td>
<td>...</td>
<td>(0.001),(0.002,002)</td>
</tr>
<tr>
<td>A4</td>
<td>(0.009,0.01),(0.012,0.014)</td>
<td>(0.011,0.013),(0.015,0.017)</td>
<td>...</td>
<td>(0.001,0.001),(0.002,002)</td>
</tr>
<tr>
<td>A5</td>
<td>(0.025,0.025),(0.025,0.031)</td>
<td>(0.011,0.012),(0.016,0.017)</td>
<td>...</td>
<td>(0.001,0.001),(0.001,001)</td>
</tr>
<tr>
<td>A6</td>
<td>(0.018,0.019),(0.025,0.031)</td>
<td>(0.013,0.015),(0.017,0.019)</td>
<td>...</td>
<td>(0.002,0.002),(0.002,003)</td>
</tr>
<tr>
<td>A7</td>
<td>(0.012,0.014),(0.018,0.019)</td>
<td>(0.014,0.014),(0.016,0.017)</td>
<td>...</td>
<td>(0.002,0.002),(0.002,003)</td>
</tr>
<tr>
<td>A8</td>
<td>(0.004,0.005),(0.006,0.009)</td>
<td>(0.002),(0.015,0.017)</td>
<td>...</td>
<td>(0.001,0.001),(0.001,001)</td>
</tr>
<tr>
<td>A9</td>
<td>(0.018,0.019),(0.025,0.025)</td>
<td>(0.009,0.011),(0.018,0.02)</td>
<td>...</td>
<td>(0.001,0.001),(0.001,002)</td>
</tr>
<tr>
<td>A10</td>
<td>(0.006,0.009),(0.01,0.012)</td>
<td>(0.008,0.009),(0.016,0.017)</td>
<td>...</td>
<td>(0.002,0.002),(0.003,003)</td>
</tr>
</tbody>
</table>

In the next step, using the expressions (14) and (15), total gap matrix is calculated (\( G \)), as in the Table 5.
Applying the expressions (16) to (19) the final gap of alternatives and their final rank are obtained, as in the Table 6.

Table 6: Alternative ranking according to IR - MAIRCA

<table>
<thead>
<tr>
<th>Alter.</th>
<th>$IRN(Q_i)$</th>
<th>Crisp $Q_i$</th>
<th>Initial rank</th>
<th>$A_{D_{ij}}$</th>
<th>Final rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>[(0.047,0.055),(0.065)]</td>
<td>0.0565</td>
<td>8</td>
<td>0.508</td>
<td>8</td>
</tr>
<tr>
<td>A2</td>
<td>[(0.057,0.062),(0.072)]</td>
<td>0.0645</td>
<td>9</td>
<td>0.631</td>
<td>9</td>
</tr>
<tr>
<td>A3</td>
<td>[(0.037,0.047),(0.062)]</td>
<td>0.0525</td>
<td>5</td>
<td>0.446</td>
<td>5</td>
</tr>
<tr>
<td>A4</td>
<td>[(0.045,0.053),(0.068)]</td>
<td>0.0562</td>
<td>7</td>
<td>0.503</td>
<td>7</td>
</tr>
<tr>
<td>A5</td>
<td>[(0.035,0.046),(0.059)]</td>
<td>0.0521</td>
<td>4</td>
<td>0.440</td>
<td>4</td>
</tr>
<tr>
<td>A6</td>
<td>[(0.027,0.04),(0.058)]</td>
<td>0.0469</td>
<td>3</td>
<td>0.361</td>
<td>3</td>
</tr>
<tr>
<td>A7</td>
<td>[(0.03,0.04),(0.056)]</td>
<td>0.0458</td>
<td>2</td>
<td>0.344</td>
<td>2</td>
</tr>
<tr>
<td>A8</td>
<td>[(0.047,0.055),(0.079)]</td>
<td>0.0651</td>
<td>10</td>
<td>0.640</td>
<td>10</td>
</tr>
<tr>
<td>A9</td>
<td>[(0.009,0.016),(0.039)]</td>
<td>0.0234</td>
<td>1</td>
<td>0.000</td>
<td>1</td>
</tr>
<tr>
<td>A10</td>
<td>[(0.043,0.049),(0.071)]</td>
<td>0.0541</td>
<td>6</td>
<td>0.472</td>
<td>6</td>
</tr>
</tbody>
</table>

In the specific case for the ten alternatives the dominance threshold (expression 20) is 0.09. Considering that in all cases the dominance index is higher than the dominance threshold, it can be concluded that initial rank is also the final rank.

4. CONCLUSION

By demonstrating the application of the IR - MAIRCA model in defining the location selection for the construction, reconstruction and repair of flood defense facilities, uncertainties in final decision making have been significantly considered. Through the paper it is presented successful application of the model, respectively, successful integration and application of interval rough numbers and the MAIRCA method. Solving specific cases of ranking potential locations indicated the degree of complexity of making such and similar decisions. Consequently, multi-criteria decision-making models, such as this model, impose themselves as highly desirable solutions.

Basic goal of the paper was to present the application of interval rough numbers and the method of multi-criteria decision making in a complex decision-making process. To a lesser extent, emphasis was placed on defining the criteria and their weighting coefficients, which should be further investigated including more experts in this field.
REFERENCES


Abstract: In a previous paper on „Digital Warehouse: Space Management“, a virtual warehouse simulation model was developed to allow optimization of storage space. The developed model allows simulation of the virtual environment in which the processes in the warehouse are performed, accommodation and moving of objects, as well as providing information on the current utilization rate of storage space. The next step in warehouse automation and digitization would be the introduction of a single information system that provides automated monitoring of the stock status of the assets stored. In addition, the integration of a warehouse simulation model and a unified information system would form the basis for further progress in improving the logistics system as a whole.

The integration enables accurate view of the state of material and technical resources of the assets and ensures optimization of the logistics system. In addition, the cost for the acquisition and storage of certain inventories of assets are also lowered, which is certainly a complex management task that the logisticians face on a daily basis. Spare parts, as one of the most numerous technical goods, were taken as an example of designing an information system. This paper is a pilot version of a Spare Parts Information System and as such forms one of the elements of a potential logistics information system.

The paper is divided into several sections, who are classified into smaller sections for the purpose of presenting the issues of monitoring the situation.

The first part defines the concept of stocks and how they are managed.
In the second part, the focus is on the process of formalizing inventory monitoring, as well as defining them.
In the third part, the aspect is set on the automation of the monitoring of the situation with the presentation of the pilot program Information System spare parts, as well as the presentation of its way of functioning and operation.
In the fourth part, the method of inventory monitoring spare parts, integrated with the mentioned information system, was statistically processed.

Keywords: advancement, system, formalization, automation, monitoring, digitalization, logistics.

1. INVENTORIES AND INVENTORY MANAGEMENT

Inventories are all quantities of energy and information materials that are excluded from production and demand process for a certain period of time, with the aim of utilizing them at a given moment.

A functional, organized and successful spare parts supply system is one of the basic conditions for efficient and effective maintenance system operation. Spare parts are one of the elements of maintenance of technical means, and therefore they are of great importance for the functioning of the supply system. Lack of and waiting for spare parts caused by problems with
the implementation of the procurement process can have an adverse effect on the maintenance and the performance of dedicated tasks. The spare parts supply system faces several basic problems with the implementation of the activities. In order to allow the system to function successfully, it is necessary to determine the optimum quantity and range of parts while reducing costs. Increasing the range and quantity of inventories increases the likelihood of meeting demand but also increasing costs. The solution to this problem is to apply different inventory management models, depending on the type and characteristics of the organization.

The objective of inventory management is to find and maintain that level of inventory that guarantees the ongoing provision of meeting current needs for specific assets, while minimizing unnecessary capital tying. The purpose of inventory management is to balance the benefits in terms of flexibility and independence of certain functions of the organization arising from the holding of inventory with the costs that holding entails.

Modern mathematical methods can be used to determine the rules by which inventories will be managed, subject to certain optimization criteria. Inventory management models represent specific and clearly defined structures of inventory behavior rules in a spare parts supply system. They, with all their elements, serve as a basis for the creation and management of inventory management policies.

Inventory management has changed over time, depending on the needs and characteristics of the assets we can see in Figure 1, and therefore different models are distinguished:

5. o JIT- Just In Time,
6. o MRP-Material Requirement Planning,
7. o DRP - Distribution Resource Planning,
8. o EOQ - Economic Order Quantity,
9. o ERP-Enterprise Resource Planning,
10. o s, S inventory management model,
11. o S, S inventory management model,
12. o s, Q inventory management model,
13. o r, Q inventory management model.

![Figure 1. Demonstration of inventory management model development](image)

Each of these models has its own advantages and disadvantages, however the model s, S is the best solution in the systems of supply with multiple types of goods and it is the subject of analysis of this part of the work, the model is also integrated into the „Spare Parts Information System“.  

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1.1. Model Description $s, S$

We assume that the time elapsed between successive unit requests four spare parts is modeled by an exponential distribution with parameter $\lambda$, while the time elapsed between successive stock replenishments is also modeled by an exponential distribution with parameter $\mu$.

The parameters by which this model was named have the following meaning [5]:

$s$ - an ordering point that determines the moment when an order for stock replenishment is to be placed,

$S$ - level ordering which determines the optimal amount of inventory to hold in the system.

This model belongs to the class of periodic models, with the inventory control periods $T$ being constant, that is, $T = t_i - t_{i-1} = \text{const}$. The size of the order is determined by the following: when the level of current stocks $y$, at the moment of control $t$, takes on a value less than $s$, that is, when $y < s$, then the order $Q = S - y$ is being placed. In case when the stock level at the time of control is $y > s$, no ordering is made. A graphical illustration $(s, S)$ of the inventory management model is shown in Figure 2.

![Graphical representation of model $s, S$](image)

**Figure 2.** Graphical representation of model $s, S$

Analyzing the diagram we can see that at the moment of control $t_1$, the stock level is $Y_1 < s$, then the order $Q_1 = S - Y_1$ is being placed. Since the term of stock control coincides with the delivery term, due to the condition that $\lambda = 0$, the stock level assumes a value $S$ after replenishment.

At another control time $t_2$, the stock level is $Y_2 > s$, so the order is not being placed.

In the third term of time control $t_3$, the stock level $Y_3$ is less than the ordering point, so the order of size $Q_3 = S - Y_3$ is again delivered.

If $\lambda > 0$, that is, a realistic case, with the simultaneous delivery of the order, then the graphical representation is shown in Figure 3.
Given that the acquisition time $\lambda$ is non-zero, the funds will be delivered at time $t_1 = t_1 + \lambda$. If there was a demand during the $t_1$-th period, the inventory level at the moment would be less than $S$, or $Y_1 < S$. This inventory management model is usually applied when the deficit is not allowed, it is very flexible and responds quickly to changes in demand.

2. FORMALIZATION OF CONDITION MONITORING

Formalization of the supply process involves the development of appropriate algorithms and procedures, which establish a logical basis for process optimization and automation, as a basis for the development of application programs and information systems.

Formalization represents the extent to which jobs in a particular organization are standardized. Jobs with a lower degree of formalization allow the employee greater freedom to make decisions regarding the mode, place and time of work. Designing certain algorithms to reduce error tends to unify the spare parts handling and disposal procedures. In order to reduce the percentage of error in the spare parts supply system, it is necessary to formalize the receipt, sending, issuing, selling, purchasing, expenditures, renaming, completing and dismantling of spare parts. When receiving and sending funds, the quantity and quality of spare parts are determined, and the handover process itself is realized through certain accounting documents.

3. AUTOMATION OF CONDITION MONITORING SPARE PARTS

Automation (Greek Automatos) is a technique of controlling and regulating the production process by automatic machines [11]. In this case, the automation of monitoring the condition of spare parts means the automatic generation of certain documents, reviews and reports based on pre-arranged (formalized) processes.

In order to facilitate the monitoring of the state of spare parts, it is necessary to create a unique information system for monitoring the assets. The information system comprises the process of collecting, processing, analyzing and delivering information for specific needs, it is essentially a model of a real system. The inputs to the system change its state, and the resulting changes reflect the output.

Information system means a system in which connections between objects within the system as well as those with the environment are made through information. The basis of all information systems in an organization is information architecture and information infrastructure. In short, the term information architecture means a higher level of information
organization that integrates the information needs of the entire organization and all individual users, information infrastructure and all applications. On the other hand, the information infrastructure consists of the physical realization of the information system together with all its components, services and human resources. The basic components of information systems are: hardware, software, network, database, procedures and manpower.

In order to improve the process of monitoring the condition of spare parts, the application "Spare parts information system" was developed in this paper. The system database was created in Access, which is part of the Windows office suite. Running the application opens the initial window shown in Figure 4.

![Figure 4. Spare parts information system](image)

The home page draws data from the following tables, queries and forms:
- frm_Материјални_лист
- frm_Реверс
- frm_Требовање_које_је_потребно_реализовати
- tbl_Требовање
- frm_ЛИП_РД
- frm_Именник_средства
- frm_Karton_skladisne_evidencije
- tbl_LIP_Query
- frm_Karton_skladisne_evidencije_Subform1
- frm_Karton_skladisne_evidencije_Subform2
- tbl_ID_karton_sredstava

\[289\]
Pressing the button opens tbl_LIP Query and gives you a new window containing all issued and received spare parts, status changes, ordering needs and the current stock level shown in Figure 5.

Figure 5. Database of issued and received spare parts

Within this Query an inventory management model $S_s$ is integrated. At each opening or checking of the base, the amount of spare parts issued and received, the quantity of the spare parts stock can be checked, and on that occasion a specific ordering point is defined. If the stock level falls below the defined ordering point, it will automatically say "Order" in the "Ordering" column. Take for example "WALL, protective rear right", as the level of current stocks, at the moment of inspection, took on a value less than the ordering point, that is, when the level of stocks is less than the point of ordering then $Q = S_y$ is placed, which in this case is 258 and is defined in the "Order Size" column.

The change in status and order size changes automatically when receiving a new asset or issuing spare parts. Changes are also defined by the SQL command:

```
SELECT tbl_LIP. [Nomenclature number and name], tbl_LIP. [Issued / Received], tbl_Party_Menu Directory. [Inventory level], tbl_Menu_party_menu. [Ordering Point], ([Inventory Level] - [Issued / Received]) AS Difference, If ([Difference] < [Ordering Point], "Order", "Not Required to Order") AS Ordering, [Ordering Level] AS [Level order], ([Order level] - [difference]) AS [Order size]
FROM tbl_Menu_partner INNER JOIN tbl_LIP ON tbl_Menu_ID.ID_ISD = tbl_LIP. [Nomenclature number and name]
WHERE ((([order_ level]) = 300));
```

If it is necessary to order spare parts, that is, if it is defined in the column "Ordering", the data of this asset will be automatically generated through Requirements, which can be accessed through the Main window as is shown in Figure 6.
Information on the amount of spare parts available and needed for demand is automatically generated in the spreadsheet and filled in, while other data such as the work number, military post and location and other parts of the material lists are entered manually via a computer. The other material documents listed in Figure 4 operate on the same principle.

Opening the database by pressing a button opens a new window containing information about the stored spare parts, and the appearance of this form is shown in Figure 7.

Introducing an identification card within the database can simplify and speed up warehouse handling. The spare part can be searched by nomenclature number or nomenclature name via
the drop-down menu. When you find the spare part required to complete the task, information about the part, such as the manufacturer's mark, nomenclature number, nomenclature name, year of production, stock level, storage life, conservation life, location of the item at which point it will automatically show the row, column and image of that asset. Searching and auto-filling of the asset data was performed by connecting the tables within the database, shown in Figure 8.

**Figure 8. Correlative form**

### 4. STATISTICAL MONITORING OF THE CONDITION SPARE PARTS

In order to predict the demand of some spare parts, it is necessary to regularly monitor the frequency of issuance of a particular spare part. Demand forecasting is essential in order to develop procurement plans. Using the statistical model of monitoring the condition of spare parts, the dynamics of spare parts issuance can be predicted, and the model itself is integrated within the "Spare Parts Information System", an example shown in Figure 9.

**Figure 9. Issue tracking spare parts**

The table in the database includes the examplery spare part, "CEP", with the amount of issue, the dates of issue within one year and the current state of the asset.

It can be noted from the table that the quantity of this part did not fall below the point of ordering, however, if adequate demand for this part is not done for the next year, there may be a shortage of the same.
Figure 10 shows the statistical analysis, changes in the amount of funds at the time of issue and the date of issue. The analysis was made on the basis of the Spare Parts Information System database shown in Figure 9, and is automatically generated within the database and is available to the user.

![Figure 10. Release dynamics of spare parts](image)

From the diagrams, the dynamics of spare parts issuance by quantities and dates of issue can easily be observed. Since the dynamics of issuing spare parts for a year is monitored, it enables faster and easier development of an annual procurement plan and the continued availability of a specific asset to the user.

5. CONCLUSION

In order to advance a particular system, it must be adequately defined, understood by all stakeholders and properly classified. In order to improve asset management, it is necessary to introduce a unique classification system. Assets classification is a complex process and for this reason it must be comprehensive and valid. It is the basis for easier management and use of the funds themselves.

Proposals for improving the organization in any segment should be harmonized with the normative regulations, in order to make progress and create conditions for achieving a higher level of efficiency and effectiveness of functioning.

The described spare parts information system model is the starting point for creating a single information system that would make data accessible to all users at all levels of organization. Creating such a system will certainly require the involvement of intellectual potential and time, but it is necessary for the initiators and creators to be the bodies of the technical service.

REFERENCES

HYBRID METHODS OF RISK ASSESSMENT IN THE SYSTEM OF HAZARDOUS SUBSTANCES

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Abstract: The basic factor that creates difficulties in risk assessment in the modern processing industry relates to the increasing complexity of the chemical processing industry (HPI) plant due to technologically more complex and more demanding production processes. Continuous technological and overall social development on the world level are accompanied by growing quantitative and qualitative requirements for energy, food, various articles and chemical products. Fulfillment of these requirements implies the expansion of processing capacities and introduction of new technologies in the HPI plants. Risk assessment is a systematic process for assessing the impact, occurrence and outcome of human activities involving products or systems with hazardous characteristics. Hybrid methods of risk assessment are characterized by greater complexity in relation to qualitative and quantitative methods, and are characterized by a concept that is functional and sustainable only for particular purpose. The paper presents hybrid methods of risk assessment.

Keywords: risk, hybrid methods, hazardous substances, process industry

1. INTRODUCTION

Manufacturing, logistics and transport activities with hazardous substances can be at high risk of accidents occurrence, bearing in mind a significant number of causes that affect the nature of the danger in carrying out these processes [1]. Assessing the risk of exposure to certain dangers is an analytical process that identifies the potential hazards and consequences of their harmful effects, especially for human health. Although qualitative methods had a significant contribution to risk assessment in the past, without reducing their importance, it should be noted that in the past few years the focus of risk assessment has significantly shifted towards quantitative methods. This fact is best illustrated by increasing use of quantitative methods in manufacturing and transportation-logistics companies, as they provide numerical information which is useful in planning, strategic and operational decision making, as well as optimizing the technological processes of these companies.

The risk is considered as probability that something that is valued will negatively affect the danger or hazard [2]. Risk assessment is a systematic process for assessing the impact, occurrence and outcome of human activities involving products or systems with hazardous characteristics. It is necessary to answer three questions: What can go wrong?, How likely is it to happen? And if this happens, what are the consequences? [3].
2. RISK ASSESSMENT TECHNIQUES

HEAT or HFEGA techniques are abbreviations from the word Human Error Analysis Techniques (HEAT) and Human Factor Event Analysis (HFEGA). This method of risk assessment in its title contains the phrase human error or human factor, which clearly indicates the fact that the essence of this method is precisely the analysis of procedures that follow the errors due to inadequate response and decision-making by the operator (human factor). This method is based on a human factor, because the practice so far has shown that human errors have become the widespread causes of accidents in a wide range of industrial processes. Practice has shown that systematic consideration of human errors in an objective and comprehensive manner in the process of designing, operating and maintaining of very complex technical and technological systems can lead to improved safety and more efficient work [4]. The projected job disposition, security awareness and culture, with the level of training, the achieved level of competence, complexity of tasks and workload, represents the basic group of factors that influence the operator’s behavior. These parameters are known in the literature as Factors of Performance Design (FOP) [5] and they can be used through the HEAT method to estimate the risk of a human factor, in accordance with certain effects on the operator's work quality (performance). Performance-shaping factors are often not direct causes of accidents, but they are certainly indirect and can be the cause of many failures in complex industrial plants that precede accidents. In the literature, as a result of the large indirect impact of the human factor on the occurrence of accidents, a number of modified risk assessment procedures based on HEAT techniques have been developed, such as [6]:

- ATHEANA (A Technique for Human Error Analysis),
- CREAM (Cognitive Reliability and Error Analysis Method),
- HEART (Human Error Analysis and Reduction Technique),
- HEIST (Human Error Identification in System Tools) and
- THERP (Technique for Human Error Rate Prediction).

The aim of this technique is to identify the causes of human error, the factors that affect the performance of the workforce (human resources) and assess the probability of potential mistakes that are unintentionally caused by the human factor. Adequate risk assessment often has tools for investigating contributions to human error in accidents, and in that sense, a widespread assessment method called HFACS, which quantitatively defines the role of a human factor, takes a prominent place. In this respect, the significance of the contribution of mathematical tools development for the inclusion of a human factor in the technical systems reliability analysis has been given by [7]. The observed results in the human factor analysis have hybrid procedure called HFEA which relies on two analytical methods:

- THERP which provides the model of the tree of of the human factor occurrences and
- CREAM which defines human factor errors during the forensic procedure of the accident.

A practical approach to the quantification of human errors, which expresses the probability of the occurrence of human factor P (HU) errors in an accidental process by the following mathematical relation:

\[
P(HU) = \left[1 - \frac{1}{f_{opc}}\right] \cdot f_{ps} \cdot f_{reg} \cdot f_{red}
\]

Where are:

- \(f_{opc} \) – the factor of options that shows that the increase in individuality in the choice increases the possibility and the probability of an error,
$f_{ps}$ – the feedback factor represents the visualization of feedback through the ability of decision-maker to examine the consequences of decision-making in spatial and temporal dimensions, $f_{reg}$ – the regulation factor implies external and internal correction (adjustment) of parameters based on registered information from the feedback sphere, related to the environment, operator experience, working environment conditions (air pressure, temperature, humidity, use of protective equipment, psycho-physical abilities, training, etc.) and $f_{red}$ – the redundancy factor shows the degree of excess of the cycle in real time with the minimum repetition to create a valid image of all working environment parameters.

2.2. FTA techniques

The FTA technique comes from the Fault Tree Analysis (FTA). The FTA is a deductive technique focused on one particular accident and provides a procedure for determining the cause of the event. The FTA is an accident analysis technique that uses visualized models to show the logical relationship between damages to technical systems, human errors, and external influences in identifying their interaction with the occurrence of specific events that precede the occurrence of accidents. The error tree is a graphic illustration that is created of events and gates. Events in the fault tree can be classified as primary and secondary [8]. Primary (basic) events are used to present technical failures that lead to an accident, while secondary events represent faults of human factors (operators) that can cause failures in technical systems. Gates in the fault tree are used as transitions between events at different levels, representing different combinations to which a particular technical system and/or human factor can lead to a technological process accident. For example, if the gate indicating "AND" implies that both initial events must occur in order to realize the secondary event. On the other hand, the gateway indicating "OR" implies that the realization of the secondary event will certainly come if it is preceded by at least one of the basic events [9-11].

Below you will find an overview of graphic symbols that are most commonly used when constructing a fault (errors) tree:

- Peak and indirect events: To represent the event, these two types are used in the form of rectangles. The peak event refers to the accident that is being analyzed, while the secondary events represent the states of the system that contributed to the occurrence of an accident.
- Basic event: Its graphic representation in the fault tree is done by a circle and is categorized into the lowest level of events that can not be further decomposed by its nature.
- Undeveloped events: These events are graphically represented by rhomb (diamond) and are used to represent the human factor failure in risk assessment, when, for various reasons, they are not developed to the level of basic events (inaccessibility of information, complexity of the problem, etc.).
- I gates: The event in rectangle (peak or indirect event) represents the output of the AND gate below the rectangle. The output event associated with this gate is only available if all the input events exist at the same time by the regular connection principle.
- OR gates: The event in rectangle (peak or intermediate event) is also an output, but in this case of the OR gate that is located below the rectangle. Output event related to this type of gate exists if there is at least one of the input events, according to the principle of parallel connection.
- Inhibitory gates: The event in rectangle (peak or indirect event) represents the output from the inhibitory gate located just below the rectangle. This gate is a special case and the gate and the output events associated with this gate exist only if there is an input event and if conditional qualifications are met graphically through the ellipses (oval shaped).
Transfer symbols: These graphic symbols are used to indicate that the rest of the fault tree is transmitted to the other party in order to establish its continuity.

The procedure for executing a risk analysis based on the fault tree includes the following 8 steps:
1) Defining the subjects or interest of research,
2) Identification of the peak event for analysis,
3) Creating a tree structure,
4) A detailed study of each branch of the structure through successive levels,
5) Resolving a fault tree for different combinations of events that contribute to the occurrence of a peak event or an accident,
6) Identification of significant potential failures that are mutually independent and appropriate model adjustment,
7) Performing a quantitative analysis,
8) Use of the results obtained in decision-making process (decision making).

In the first step, it is necessary to define concrete and clear boundary and initial conditions of the systems for which information on the failures of individual unity of the system is needed. The second step is to define the problem of interest that will be analyzed by the FTA. As part of this step is referred to specific cases to be dealt with, such as quality problems performing some processes, inclusion, exclusion, security installations etc. The third step identifies the events and conditions that are directly related to indirect events, with which, in most cases, can be established a direct connection with the peak event. In the fourth step, the events and conditions that directly lead to each indirect event are determined. This procedure is successively repeated for each level of the fault tree structure until the model is fully completed. The fifth step involves examining the fault tree model in order to identify all possible combinations of events and conditions that can cause a peak event of interest in the functioning of the technical system. A combination of events and conditions that are needed and sufficient to trigger a peak event is called the minimum cross-section set. For example, the minimum cross-section set for the state corresponding to the overpressure in the tank includes the following two events: an untimely operator response and failure of the safety valve. So, in the absence of an appropriate operator’s response due to excessive pressure leads to the safety valve activation as a final safety measure. If the operator responds in a timely manner, then the pressure in the tank is reduced in time, so there is no need to activate the safety valve. The situation leading to an accident implies the simultaneous occurrence of two independent and regularly related events: the absence of operator’s reaction and the occurrence of the safety valve failure. In the sixth step, the fault tree model based on the results of the analysis in the previous step is studied, in order to identify, on the basis of minimal cross-sections, the potentially important dependencies between the events themselves. These dependencies are characterized by individual phenomena that can cause the simultaneous occurrence of multiple events or conditions that directly precede an accident. This step provides a qualitative risk analysis due to the failure of system components. The seventh step includes the use of statistical characterization of events related to failure of system components and their reparation in terms of changing the state of the event and the conditions of the model based on the fault tree, in order to predict the system performance for an upcoming period of use based on this analysis. In the eighth step, the results of the analysis are used to identify the most significant weaknesses in the system and to create effective recommendations in order to reduce the risks associated with these weaknesses.
2.3. ETA techniques

The ETA technique is an abbreviation for Event Tree Analysis. ETA is a technique that uses decision trees and logically developed models to visualize the possible outcomes of an initial event. In addition, the technique is based on a graphical representation of a logical model that identifies and quantifies possible outcomes and next initial event. The mentioned ETA approach models investigate how protection measures and external influences under the name of the insurance or security line affect the chain of accidents. In this process, initiating events such as functional disturbances (defects, failures, etc.) of technical systems and technological processes are considered as the starting point in the process of defining predictive results and their sequential propagation is represented graphically over the tree of events. ETA is a system model that represents a security system based on the satisfactory security of the sub-events. Based on this fact, the name of the event tree is derived, since the graphic representation of the sequential events develops as a tree from the stem to the branches, thereby increasing the number of influential events. Each event tree must have an initial event, in most cases, subsequent events and final results caused by sequential events in most of the cases. Later events are probably independent of each other and specific final results depend only on the initial event and subsequent events that follow. Therefore, the probability of occurrence of specific paths can be obtained by multiplying the probability of all subsequent events on the path. All events that are graphically presented through the event tree can be very efficiently described from the aspect of their order in relation to time. This interpretation is justified by the fact that the event tree just refers to the sequence of events. At the design stage, ETA is used to verify the criteria in order to improve the performance of the system in order to obtain basic information of the tested operability and management in order to identify the methods for system protection from failure. The ETA procedure is a universal risk assessment tool that does not apply only to the design and operability of the system, but it has significant application in monitoring the system's operability and analyzing the causes of accidents. The main characteristics of the technique can be conceived as follows:

1) Models based on the ETA approach in a wide range of possible accidents arise from an initial event,
2) ETA approach is a risk assessment technique that effectively describes the time component and the interdependence between different actors of accidents that are complicated for modeling through FTA techniques, such as domino effect phenomenon,
3) An ETA-based analysis provides a qualitative description of potential problems as a combination of events that produce different types of problems compared to initial events,
4) The ETA approach provides quantitative estimates of the events frequency, i.e., their probability and relative significance of the characteristic sequences of failure,
5) ETA methodology provides a list of recommendations for risk reduction and
6) The risk assessment analysis by the ETA method provides a quantitative evaluation of the recommendations effectiveness.

2.4. RBM techniques

RBM technique is a hybrid risk assessment method, which is the abbreviation of Risk-based Maintenance (RBM). RBM belongs to a group of hybrid risk assessment methods that, through qualitative and quantitative analysis, can be applied to a wide range of problems, regardless of their characteristics.

The quantitative description of the risk depends on the quality of the research process concerning the consequences of the accidents and the accuracy of the probabilistic assessment
of the accident occurrence or the vital parts of the plant failure. RBM methodology is implemented through three segments:

i) A risk analysis that includes its identification and assessment,
ii) Evaluation process that considers the risk aversion phenomenon and the conditions for its acceptability and
iii) Maintenance planning with regard to risk factors.

The above mentioned three phases of the RBM method are gradually implemented through the steps, so that the first phase is realized in the four steps, the second and the third through two steps. Below is a detailed description of these steps by the RBM method stages.

Step 1 refers to the development of a failure scenario (accident) necessary to describe a series of events that can lead to system failure. An accident scenario can be created based on the content of one or combination of several sequentially related events. Practical experience has shown that the usual situation of system failures or plant accidents is the consequence of the sequential disposition of the event interaction, which is a typical situation for the domino effect manifestation. Designing an accident scenarios does not mean that it really will take place in real conditions, but that there is a reasonable probability and a certain degree of justification in terms of its realization. However, a set of accident scenarios provides us with all the potential alternatives that can occur in real-life situations, and only one can be realized, which means that all others automatically fall back on the legality of the complanary events. A failure scenario or occurrence of an accident scenario is a risk analysis database and provides an overview of what can happen and how (in what way), which is needed to take measures and resources to prevent or minimize the possibility of such situations. These scenarios are generated based on the operational characteristics of the system, the physical conditions under which its functioning is performed, the security parameters, the types of technological processes, the disposition of the drive units of the plant, the organizational structure, etc.

Step 2 relates to the assessment of consequences which aim is to prioritize the significance of plant (system) equipment and components based on their contribution to the occurrence of system failure or the causing of accidents. Consequences analysis involves an assessment of possible consequences if the failure scenarios of the system or the occurrence of accidents are not materialized. The initial stage of this analysis includes the quantification of consequences in terms of defining the area of damage with a clearly defined range or radius in the area of a plant that would be vulnerable to damage due to the operation of certain hazards. The degree of plant damage in the first place depends on the nature of the technological process that takes place in the plant and the types of hazardous substances used as a working medium. Depending on these two indicators, global accident scenarios can be created that exclusively show the consequent effect of damage to the plant (explosive-fire, toxic, radioactive or combined). Calculation of damage to the plant area is necessary in order to determine the consequent effect on losses of production capacities, material and human resources, the environmental impact and the population in the immediate vicinity of a potential accident. Accordingly, total estimate of the consequences due to damage to the plant requires consideration of the following four categories of losses:

a) The loss of the plant (system) functionality is expressed through factor A which takes into account the loss of system functionality and its performance due to damage to the technical and technological units of the plant. Evaluation of the plant performance losses is qualitatively assessed on the basis of expert opinion. In order to improve this estimate, Khan and Haddara [12] proposed a semi-qualitative approach in determining the value of parameter A in the function of system performance, so that the relation A = f (system performance) applies.
b) Financial loss due to system failure is expressed by factor $B$, which expresses material damage to facilities and technical equipment of the plant, which is assessed for each accident scenario using the following relations:

$$B_i = \frac{(AR)_i \cdot (AD)_i}{UFL}$$

(2)

$$B = \sum_{i=1}^{q} B_i$$

(3)

Where is:
i – number of accidents (fire, explosion, toxic form, radiation, etc.),
$(AR)_i$ – the area surface affected by damage for the i-th event expressed in m$^2$,
$(AD)_i$ – the density of plant equipment up to 500 m from the i-th event expressed in $$/m^2$$ and
$UFL$ – indicates the level of unacceptable loss that is subjective in nature and varies on a case-by-case basis, bearing in mind the organizational criteria of the companies and the type of technological processes performed within the facility that the company manages.

c) Human resources losses are assessed through the factor fatalities $C$ for each accident scenario using the following equations:

$$(PDI)_i = PDI \cdot PDF$$

(4)

$$C_i = \frac{(AR)_i \cdot (PDI)_i}{UFR}$$

(5)

$$C = \sum_{i=1}^{q} C_i$$

(6)

Where is:
$UFR$ – indicates an unacceptable mortality rate that is subjective and variable, depending on the case to the case with the most common value of about $10^{-3}$,
$PDF$ – indicates a population distribution factor that expresses the heterogeneity in distribution of the population around the plant. If the population uniformly inhabits the area that radiates about 500 m relative to the plant, then this factor takes a value of 1. If the population is localized (only in one zone around the plant), the PDF value takes less value and decreases with the increase in the radius (distance) of the plant. The minimum value that can be assigned to this factor is 0.2 and
$PDI$ – defines density of the population near the occurrence of the i-th event, refers to the area affected by the radius of up to 500 m from the plant and expressed by the number of inhabitants/m$^2$.

d) Environmental losses and environmental threats are manifested through the factor $D$ representing the damage to the ecosystem, which is assessed through the following terms:

$$D_i = \frac{(AR)_i \cdot (IM)_i}{UDA}$$

(7)

$$C = \sum_{i=1}^{q} C_i$$

(8)
Where is:
UDA – indicates the level of ecological inadmissibility of the vulnerable area located in the immediate vicinity of the plant. This parameter is characterized by certain subjectivity, which means that its value is variable, depending on case to case. The typical value of this parameter is about 1,000 m².

(IM)i – is a factor of significance that takes a unit value if the radius of damage is greater than the distance between the accident focal point and the observed ecosystem location. Khan & Haddara [12] gave significant results in terms of the quantification of this parameter are given by 8.

Finally, in order to obtain the unique factor of the consequences, FP, it is necessary to consider all consecutive factors (A, B, C and D), whose interaction is manifested by the process of combining their values by the following mathematical relation:

\[ FP = \frac{1}{2} \sqrt{A^2 + B^2 + C^2 + D^2} \]  

Step 3 refers to the probabilistic analysis of failure and accidents of the plant and is carried out using the FTA risk assessment technique. Effective application of the FTA method requires an integrated approach to risk analysis, which implies that in the assessment process, statistical data on potential failures are combined with reliable expert assessments in order to determine the incidence of an accident occurrence. Step 4 implies a risk assessment that is carried out on the basis of the results of previous steps research. The result of the sequential analysis is the consequence factor FP, while the probabilistic analysis of the damage examines the likelihood of damage occurrence from a qualitative and quantitative aspect within the FTA method.

Phase II refers to the risk assessment whose algorithm comprises two steps. Step 1 implies the establishment of acceptability criteria for the risks that were the subject of the first stage of proceedings. Various acceptability criteria are available in the literature. Step 2 includes comparative risk analysis according to acceptability criteria. In this step, the acceptance criteria for the estimated risk of each technological unit of the plant under consideration are applied. Sections of the plant whose estimated risk exceeds the frames defined by the acceptability criteria are identified. Such technological units of the plant must be subject to subsequent analyzes in terms of defining more effective preventive plans that create better operating conditions through improved maintenance measures.

Phase III is reserved for plant maintenance planning and represents a logical continuation of the previous phase last step. Within this phase, special attention has been paid to plant units that have assessed the risk beyond the acceptance limits according to pre-defined criteria. Therefore, they are the subject of detailed studies to identify all influential factors relevant to risk reduction and improved maintenance conditions. This phase is also realized in two steps: Step 1 refers to the assessment of the optimal maintenance duration in which individual causes of damage are studied to determine the negative impacts on the probability of damage to the plant. Within this step, a reversible analysis is carried out to determine the required value of the probability of failure of the root or peak event. Based on the reversible analysis of the fault tree and the reversibly determined damage probabilities, it is possible to identify the most influential parameters of the system failure and thus complete the revised maintenance plan. Step 2 is the final step of phase III and the overall methodology, and is related to the re-assessment and re-evaluation of risks. The aim of this step is to verify a developed maintenance plan that generates an acceptable level of risk for the individual units of the considered plants (systems).
5. CONCLUSIONS

Risk assessment is often formally described as a process consisting of three different stages: hazards and risks identification, risk assessment and risk evaluation. Risk analysis plays role of an effective and comprehensive process complemented by use of various techniques. Hybrid methods of risk assessment are characterized by greater complexity in relation to qualitative and quantitative methods, and are characterized by a concept that is functional and sustainable for a specific purpose (“ad hoc”). This means that some risk assessment methods from the category of hybrid techniques cannot be universally applied to a wide range of problems, but its purpose is limited to the analysis of a specialized problem. Application of appropriate hybrid method represents an efficient and effective way of assessing, managing, and therefore reducing the risk in HPI.

Much effort has been invested in development of hybrid methods that have a significant role in improving operational safety, reducing maintenance costs, and reducing the frequency and severity of systems and subsystems failures. Keeping this in mind, in addition to existence of a significant number of hybrid methods that are listed in the work, it is necessary to select the optimal technique depending on the industrial branch or the production process, which significantly contributes to the reduction of the percentage of sick and injured. In other words, a higher level of safety and health of employees, as well as environmental protection, would be achieved. So all of these elements, making a single complete entity, positively influence the safety, security, economic and environmental aspects of the process industry.

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