CMDR COE PROCEEDING 2017

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Crisis Management and Disaster Response Centre of Excellence (CMDR COE), September 2017

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Dear Readers,

It is a great pleasure to present you the third annual proceeding book of the Crisis Management and Disaster Response Centre of Excellence. Our efforts are to provide useful information for all subject-matter experts in the area of CMDR. We stress the importance of the subjects and the present edition gives me optimism that it will enhance the common understanding and expertise on international, regional and interagency level. Therefore on behalf of the entire editorial board I express appreciations to all authors and reviewers of the third year of CMDR COE Proceeding.

Presenting this edition, I would like also to express my gratitude to the Defence Ministeries of Bulgaria, Greece and Poland for their support and sustain. Common interest in subjects of CMDR is vital for our organization and shows the level of commitment of the political and military leadership in these NATO Member States and the full support to the CMDR COE activities as an International Military Organization.

We all are aware that Crisis Management is one of the core tasks for NATO and EU. Therefore, we aim to develop common understanding and capabilities to train, prepare, mitigate and respond in case of emergency.

I am convinced the present edition is contributing to the knowledge of CMDR and will be a useful tool for all SME in this area.

Based on our activities in the last years the CMDR COE Proceeding 2017 focuses attention to factors and implications that insist interactions in response of disasters and crises.

Vassil ROUSSINOV,

CMDR COE Director

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Keynote speaker

Rear Admiral PETER GUMATAOTAO,

Deputy Chief of Staff for Strategic Plans and Policy,
NATO Allied Command Transformation, US Navy,

CMDR COE 5th Annual Conference "Interagency Interaction in Crisis Management and Disaster Response"

June 1st 2017, Central Military Club, Sofia

I am very privileged and honored to be here today and especially to represent General Denis Mercier, commander of ACT. I am the FOGO champion from ACT. Let me first thank our host - Bulgaria and specifically the CMDR COE but to be honest – there are a lot of COEs and as I think about the relevance and the value of the COEs they have overall importance but it is critical that we use this CMDR as a polar to connect and as a polar to bring together SMEs not only from Europe. At least 14 countries are here today. You have travelled from so far to bring them about your expertise, to come together and start to plan and to develop and adapt to planning. You see a lot of faults in this very complex 21st century and Deputy Minister explained how complex and unstable our environment is. Then we come complacent when we only have a plan. As an operator it is important to understand that planning is more important than plans. Plans are meant to be on the shelf. We need to take the plans, we need to challenge the assumptions of those plans and I think the CMDR could be the polar for that. So Col Roussinov with your leadership and your people you only have a small group in front of you and I am sure that in your regular accomplishments you have done a lot. But we have to do more. In 21st century we need to be able to operate and adapt simultaneously. If we do not do that, we will fail. A lot of thoughts talked about the complexity of the 21st century but many of you in this room have the important partial to the effort, particularly with ACT to look at how we can operate today, how we can improve today, how we can shape the future and how we can bridge the two. We all are involved in that. This is not just the ACT's effort. This is the Alliance's effort to promote stability, to promote the values that we have. And I encourage all of you to define the value that we have from this effort and the value that we will bring on the table to be your unique perspective. As I look at the agenda, to be honest - it is very ambitious agenda, and you would not be able to express your use because of the time that is limited for each discussion. But I encourage all of you to speak your mind- politely and curiously. And if you do not have the chance to stay during the sessions, you could challenge the CMDR COE for future discussions or even continuing discussions because that is the value we speak about today.

I would say that the Strategic Foresight Analysis (SFA) switched by the way is being updated as we speak by SPP and ACT is going to publish it. If you have not read the 2013 publication and 2015 update of SFA, I recommend you to do so, because it talks about this rapid changing environment, but it does not predict the future. What we need is to understand the trends, survey, the changes and dynamics of political environment, we need to know what is happening as a result of the migration of technology. Leveraging technology of GPS for example, leveraging technology of connecting with the customers applies a very sufficient system to be able to get a vehicle and its real destination – you know where the person is, you know what time he is going to be there and you even know his license number. I use that in a very simplistic form because imagine what we can do in terms of CMDR when we are responding to national disasters. National disasters – is that a trend of SFA – absolutely. It is not if a disaster (earthquake, tsunami, and sea level rise as a result of climate change) will happen – it is when it is going to happen. And the planning to do that is not right before, the planning to do that is today.

Here is why I was mentioning our aftermath last night about urbanization. In about 15-20 years a majority of our populations which will go up towards 9 billion people in the world will populate hundreds of miles of coastline and will be situated in places called megacities. So we are talking about compressed population in concentrated areas that will be impacted for example by a natural disaster. You do not need even think about only manmade disasters or conflicts. Think about what would happen if you had flooding in these areas. Just a month ago the mayor of New Orleans came to Norfolk for Resilience Conference. Some of you have attended it. And the mayor had expressed to the audience that the citizens of New Orleans consider themselves very resilient to storms, to a lot of things. But he said their failure was complacency. They had never thought about what to do for the comprehensive approach if the mother of all typhoons and hurricanes hit New Orleans. And that mother of all hurricanes was Katrina. And he said: "All the things that we have listed on the baseline requirements that we have to put together in CEPC - all of these seven baseline requirements were neutralized in New Orleans when Katrina and the surge of the sea level broke the levees". And he said all of the transportation, all of the airfields that they used to move logistics were flooded out. All of the rescue teams that had to go to remote areas to rescue people that were isolated as a result of flooding were not accessible because rescue teams could not move. Local governments, government, transportation and energy services desired to ring the bell to any of us. It happens in front of all of us. And

New Orleans should be a wakeup call. But you know as finding resilience – people did not learn from New Orleans, because when hurricane Cindy hit the north-eastern side of the United States they did not take advantage of the lessons learned from Catrina and they suffered the same lessons during that storm. We all even say: How is that possible? Why was it not possible? Because we did not have agencies or COEs like CMDR to connect everybody together so that when you do know something, you do not come together to better understand and to better improve. So I challenge this group for the next two days: please, engage your measure of value from what actions and deliverables come out of your reports. From those wearing uniform today, and sorry for my uniform – this is my travelling uniform, I think we need to have a shift in our minds from being warfighters to perhaps being an assist model or a rescue model to help the state officials or the government officials and UN agencies for what we can do to support them. Here is the challenge that we have. Most of the time when military operations are happening they go in the way that we are in charge of staying aside. This is not in 21st century. When we do that in these kinds of circumstances particularly in civil crises the forces that are in charge on the ground are looking at what plan you have. You are not in charge, we are in charge. So it is very important that we continue this dialogue with the government agencies, international agencies, private industry which is a big part of this. And one of the things that we need to do is to reach out of private industries and to state the problem to them. And then let them say: "Yeah, we got that or we did not even think about that." The good news for all of us even coming out from the Warsaw summit is that this dialogue is happening across the border from my comprehensive way. But just to have videos, CDs and say that is what we have, this is what we can do, that is not enough. I challenge you all that we are not only to educate, and better understand and share information.

That is good, but that is not enough. I think what we need to do is to exercise these things that you talk about. And as I was telling Jean Dominique before I came up to here, our exercises should not be perfect. Exercises should strain our assumptions. We should be ready to fail during the exercises. We should fail, we should feel the pain in exercises so we don't repeat the same pain in real life. And I just gave you a very easy example of New Orleans versus New York and how they did not exercise that and then they did not institutionalize that. And finally the most important thing that I think is very valuable thing in these sessions that CMDR COE has is that it brings you together to connect and I will offer you this – if you look at the list of presenters and panels' members in the next two days and if you hear what they say first of all I will ask you that you listen because it is their perspective. And then you say: "Do I know that person?" If you do not know that person, use this event to connect, because it is very simple but I have to say - when you start to connect, then you will better understand, when you better understand, then you will start to trust. That is the only way you can have a relationship and the phenomenal peace is trust. If you ask me I will give you the bad grade but it comes to trust. And still what I will recommend you today it is to take advantage of who is around you and connect, so we can better understand and build trust. Thank you again for making your time to come here today, take it count, come up with deliverables and don't be afraid to fail in these exercises.

Thank you very much!

Keynote speaker

Mr. JEAN-DOMINIQUE DULIÈRE,

Crisis Response and Exercises Section Head, NATO HQ, Brussels

CMDR COE 5th Annual Conference "Interagency Interaction in Crisis Management and Disaster Response"

June 1st 2017, Central Military Club, Sofia

Mr. Deputy Defence Minister,
Generals,
Admirals,
Ladies and gentlemen,

It's a pleasure and a great honour to be here at Sofia today to attend this conference. And like RA Gumataotao I do pretty assess this Crisis management and disaster response Centre of excellence as a key role to play in bringing together a number of stakeholders in exchanging best practices providing an excellent forum for information. And I would like to commend Col Roussinov for all the things they have done. Four -five years ago there was an initial discussion at ACT on setting up this Centre of excellence and it is amazing to see how much it has developed and grown. So it is great pleasure to be here coming from Brussels. And I am not here to present any official view on that but I will just give you my view on the challenges that we are facing today and the issues that we are dealing with.

As you all know, the Alliance is actually currently confronted with a number of hybrid challenges from the East and from the South. To the East Russia's actions in terms of security are shaking regional stability. They ultimately challenge the EU and they have damaged the Euro-Atlantic security in broader terms. To the South, terrorism as a reason for high level of tenacity, represents an immediate and direct threat to our nations but also to whole Theatre of operations. The recent cyber-attacks that have targeted a number of Allies and nations as well as the terrorist attacks in UK or yesterday in Afghanistan are not only the most recent reminders of the urgent need to strengthen our ability to respond in a swift and effective way to some challenges at 360 degree. That is the way in which we call them. Furthermore, as admitted by admiral Gumataotao, there are unpredictable natural disasters as well as manmade disasters that will cause actually great destructions to the infrastructures and will affect our security. That calls obviously the need of a number of appropriate responses. In few days ago in Brussels the Heads of States and Governments have decided to do more in the fight against terrorism – an Action plan was approved. NATO will become a member of the Coalition against ISIL. Head of state and government have also confirmed the need to step up the burden-sharing and the commitment to spend 2 % of the GDP of defence, including 20 % for our major equipment. All this together should increase our capabilities. But these increasing efforts in military capabilities will also be complementary by the increasing efforts in the domain of resilience. And the heads of state and government have agreed to increase the resilience in seven strategic sectors. The main name of this is to protect all soft targets – the civilian population, the critical infrastructure, our cyber networks and the essential government functions. When we look at all these functions they are directly linked to Article 3 of the Washington treaty which launches every Ally to develop its capacity to resist an armed attack. Beyond NATO it has already also been agreed last week in Warsaw summit to increase our cooperation with the EU in some fields. The Secretary General signed together with Mr Tusk and Mr Junker a Joint NATO-EU declaration and this led them to the foreign ministers for the endorsement of 42 proposals to increase our interaction with the EU within four fields – situational analysis, crises prevention and response, cyber and strategic communications. And in effect nowadays in a number of NATO countries the civilian infrastructure that we would connect is regulated by European legislation and we need to ensure also what this legislation says and our different needs. And finally beyond NATO again the interaction that we have with our partners is absolutely key not only for them but also for us. Finally I would like to say a few words on decision-making the Alliance has made. In the past year a number of adaptations in the field of decision-making were made in order to make the decision-making swifter and more responsive in times of crises. The NATO Crisis Response System which is the cornerstone of the way in which NATO will react in times of crises has been significantly adapted and reviewed and many nations including Bulgaria have also adapted that decision-making to synchronizing all together, not only internally, in interagency mode, but also in the whole decision-making process. And I think that once those procedures have been adapted, then they need to be exercised, it is key to challenge those procedures, it is key to stress- test them, it is key to put strain on our decision-makers to ensure that we are ready for the crises. In this field this COE has also a key role. I would like to thank you for hosting the final planning conference of CMX 17, as this exercise will have a stress-test for a number of decision-making procedures among Allies. I would like to thank Col Roussinov for setting up this conference and for providing me the opportunity for this introduction. So I wish you the very best conference!

Thank you very much!

Keynote speaker

Brigadier General KONSTANTINOS ALEXOPOULOS,

Director of A6 Directorate (Civil Defence, CIMIC and Civil Emergency Planning) of Hellenic National Defence General Staff and the Chairman of the Coordinating Committee of the Multinational CIMIC Group

CMDR COE 5th Annual Conference “Interagency Interaction in Crisis Management and Disaster Response”

June 1st 2017, Central Military Club, Sofia

Ladies and gentlemen,
Deputy minister,
Distinguished guests!

I would like first of all to thank you for this outstanding opportunity to present my personal view on the subject that is critical to European security. I will try to switch over from strategic to operational level and to give my point of view in most slides with a short introduction to the European security, then I will analyse the security environment in South-Eastern Europe, I will shift from my point of energy issues from security military standpoint and I eventually I will draw some conclusions. I support that the approach to discuss about the European security environment has to be the holistic one. It has to consider both the Russian Soviets and the so called Eastern flank, but also other areas to bring them the status of regional main powers and main challenge like MENA (Middle East-North Africa). Massive migrant flows coming from Asian states are in certain importance in terms of energy security for the European continent and multi-crises situation connected with the events in Syria, Libya and Iraq that challenged the Alliance security. And it sets efforts - sometimes successful to shake Europe in that risk - for example last event in Paris and in Belgium. Energy security is under increasing global threat. It includes additional factors and assets like price stability, business continuity and timeliness as well as security of network infrastructure. The latter is basic for the use of armed forces. In 2014 during the Wales summit NATO Heads of states and governments have recognized that both Russian aggression against Ukraine and growing instability in the Southeast Europe were challenging the Alliance security. Thus NATO identified two threats without determining the scale value between them. And in 2016 Warsaw summit confirmed the same frame and depicted the security environment split between two main poles – one on the east including the Baltic area to the north and the Black sea and another to the south which is presented by MENA. In short, going to the point we can say that there was no difference between 2014 and 2016. NATO had identified the threats as you can see on the screen. In this slide we can see a framework that depicts NATO strategy divided during the Wales summit, very crucial in my point of view to respond the threats emanating from the East and from the South. To enhance NATO response force (NRF) was meant as a long-term adaptation measure which serves to the Alliance as a whole. However the specified measure would be of limited impact on the MENA region. Emerging security challenges – both ambiguous and integrated use of military and non-military assets by Russia in Ukraine. These are Russia aggression actions, including provocative military activities in the periphery of NATO territory that are a source of regional instability. Other challenge is instability in MENA region.

The situation of NATO in Warsaw summit is connected with the resilience commitment. Energy security connectivity and the promotion of sustainable energy should remain key objectives of a strategy for South-East Europe regional stability to which NATO can contribute. Countries of South-East Europe serve as an energy bridge connecting major producing countries in the East with the biggest consumers in Western Europe. South-East Mediterranean has attracted the interest of the oil industry and all major world actors. The US are also interested in South-East Europe for energy issues. On the other side is Russia's presence in this region that is interested again in energy issues. The Russian federation is the largest exporter of oil and natural gas to the EU. Main Russian pipelines in Europe are "Nord stream", "Yamal-Europe" through Belarus, "Blue Stream", "Urengoy – Uzhogorod" through Ukraine. It does not include only East and Central Europe, but there is Russian economic and diplomatic penetration in Sub-Saharan and Northern Africa. Another critical energy transport hub is Turkey. So in order to better describe Europe today we can call it a "giant on a shaky base" with energy dependency on the Russian Federation that is a major weakness. So Europe has to look for Energy Security Strategy without Russia. EU imports 53 % of the energy it consumes costing about 400 million euro per day. Many European countries are dependent on one legal source of energy supply that is Russia. That is the reason the EU has to work on EU's energy diversification strategy which suggests as an alternative to look at the Southern corridors and Mediterranean hubs (North Africa) where Nigeria could link with Niger, Egypt and Algeria and thus being suppliers for Italy. But we should pay attention to the political danger of the route. China could be other alternative to diversify energy supplies for Europe also referring to the opportunities the Black See provides. It is obvious that Syria and Iraqi gas fields are possible sources for diversification and it depends on who will get the control on pipe lines situated between Iran and Qatar. The capacity that Syria provides mostly in the area north of Damask counts on 400 000 cubic meters per day which will make the country the fourth major producer on the Mediterranean base in the region.

In the future the gas fields in Eastern Mediterranean could provide gas for Europe and especially for Bulgaria. The eastern Mediterranean region—Cyprus, Israel, Jordan, Lebanon, Syria, and the Palestinian territories—is currently undergoing changes to its energy landscape. Cyprus and Israel are cooperating on the possibility to construct a gas pipe linking the gas fields. This cooperation between Greece, Cyprus, Italy and Israel in the future will signify an alternative energy group which will enhance energy security. This will strengthen SE Europe as a regional energy hub. Among the major issues in the region, physical and economic security as well as offshore hydrocarbon development will have the most influence on the region's energy sector. Unrest in Syria and Egypt and territorial disputes between several of the countries in the eastern Mediterranean will impact regional energy production, consumption, and trade. Further, negative economic developments in the region —influenced by issues such as the Cyprus debt crisis and the war in Syria—could undermine demand, interrupt production and trade, and threaten the viability of several energy infrastructure projects. Overcoming these challenges is critical to the success of the region's energy future.

The security environment in SE Europe relies on NATO to be in cooperation with EU and other relevant non-NATO entities implementing comprehensive strategic and political approach to the region with determination to promote stability which has social, economic, cultural and diplomatic advantages. In this regard NATO members and Energy Planning Committee have proposed the following countermeasures for possible attacks against strategic infrastructures: maintaining situational awareness through a system of indication and warning; provision of proper intelligence flow; development of Defence Capacity building to strengthen local government, implementing military partnership in the area, deploying NRF components to intervene securing or regaining control of the infrastructures; securing sea lines of communication and neutralizing hostile ships and their bases.

In the area of resilient energy supply national authorities ought to take appropriate measures and to protect critical energy infrastructure, installation systems and assets; to promote crisis management training and exercises; implement national arrangements to asses energy usage; identify critical supply chain nodes and cross-border interdependencies; develop arrangements for prioritization of civilian and military energy needs and alternative supply options to mitigate energy vulnerabilities; establish robust and effective info sharing. The HAF (Hellenic Armed Forces) are an instrument of foreign policy and key instrument and power factor. Along with the national security forces they are responsible for protecting networks, energy transport routes and energy infrastructure of the country. They are critical for the national interest directly related to national resources that are essential for the survival and protection of the nation. They are an essential factor of building national resilience.

Concluding, I would like to focus that energy security development in SE Europe would be transformed both from the economic and political standpoint. The main lesson could be integrating EU energy markets and enhancing cooperation between member states as the most efficient tool to improve energy security.

Thank you very much!

THE CASE OF DAESH

Zhuliyan Zhelezov

Introduction

Considering the importance of ensuring that the civilian population is respected and protected during operations, missions and other activities led by NATO, at the Warsaw Summit, in 2016, NATO adopted a Policy for the Protection of Civilians (PoC). Further, a consistent and complex approach to the PoC irrefutably necessitates conceptualizing and operationalizing civilian protection (Beadle, 2015). The purpose of this paper is to elaborate on the latter while concentrating on the physical protection. In order to provide effective protection, NATO's military forces have to understand the threat that exists and create capabilities to counter it. The concept of PoC must be considered throughout the entire military operations – before, during, and after the operations in order to be completely efficient. Therefore, operation strategy *per se* is not enough; it must be conceptualized and operationalized at all levels (Beadle, 2015). Operationalizing physical protection successfully is not feasible without concentration on the *'before'* stage of the operation. Thereby, a certain level of proactivity is needed in reference to the potential approach that can be chosen, based on the nature of the threat and the enemy force. *Therefore, the main purpose of this paper will be to answer the question of what should we know about the enemy force in the case of Daesh.*

Operationalizing physical protection means to create and implement military capabilities to actually protect civilians from physical harm and to defend vulnerable population from the effects of contemporary conflicts. This, however, is only feasible after we answer the questions of why certain perpetrators target civilians and for what purpose. After all, the threat is composed and employed by the perpetrator against the civilians and serves to achieve certain objectives. Thereby, the threat assessment process in NATO's PoC concept on the *'before'* stage of the operation is crucial for creating and employing efficient approach against the perpetrators that will serve throughout the entire operation on all levels.

The purpose of war, as a duel in which one tries by force to incapacitate the other and to compel him to do his will, thus ending the conflict (Clausewitz, 2007), no longer applies. Contemporary conflicts, in the 21st century, are lasting and inconclusive. (Kaldor, 2010) They are instrumental and rational but not in accordance with recognized rules and values such as the recognition of human rights. The violence in these conflicts for one or another purpose is mainly directed against civilians (Kaldor, 2010). These conflicts take place in urban networked littoral areas (Kilcullen, 2013) vastly populated by civilians who become victims of either unintentionally directed violence (collateral damage) or intentionally directed violence (terrorism). By approaching this issue from the perspective of the victim, it seems that both cases lead to the same result. Therefore, a concept concentrated on the protection of civilians is a must that the international community should address. Driven by its values and perceptions, NATO recognized the necessity to protect civilians from the short-term effects and long-term consequences of armed conflicts. (*Warsaw Summit Communiqué, 2016*) Thus, NATO approved the NATO Policy on the Protection of Civilians, developed in direct coordination with the UN and other international organizations.

New strategic challenges imposed by Daesh with the aim to disrupt the *status quo* of the European security order and to destroy the State structure in the Middle East have emerged in the 21st century. The United Nations Security Council determined that Daesh constitutes a threat to international peace and security by its systematic and widespread attacks again civilians, its ideology, and the terrorist acts it perpetrates. (*UNSC Resolution 2249, 2015*) This threat has forced the international community to adopt new strategic approaches to counter Daesh and to contribute for the protection of civilians.

In the beginning and mid-2014, Daesh emerged onto the global stage with series of spectacular victories in Iraq and Syria, thus challenging the principle of State sovereignty, on which the international order has been based since 1815. The terrorist organization proved right David Kilcullen's statement that conflicts in most cases will move to urban areas due to the changing demographic, geographic, and technological environments which will necessitate considering the new set of challenges – coping with complex irregular warfare against non-state actors in urban networked areas, different from the rural remote landlocked environments. (Kilcullen, 2013) Daesh's use of myriad tactics to push forward its agenda of creating a global caliphate and to saturate the entire operational environment with the aim to facilitate their course of action, compels their opponents to react along multiple lines of operation, i.e. to engage in multidimensional warfare (Ganor, 2015) while trying both - to protect the civilians from harm and to defeat the terrorists. In order to understand the perpetrator, we should analyze the rise and the consolidation of Daesh and to approach the topic from another perspective, thus answering the question of whether Daesh wages hybrid warfare or not.

The Rise and Consolidation of Daesh in Iraq and Syria

Two core, structural causes can be highlighted as we speak about the rise of Daesh in Iraq. The first factor can be observed in the new constitution from 2005 which facilitates a political sectarianism. The second factor was the forced displacement of people based on religious affiliations which resulted in the emergence of sectarian lines. (Bryan Price, Dan Milton, Muhammad al-`Ubaydi, Nelly Lahoud, 2014) Further, the fact that the U.S. forces left Iraq and the destructive policy of Nuri al-Maliki had provided a strong *raison d'être* for Daesh in Iraq (Cheterian, 2015). Instead of concentrating on the elimination of differences and divisive issues and working for consolidation and unification of the different elements of Iraqi society, the new constitution did not create a sense of community. On the contrary, it created a sense of separation between Sunnis, Shi'as, Christians, and others. (Bryan Price, Dan Milton, Muhammad al-`Ubaydi, Nelly Lahoud, 2014) Further, a root cause for the rise in Iraq is related to the inevitable change of the regime in Iraq started by the U.S. and the dissolution of the Iraqi army which led to unemployment of many Sunni military officers who later established the core of the military wing of Daesh. The lack of Sunni support to the new Shia-dominated regime in Baghdad and the huge level of corruption among the government was another major reason.

Some of the newly established Sunni areas of the demographic map along sectarian lines preferred to affiliate themselves with Daesh and not the government of Maliki. This gave opportunities for consolidation. Moreover, Daesh managed to provide more security and stability to the people in these regions than the government. Its military capabilities and the ability to provide services and a kind of rule where there was a lack of rule or where there had been none, led to the perception that Daesh is more desirable than the government of Iraq. Another reason is that the Iraqi forces were too weak to defeat the military wing of Daesh which was composed by experienced military personnel which, in the past, had formed Saddam Hussein's army. Finally, the people in the Shia-dominated areas and the Kurds had no interests in conquering Sunni-dominated areas in the beginning, thus allowing Daesh to operate and obtain more power.

The war in Syria provided opportunities for Daesh to expand beyond the borders of Iraq. The armed rebellion against the Syrian regime created power vacuum which was exploited by the group. Assad's regime lost control over large swaths of territories in Syria. This fact gave the opportunity for Daesh to acquire territories. The organization took advantage and managed to conquer al-Raqqah, making it a safe haven from where to consolidate and initiate operations against Mosul. Syria turned into a failed state since it has lost the control over its territory and over the legitimate use of physical force. The huge success for Daesh came when they conquered Mosul. The group used the momentum and managed to obtain several areas that linked it to the eastern part of Syria through Hasaka and Deir al-Zur, thus removing the borders between Syria and Iraq and obtaining the territories and the control over them. Finally, another cause for the rise of Daesh in Syria, was the inability of many rebel factions and their external supporters to cooperate in their efforts to defeat the regime and its backers. Daesh could enter and operate among these factions - to recruit people from them or destroy them, or control them, thus utilizing the power vacuum.

A huge impact should be given to the external actors and their perception of how the disputes must be resolved. The problem was that there was no common perception of how the peace should be achieved or to whom to give trust and support. The different actors supported with resources different factions and this lack of consent was exploited by Daesh in the best possible way.

The process of consolidation was possible due to the disagreement and the lack of consent regarding the future of the Assad's regime among the global and regional powers. For instance, Iran, Russia, and Hezbollah supported the regime. Turkey, Saudi Arabia, Qatar, Jordan supported different rebel factions which operated against the regime. The U.S. also wanted al-Assad's regime ceased to exist. The focus on the Assad's regime made it easier for Daesh to raise and consolidate. Instead of reaching an agreement concerning the future of the Syrian regime and concentrating on the threat emanating from Daesh, subsequently eliminating it, the international community was driven to a deadlock, wherein effective mediation and conflict management was impossible. Thus, letting Daesh to take advantage and exploit every opportunity to utilize the power vacuum and gain the momentum in the war. After considering the root causes for the rise and consolidation of Daesh in Syria and Iraq, it is important to analyze the asymmetrical approach that has been taken by the terrorists to operate and compete with other actors.

The Approach of Hybrid Warfare

The concept of hybrid warfare which was provided by the NATO Defense College, in April 2015, relied on three main elements – the actors, the means, and the territory. According to research paper №112(2015), hybrid warfare is '*a form of violent conflict that simultaneously involves state and non-state actors, with the use of conventional and unconventional means of warfare that are not limited to the battlefield or a particular physical territory*'. (Andreas Jacobs and Guillaume Lasconjarias, 2015) Therefore, kinetic means are only one of the alternatives since the objectives of the hybrid force might necessitate cyber operations in the virtual space that can facilitate the operations in the physical territory. Further, with a report from 2015, NATO's Defense College defined hybrid warfare from the procedural perspective as the '*denial of – and defection from – standard norms and principles of international relations in pursuit of narrow interests*'. (Lindley-French, 2015) In other words, the approach of hybrid warfare includes *per se* actions – be it cover or be it overt – which are neither in compliance with the international law, including *jus in bello* and *jus ad bellum,* nor in accordance with the customs of war. Hybrid wars are designed to prolong certain insurgency, to exhaust the superior force, to put political pressure on the government in point, and to achieve a state of a conflict inconclusiveness. It is neither about achieving a decisive victory nor about ending the conflict. It is about creating a state of war in which the insurgents might benefit by gaining capabilities and legitimacy. (Kaldor, 2010) The engagement in hybrid warfare presupposes avoidance of a direct conflict and in the same time – committing to a continuous conflict. In this relation, countering hybrid warfare looks like neither war nor peace – this type of warfare is fought in the militarized grey zone in between war and peace. (Mumford, 2016)

The hybrid force combines conventional and unconventional capabilities – concentrated to produce synergistic effects on the battlefield. For the purpose of these effects, all the available means (conventional, irregular, cyber, strategic communication, intelligence, etc.) at disposal are applied and all the available resources (human and non-human) are utilized. These synergistic effects are directed against the people, the enemy force, and the government. Even if one of these groups is targeted, it has consequences for the others since the three are intertwined and mutually dependent. Further, by targeting the population, the government or the enemy force, the hybrid force always achieves certain results on the battlefield since the battlefield consists of several domains. The hybrid force might try to disrupt or even cut the relations between the people, the government, and the military. If it infiltrates within a certain community, it can easily cut the ties between the community and the military. It can alienate the community from the government too. Further, it can cause disruptions and conflicts among the population, thus affecting the government. It might target the government and decrease its legitimacy, thus affecting the military force. In case the hybrid force is strong enough and has serious capabilities, it might target the military force, thus affecting the government and the population. For further clarifications, these examples will be applied to the case of Daesh. In other words, targeting a particular group or the links between the groups has consequences on the other groups and this affects the outcome of the conflict in a certain and desirable for the hybrid force way. The effects should match the political objectives that have to be achieved by the hybrid force. Every hybrid force is unique *per se* – its capabilities, structure, and effects are dependent on the context and the environment within which the force operates. Further, each hybrid force has its own ideology and motivations that are linked to the strategic context and is grounded in the identity of the force. (McCulloh, 2013) Every hybrid force perceives a threat emanating from a stronger enemy that should be countered by all the means at disposal without any limitations.

Hybrid warfare incorporates and combines conventional capabilities, irregular tactics and terrorist acts perpetrated in places affected by and in nexus with the criminal disorder. (Hoffman, 2007) The hybrid force uses a certain mode of warfare, consequently, uses violence with a certain level of intensity based on the capabilities it possesses and the resources at its disposal. It starts as a terrorist organization, that perpetrates acts of violence and coercion in order to gain capabilities and to build an insurgency. The insurgency, once organized, strives to create and maintain conventional capabilities and in some cases might enter into direct engagement with the stronger enemy. However, in most of the cases, the hybrid force is on the defensive.

Hybridity is about complexity, adaptation, and agility of conventional and unconventional capabilities combined through technological and other means in ways that give an advantage to the hybrid force in at least one dimension of the conflict. (Guillaume Lasconjarias and Jeffrey A. Larsen, 2015) Hard power and soft power in combination with information and media control are used for the purpose to support the operations that take place on the physical and psychological field, blending the lethality of state conflict with the fanatical and protracted fervor of irregular warfare. (Hoffman, 2009) Information technology gives opportunities to weaker forces to wage information warfare and to target decision-makers and the public through networked media and the Internet thus, enabling cultural, legal, social, psychological and moral dimensions where military power is not that relevant. (Wither, 2016)

Hybrid warfare as an approach from the operational perspective depends heavily on the environment. Therefore, hybridity is always contextual. Hybrid warfare is not a strategy *per se* but a combination of conventional and unconventional means that aims to provide certain political objectives. It is an operational approach that necessitates a comprehensive response. (Bettina Renz and Hanna Smith, 2016) The hybrid warfare approach encompasses the application of all the means and the use of all the resources at disposal. Hybridity does not come from the particular means and capabilities but from the combination of these means and capabilities and their contextual dependence. As long as the threat is not limited to a single form and dimension of warfare, it can be a hybrid. (Puyvelde, 2015)

The way in which a hybrid actor approaches a certain conflict – the means it applies, the ways it fuses them, and the dimensions it decides to consider while fighting depends on the environment and on the actor – its unique features that make it a hybrid actor – structure, ideology, motivations and capabilities.

Therefore, hybridity is not only based on the mode of warfare employed but also on the unique features of the actors and their objectives. A hybrid actor might consist of a combination of terrorist or insurgent network, organized crime groups and social groups such as ethnic groups, clans, and religiously and/or ideologically motivated groups. (Josef Schroefl and Stuart J. Kaufman, 2014) Daesh is a case in point for a movement that has chosen the approach of hybrid warfare and applied it accordingly – engaging when the circumstances are favorable and disengaging when they are not.

Daesh as a Hybrid Actor

What differentiates Daesh from other terrorist organizations, is that it is a hybrid terrorist organization on at least two levels. First, from the perspective of the organizational model, it is a hybrid terrorist organization because its structure encompasses the elements of networked and hierarchy structures. Second, from the perspective of the activities initiated by the organization, it is a hybrid terrorist organization which is mixing legitimate with illegitimate activities, thus trying to establish an effective government and forming different wings – a military wing, a political wing, a wing that is dealing with information operations, and a wing that is trying to gain the trust of the locals. For the purpose of neutralizing Daesh, the engagement in a multidimensional warfare is inevitable - fight on the military field, on the legal field, and in the media. (Ganor, 2015)

Daesh is known as a loosely affiliated networked structure and (U.S. Army TRADOC G2 Handbook, 2007) as a three-level structure – a state-like core entity in Syria and Iraq (hierarchy), external territories in other countries and an *ad hoc* global network of supporters. (Kilcullen, 2016) Due to the technological advancements, the emergence of social media, the access to the Internet, and the use of electronic devices in the world, we have witnessed the remote radicalization. (Kilcullen, 2016) For instance, Daesh uses tools such as YouTube, Facebook, Twitter, Snapchat to radicalize and operationalize different people the world over. In other words, Daesh managed to observe, assesses, radicalize and recruit, thus handling operational assets from a distance. (Kilcullen, 2016) It could fully operationalize a person – indoctrinate, motivate, radicalize, train, organize, equip and launch into action – through electronic means. This was feasible even without the necessity of going to Iraq or Syria and joining physically Daesh. The most recent example is the attack on Manchester Arena, which killed at least 22 people on the 22nd of May 2017. Behind the deadly bombing at the Ariana Grande concert was the 22-year-old Salman Abedi, a British-born national of Libyan descent who died in the suicide bombing mission.

We have also witnessed the remote radicalization that evolved into leaderless resistance. (Kilcullen, 2016) Furthermore, this leaderless resistance movement was carefully designed by Daesh for the purpose to increase the operational security and the operational capacity of the organization, thus making the objectives more feasible. Daesh created and used symbolic figures for the movement who acted anonymously or openly but without direct links to the organization. These people gave general guidelines of how self-recruited and independent groups, and lone-wolf terrorist should act without further coordination, communication or any detectable link to the organization.

Daesh has different approaches towards governing the occupied territories in Iraq and Syria. The caliph and his Cabinet of advisers, and his two key deputies (in Iraq and in Syria) reveal the executive branch of the government of the organization. There is also a Shura Council that is dealing with religious and military affairs. It reports to the executive branch about the correct version of the implementation of the Sharia law by local councils and governors. The two deputies distribute orders to the people in charge of the various occupied territories in Iraq and Syria under Daesh control. The people in charge (governors) deliver these orders with some clarifications to the local councils on how to implement the executive branch's decrees regarding different matters – recruiting, media campaigns, financial matters, etc. (Nick Thompson and Atika Shubert, 2015) The Financial Council is dealing with the funding of the organization through grey and dark markets - fraud, legal businesses, secret charities, money laundering, kidnapping for ransom, armed robbery and theft, smuggling, trafficking, counterfeiting, extortion, State and non-State support, etc. The Leadership Council is drafting the laws and running the key policies on a local level. The Military Council is occupied with the defense and security matters. The Legal Council is empowered to solve different cases, including the issuance of decrees – judgments, punishments, etc. It controls the locals and observes if the population is adhering to the law. The Fighters Assistance Council is dealing with foreign fighters – aiding them, organizing them, training them and helping them to get settled. The Security Council is coordinating and co-operating its activity with the Military Council in order to provide security. While the Military Council is dealing with internal and external security affairs and matters, the Security Council is more concentrated on internal policing and internal matters. The Intelligence Council is dealing with information gathering and intelligence activities, thus trying to obtain as much information as possible about the enemies of Daesh.

The hybridity on activity level is closely related to the hybridity on the organizational model level. Moreover, they are intertwined. The capacity for different activities is based on the organizational structure of a particular group and its goals. For instance, Daesh organization's goal is to create a caliphate in which to implement rules based on own narrow interpretation of Sharia law. The ideology of the group is believed to be Wahhabism. However, Daesh is not relying only on illegitimate activities such as organized crime and terrorism. The group is concentrating on state building. It has developed a state-governing apparatus in the territories that were conquered. Moreover, Daesh tried to provide social services such as developing an educational system, building roads, opening hospitals, maintaining electric services. (Stewart, 2014) The fact that the group is engaged in legitimate activity such as social services leads to several implications. First, it gains legitimacy, support, and new recruits from the occupied territories. Second, through infiltration Daesh has embedded itself so deeply inside the civilian population, it may be difficult to limit the number of civilian casualties caused by the use of force. (Stewart, 2014) Third, the increased number of civilian casualties might appear counterproductive for those who use force against Daesh. It might trigger hatred towards the great powers and sympathy towards the terrorist group, thereby increasing more the number of the new recruits.

In conclusion, Daesh is fit to survive, adapt and, in the same time, to develop as a terrorist organization due to the fact that it has evolved from a simple terrorist organization to a sophisticated hybrid terrorist organization that encompasses, on the organizational model level, elements of networked and elements of hierarchy structures, and on the activity level it is engaged with not only illegitimate activities such as organized crime and terrorism but also legitimate activities such as social services and implementation of rules of conduct. In other words, Daesh has evolved from a terrorist organization to become a political-military entity and a quintessential hybrid organization in military terms (Gaub, 2015) which has developed a clear strategy to be carried out.

The Grand Strategy of Daesh

Daesh has an offensive grand strategy to expand and a defensive grand strategy to preserve. Therefore, the strategic mission of Daesh is a combination of offensive and defensive strategy. The terrorists want to preserve the territories that they have conquered and to preserve the caliphate that they have established within these territories. Furthermore, Daesh wants to obtain new territories in order to expand the caliphate that it has created within these holdings. It has announced operations that aim at expanding to other States of the Arab world, Libya, Sinai, etc. Every action, every initiative, on every mode of warfare, by every instrument of power of Daesh, is subjected to this 'expand and preserve' political mission, that is pursued in the light of a grand strategy. It includes the defense in Syria and Iraq, the regional expansion to other States, and the recruitment on a global scale. In other words, Daesh's grand strategy includes expanding elsewhere in the Middle East and North Africa, while also maximizing combat power and future opportunities to launch offensives inside Iraq and Syria. (Mcfate, 2015)*. The success of this grand strategy relies heavily on the way that Daesh is fighting – conducting hybridized warfare. This gives the chance for the organization to be flexible, adaptive, and most important, to outlast its enemies by remaining in Iraq and Syria and expanding beyond those areas*. (Mcfate, 2015)

As of the time of writing the paper, Daesh's primary forces are in Syria and Iraq – the heartland of the organization but the terrorists aim to establish affiliates in the Middle East and Africa. Through the mechanisms of remote radicalization and leaderless resistance (Kilcullen, 2016) they try to encourage attacks in the world over. Therefore, Daesh strives to survive and preserve itself by expanding its operations and presence outside Syria and Iraq. The strategy to remain and expand is considered across the heartland of the organization, including Lebanon, Jordan, and Palestine, the Near Abroad (the rest of the Middle East and North Africa), and the Far Abroad (the rest of the world). (Gambhir, 2015) In the Near Abroad, Daesh begun to expand by establishing safe havens and declaring satellite operations and creating regional affiliates. Regarding the Far

Abroad ring, Daesh focused mainly on Europe since it contains a great number Muslim populations who are vulnerable to influence and susceptive to information warfare. The main purpose is to polarize these Muslim communities and to destabilize the West. (Gambhir, 2015) In other words, the goal to preserve and expand is pursued in terms of the Interior and the Near Abroad rings while the acts of terrorism are mainly concentrated on the Far Abroad ring. (Gambhir, 2015) These parallel and interlocking strategies in combination reveal the ultimate objective of the organization. Global operations give Daesh the strategic resiliency it needs in case it loses terrain in Iraq and Syria. (Gambhir, 2015) For instance, when Daesh lost Tikrit, the affiliates and the supporters in the Near Abroad accelerated their terrorist activity, thus giving Daesh the opportunity to continue its campaign. The same can be observed during the ongoing operation for Mosul.

In conclusion, the insurgents are aware that the economic, informational and international aspects of the conflict are as important as the employment of military force. Insurgencies are all about politics and the allegiance of the people. (Corum, 2008) Further, the insurgents are aware of that fact that the population might change its allegiance from the government to them, and *vice versa*. Winning the allegiance of the people is crucial and in most of the cases, requires a political settlement. Daesh knows that if it is best placed with the population, it will have the strongest position in the potential negotiations and that its insurgent center of gravity is the population. (Corum, 2008) Taking into account the grand strategy of Daesh that has been analyzed, it is necessary to explain how do the different strategies and tactics fit within the overall hybrid warfare fought by the terrorists.

Daesh's Terrorism as a Mode of Warfare

Terrorism works on several levels. The combination of these levels composes the whole *stratégie intégrale* and reveals the whole picture of a certain crime of terrorism, its purpose, and its relation to given circumstances. Crimes of terrorism should not be scrutinized as isolated events. Therefore, the relation to given circumstances is as much of importance as the crime *per se*. Regardless of the motivation, these crimes are all perpetrated to serve a political purpose. In most of the cases, they are related one to another - in pursuit of a political objective. They reflect a chain of circumstances in relation to events with which the perpetrators do not agree. Their political agenda clashes with the established political framework in a State.

There are four levels of terrorism's *stratégie intégrale*: preparatory level, operational level, tactical level, and strategic level. The preparatory level is fundamental for carrying out the operations successfully. There is nothing spontaneous as we speak about the acts of terrorism. They are deliberate, planned and surgically precise in terms of the targets that are chosen and the objective that is pursued. There is nothing irrational or coincidental about these acts. A fundamental part of the preparation is the assessment whether an act to be perpetrated or not and whether the organization possesses the necessary capability or not. This encompasses the choice of methods that must be used, on the first place. It also includes the assessment of the availability of material and human resources and the possibility to obtain such, if necessary, for the accomplishment of the mission.

During the first stage of preparations, Daesh aimed to obtain material resources in order to fund their operations. Therefore, they managed to exploit gray and dark markets in order to gain money profit. They used gray markets for oil, arms, and human trafficking and money laundering. Daesh used dark economy networks for kidnapping for ransom, armed robbery and theft, smuggling, trafficking and counterfeiting, and extortion. By these activities, Daesh gathered material resources that were necessary to start a campaign of terrorism, especially between 2012 and 2013.

The second stage was to recruit and indoctrinate people who could show a high commitment to the cause. The personality of the members of the group is crucial for the whole organization, its ideology, and its goals. The targets and tactics of choice of the terrorists, as well as the combination of capabilities and weapons of choice for certain operation, are shaped by the group's ideology, its internal organizational dynamics and the personalities of its members, as well as the internal and external stimuli at disposal. (Hoffman, 2006)

The third stage was to infiltrate in urban centers in Iraq and Syria. Daesh managed to create sleeping cells within cities like Baghdad and Mosul. The organization managed to create a network of cells throughout Hawija, Ramadi, and Fallujah. The infiltration within urban centers and disenfranchised communities close to urban centers gave more opportunities for Daesh to run a campaign of terrorism. In Syria, the terrorists managed to create a network of sleeping cells within and near Damascus.

The fourth stage was to create networks of suburban roads that include towns which surrounds major city such as Baghdad and Mosul. This ring of roads is known as '*the Belts'*. By using dispersed units, terrorist tactics and the freedom of maneuver, Daesh tried to compromise the main defense of the enemy's conventional forces and consequently, shaped an offensive belt framework and a battle plan. (McFate, 2015)

The last stage was to choose the methods that had to be employed in order to carry out the campaign of terror and violence. The methods can be divided into several categories such as bombings/explosions, armed assaults, unarmed assaults, assassinations, facility attacks, and hostage taking.

Considerations on the strategic level encompass three sequential stages-disorientation, target response, and gaining legitimacy. (Peter R. Neumann and M.L.R. Smith, 2008) The loyalty and the bond between the citizens and their State are based on something stronger than the State control *per se*. People prefer certainty and predictability which emanates from the State and its affairs. The sense of certainty and predictability of the social processes gives to the population a feeling of stability and security. Thereby, the support for the current State is not only structural but also psychological. Therefore, the objective of terrorists, in the stage of disorientation, is to destroy the recognized patterns of societal interaction in the society and to cut the link between the individual and the government, i.e. to destroy the social contract. (Peter R. Neumann and M.L.R. Smith, 2008) The notion of stability and certainty is replaced by uncertainty, confusion, sense of panic, and chaos. The purpose of Daesh is not only to prove that the targeted government is no longer capable of providing basic security and stability but also to confuse the individual so he cannot discern the source of fear. (Peter R. Neumann and M.L.R. Smith, 2008) Only when is this achieved, the terrorists will have the chance to change the identities and preferences of the population in their favor. What can be manipulated through a campaign of terrorism is the reaction of the government and the attitude of the government towards the supporters of this campaign and the moderates who, in both cases, are not engaged directly in the campaign. (Berry,

1987) Therefore, the provocation aims to achieve a favorable response from the government that can be decisive in the momentum and the situation when the population is disoriented and cannot define the source of fear. What can be defined as a favorable response to the terrorists is the response with which the government undermines its legitimacy and authority. The success of this stage depends on the target and its response. The government can undermine its own legitimacy and image by under-reacting, overreacting or even by repressing the moderates. The purpose of the campaign of violence is to lure the government into a reaction that goes beyond the legally acceptable methods. Therefore, the action is extra-legal and heavy-handed – resulting in civilian casualties. (Wilkinson, 1977) In the last stage of the process, the terrorists aim to gain legitimacy. The terrorists refer to the power of media and information warfare to spread their propaganda among the population. Once the old order is destroyed, the terrorists fill the vacuum of power and legitimacy that they generated. (Peter R. Neumann and M.L.R. Smith, 2008) Considerations on the strategic level also encompass the objectives to polarize the Muslim communities and to generate chaos in order to destabilize the West. This is relevant in terms of the objectives of Daesh in the Far Abroad. It is also relevant to some extent to the strategies employed in the Near Abroad.

Further, Daesh knows the simple reflection of the events would not bring the success of the campaign. Consideration on the strategic level means to be able to control the events in a beneficial direction that will certainly achieve certain objectives. Without considering the strategic level of the strategy of terrorism, the whole campaign is nonsensical and the objectives – unachievable.

Once the preparations are made and the strategic level of terrorism is considered, the terrorist organization concentrates on the tactical level. The tactical level necessitates concentration on every event. If the consideration on the strategic level has been properly made, the control of the events on the tactical level is achievable. Thereby, the acts of terrorists are not just a mere response or reflection of the events. Terrorists control these events and direct them towards beneficial ends. Those who control the events can set the rules in their favor. That is what terrorists strive for on this level of terrorism. The *modus operandi* on this level of analyses encompasses as follows: attrition, intimidation, provocation, spoiling, outbidding, propaganda of the deed, and lone-wolf terrorism. (Kydd, A and Walter, B, 2006) Terrorism was necessary for

Daesh to remain, outlast, and gain power and capabilities. In the moment it felt more powerful, it started building an insurgency and conducting insurgency operations against the governmental powers of Iraq and Syria.

Daesh's Insurgency as a Mode of Warfare

The assessment of the strategic environment is crucial for the successful adaptation of a COIN doctrine to it in order to achieve victory, i.e. in order to apply appropriate strategy, deliberation on the environment is a prerequisite and a must. (Porch, 2013) Therefore, when COIN fails in some cases, the problem is not about COIN *per se,* but the lack of precise assessment of the strategic environment within which it should be adapted. (Porch, 2013)

Daesh's insurgency represents an organized, protracted, and violent struggle for control and influence, on one hand, over the policy of the governing authorities in Syria and Iraq, and on the other hand, over the population within these territories. (Kilcullen, 2010) The inability of the government of Syria and Iraq to control its territory and population and the lack of strategy for domestic surveillance and intelligence activities led to opportunities that Daesh used to build an insurgency. Neither the Syrian nor the Iraqi governments could suppress the insurgency in a way that was effective enough to prevent other potential rebels from joining Daesh's cause. Not only were these governments incompetent regarding their prevention policies but they contributed to achieving Daesh insurgent objectives by provoking wider resistance and consequent recruitment. Since the relations and the social contract between the population and the governments were nonexistent, the population became unsupportive of the Syrian and Iraqi authorities. Subsequently, the two States had no means to prevent the insurgency in these remote and hostile areas. The second core condition for the emergence of Daesh's insurgency was the vulnerability of the population. Daesh managed to create a compelling narrative that connected grievances to its political agenda and managed to mobilize the population to support a potential violent social movement. (FM3-24/MCWP 3-33.5, 2014) Thus, Daesh's ideology can be perceived as a coherent set of ideas that represents the framework for this narrative. Considering the opportunities in the remote areas and the existence of these grievances, Daesh managed to fuse them in order to mobilize the vulnerable population. Once these grievances mobilize the vulnerable population, they become the root causes for Daesh's insurgency. What all the grievances have in common is the perception of injustice that should be dealt with.

The first root cause that Daesh managed to address was based on identity. Religion was also an effective root cause for Daesh's insurgency. The high level of corruption in the Syrian and Iraqi governments was another root cause. Considering the mechanisms for infiltration that Daesh used in compliance with the objectives of strategic terrorism, i.e. to cut the link between the population and the Iraqi government and to alienate the population from the intervening forces, an important root of insurgency is the fact that the population in Iraq do not want to be ruled by foreign powers. (Porch, 2013) Further, insurgency is less about solving certain or potential grievances, than about ideology and political objectives. (Porch, 2013)

The strategy of Daesh is defined by its own motivations, objectives, and means. The strategic behavior of the insurgents is determined by the ways in which they strive to gain legitimacy and control the population within the societies in the Middle East. The insurgents managed to create political objectives with the purpose to shape their strategy and established infrastructures to promote and refine these objectives. (FM3-24/MCWP 3-33.5, 2014) The violence that the insurgents used has become more organized since Daesh managed to gain popular support and human resources which led to increasing the capabilities of the movement. They managed to develop networked structures with a connection to criminal organizations and combined these structures with hierarchical structures. Thereby, the combination between hierarchical and networked structure has tactical and operational implications for Daesh's insurgents.

Daesh's insurgency has gone through three basic phases of development: the strategic defensive phase during which the insurgents resorted to the urban (terrorist) approach. During this phase, the insurgents managed to establish the insurgent leadership, the organizational infrastructure, and the acquisition of resources. The second phase was the strategic equilibrium when the insurgents resorted to the protracted approach. They used small-unit tactics to attack the security forces of the governments of Iraq and Syria – striving to undermine the governments' legitimacy and aiming to obtain own legitimacy through provocation and intimidation. This was the phase when the insurgents started to provide social services for the same purpose. The strategic offensive phase was the third phase wherein Daesh applied the military-focused approach. The three phases of development are sequential and complement each other. The constant feature of all phases is the insurgents center of gravity – the population and its support and consent. These three phases encompass radicalization, extremism, irregular activities, terrorism, organized crime, and conventional armed conflict. The three faces were facilitated by the information campaign that the insurgents have carried out. Daesh can switch into the different phases depending on the environment and the circumstances, i.e. the insurgents can revert to the defensive phase when they are pressured and to the offensive phase when conditions are favorable. Therefore, movement from one phase to another does not limit or end the operational and tactical activities typical of the earlier phase; it incorporates them. (FM3-24/MCWP 3-33.5, 2014) Daesh can rapidly split, shift, combine, and reorganize since it is dynamic and adaptive. (FM3-24/MCWP 3-33.5, 2014) This is feasible due to the ability of the insurgents to find the external and internal support of the locals. The internal support includes the freedom of movement that is provided for the insurgents to rest, train, plan or even carry out operations. The support can also be active – the locals participate in the operations by aiding or abetting the terrorists, perpetrating different acts in accordance with the operations and facilitate the operations. They participate in the recruitment process by providing new recruits for the insurgents or providing material assistance and intelligence. Daesh development in these three phases created a strong political and military organization with deep roots in the Syrian and the Iraqi societies.

The ability of Daesh to refer to different approaches and the ability to move between the phases prove of the capabilities of the insurgents and the fact that they fuse regularly with irregular activities for better outcomes on the battlefield. By reason of that, the combination of the basic and advanced approaches leads to the conclusion that Daesh uses the hybrid approach. In other words, the hybrid approach is the combination and application of these approaches that I have mentioned hereinabove to achieve synergistic effects on the battlefield.

Regarding the third phase that was based on the military-focused approach, the insurgents attacked enemy forces and engaged directly in order to destroy the enemy forces in open battles and to occupy new territories. The conventional maneuver warfare included the use of VBIEDs, IEDs, SVEST, artillery, armor, engineering, and small arms. (McFate, 2015) Further, the insurgent defensive strategies included: fortified defense, area defense, zone defense, hibernation, and expansion. (McFate, 2015)

In conclusion, Daesh's insurgency is a fusion of three elements considered according to the circumstances on the ground and the regional environment – functional focus (generating people, material and human resources, arms, and information), organizational coherence (a formal organization with internal specialization and a command hierarchy combined with networked structures), and objectives. (Metz, 2012) From the strategical perspective, the insurgents use the hybrid approach in a strategic continuum that includes strategic defensive, strategic equilibrium, and strategic offensive phases. It is important to note that the insurgents would not have been successful in using this approach, in achieving organizational coherence, pursuing their objectives or possessing a clear functional focus if they had not been so successful in their information campaigns.

Daesh's Information Operations

Daesh managed to build a link via information operations between its military operations and its political objectives and to enhance the success of its military initiatives in Syria and Iraq. (Gambhir, 2016) The main objective of the insurgents is to amend the perceptions of the population in a way that would benefit Daesh. The second objective is to polarize the communities and to gain the support of certain factions within the population. In order to achieve this synergistic effect, during their information operations, the insurgents use different tools and refer to different factors such as identity, security, capability, stability, and livelihood. Further, the factors that are deemed necessary to shape the perceptions are different than the factors that are necessary to generate beneficial polarization and subsequent support. Therefore, Daesh conducts multidimensional communications strategy that should be explored in detail in order to find the strategic logic behind it and to counter it. (Obama, 2015)

Regarding the first objective of Daesh – to amend the perceptions of the population, the insurgents refer to factors such as stability, military capability, livelihood, and security. (Ingram, 2015) Through their information campaigns, the try to prove and disseminate their message that they are more capable than their enemies, clearer of purpose, and the only viable actor on the ground that can provide security and stability for the population. Regarding the second objective – to polarize the population and to gain support, the insurgents refer to identity-based factors and to the interplay of in-group, out-group (Others), crisis and solution constructs. (Ingram, 2015) Through provocation and attrition, the insurgents use violence to target governmental forces and Shia communities. Subsequent heavy-handed responses from the targeted communities and powers against the Sunni communities with the purpose to eradicate the insurgents led to innocent victims and a potentially never-ending cycle of violence that was explored by Daesh. The insurgents manage to portray themselves as the only capable movement that can protect the Sunnis, to provide security and to solve the crisis.

Daesh's media successes and proficiency is a result of its media infrastructure and advanced organization that makes it possible for the insurgents to produce and disseminate high-quality video products in different languages. The insurgents present a multi-level organizational structure, including central media units under the auspices of Daesh's Ministry of Media that aim to control the movement's external messaging, provincial information offices (bureaus), and a supporter base. (Milton, 2014) The central media units serve to provide and manage content from different areas in which the insurgents operate. Further, the Ministry of Media is engaged in the creation and dissemination of the official content of the movement, including official statements and videos. (Milton, 2014) The regional media bureaus produce and distribute its own content that should be in compliance with the Ministry of Media guidance and policies. Therefore, this content and its subsequent creation are dependent on the approval of the Ministry of Media. The insurgents also established a radio station after capturing Mosul (al-Bayan radio) and several TV stations in Iraq and Syria. The unofficial social media that comes from the supporters of the insurgents and the forums on the Internet serve to further the insurgents' objectives by providing additional content that in most of the cases is in accordance with Daesh's narratives.

The insurgents' online propaganda has been decisive in its recruitment of foreign fighters and successful in its attempts to radicalize remotely vulnerable individuals the world over to extent to which it is not necessary for the radicalized target audience to coordinate or communicate or even wait for guidance from Daesh before perpetrating acts of terror and violence. The leading expert in terrorism and violent extremism, Jessica Stern, goes even further by stating that Daesh shaped and confirmed its leading position in the region through manipulation of social media and has managed to influence not only today's generation but also the next generation of jihadists. (Jessica Stern and J. M. Berger, 2016) Therefore, the outcome is not only about the war, but also about the influence – the establishment of virtual presence that is even more difficult to eradicate. (Jessica Stern and J. M. Berger, 2016) In this relation, in late 2016, through its information operation campaigns, Daesh established a second center of gravity – the '*Virtual Caliphate*' as a remotely radicalized community that has been organized online and has empowered a global Salafi – jihadi movement which could operate independently of Daesh. (Gambhir, 2016) This virtual movement tries to compensate the territory loss of the insurgents. The insurgents try to encourage their supporters to conduct acts of terrorism in their homelands instead of immigrating to the Caliphate, thus establishing its global attack network in June 2016. (Gambhir, 2016) In other words, Daesh information campaigns strive to sustain the insurgents' global campaign in a condition of diminishing military capacity, loss of control and territories, including the city of Mosul which should be liberated within a month as of the time of May 2017. Daesh lost control of the city of Sirte in Libya on the 5th of December 2016. Meanwhile, in 2017, the insurgents expanded their activity in Egypt and Asia while its African and external networks maintained operational depth and attack capability despite the death of their official spokesperson Adnani. (Gambhir, 2016)

In conclusion, Daesh's information operations campaigns succeeded due to the coordinated exploitation of physical and digital presence and its formulation of effective institutions. The success came from the ability of the insurgents to fuse different information-related capabilities and activities akin to cyberspace operations, operations security, military deception, military information, combat camera strategic communications, and civil-military operations to be in concert with other lines of operations and to create the link between the facilitated military operations and the political objectives of Daesh. (Joint Publication 3-13, 2014)

Conclusion

The Prussian general Carl von Clausewitz once said that '[w]*ar is the realm of uncertainty; three quarters of the factors on which action in war is based are wrapped in a fog of a greater or lesser uncertainty*'. (Clausewitz, 2007) In this relation, hybrid warfare can be described as the foggiest form of war considering the deliberate confusion and bafflement that emerge in hiding the identity of the perpetrator, blurring the line between the traditional typologies of warfare. (Mumford, 2015) Moreover, the deliberate inclusion of civilians and subsequent engagement in the conflict as a part of movements increase the obfuscation. In order to reduce the uncertainty and the '*fog of war*', the strategies of hybrid warfare should be developed in accordance with the sound understanding of hybrid actors, hybrid warfare, and the logic behind it. Further, a sound understanding of the environment on a case-by-case basis should be provided to understand the hybrid actors and the hybrid approach they decide to refer to.

Contemporary conflicts are no longer – and cannot be – won by decisive battles and mass offensives. Defeating the enemy is the justification and not the objectives of the conflicts. (Kaldor, 2010). For instance, the objectives of Daesh are to create a global caliphate. In order to do so, the insurgents have to delegitimize the governments that have the authority and power within the territories where they want to establish their caliphate. Since Daesh is the weaker actor in the conflict and considering the capabilities of the Syrian and Iraqi governments, the direct approach that includes the direct conventional engagement is not beneficial to the insurgents because they will be demolished. Therefore, in order to achieve the strategic success and to achieve its goals, Daesh has found new ways and new approaches that would avoid the necessity for extensive kinetic warfighting and in the same time compete with the superior powers in the region. The insurgents are aware that this requires focusing strategic efforts on the psychological will of the enemy, thus considering the nature of surprise and considering the use of a hybrid approach that will include the fusion of conventional and unconventional capabilities for achieving synergistic effect on the battlefield – encompassing cyber-attacks, information and psychological operations, economic attacks, terrorist tactics, generating communal conflicts, and insurgency operations. (Mumford, 2015) In other words, affecting the psychological will and condition of the enemy, prolonging the conflict, exhausting and degrading the enemy forces, and surviving as much as possible on the defensive is what matters in contemporary conflicts. To this extent, contemporary hybrid warfare is a modern manifestation of an indirect strategic approach (Mumford, 2015) that is contextual and considered as a key viable option in the asymmetrical security environment for insurgency such as Daesh which try to '*avoid what is strong and to strike at what is weak*'. (Sun Tzu, 1910)

Daesh's '*shock and awe*' style in Syria and Iraq has caught the governments in the Middle East and the whole international community by surprise. Sound understanding how Daesh fits the profile of a hybrid actor using the hybrid approach in contemporary conflicts is crucial and integral to the development of unified strategies to counter it. The president of the United States, Barack Obama, warned that Daesh represents a new type of challenge; a '*sort of a hybrid of not just the terrorist network, but one with territorial ambitions, and some of the strategy and tactics of an army*'. (Obama, 2014) Neither the successful campaign in Mosul nor the successful campaign in al-Raqqah will bring the end of the insurgents. Even if all of their territories are claimed back, they will still exist. There is a high probability that Daesh will go underground and rely on its networks and perpetrate acts of terrorism in the future. The insurgents try to establish affiliates in other regions in the Middle East. Their presence has been increased in the remote regions of Afghanistan. Therefore, a strategy against these terrorists and insurgents should be comprehensive and should address all the necessary elements in order to counter the threat effectively, including counter-terrorism, counter-insurgency, and counter-radicalization policies combined with policies for integration and clear information campaigns directed towards the population.

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MASS MIGRATION – BULGARIAN UPDATE 2016

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Preface

Mass migration is not an alien phenomenon – neither worldwide nor particularly for Europe. Historically, migration waves have occurred before consistent with, inter alia, development trends and the search for better life opportunities. However, the current mass migration, in which Europe finds itself entangled, poses a lot of challenges to the very modus operandi of the European Union (EU) as a supra-national sui generis organisation of sovereign countries in general, and to the coping mechanism of individual member states.

The Crisis Management and Disaster Response Centre of Excellence (CMDR COE) has been closely monitoring and reporting on the afore-mentioned problematic conducting open-source research which looks into the main triggers and challenges of mass migration within the EU and possible corrective actions. To this end an analysis on the “Migrant Influx in the EU 2015” has been produced and published. As the parameters and dynamics of the crisis are both a moving target and hence require continuous alignment and adaptation, the CMDR COE has revised its research findings, and conclusions thereafter, in the updated “Mass Migration and Refugee Movement in Europe – 2016” report.

Consistent with the CMDR COE working methods and procedures, this report is the outcome of a request for support (RFS) from the Hellenic National Defense General Staff for a research paper focusing on the Balkan region and more concretely on the Republic of Bulgaria and on the financial and human resources in tackling the crisis as a transit country and also an external border of the Union.

The authors of the report would like to express their gratitude to the Ministry of Interior of the Republic of Bulgaria which supported their work on the research by providing official unclassified data.

Methodology

This Report is based on compiling existing data from a wide range of sources with the aim of providing up-to-date reliable and comparable information on migration subject in Bulgaria during 2016. The relevant government agencies – the Migration Directorate ((Ministry of Interior), Ministry of Labour and Social Policy and the State Agency for Refugees (SAR) have been consulted in the process of compiling the information. Additionally is used a data from NGOs' domains [1] , media coverage [2] , the UN Refugee Agency (UNHCR), the International Organization for Migration (IOM) and the International Federation of Red Cross and Red Crescent Societies.

The Report is conducted on the basis of the available data and sources. This paper relied on free access and subscription-based official information systems of the institutions and organisations, dealing with the present aspects of the migration in Europe. It is based largely on publicly available governmental documents, annual reports, grey (unpublished) papers, monitoring studies. Relevant statements and publications by non-governmental or international organisations have been used as well.

This paper is based upon open sources knowledge and any kind of classified information is not presented here.

Overview

Bulgaria slowly became a country for mass migration in the period 2013-2015 and this continues to be in nowadays. In the period 2014-2016 people who sought asylum in Bulgaria count seven-fold increase from an annual average of 1,000 asylum-seekers over the past decade (2000-2010) within the space of one calendar year. The influx created enormous pressure on the ill-prepared reception and asylum system with the authorities hardly struggling to respond

[1] Bulgarian Helsinki Committee, Association for Refugees and Migrants, Bulgarian Council on Refugees and Migrants (BCRM); Assistance Centre for Torture Survivors (ACET). Association of Syrians in Bulgaria, Association of the Ethiopian Community in Bulgaria, Institute of Economics and International Relations, Sofia Security Forum

[2] Deutsche Welle (DW); Bulgarian National Radio (BNR); Sofia News Agency (novinite.com); Sofia Echo (capital.bg/kquarterly); Club Z Magazine (clubz.bg); mediapool.bg; faktor.bg; vek21press.com

adequately. Throughout 2016 the challenges related to providing an effective humanitarian response to the large influx of refugees (largely from Syria, Afghanistan and Iraq but also from Pakistan and African countries) began to be gradually overcome. Due to intensified political efforts the accommodation and residence conditions began to improve while processing of asylum applications increased with more staff allocated on terrain.

In 2016 Bulgaria continues to strengthen the physical control and surveillance along the borders with Turkey and the adjacent region to the Turkish-Greek border. The construction of the preventive assets (fence, constructed and finalised in 2014) along the southern border with Turkey aims at stopping the flow of irregular migrants. A new fencing facility is in progress (announced mid-2015), which will cover additional 80 km of the border stretch and will be stronger and more difficult to penetrate. In addition the Bulgarian Border Police units were reinforced by gendarmerie and army. It is envisaged by the end of 2016 the total number of military personnel deployed in support of border policing to reach 1000. In comparison, at the beginning of 2016 they were 250 totally and mainly engaged in logistic assignments. Based on information transmitted by the Chief Directorate Border Police and Migration Directorate, the present CMDR COE research made comparisons to a data provided by some NGOs[3] in the end of November`2016 about the migration routes “In-and-Out” of Bulgaria. It brings out the main course of refugees movement inside Bulgaria. It is the axis of Malko Tarnovo-Yambol/Burgas-Serbian border, mainly because of the quick access from one end of the country to the other via-Thrace highway (Avtomagistrala Trakia).

On this route the infestation into Bulgarian territory comes through the Strandzha Mountains in the vicinity of Malko Tarnovo. The wooded terrain and low-populated area provide sufficient cover for migrants’ passage. Although no major roads are located there, separate paths in it are numerous as once were used for years by smugglers of cigarettes and drugs. Usually intruders are gathered to form a group of 10-15, mostly young men who can pass the area for a short time. Small vans and trucks with local registration attract the attention of police, so recently smugglers change the tactic and use cars, stolen or with

[3] The Bulgarian Council on Refugees and Migrants (BCRM); Assistance Centre for Torture Survivors (ACET) and Association of the Ethiopian Community in Bulgaria

false plates, to heading to Burgas or Yambol. Allegedly the cost of such service is about 200-250 euros.

Distribution depots for smugglers are usually residential quarters in the big cities of Burgas, Plovdiv and Sofia, away from the downtowns and preferably populated by Gypsies minorities. Living in such neighborhoods, the refugees are almost indistinguishable and undetectable to the authorities.

Reportedly the cost is about 300-500 euros per Burgas-Sofia transportation. Depending on the situation whether there is an increased police presence, migrants may stay for days in motels located in the outskirts of Sofia. Here they take transport by taxis to the Serbian border as groups are divided into smaller and mostly remained 2-3 persons per taxi cab. The price is determined again – no less of 400 euros per a transfer to the Serbian border. Depending on where border control is weaker, the passage in Serbia can occur in many places. Previously, major paths were in the region of Vidin and by the river of Danube. After a number of media reports and security operations in mid-2016, the route is shifted south and now main targets are areas of the Ridge of Stara Planina Mountains.

Human trafficking through Bulgaria is very well organized, as General (ret) Valeri Grigorov, a former director of Bulgaria's border police stated in a conference[4]. “Migrants and refugees are taken from the Turkish border to the Serbian border within 72 hours. In the first leg of the journey smugglers send them to Sofia by car, where person pays 20-30 euros per night, usually in the houses of Gypsies”. According to Commissioner Georgi Kostov, Secretary General of the Interior Ministry, there have been violent clashes between Gypsy criminal clans in Sofia and Plovdiv over this increasingly lucrative business.

The number of migrants seeking protection from Bulgaria from the beginning of the year 2016 (January - October) is 16 806. Humanitarian status was given to 49 people from two countries in October and the total number of people with this status from January to October, 2016 is 411. The applicants were from 15 different countries.

The SAR registered 2776 asylum seekers during August, which makes 1543 asylum seekers more than it registered in July. For October 2016 the total is

[4] Nov 17, 2016, Roundtable discussion "Radicalization and terrorism", Central Military Club, Sofia,

2526. The number of migrants who were denied status in October alone is 190. Since the beginning of the year the total figure is 1019. (*Data by the Bulgarian State Agency for Refugees*)

Most undocumented migrants who are detected by the Border Police initiate a procedure for seeking international protection, according to the International Organization for Migration (IOM). The increasing numbers of asylum seekers is rising, because the Bulgarian authorities have strengthened their controls. By the beginning of the year the number of arrivals in Bulgaria from Afghanistan is 7961, second come Iraq nationals (4708), and followed by Syrian nationals (2122), applicants from Pakistan (1370) and Iran (378). According to the Interior Ministry 12 500 migrants in total, mainly from Afghanistan, were detained in 2016. (*Data by the Migration Directorate*).

The International Organization for Migration (IOM) reports for the period January-September 2016 the top five nationals entering Bulgarian borders are Iraq, Afghanistan, Syria, Pakistan and Iran. The analysis points the increase in 2015 and 2016 of the number of Afghan citizens who represent over 46% of the total number of migrants detected by Bulgarian Border Police for 2015 and 40% of the new asylum seekers for 2016 (*Data by the IOM*).

In the refugee camps the number of people, who are staying there, is rising. The head of the SAR, Mrs. Petya Purvanova, claimed that ninety-three per cent of the capacity of the refugee centers is filled. The some news agencies reported recently that in the detention center of Busmantsi (Sofia) there are now 1,631 persons, which is an occupancy rate of 174%. The UN Refugee Agency (UNHCR) provided some books in Arabic, Dari, Farsi and French in Bustmansi. The Bulgarian Helsinki Committee (BHC) keeps on providing regular legal counseling to asylum-seekers in detention with the service of interpreters. Social counseling including referral to BHC is also provided on a weekly basis by another implementing partner, Bulgarian Red Cross (BRC).

Bulgaria has asked for a 160 million euro aid from the European Commission for protecting and surveilling its borders. Already in August`2016, the European Commission announced that it has granted Bulgaria 72.7 million euros for the security of the country’s borders, from the EU’s Internal Security Fund (ISF), during the next five years.

In the end of September`2016, the European Commission announced up to 108 million euros “in emergency funding to Bulgaria to improve border and migration management”. The Commission announced also to proceed “further emergency applications” for an additional amount of 52 million euros[5]. By far almost 12 million euros were awarded to the country to respond to the migration crisis in order to provide accommodation facilities, food and medical supplies to migrants and to provide equipment to the Bulgarian border guards.

In response to the request from Bulgarian government, the FRONTEX reinforced the ongoing activities at the EU land border of Bulgaria. The assistance is mainly focused on the border with Turkey but surveillance of the border with Serbia has also been reinforced. FRONTEX has deployed 210 officers and staff, including 136 border surveillance experts, at Bulgaria’s borders with Turkey and Serbia. The agency also deployed 10 dog teams, 46 patrol cars and five thermo-vision vans. The EU border guard officers are currently taking part in six coordinated joint operations in Bulgaria. These operations are: JO Focal Points Sea, JO Flexible Operational Activities 2016 Land on border Surveillance (South Eastern Borders and Western Balkans), JO Focal Points Land, JO Flexible Operational Activities 2016 Land on Border Checks, JO Focal Points Air and JO Vega Children 2016.

Legislation

In the national legislation of the Republic of Bulgaria are introduced and apply the relevant Community acts related to migration and asylum. They reflected in a number of legal acts in primary, secondary and tertiary domestic law. Meeting the criteria set out in EU Directives is a key element for realization of a common immigration policy aimed at ensuring all stages effective management of migration flows, fair treatment third-country nationals residing legally in Member States, and prevent illegal migration and human trafficking, and enhanced combat these phenomena.

- The Law on Foreigners in the Republic of Bulgaria – introduced all relevant instruments governing right of entry, residence and exit from the country of third-countries.

[5] http://europa.eu/rapid/press-release_IP-16-3088_en.htm

- The Law for the Bulgarian Identification Documents (1998, as amended 2007) – regulates the terms and conditions for issuance of Bulgarian identity documents to third countries of persons granted under the Asylum and Refugees Act and the EU citizens and members of their families whose status is regulated by the Law for Entering, Residing and Leaving the Republic. It is ensured the implementation of Regulation (EC) 1030/2002 on the issue of residence permits for single European format.
- The Law for Entering, Residing and Leaving the Republic of Bulgaria – regulates the status of this category of persons.
- The Citizenship Law – contains provisions on the implementation of various procedures related to the Bulgarian citizens and Bulgarians living abroad.
- The Penal Code – contains provisions penalizing illegal migration, trafficking in people and illegal crossing of the state border.
- The Law on Combating the Illegal Trafficking in Human Beings – the focus of the law is on prevention and protection of victims, particularly women and children, as well as the special protection of victims who cooperate with the police.
- The Law on Asylum and Refugees – defines the terms and conditions for granting special protection to foreigners as well as their rights and obligations.
- The Employment Promotion Act – regulates the issuance of work permits, access to register in the Labor Directorate offices and the services provided by the Agency for Employment.
- The Civil Registration Act – regulates the terms and conditions for civil registration of individuals in Bulgaria. In civil registers fit foreigners who have received a permanent residence permission, stateless persons who reside permanently in the country and persons who have been granted asylum in Bulgaria with refugee or humanitarian status.

Authority

The State Agency for Refugees (SAR) is a legal body subordinated to the Council of Ministers and financed by the State budget. Its headquarters is located in the capital of Sofia. SAR has territorial units in the country. The

Agency is led by a Chairperson who is an executive authority organ entrusted with special competence. SAR manages, coordinates and controls the implementation of the State policies relating to granting a refugee status and humanitarian status to aliens in the Republic of Bulgaria. The Agency staff numbers 127 on pay roll.

The National Council on Migration Policy, established under the National Strategy of the Republic of Bulgaria on migration, asylum and integration (2011-2020) is chaired by the Minister of Interior in view of improving inter-ministerial co-operation and coordination between the structures engaged in the migration processes. The Council functions as a linking unit between the respective ministries, the local authorities and the nongovernment sector engaged in the management of migration processes.

The SAR is implementing the State policy on foreigners seeking and receiving protection under the provision of the Law on Asylum and Refugees. Presently it provides four types of special protection:

- Asylum – granted by the President of the Republic of Bulgaria.
- Temporary protection – provided by the Council of Ministers for a period determined by a decision of the EU Council in the event of a mass influx of foreigners who are forced to leave his country origin.
- Refugee Status – acknowledged by the SAR Chairman to a foreigner who meets the criteria set out in Geneva Convention on Refugees and the Law on Asylum and Refugees.
- Humanitarian Status - granted by the SAR Chairman to a foreigner forced to stay outside his/her country of origin due to other humanitarian circumstances outside the scope of provisions for granted refugee status.
- The asylum, refugee and humanitarian status are given on the base of an individual examination of the applicant. Beside the temporary protection is defined to a group as each member of the group considered *prima face* (absence of evidence to the contrary).

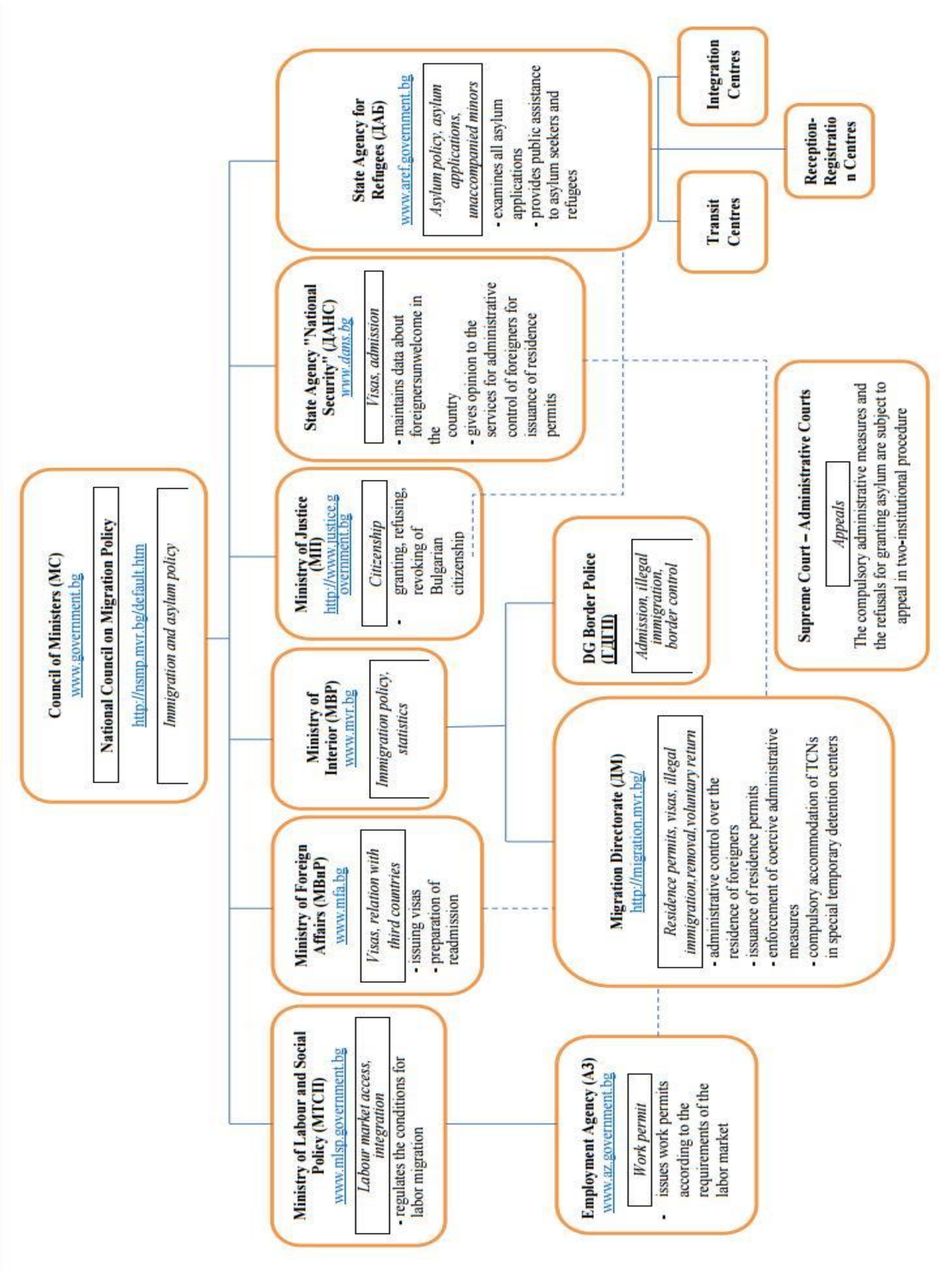
The Migration Directorate is a national specialized structure of the Interior Ministry for the administrative issues of migrants and foreigners residing in Bulgaria. The Directorate is in charge to regulate and control the order and conditions of residence of foreign nationals in the country, as well as in the issuance, rejection/denial and deprivation of long term residence permits, and also in charge of the interaction and information in the area of migration processes with other state authorities, NGO-s, etc, and for the exchange of information with all the latter. The permissions for permanent stay in Bulgaria are issued by the director of Migration Directorate.

The Ministry of Labour and Social Policy proposes and implements measures for regulation of labour migration, regulates access to the national labour market and is responsible for the coordination of the imigrants integration measures.

The Employment Agency under the Ministry issues work permits.

The State Agency for Child Protection is responsible for the development and coordination of the State policy for child protection and implementation of related programmes.

The Ministry of Justice is responsible for granting citizenship; the decision is taken by the Presidential Institution under the Vice President.


Council of Ministers (MC)
www.government.bg
National Council on Migration Policy
http://nsmp.mvr.bg/default.htm
Immigration and asylum policy
Ministry of Labour and Social Policy (MTCП)
www.mlsp.government.bg
Labour market access, integration
- regulates the conditions for labor migration
Ministry of Foreign Affairs (MBнP)
www.mfa.bg
Visas, relation with third countries
- issuing visas
- preparation of readmission
Ministry of Interior (MBP)
www.mvr.bg
Immigration policy, statistics
Ministry of Justice (MП)
http://www.justice.government.bg
Citizenship
- granting, refusing, revoking of Bulgarian citizenship
State Agency "National Security" (ДАНС)
www.dans.bg
Visas, admission
- maintains data about foreignersunwelcome in the country
- gives opinion to the services for administrative control of foreigners for issuance of residence permits
State Agency for Refugees (ДАБ)
www.aref.government.bg
Asylum policy, asylum applications, unaccompanied minors
- examines all asylum applications
- provides public assistance to asylum seekers and refugees
Integration Centres
Reception-Registration Centres
Transit Centres
Employment Agency (A3)
www.az.government.bg
Work permit
- issues work permits according to the requirements of the labor market
Migration Directorate (ДМ)
http://migration.mvr.bg/
Residence permits, visas, illegal immigration, removal, voluntary return
- administrative control over the residence of foreigners
- issuance of residence permits
- enforcement of coercive administrative measures
- compulsory accommodation of TCNs in special temporary detention centers
DG Border Police (ГДГП)
Admission, illegal immigration, border control
Supreme Court – Administrative Courts
Appeals
The compulsory administrative measures and the refusals for granting asylum are subject to appeal in two-institutional procedure

Execution Policy

The third-country nationals (TCNs) may enter the Bulgarian territory with the required valid travel document and visa. Visa types include: air transit visa, transit visa, short-term residence visa, and long-term residence visa. A visa is not required if the foreigner holds a prolonged, long-term or permanent residence card. Admission requires the fulfillment of specific criteria and the possession of documentation. EU citizens and their family members wishing to stay for more than three months must register to receive a residence permit. Applications for international protection may be lodged with the SAR or any other governmental authority. During the asylum procedure, accommodation, health care and social assistance are provided to applicants. All applicants, except unaccompanied minors are determined under an accelerated procedure and receive a decision (whether rejected as unfounded or admitted to general procedure) within three days. Legal aid is available at all stages.

Short-term residence may not exceed ninety days. Prolonged residence is given for the period up to one year mainly for reasons connected with education, family reunification and labour. Long-term residence is given for a period of 5 years, with a possibility of renewal, for the purpose of e.g.: employment, (freelance) self-employment, commercial activities, study, non-profit activities, medical treatment, and family reunification.

Requirements must be met regarding housing, subsistence, compulsory insurance and social insurance. Permanent residence may be granted after five years of uninterrupted residence or in case of e.g. certain family ties, investments or Bulgarian nationality.

Regarding access to the labour market, certain types of short term employment and study are exempted from work permit requirement. Registration must however be done before entry and employment. Work permits may be issued to a TCN having specialised knowledge, skills and professional experiences, where certain conditions are met. A work permit can be extended for up to 12 months if valid grounds exist and employment is not interrupted. Asylum applicants have access to the labour market if the asylum procedure has not been finalized after one year. Refugees and persons granted humanitarian status have the right to work.

Return can be forced or voluntary with the latter as the preferred option. Centres for temporary accommodation of foreigners anticipating escort to the border and expulsion have been established.

Under Bulgarian law, border or immigration police may detain people on grounds of unauthorised entry, irregular residence or lack of valid identity documents. Persons arrested on these grounds are normally subject to removal. By law, asylum-seekers have to be transferred within 24 hours from the Border Police to SAR reception facilities. In practice, asylum-seekers are transferred by the Border Police within 24 hours to the Elhovo Triage Centre, a detention centre, where they spend between three and five days before being transferred to a SAR reception facility. Irregular immigrants, on the other hand, are kept in the SCTAFs, pre-removal detention centres13 managed by the Directorate of Migration. If they apply for asylum while in detention, they are transferred to a SAR facility where they are registered. In all detention centres managed by the Directorate of Migration, detainees receive food regularly, have access to medical care when needed, have access to basic recreational activities which includes television, and have access to outdoor recreation areas.

Persons detained on grounds of unauthorised entry, irregular residence or lack of valid identity documents who make an application for international protection are transferred from SCTAFs and Elhovo Triage Centre to SAR centres within 24 hours in accordance with the law.

Hosted in the Migration Directorate centres - up to 31 Oct 2016.	
Capacity	1200
Current Occupation	1608
Nationality	Syria – 238 Afghanistan – 586 Iraq – 274 Pakistan - 287

	Other – 223
Hosted in the SAR centres - up to 31 Oct 2016.	
Capacity	5190
Current Occupation	5527
Nationality	Syria – 1126 Afghanistan - 2680 Iraq – 1149 Pakistan – 290 Other – 282
Hosted in external addresses – up to 31 Oct 2016.	
	Total – 470

As a matter of principle, where the asylum claim of a person transferred under the Dublin Regulation to Bulgaria has not been decided substantively, the asylum procedure is re-opened at the stage where it left off, provided the person gives consent to continue his/her asylum procedure in Bulgaria. There are no additional requirements and an examination on the merits is ensured. Should the transferred individual wish to continue his/her asylum procedure in Bulgaria and depending on the stage of his/her procedure, the person will be transferred to a SAR centre and will enjoy the same entitlements as other asylum-seekers. If the application has been suspended and the applicant fails to appear before SAR within three months following the suspension of the procedure, the law stipulates that the applicant's procedure (not the claim) be terminated in absentia.

If the asylum claim of the person returned to Bulgaria under the Dublin Regulation was already decided on its merits and s/he received a final negative decision which has entered into force, the person is re-admitted to the country, but then treated as an asylum-seeker whose application for international protection was rejected in a final decision unless he/she introduces a subsequent application. Only asylum-seekers whose claims were rejected through a final decision and who do not make a subsequent application can be held in a detention centre under the Migration Directorate – Interior Ministry in order to carry out the removal process.

TRANSFERED TO 2016 (up to 31 Oct 16)
TURKEY **TOTAL – 94**
Turkey – 79
Georgia – 3
Afghanistan – 2
Morocco – 2
Gambian – 2
Algeria – 1
Iraq – 1
Congo – 1
GREECE **TOTAL – 283**
Afghanistan – 86
Syria - 89
Iraq – 90
Iran – 9
Albania – 2
Azerbaijan – 2
Egypt – 2
Morocco – 2
SERBIA **TOTAL – 5**
Serbia - 2
Afghanistan – 1
Pakistan – 2
FYROM **TOTAL – 24**
Albania – 17
FYROM – 5
Kosovo – 2
ROMANIA **TOTAL – 3**

Under Dublin Regulations Bulgaria has received since the end of 2015 as follow:

Mar	Apr	May	Jun	Jul	Aug	Sep	Oct
63	44	55	63	41	81	53	58

About 40 percent of resident migrants in Bulgaria prefer to work mostly in the so-called "non-standard working hours" – mostly at night, weekends or without specified scheduled duties. An overwhelming majority of them are not particularly high qualification, according to the analysis of the European Statistical Office. With the employment of part-time were about 1.4 percent of the migrants in the country, and another 5 percent were employed on temporary contracts. Migrants are most attractive to the labour market of constructing companies, catering and food manufactures. Another 13 percent prefer working as self-employments in the market as hairdressers, barbers and tailors mostly.

Conclusions

Being an external border to the EU entails certain challenges in terms of migration policy, and it led to the need of upgrading the mechanisms for control and regulation of the influx, including a long-term strategy with a view to national security and economy. So, Bulgaria is in need to develop and apply a successful procedures and practices at EU level as well as regionally and nationally to overcome existing challenges.

In 2016 Bulgaria focused significant efforts to the Return policy as an important step to reduce the influx by sending a firm message to potential migrants that compliance with the provisions of legislation is the only way to enjoy the benefits of residing in the country. Optimal results are seen to be achieved when such policy is combined with effective measures of border control as well as appropriate human traffic management and admission mechanisms. At the same time the return issues and reintegration problems are considered to go beyond one's national policy as they are key elements of the development of EU cooperation with countries of origin and transit countries in international migration flows.

During 2016 Bulgaria has planned several measures directed to the efforts to reduce its vulnerability towards migration influx:

- Continue the negotiations for readmission agreements with countries of origin and transit of the illegal migratory flows.
- Improving the interagency cooperation and coordination between all actors responsible for the management of migrants' issues.

- Strengthening the institutional capacity in the field of detention.
- Promoting the development and implementation of special programs assisted voluntary return of vulnerable group.
- Strengthening the cooperation with third countries, EU States and the FRONTEX agency.

Foreseen changes in the Law on Refugees have been met with criticism from the civil and nongovernmental sector (in particular the Bulgarian Helsinki Committee and the UNHCR). The recommendations concern the treatment of children and other vulnerable groups, as well as the freedom of movement of foreigners. The High Commissioner advocates for prompt registration of the foreigner's application and issuing him/her a document. As for the closed type centers, the UNHCR states that detention should be only a measure of last resort.

The National Strategy on Migration, Asylum and Integration 2015-2020 is implemented as it aims to create favorable conditions and effective mechanisms for integration of third-country nationals (TCNs) with humanitarian or refugee status into Bulgarian society. However there have been reports for delays in the integration process, as well as incidents related to refugee accommodation, access of children to school, integration into the labour market, etc.

In 2016 the main nationalities of the migrants are Afghanis, Iraqis, Syrians and Pakistanis and are the core target of the criminal networks which smuggle migrants across the border from Turkey to Bulgaria and hand them over to other smugglers in the so-called Balkan route. To cross the Bulgarian-Serbian land border, migrants often use the service of smugglers, who transport them towards the border section with Serbia and show them the direction in which to walk.

The increased migration pressure led to manifestations of xenophobia and intolerance towards refugees. The biggest tension so far was in the town of Harmanli, it escalated in mid-November`2016. Over 1000 migrants clashed directly with the riot police. Simultaneously more than 500 local citizens marched on the streets of Harmanli demonstrating against the migrants. The Interior Ministry announced that the situation was under control after 12-hour rampage and that no further use of force or auxiliary means had become necessary. Reportedly 29 policemen were slightly injured while about 20 migrants were hospitalized. A new facility building, built with European funds, was demolished. Mattresses, beds, chairs, plastic pipes were being carried out as they have started several consecutive fires. Migrants protested against the temporary restriction to leave the centre and claimed the border with Serbia to be opened.

The Bulgarian prosecuting authorities have indicted 19 migrants in relation to the disturbances in the Harmanli reception and accommodation center, as 18 of these are with hooliganism charges, the prosecution's spokesperson Rumyana Arhaudova has told. The nineteenth indictment includes charges of desecration of Bulgaria's national flag, Arnaudova has added. As many as 300 migrants were arrested after the riots.

In connection with Harmanli's case, the procedure for the voluntary repatriation of 50 Afghanis who have arrived in Bulgaria illegally has been launched. Another 200 will also be repatriated after their documents have been processed. This was decided on 28 November 2016 at a ministers meeting with outgoing PM Boyko Borisov. The migrant centre at the village of Pastrogor will become a closed camp of a type. Some of the migrants who are currently placed at the Elhovo Camp will be moved there. The capacity of the Lubimets Placement Centre will be increased. 50 caravans and 400 blankets have already been dispatched there. Immigrants will be placed at former border cross checkpoints along the Bulgarian-Turkish border. These new centres will be of the closed type and will be secured by employees of the Ministry of the Interior.

Recent sociologist research[6] shows the attitude towards migration problems in Bulgaria. It is not unambiguous as a whole. According to the survey, nearly 47% of people believe that the EU should assist to refugees whilst the most frequently considerations by the public opinion are:

- "Together with refugees in Europe come terrorists".
- "Bulgaria is not so rich and cannot allocate funds for the refugees, that's why Bulgaria needs EU support".
- "Refugees are dangerous and pose a threat to Pan-European security and a risk to the EU economy".

[6]The Friedrich-Ebert-Stiftung, http://library.fes.de/pdf-files/bueros/sofia/12571.pdf

Predominantly there is a public fear of the increased risk of spread of Islam in Europe. Opinions claim refugees are people with a different mentality, a different religion and most of them could not accept European values and behaviour patterns. "*They could not be integrated into the European community, so the refugees have no place in Europe and should seek refuge in the nearest peaceful country in its region".*

In turn, 28% of interviewed citizens believe that EU should help people seeking asylum. They consider it as a manifestation of humanity to help people in trouble. About a quarter of responders believe that the EU should shelter the asylum seekers on its territory but only mothers with children and adults coming from war zones in Middle East. The data shows that a significant proportion of people approve assistance to refugees, while at the same time they share views that the EU must keep strict migration policy. A dominant idea is that EU needs stricter control measures, better border management, new regulations and clear conditions for the entry of migrants. Nearly 81% of responders in the research agree with the statement that it is necessary to build a Pan-European mechanism by which to make a primary segregation outside the EU borders in order to control mass movements. The majority of the responders (57%) of share the view that the solution to the refugee problem should be common to all countries within the EU.

Around 78% of the interviewed believe that refugees will become a burden on the Bulgarian economy and 60% of them consider refugees pose a threat to the national security. According to the survey data, this view is shared by:

- 64% of men and 56% women;
- 63% of adults over 61-year of age;
- 63% of age 31-50 old;
- 59% of age 51-60 old;
- 52% of young (aged 18-30 years);

and

- 64% of Bulgarian Christians and 53% of Bulgarian Muslims.

Bulgaria is suffering from problems of collecting and analyzing the statistical information from various domains – governmental bodies, local authorities, private enterprises and labor market – dealing with the migrants. More quantitative and qualitative researches are needed to analyze and forecasts mass movement across national territory, respectively the EU's. Governmental bodies recognize the importance of public awareness however providing publicity reports on migration situation are insufficient. Different social organisations and NGOs remain insisting upon conducting mandatory public hearings on proposals for legislative changes, organizing forums on migration policy, anticipating forms of civil control over the implementation of the measures in the government plans for action.

There are some gaps in the long-term policies on voluntary return which was claimed by the governmental officials as an important tool to reduce illegal migration and providing an effective answer to the migration influx. The Migration Directorate is assigned to improve the enforcement procedures refoulement, coercive administrative measures ("deportation" and "expulsion") and to develop programs for voluntary cooperation.

Bulgaria, as well as virtually all the Southeast European countries is considered by migrants exclusively as a transit corridor towards Central and Western Europe. However the country remains aside of the main route of movement of refugee flows the Western one, running from Greece via FYROM and Serbia to Central Europe. Several key factors contribute to it:

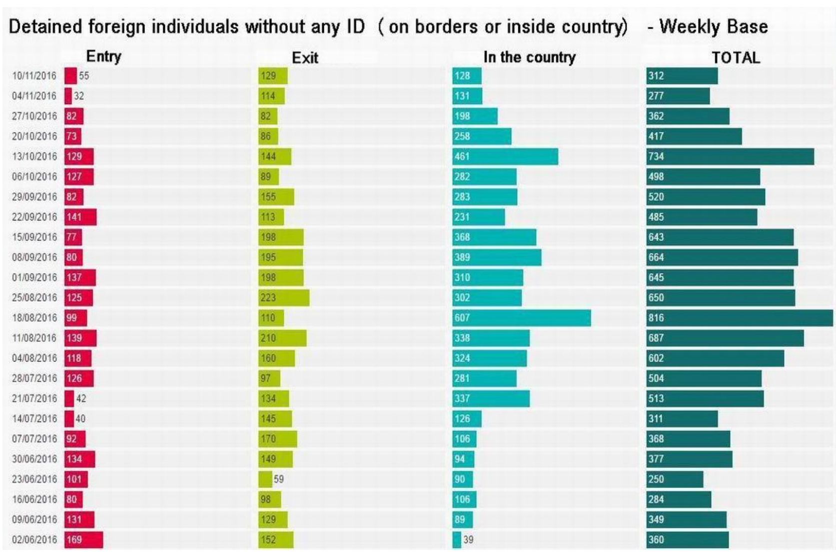
- The so-called Western route is more direct; "more developed" both by the refugees themselves and by human traffickers above all.
- FYROM and Republic of Serbia are not members of the EU, respectively the EU approaches to regulate intake, especially at the initial stage, are much more difficult to coordinate and often ineffective.
- Bulgaria and Romania are not Schengen members, which cut off the ability to move from Greece to Western Europe without leaving the Schengen area.
- Bulgaria has implemented very strictly (even meticulously) the EU Regulation 604/2013; the so-called "Dublin Regulation"[7] since its amendments in 2013.

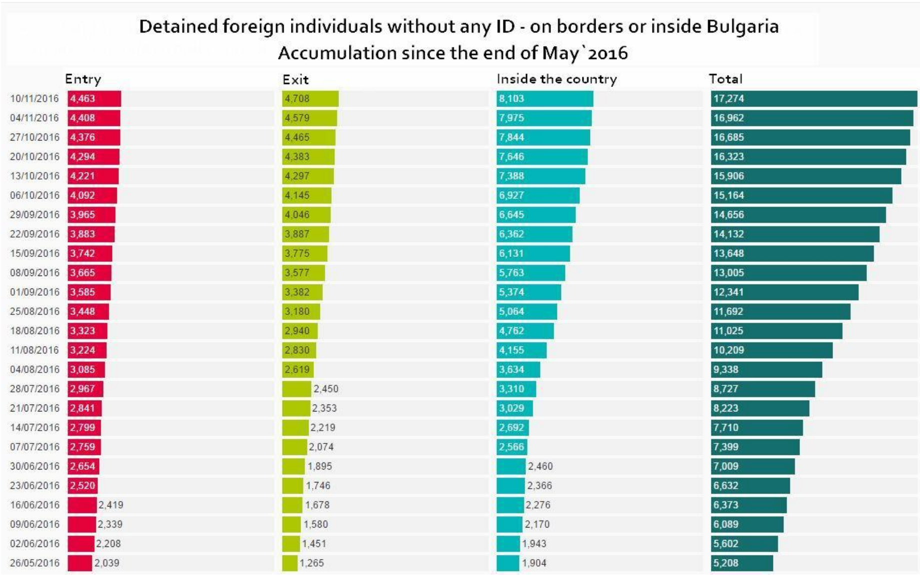
[7] A European Union law that determines EU Member State responsible to examine an application for asylum seekers seeking international protection under the Geneva Convention and the EU Qualification Directive, within the EU. It aims to determine rapidly the Member State responsible for an asylum claim and provides for the transfer of an asylum seeker to that Member State. Usually, the responsible Member State will be the state through which the asylum seeker first entered the EU. (Council Regulation (EC) No 343/2003 of 18 Feb 2003)

- Bulgaria applies more harsh and restrictive policy to the illegal border-crossing, which creates a general attitude of avoiding paths through the countryside as more risky.
- The direct penetration of migrants from Turkey is relatively low due to the fact that it involves crossing the entire Turkish land territory and a temporary stay in Istanbul where daily life is expensive and the security observations are stronger.

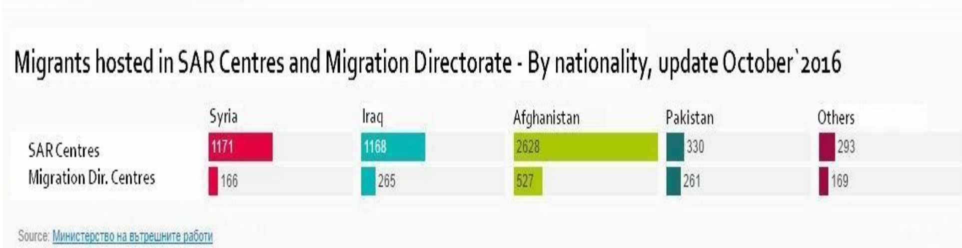
A summary conclusion can be point out at this stage: – the current migrant influx in Europe reflects primarily in political and psychological terms on Bulgarian society. The real pressure, including economic and social aspects, remains relatively low compared to other countries, especially those from South and Southeast Europe. Nevertheless, it should not ignore the financial burden of control measures. They are taking considerable reassignments of professional resources and significant expenditures to create overall organization in accommodation of refugees.

ANNEX A – STATISTICAL DIAGRAMS

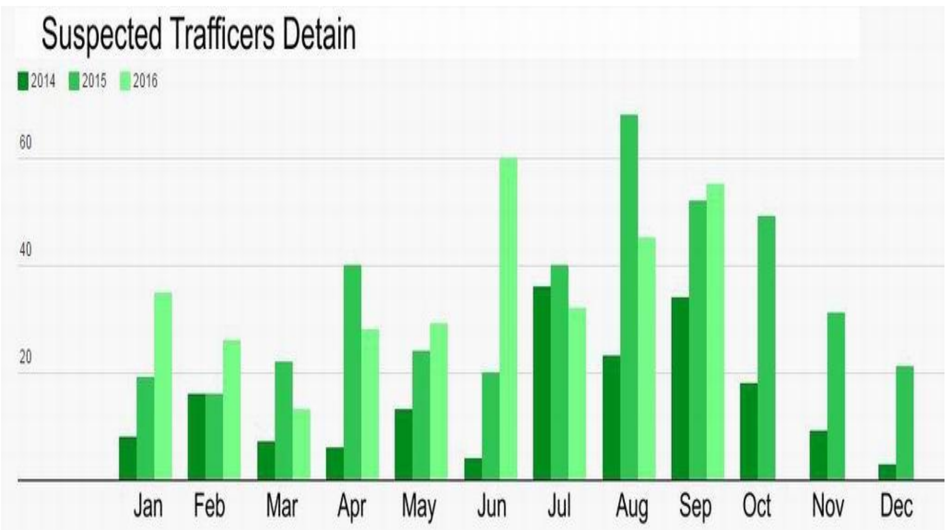


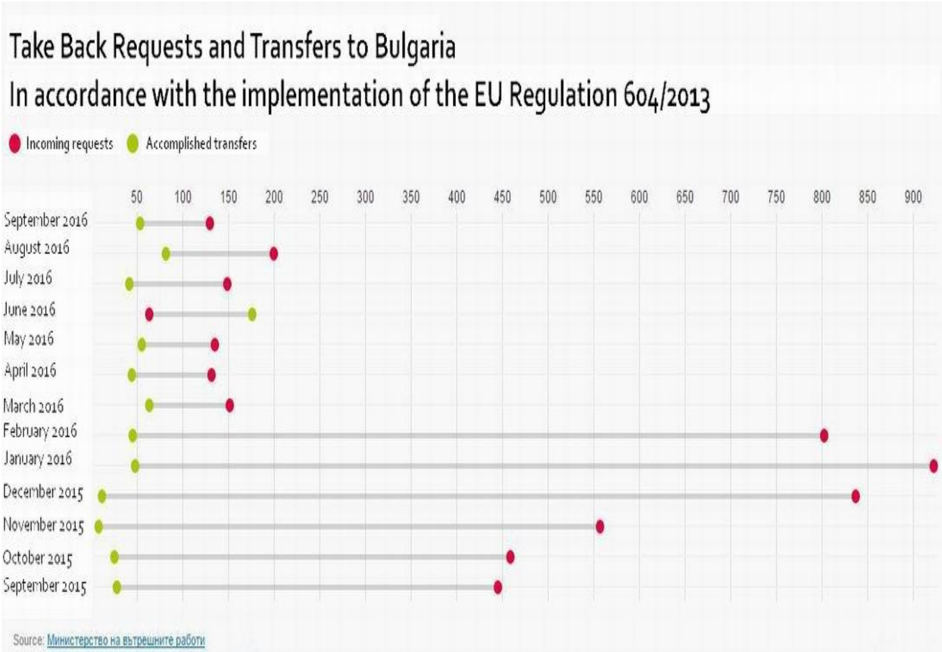

Detained foreign individuals without any ID - on borders or inside Bulgaria
Accumulation since the end of May`2016
Entry
Exit
Inside the country
Total
10/11/2016 4,463 4,708 8,103 17,274
04/11/2016 4,408 4,579 7,975 16,962
27/10/2016 4,376 4,465 7,844 16,685
20/10/2016 4,294 4,383 7,646 16,323
13/10/2016 4,221 4,297 7,388 15,906
06/10/2016 4,092 4,145 6,927 15,164
29/09/2016 3,965 4,046 6,645 14,656
22/09/2016 3,883 3,887 6,362 14,132
15/09/2016 3,742 3,775 6,131 13,648
08/09/2016 3,665 3,577 5,763 13,005
01/09/2016 3,585 3,382 5,374 12,341
25/08/2016 3,448 3,180 5,064 11,692
18/08/2016 3,323 2,940 4,762 11,025
11/08/2016 3,224 2,830 4,155 10,209
04/08/2016 3,085 2,619 3,634 9,338
28/07/2016 2,967 2,450 3,310 8,727
21/07/2016 2,841 2,353 3,029 8,223
14/07/2016 2,799 2,219 2,692 7,710
07/07/2016 2,759 2,074 2,566 7,399
30/06/2016 2,654 1,895 2,460 7,009
23/06/2016 2,520 1,746 2,366 6,632
16/06/2016 2,419 1,678 2,276 6,373
09/06/2016 2,339 1,580 2,170 6,089
02/06/2016 2,208 1,451 1,943 5,602
26/05/2016 2,039 1,265 1,904 5,208


Nationality of migrants detained on Bulgarian borders in 2016
Syria
Iraq
Afghanistan
Pakistan
Iran
Others
Entry 1201 1483 1312 233 68 166
Exit 898 2407 6874 1386 246 192


Migrants hosted in SAR Centres and Migration Directorate - By nationality, update October`2016
Syria
Iraq
Afghanistan
Pakistan
Others
SAR Centres 1171 1168 2628 330 293
Migration Dir. Centres 166 265 527 261 169
Source: Министерство на вътрешните работи


Asylum Seekers` Claims and Granted Status Decisions
Asylum Claims
Granted Refugee Status
Humanitarian Status Given
Rejected
Terminated Procedures
September 2016 2076 115 60 232 744
August 2016 2776 19 43 213 624
July 2016 1534 77 45 63 398
June 2016 1424 31 34 135 386
May 2016 1116 51 38 49 303
April 2016 243 34 40 25 243
March 2016 1042 27 15 39 519
February 2016 1194 90 69 40 1011
January 2016 1966 47 18 33 1638
December 2015 1695 138 45 11 2226
November 2015 2413 210 52 20 2738
October 2015 3545 237 70 47 2326
September 2015 1277 365 68 30 1145


Suspected Trafficers Detain
2014
2015
2016
60
40
20
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec


Take Back Requests and Transfers to Bulgaria
In accordance with the implementation of the EU Regulation 604/2013
Incoming requests
Accomplished transfers
50 100 150 200 250 300 350 400 450 500 550 600 650 700 750 800 850 900
September 2016
August 2016
July 2016
June 2016
May 2016
April 2016
March 2016
February 2016
January 2016
December 2015
November 2015
October 2015
September 2015
Source: Министерство на вътрешните работи

WHY RESILIENCE MATTERS?

***Gloria Stoyanova*[1]**

„The dogmas of the quiet past are inadequate to the stormy present. The occasion is piled high with difficulty, and we must rise with the occasion. As our case is new, so we must think anew and act anew."

Abraham Lincoln Second Annual Message to Congress December 1, 1862

Abstract: *The article presents the recent work within NATO on the topic of resilience, ensured through robust civil preparedness and effective civil-military planning. It stresses the importance of a high-level political engagement and investment in order to fulfil the Warsaw Commitment to Enhance Resilience. Within the new security environment, NATO is adapting its approach to civil preparedness as critical enabler for collective defense.*

Resilience has become an important issue for both NATO and the European Union, and the two organizations make efforts to advance their cooperation in the field of resilience.

Keywords: Resilience, Warsaw Commitment, Civil Preparedness, Baseline Requirements, Article 3, collective defence, deterrence

Introduction

The notion of resilience is gaining more and more popularity in the Euro-Atlantic area. The concept suggests the capacity to withstand stress and recover, strengthened from challenges. Reading article 3[2] of the founding document of NATO, it becomes apparent that the founding nations had already thought about the principle of resilience. By committing themselves to be prepared and resist an armed attack, they knew that being strong at home would be a source of

[1]This article reflects the author's personal views and findings and does not represent those of any institution, organization or government.

[2] Article 3 of the Washington Treaty: "In order more effectively to achieve the objectives of this Treaty, the Parties, separately and jointly, by means of continuous and effective self-help and mutual aid, will maintain and develop their individual and collective capacity to resist armed attack."

strength for the Alliance as a whole. This notion of resilience was always understood to go beyond military capabilities.

In the 1950s, NATO had policies and planning for civil preparedness. The Alliance maintained plans for eight NATO civil wartime agencies[3] to ensure that NATO commanders could rely on civilian assets and commercial markets, that refugee movements could be coordinated and deconflicted with military operations, and to guarantee continuity of essential civilian operations. The main task was to ensure that military operations could proceed without additional burden. More than 1400 international experts were involved in this work, and all NATO members had corresponding resources in their capitals. Following the fall of the Berlin wall, the significantly reduced threat meant that the likelihood of a direct attack on mainland Europe diminished. Consequently, attention to and investment in civil preparedness started to decline. After the changes of the 1990s, this invaluable expertise was either dismantled or shifted to specialized agencies, such as fire and rescue services, which did not have the necessary knowledge and resources to undertake robust planning for civil defence.

After almost two decades of lost opportunities the time has come to rebuild resilience. The near absence of robust national and Alliance resilience planning became apparent after the Wales Summit in 2014 and the efforts to improve NATO's deterrence and defence capabilities with the Readiness Action Plan.

Faced with the greatest challenges for decades, the Alliance had to adapt and operate simultaneously. Not only the new type of threats, but also the greater challenges in dealing with these threats, the bottom line being that most nations have reduced their investments in defence, have weakened our societies as a whole.

Thus, NATO is currently implementing the most significant reinforcement of its collective defence capabilities since the end of the Cold War. While most of the public attention has been focused on NATO's military adaptation to the new security environment, the efforts to strengthen the Alliance ability to resist and

[3] Defence Shipping Authority, Agency for Coordination of Inland Surface Transport in Europe, Southern Europe Transport Organization, Civil Aviation Agency, Inter-allied Insurance Organization, Central Supply Agency, NATO Wartime Oil Organization, NATO Refugee Agency.

recover from attack not just militarily, but also with civilian capacities, have been less visible. However, this is changing.

The renewed emphasis on resilience is based on two important facts: First, armed forces today are more reliant than ever on capabilities and infrastructures that are civilian-owned or operated. The massive cuts in defence budgets since the end of the Cold War in addition mean that our military relies upon civilian assets unable to sustain or deal with potentially severe disruption. In large-scale operations, around 90 % of military transport is provided by the commercial sector as well as 40 % of military satellite communications. 75 % of all host nation support is dependent on the use of locally procured infrastructure and services. Deployed NATO forces need access to host nations' industrial infrastructure, access to the power grid, food, water and fuel supplies, access to civilian telecommunications infrastructure, as well as local civilian expertise and manpower[4].

Second, civilian services and infrastructures are potentially vulnerable to outside attack or internal disruption and such vulnerabilities could be exploited by potential adversaries. In an age of hybrid threats, strengthening resilience by improving civil preparedness and cyber defence is critical component of the efforts of NATO to deter and defend against the full range of threats.

Because of the existing interdependencies between the military, civil and private sectors, there is a need for a redesigned framework and concept that fits the new era[5].

Deterrence and resilience seem to be two sides of the same coin: while the first encompasses the broad military dimensions, as well as the means and capacity to respond to an external threat, resilience deals with mostly civil preparedness that fundamentally allows the military to carry out its mission. In other words, reducing societies' vulnerabilities limits the likelihood of an attack, thus reinforcing deterrence[6].

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[4]http://www.nato.int/cps/eu/natohq/topics_49158.htm?selectedLocale=en

[5]HQ SACT, "Building Resilience across the alliance," Food for Thought Paper, 14 January 2016.

[6]Lasconjarias, G. (2017) Deterrence through Resilience. NATO, the Nations and the Challenges of Being Prepared,*Eisenhower Paper,* №7, Research Division, NATO Defence College, Rome, Available from: http://www.ndc.nato.int/news/news.php?icode=1060 [Accessed 31 May 2017]

In this context, in July 2015, the North-Atlantic Council tasked the Civil-Emergency Planning Committee to develop a Report on the state of the civil preparedness, which should include an analysis of possible gaps. This assessment, together with parallel efforts to improve NATO's and NATO nations' cyber defences, laid the groundwork for the now ongoing, systematic effort to improve resilience across the Alliance.

The report identified continuity of government, of essential services to the population and support to military operations as the three critical civilian functions that a country must be able to uphold under all circumstances. Based on an assessment of threats and vulnerabilities, Allied Defence Ministers agreed **"baseline requirements**," in seven strategic areas that were deemed most critical to NATO's collective defence tasks and against which Allies can measure their level of preparedness:

1. Continuity of Government and critical government services – the ability to make decisions, communicate them, and enforce them, and to provide essential government services to the population.

2. Resilient Energy Supplies – ensuring that energy supply, including national power grids, are secure and that nations maintain the necessary prioritization arrangements and redundancy.

3. Resilient Civil Communications Services – ensuring that telecommunications and cyber networks remain functional even in demanding conditions and under attacks.

4. Resilient Food and Water Supply – ensuring sufficient supplies are available to both civilians and the military, and safe from disruption or sabotage.

5. Ability to Deal with Large Scale Population Movements and to be able to deconflict such movements from potential national or Alliance military deployments and other requirements.

6. Ability to Deal with Mass Casualties – ensuring that health systems can cope in very demanding situations when there might be simultaneous pressure on civilian and military healthcare capabilities.

7. Resilient Civilian Transportation Systems – ensuring that NATO forces can **move across** Alliance territory rapidly and that civilian transportation networks remain functional and effective to support civil and military requirements even when challenged or attacked.

A few months later, the issue was brought into the political spotlight with the "**Commitment to Enhance Resilience**"[7] adopted by Heads of State and Government at the July 2016 Warsaw Summit.

The Warsaw Summit Resilience Commitment makes three critical points. First, it stipulates that resilience is an essential basis for deterrence and effective fulfilment of the Alliance's core tasks. Second, it makes clear that to be able to deter and defend against the full range of modern threats, Allies need to maintain and protect critical civilian capabilities alongside and in support of military capabilities in an integrated way, and with the involvement of the whole of government and the private sector. Third, it constitutes a political commitment at the highest level by each allied nation to strive to achieve the agreed requirements for national resilience. [8]

Resilience is first and foremost a national responsibility, but NATO can serve as a clearinghouse, while taking a close interest in integrating Allies' and partners' vision of resilience. Very good example is the recent Joint Planning Groups seminar on implementing the seven baseline requirements, held in Bucharest, Romania in March 2017.

NATO has defined a set of requirements, but Allied nations will have to integrate these resilience requirements **across government and the private sector**.

Currently nations are doing self-assessment to what extent they fulfil the resilience requirements. In line with that the Defence Planning Capability Survey is already a fact and nations have to reply to civil-preparedness and resilience related questions. The seminar in Bucharest was an opportunity for Allies and partners to discuss national best practices, to raise awareness of NATO and European Union efforts and tools to bolster resilience, to familiarise nations with

[7]NATO, "Commitment to enhance resilience," issued by the Heads of State and Government, Warsaw, 8 July 2016, Available from: http://www.nato.int/cps/eu/natohq/official_texts_133180.htm?selectedLocale=en [Accessed 29 May 2017]

[8]Meyer-Minnemann, L. (2016) Resilience and Alliance Security: The Warsaw Commitment to Enhance Resilience, In: Hamilton, D.S. (ed.) *Forward Resilience: Protecting Society in an Interconnected World*, Washington DC , Center for Transatlantic Relations, pp. 91-98

assessment methodologies, including as part of the NATO Defence Planning Process; and to highlight NATO collective tools, such as the Resilience Advisory Support Team and the NATO Crisis Response Measures.

Some of the key findings[9] of the seminar are now being taken forward by national authorities, the Civil Emergency Planning Committee, the Planning Groups, and NATO civil and military staffs. In the current security environment, civil preparedness must be strengthened alongside NATO's military preparedness with adequate and sustained resources, including human resources. This might even require investment beyond the 2% Defence Investment Pledge. Achieving resilience in a globalised world requires not only a whole-of government approach, but also effective platforms to engage and exchange information with private stakeholders, neighbouring countries, and other partners. A joint meeting of NATO Defence and Interior Ministers or other Ministries responsible for the coordination of civil preparedness was proposed to raise awareness at the highest political level on the future tasks.

Contemporary problems demand new approaches and the old way of doing business do not apply. Expanding involvement away from the usual group of specialists dealing with NATO Defense Planning Process towards engagement with many stakeholders is part of achieving broad-based ownership and mainstreaming civil preparedness and resilience policy. More players, each with their own agendas and priorities, almost inevitably lead to more complex patterns of participation, with greater demands for coordination. It also increases demands for time, skills and resources to make such participation effective. Participation involves communication, and the essence of communication is establishing dialogue or engagement. It is not simply a one-way transfer of information, which is unlikely to be successful anyway without some degree of engagement. Enhancing resilience requires processes that engage with the broad range of actors and stakeholders both for policy development and implementation and, in many cases, to assist with operational measures. The civil, private and military sectors should not perceive each other as opposing or in competition, but mutually reinforcing, complementing and collaborative. In this regard, situational awareness and dedicated mechanisms

[9] AC/98-N(2017)0031 (INV) - The 2017 Bucharest Seminar Report: Implementing the Seven Baseline Requirements

for the exchange of information are essential in order to build resilience and meet the challenges of the hybrid threats.

Another very important element is the legislation. In some cases, it is necessary to modify, change or make the legislation evolve in certain domains, especially in giving national governments and institutions greater flexibility to deal with the notion of crisis; and avoid the separation between what can be done in peacetime and wartime.

Considering the nature of the seven baseline requirements, substantial and long term financial investment in infrastructure is required. Moreover, an investment in human resources, including through education and training, is also of utmost necessity. The existing expertise within the NATO's Centers of excellence[10] should be exploited in supporting NATO's and Allies efforts.

At first, better educating our senior management is mandatory, if we intend to cope with the current level of threats and challenges that need smart and well-informed people. Education and training needs to broaden the understanding of the exposures security actors face. It requires developing a comprehensive view across all dimensions, to encourage broad thinking about how to enhance the resilience of societies, nations, economies and organizations against the constantly changing contemporary risks. It is important to ensure that mechanisms are flexible and that senior leadership, as well as national, regional and local government and relevant private sector stakeholders are closely involved in this effort. Roles, responsibilities and resources need to be clearly defined and assigned.

NATO Ambassadors and Defence Ministers have held several simulations and scenario-based exercises in order to check their situational awareness and response to potential hybrid threats. They were instrumental for developing a common and shared understanding of the threats and vulnerabilities, the tools and mechanisms and for improving the integrated decision-making.

In this new strategic environment, the importance of EU-NATO cooperation, based on shared values and interests, becomes ever more pertinent. 22 out of 29 Allies are also part of the EU. But nations only have one 'single set of forces'. In this regard, closer and mutually reinforced cooperation between NATO and

[10] http://www.natolibguides.info/coe

the EU is essential. While NATO can set requirements and guidelines, the Alliance itself does not possess legislative or regulatory powers over the private sector, nor is a funding mechanism for national civil preparedness. This makes transparency and cooperation with the European Union a critical task. Although resilience is a national responsibility, given the challenges the Euro-Atlantic community is currently facing, the need for substantive cooperation among members of the EU and NATO on the topic of resilience is more urgent than ever. Boosting resilience against hybrid warfare was highlighted as one of the priority areas for cooperation in the Joint Declaration on NATO-EU Cooperation[11] that was signed on July 7, 2016 by the Secretary General of NATO Jens Stoltenberg, the President of the European Commission Jean-Claude Juncker, and the President of the European Council Donald Tusk. It is interesting to note that the Joint Declaration of July 2016 was signed only by the top representatives of the two organisations, without formal endorsement by the Member States. It was obviously easier to bring together staffs working in different parts of Brussels than to change the mindset in all capitals. However, the staffs have succeeded in having Member States support for a detailed common agenda: a set of 42 proposals for the implementation of the Joint Declaration was approved in a parallel process by the Councils of the EU and NATO on 6 December 2016[12].

The common set of proposals for the implementation of the Joint declaration include the implementation of **parallel and coordinated exercises (PACE)** as a pilot project for 2017 and 2018. This will be done with NATO in the lead through the Crisis Management Exercise 2017 (CMX 17) and the EU in the lead through Multi-Layer Crisis Management Exercise 2018 (ML 18) or other types of exercises in 2018. The exercises will include a hybrid element.

The European Commission and the High Representative adopted in April 2016 a Joint Framework on countering hybrid threats, which is meant to foster the resilience of the EU, its Member States and partner countries, in close cooperation with NATO. The Joint communication further invites Member States to identify common tools, including indicators, with a view to improve protection and resilience of critical infrastructure against hybrid threats in relevant sectors

[11] http://www.consilium.europa.eu/en/press/press-releases/2016/07/08-eu-nato-joint-declaration/

[12] http://data.consilium.europa.eu/doc/document/ST-15283-2016-INIT/en/pdf

(Action 5). The Joint Communication also suggests the Commission, in cooperation with Member States, to support efforts to diversify energy sources and promote safety and security standards to increase resilience of nuclear infrastructures (Action 6) and to monitor emerging threats across the transport sector (Action 7), as well as improving awareness of and resilience to hybrid threats within existing preparedness and coordination mechanisms in the public health and food security sectors (Action 10). It is important that these EU efforts draw upon and complement the important ongoing work in NATO on achieving the baseline requirements for resilience.

Conclusion

Civil preparedness and resilience have once again become core business for the Alliance and for national security planners in capitals. The Warsaw Summit Commitment to Enhance Resilience was a historic reaffirmation that resilience, ensured through systematic civil preparedness and effective civil-military planning, is a central pillar of NATO's collective defence. However, delivering on the Warsaw Commitment remains a complex task that requires political attention, reforms, education and investment. NATO Heads of State and Government have given the high-level political green light. In order to achieve success in building more resilient Alliance, this must now be followed up at all levels, from national security councils and key government departments to municipal levels, and across the public and private sectors. The existing network of Centres of Excellence could also be of great use to nations in order to provide expertise and insights into hybrid threats, crisis response, cyber defence, strategic communication, civili-military cooperation, energy security, etc.

IMPROVING OPERATIONAL RESILIENCY AND SENSEMAKING DURING CRISIS

Karim M. A. Hardy, Captain Dominique Costargent

Abstract: *Understanding the mechanisms of analysis and decision-making processes during extreme events allows to improve an organizational state and to maintain an ideal level of resilience through situational (re)formulations and awareness. Studying the concepts of sensemaking altogether, situational awareness and resilience highlight their affinities to understand their mutual influences in the construction of organizational performance in times of crisis. This article is structured around three objectives. Initially, it defines what sensemaking, situational awareness and resilience are. Secondly, it intends to show how the concepts of sensemaking, situational awareness and resilience are interconnected. Finally, regarding system dynamics, this article attempts to underline the various factors and variables that influence levels of operational resiliency, sensemaking and situational awareness critical maintaining an optimum level of performance.*

Keywords: Resilience, sensemaking, situational awareness, operations.

Introduction

Understanding decision-making processes in extreme situations allows maintaining a stable organizational state, a suitable level of resiliency and preventing catastrophe. Recreating the information flow in the post-adventitious process allows understanding better what could happen when time and resources were limited (Hardy, 2014). Construction of a process of decision-making in an extreme situation is a dynamic process where stakeholders are facing a time pressure, high complexity, and uncertainty (Drennan and McConnell, 2007). This lack of information push decision-makers to search for information to understand any new situation and to better communicate through a process of Sensemaking. This need for communication during a crisis brings anyone to grasp the meaning of a new, ambiguous, confusing or unexpected situation.

Operations during extreme events are increasingly confronted with emergencies and crises that challenge their stability. They rely on services provided by temporary organizations to enable them to plan for, respond to, and recover from emergencies and crises. However, operational resilience has two objectives of the concepts of sensemaking and situation awareness; if organizations are not prepared to respond to emergencies and crises, individuals and groups also are not ready. In addition to the link between sensemaking and situation awareness, there is also a link between sensemaking and resilience and between situation awareness and resilience. To be resilient, operations rely on strong sensemaking, a situation awareness and understanding of their operational environment, their aptitude to manage vulnerabilities, and their capacity to adapt in response to fast variation. Notwithstanding the possible operations of becoming more resilient, organizations struggle to prioritize resilience and to link resilience to emergencies and crises with the ability to operate successfully and, competently. Many operational commanders agree with the need to increase operations' resilience; but, they lack the time or resources to address the trouble. There continuously seems to be something more vital or necessary to address. To improve operational resilience, it is central for temporary organizations to make the link between resilience, sensemaking and situation awareness.

What Are Sensemaking, Situation Awareness, and Resilience and How Are They Connected?

The sensemaking literature poses definitional challenges. Even though the concept of sensemaking has pervaded much of the organizational publications, there is a substantial difference in how it is employed. While some researchers make locus on a "sensemaking theory" (Holt & Cornelissen, 2013; Jensen, Kjaergaard, & Svejvig, 2009; Stein, 2004), there is no distinct definition of sensemaking. Undeniably, reliable with numerous other writers (Drazin et al., 1999; Hsieh, Rai, & Xin Xu, 2011; Schultz & Hemes, 2013), Weick describes a "sensemaking perspective," labeling as "a developing set of ideas with explanatory possibilities" (Weick, 1995). He notes, "There is no such thing as a theory of organizations that is characteristic of the sensemaking paradigm" (Weick, 1995). Others state a "sensemaking lens" (Sonenshein, 2009; Stensaker & Falkenberg, 2007; Vough, 2012), though others (Helms Mills, Weatherbee, & Colwell, 2006; Mikkelsen, 2013) write of Weick's "sensemaking framework", often discussing the seven properties of sensemaking (Weick, 1995). Sensemaking is frequently quoted as a widespread notion, without a detailed description. Even when sensemaking is well-defined, it is assumed a variety of significances. According to Louis, sensemaking can be seen as a recurrent rotation comprised of an arrangement of events happening over time. The cycle commences as people arise unconscious and conscious anticipations and assumptions, which help as forecasts about upcoming events. Then, individuals are subjected to events that might be discrepant from expectations. Discrepancies, or surprises, generate a want for clarification, or post-diction, and, congruently, for a process through which explanations of discrepancies are established. The explanation, or meaning, is credited to surprises. Based on the attributed senses, any essential social responses to the immediate situation are chosen. Also based on attributed meanings, understandings of actors, actions, and settings are updated, and predictions about future experiences in the environment are reviewed. The rationalized anticipations and revised expectations are similar to changes in cognitive writings. (Louis, 1980).

Starbuck and Milliken state that sensemaking has many separate aspects comprehending, explaining, attributing, understanding, predicting, and, extrapolating. For instance, understanding appears to go before explaining and to necessitate less input; predicting can happen without either understanding or explain. What is universal to these developments is that they involve putting stimuli into frameworks (or schemata) that make sense of the stimuli (Goleman, 1985) (Starbuck and Milliken, 1988) Gephart writes that sensemaking has been described as the “discursive process of constructing and interpreting the social world.” (Gephart, 1993). To Weick, Sensemaking is assumed as a process that is established in identity building, retrospective, enactive of sensible situations, social, ongoing, directed on and by extracted cues, and driven by plausibleness rather than accurateness. (Weick, 1995). Taylor and Van Every defines sensemaking as a way station on the road to a consensually built, synchronized system of actions. (Taylor and Van Every, 2000). Balogun and Johnson think that sensemaking is an informal and narrative process through which individuals form and keep an intersubjective world (Brown, 2000; Gephart, 1993, 1997, Watson & Bargiela-Chiappini, 1998). (Balogun and Johnson, 2004). According to Watson & Bargiela-Chiappini, sensemaking is mostly a chatty and narrative process (Brown, 2000; Gephart, 1993, 1997) including a diversity of communication variety (Watson & Bargiela-Chiappini, 1998), both spoken and written, and formal and informal. Conversely, more specifically, sensemaking involves conversational and shared practices' (Gephart, 1993).It happens over both verbal and non-verbal means (Gioia & Chittipeddi, 1991; Gioia et al., 1994). Plus, sensemaking occurs in groups when members challenge occurrences, issues, and actions that are by some means unexpected or unclear (Gioia & Thomas, 1996; Weick, 1993, 1995). As Weick said, the simple notion of sensemaking is that reality is a constant achievement that emerges from efforts to make order and retrospective sense of what transpires. Hence, Sensemaking is a process of social construction (Berger & Luckmann, 1967) in which individuals try to understand and elucidate sets of cues from their surroundings. This occurs through the building of 'accounts'-discursive structures of reality that interpret or explain (Antaki, 1994) or over the 'activation' of current accounts (Gioia & Thomas, 1996; Volkema, Farquhar, & Bergmann, 1996). In each case, sensemaking lets individuals deal with uncertainty by generating cogent explanations of the world that allow action (figure 1).

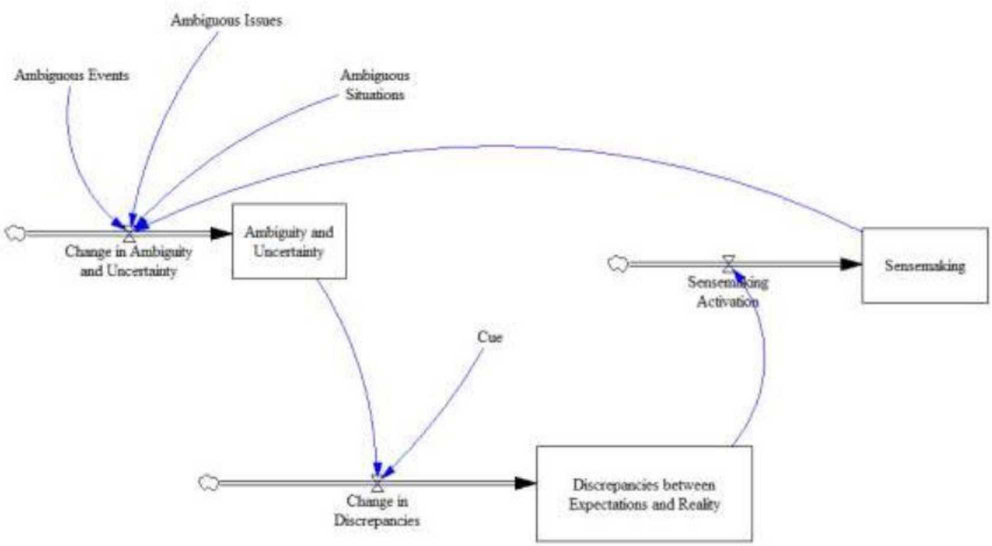

Figure 1: Process of Sensemaking

Sensemaking both goes before decision making and follows it: sensemaking offers the 'clear questions and clear answers' (Weick, 1993) that feed decision-making process, and decision making often arouses the surprises and confusion that produce circumstances for sensemaking. Organizational sensemaking is a fundamentally social process: organizational participants infer from their environment and through connections with others, building accounts that let them comprehend the world and act cooperatively (Isabella, 1990; Sackmann, 1991; Sandelands & Stablein, 1987; Starbuck & Milliken, 1988; Weick & Roberts, 1993). Rouleau states that sensemaking has to do with the approach managers understand, interpret, and create a sense for themselves grounded on the information surrounding the strategic alteration. Sensegiving is related to their efforts to impact the outcome, to communicate their views about the change to others, and to get their support. While these processes appear to be theoretically different, the limits of each are pervaded by the other. As discourse and action, sensemaking and sensegiving are less separate domains (Hopkinson, 2001) than two sides of the same coin. (Rouleau, 2005). Weick adds that sensemaking discloses as a sequence in which persons concerned with identity in the social setting of other actors. (Weick et al., 2005). To Gephart, Topal, and Zhang, sensemaking is a continuing process that creates an intersubjective sense of common meaning through discussion and non-verbal behavior in face to face situations where individuals look for creating, negotiating, and sustaining a mutual sense of meaning. (Gephart, Topal, and Zhang, 2010). For Weick, Sensemaking involves individuals engaging in retrospective and prospective thinking to construct an interpretation of reality. Sensegiving is a related process by which individuals attempt to influence the sensemaking of others, and both sensemaking and sensegiving are closely linked to narratives. In fact, many scholars have treated sensemaking and sensegiving as interchangeable with constructing narratives (Currie & Brown, 2003; Dunford & Jones, 2000; Gabriel, 2004) (Weick, 1995).

How Connected is Sensemaking to Situation Awareness?

Sensemaking is a word promoted by Weick (Weick, 1995; Weick, Sutcliffe, & Obstfeld, 2005) that is focused on how persons perform to make sense of the information and situations in which they find themselves, principally at the fundamental level on supporting organizational accidents. Consequently, it is mainly retrospective in nature. While some persons have strained to claim that sensemaking is dissimilar than situation awareness, Weick truly references the

Endsley 1995 Model for his explanation of how situation awareness functions at the single cognitive level, converging more at the organizational level in his work. Sensemaking is fundamentally the process of modeling level 2 from level 1 data through effortful processes of collecting and synthesizing information, by story building and mental models to get some picture that accounts for and clarifies the different data (Endsley, 2004). There are some resemblances and some dissimilarities between SA and sensemaking. While situation awareness is from time to time consequent to a mindful deliberative process to form a perception of what is going on, it is also frequently founded on a vastly unconscious process of situation recognition, using representation of archetypal situations, that is dynamic and continuing, while sensemaking is branded as chiefly of the conscious, premeditated type. For example, Kaempf, Klein, Thordsen, and Wolf (1996) found 87% of decision cases comprising tactical commanders were described by fast, deep situation recognition, as compete against planned story building. In this sense, the Endsley 1995 Model seizes the deliberative sensemaking processes, as well as other processes that are used in more fluid decision-making processes. A mixture of pattern-matching, cognizant analysis, story building, rational simulation, and meta-cognitive processes all may be utilized by operators at several times to shape situation awareness (Endsley, 2000). Sensemaking is usually backward looking, while situation awareness is forward looking. Sensemaking focuses on establishing reasons for previous events and identifying the contributing factors for perceived mistakes, which is undoubtedly significant given Weick's emphasis on comprehension problems in organizations. Even though situation awareness includes such assessments as a part of understanding, it also focuses on interpretation how these factors impact other areas of the situation and forecasts of the future. While sensemaking concentrates on merely the more considered of these two possibilities, situation awareness theory consists of both the deliberative and reflexive, instinctive case. Though sensemaking concludes with whatever justifications it derives, situation awareness theory similarly contains how people use those analyses and explanations to notify their extensive understanding of the situation and their projections of expected yet to come events. Therefore, situation awareness is also focused on the consequences of developments in the rest of the system and the enduring projection and decision cycle that arises in the dynamic decision-making process. Sensemaking, therefore, focuses on a subgroup of the processes involved in situation awareness. It does not represent any particular cognitive processes or aspects from the standpoint of cognitive psychology. Klein and his teammates (Klein, Moon, & Hoffman, 2006; Klein et al., 2007), have lately presented a Data-Frame model of sensemaking. Klein et al. (2007) state that this paradigm is different from the Endsley 1995 Model of situation awareness in numerous aspects. Firstly, in contrast with the Endsley 1995 situation awareness model, they affirm that they are interested in “sensemaking as a process and not just a state of knowledge” (Klein et al., 2007). This has been exposed to be a false distinction in Fallacy 3 - the Endsley 1995 Model deals widely with the processes engaged in advancing situation awareness. Secondly, they declare that their method contrasts with Endsley in that she is expressing how people perceive and make extrapolations about data, while they aver that individuals use their frames to outline what matters as data in the initial place (Klein et al., 2007). This likewise is a false distinction, as established in Fallacy: The Endsley 1995 Model defines comprehensively how mental models, objectives, and schema push the hunt for data and the incorporation of that data into meaningful evaluations. Klein et al.’s use of frames to establish and direct consideration to certain information provides fundamentally the same the role as the mental models in the Endsley 1995 Model, persuading information search, interpretation, and integration. Therefore, the sensemaking model is not different from the Endsley 1995 Model on these two points. Thirdly, Klein et al. (2007) say their model is different in that sensemaking is more than a precise retrieval of information and interpretations. Sensemaking is focused on achieving purposes such as obstacle finding, problem recognition, preventive thinking, developing explanations, grasping connections as well as projecting the future. Nonetheless, the Endsley 1995 Model deals significantly with these subjects as well. Obstacle finding, problem recognition are often an important part of situation understanding. Klein et al. (2007) take advantage of the example of weather forecasters needing to decide which are the strong storms they need to track for the day. In the same way, Endsley (1995) indicates that understanding and projection frequently focus on sensing and identifying acute problems. For instance, an air traffic controller wants to put simultaneously information on istinct traffic patterns to determine which runways will be open and where there is a possibility for crashes. An automobile driver also needs to identify probable future impacts to act successfully, and an adaptable industrial system operator needs to foresee future blockages and available machines for real planning. Such problem detection and identification assessments often come up in analyses for forming high levels of situation awareness in a wide variety of domains, including aviation, driving, medicine, and military operations (Endsley, 1993, 1995, 2006; Endsley et al., 2003; Endsley & Robertson, 2000). Contingency planning significantly is a factor of high levels of situation wareness projection and the capacity to rapidly perceive and understand events. Pilots who do not dynamically involve in contingency planning are far more apt to be burdened by episodes in high workload times (Bolstad, Endsley, Howell, & Costello, 2002). For that reason, problem recognition, problem detection, preventive thinking, shaping explanations, spotting interactions, as well as projecting the future are entirely built-in within the Endsley 1995 Model. Though there is plenty of room for intensified research on these subjects, situation awareness obviously participates in them, and the situation awareness model does not address them as exaggerated. Then, Klein states the sensemaking model is simply focused on deliberate attempts to understand events. Thus, it does not apply to the more rapid and dynamic situation assessment type behavior related to dynamic systems that the Endsley 1995 Model reports. Even though Klein et al. (2007) argue their model regarding frames rather than mental models, these two ideas are truly similar. They indicate a frame as a detailed construction that outlines objects by describing their connection to each other (Klein et al., 2007). They describe stories, scripts, plans and, maps as kinds of frames, in the sense that arrangements of this nature can be used to think about and manage information. In contrast, the Endsley 1995 Model defines mental models as processes whereby humans can engender explanations of system purpose and form, descriptions of system functioning and perceived system states, and expectations of future states (Rouse & Morris, 1985). The mental model offers information of the pertinent components of the system that can be used in guiding attention process, a way of incorporating the parts to create an understanding of their sense (level 2 situation awareness), and a process for envisaging impending states of the system founded on its present condition and an interpretation of its dynamics (level 3 situation awareness) (Endsley, 1995). The model also delivers for plans connected to the mental model which are consistent frames for comprehending information, incorporating extremely complex system elements, states, and operation (Endsley, 1995). In this respect, it also is an instructive assembly that explains the relationships between elements. The notion of a frame is comparable to the idea of a mental model in describing sensemaking behaviors and provides no original or contradictory interpretations of this process compared to the Endsley 1995 Model. The Data-Frame model of sensemaking, conversely, does not give details about many characteristics of cognition that the Endsley 1995 Model does, including how such mental models are settled and adapted, how they are connected to objectives and tactics, how they encourage dynamic replanning, how expectancies or presumptions are acquired and affect the process, and the many tasks, system, and nvironmental factors that can touch the process. Most notably, however, this representation of sensemaking strives to detach the aware intentional type of event understanding from that which occurs promptly and mechanically in so many situations. Even if it might make sense at one level, the reality is that, in many cases, the recognition of when one needs to use a more deliberative process to understand the situation is in itself a considerable part of the process. That is, most of the time people are using a fast event identification pattern corresponding type process to describe recognition-primed decision making (Klein, 1993). This is perceived in specialists of many sorts – pilots, air traffic controllers, drivers, system operators, power grid operators, managers, military, firefighters, physicians. A significant activity is identifying that the situation signals given do not correspond well or evidently to comprehensive scheme and that the person needs to take into account alternative opportunities for what is going on or may occur. The Endsley 1995 Model of situation awareness provides for situation awareness as it exists in dynamic decision-making cycle, with the complete range of processes used for situation assessment, interpretation (sensemaking), and projection as well as the relation between situation interpretation and plans and actions, and addresses how the state depiction directs the attention and interpretation processes. A more comprehensive illustration of sensemaking is delivered by the Endsley 1995 Model, involving how the underlying mental models and plans are established and adapted and the ways in which the instinctive and anticipated types of processes match at the same time especially to manage an unexpected and unplanned event like crisis and disaster.

Sensemaking, Situational Awareness and Operational Resilience

Individuals and emergency teams managing disasters, crisis or unexpected events are confronted with a predicament. On the one hand, hazardous and fast evolving situations are challenging to understand, so individuals want to collect more information to settle the most suitable action. On the other hand, the stresses of the situation frequently necessitate them to take action with partial information (figure 2). For example, health care providers in the emergency department normally care for patients who have an altered mental state (i.e. have dementia or have taken drugs) or who are totally unable to communicate (i.e. are unconscious) yet must still quickly diagnose and treat those patients with incomplete information (Christianson & Sutcliffe, 2009). Taking action in crisis includes a trade-off between unsafe action which engenders awareness and safe indecision which produces misunderstanding (Weick, 1988). The point to which and the manner in which actions form the emerging crisis is contingent, in part, on how much emergency operators have, how much interdependency and differentiation (LaPorte & Consolini, 1991) are existent in the system, and how tightly or loosely coupled the system is (Orton & Weick, 1990; Weick, 1976). Enactment is complicated in loosely coupled systems. Tight coupling denotes adjacent and interdependent relations between components in a system; a variation in one part of the system leads to a foreseeable change in alternative part. In loose coupling system, the interactions between interdependent components are much more problematic to discriminate, and fluctuations in one part of the scheme have a much less expectable outcome on other elements of the system. Enactment gets even more erratic in complex systems, where results can be slow and minor actions can cause too significant and often unexpected effects. Prompt measures in a disaster “do more than set the tone; they determine the trajectory of the crisis" (Weick, 1988). Weick's (1988) study of Bhopal is a typical illustration of how timely actions and delays (justifying away and flunking to examine a high-pressure gauge interpretation) can deteriorate an unfolding disaster: as action was postponed, the toxic gas persisted in building up, ending in an explosion that frees the gas over a wide area, slaying thousands of people. Many of the ways in which action obliges impending sensemaking are amplified during a disaster. For instance, people are much more likely to be devoted to the descriptions they have shaped to explain measures they have chosen when their actions are public, free, and irreversible (Salancik, 1977). Moreover, in sensemaking, individuals must enact order into chaos (Weick et al., 2005). Research on creating or failing organizations makes consideration to the conditions in which action generates organizations that enable sensemaking.

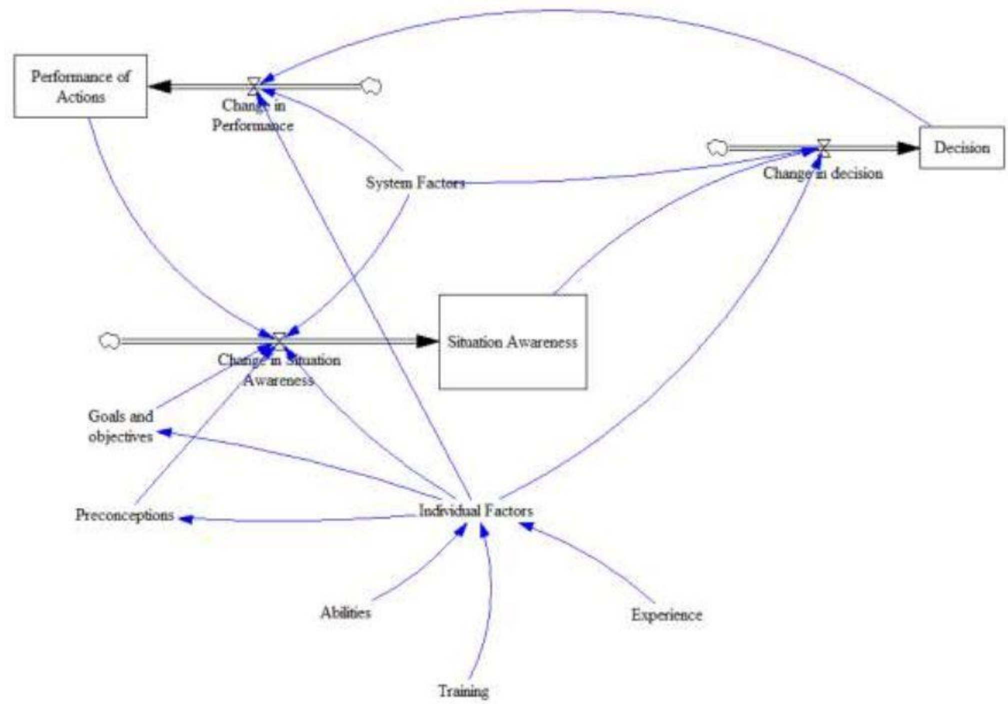

Figure 2. Dynamics of Situation Awareness vs Decision Making

Organizations are all the time in the process of being built and rebuilt (Tsoukas & Chia, 2002) however this is particularly exact in temporary organizations, where nothing exists till establishing organizations takes place. Emergency response teams are archetypal illustrations of temporary organizations, which are shaped on an ad hoc foundation and bring individuals collectively with specific abilities to operate interdependently to tackle a complex challenge or situation (Bechky, 2006; Goodman & Goodman, 1976; Meyerson, Weick, & Kramer, 1996). Role organizations have appeared as a crucial constituent of organizing in circumstances of extreme uncertainty, including temporary organizations (Bechky, 2006; Bigley & Roberts, 2001; Meyerson et al., 1996). When role structures and groups collapse, panic can follow, leading to the successive fall of sensemaking (Weick, 1993). Large-scale disasters such as wildland fires, natural, technological catastrophes, and multi-casualty disasters need many diverse sorts of emergency responders to come simultaneously, make sense of a developing state, and quickly organize their activities to focus on the event. For instance, Bigley and Roberts (2001) examined how the incident command system (ICS) was used by a significant California fire agency to manage responses to forest fires. While the ICS was described as a hierarchical organizational structure with full rules, procedures, and policies (Bigley & Roberts, 2001), it also proposed superior flexibility in vastly adjustable conditions. For example, within this obviously defined system, responders could interchange from one role to another as needed, and command can transfer to those holding the appropriate expertise to address disasters. Thus, the ICS, extremely organized but innately flexible, proposes a structure that eases sensemaking and situation awareness, exempting responders from having to make sense of how to organize among themselves so that they can dedicate more resources to apprehending the changing situation. Indeed, Sensemaking is the process through which actors work to understand a situation or events that are novel, unclear and baffling (figure 3).

Undoubtedly, sensemaking begins with chaos and continue with situation awareness to make operations resilient through three levels of analysis. The level l of situation awareness is described as the perception of the elements in the environment. This initial step in attaining situation awareness is to observe the status, attributes, and dynamics of relevant components in the environment. An emergency responder would perceive elements such as fire dynamics, wind speed, houses, and people location. A tactical commander needs precise data on the location, type, quantity, capabilities, and changing aspects of all enemy and friendly forces in a particular region and their connection to other points of reference. The level 2 of situation awareness is defined as the comprehension of the current situation. Comprehension of the situation is grounded on a synthesis of fragmented level l components. Level 2 goes beyond only being conscious of the elements that are existing to take account of an understanding of the meaning of those features in light of important operator objectives. Established on knowledge of Level 1 components, mostly when put together to model patterns with the other elements, the decision maker forms a complete representation of the environment, understanding the meaning of entities and events. For instance, a military pilot or tactical commander must understand that the arrival of three enemy aircraft within a particular closeness of one another and in specific geographical location signals assured things about their purposes. The worker of a power plant needs to put as one incongruent bit of data on single system variables to decide how well separate system components are working, deviations from expected values, and the particular locus of any divergent interpretations. In these situations, a rookie might be able of completing the same Level I as more skilled decision makers but may fall far short of being able to incorporate numerous data components along with important objectives to understand the situation. The level 3 of situation awareness is defined as the projection of future status and the aptitude to project the future actions of the components in the environment. This is accomplished via knowledge of the situation and dynamics of the components and understanding of the state (Level I and Level 2). For instance, understanding that a menace airplane is currently aggressive allows a military commander to project that the aircraft is probable to assault in a certain way. This offers the knowledge (and time) required to make a decision on the most satisfactory sequence of action to meet one's goals. By the same token, an air traffic controller wants to put simultaneously information on distinct traffic patterns to determine which runways will be open and where there is a possibility for crashes. An automobile driver also needs to identify probable future impacts to act successfully, and an adaptable industrial system operator needs to foresee future blockages and available machines for actual planning. It includes comprehending the meaning of that information in an integrated form, comparing it with operator objectives, and giving projected future states of the environment that are valuable for decision making. In this aspect, situation awareness is a broad construct that is applicable across a wide range of application areas, with many underlying cognitive processes in common.

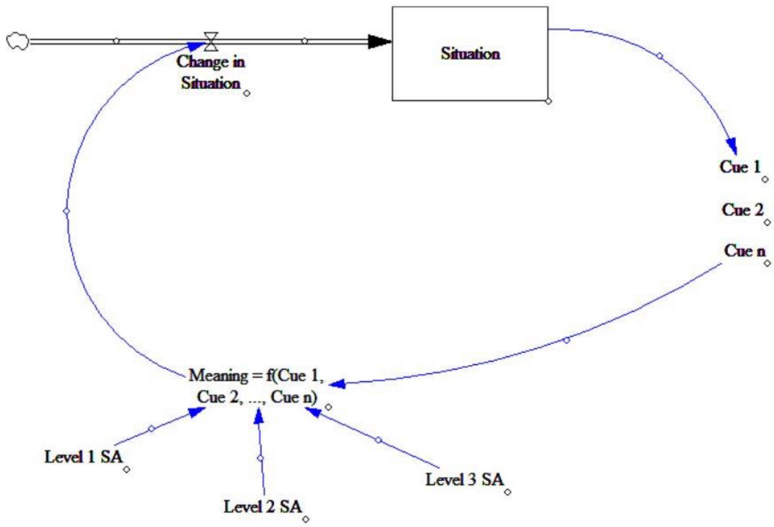

Figure 3: Dynamic of Situation Awareness

The relationship between situation awareness, performance and then resilience, though not always direct, can also be anticipated (figure 4). In general, it is predictable that poor performance and resilience will occur when situation awareness is partial or imprecise, when the appropriate action for the recognized situation is not known or planned, or when time or some other factor reduces a person's ability to carry out the proper action. For example, in an air-to-air combat mission, Endsley (1990b) found that situation awareness was meaningfully related to performance and then resilience barely for those people who had the technical and operational competencies to take benefit of such knowledge. The similar research found that poor situation awareness would not unavoidably lead to poor performance and resilience if people completed their absence of situation awareness and were able to adjust their behavior to decrease the likelihood of poor performance. Moreover, Venturino, Hamilton, and Dvorchak (1989) noticed that performance was projected by a combination of situation awareness and decision-making processes in combat pilots. Suitable situation awareness can consequently be observed as a factor that will foster the probability of good performance but cannot automatically promise it and resilience.

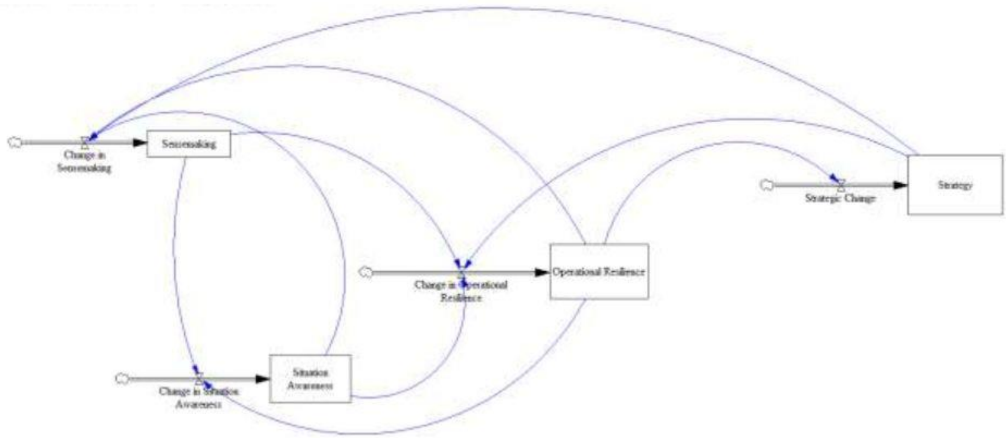

Figure 4: Dynamics of Operational Resilience vs. Sensemaking and Situation Awareness

Operational resilience is strongly influenced by the work of Weick (1993, 1995; Weick, Sutcliffe & Obstfeld, 2005) on sensemaking and research on the attributes of highreliability organizations (La Porte, 1996; Sagan, 1993; Schulman, Roe, Van Etten & de Bruijne, 2004; Hardy, 2012). Resilience aspects comprise the value, diversity and 'slack' of resources used, the team dynamics as well as patterns of decision-making processes and information flow. It focuses on constant learning processes, research malfunctions, risk management plan and the safety culture. Interorganizational aspects focus on rudiments of success for enhanced management between organizations and the situational dimensions of the link such as government policy and rules, economic situation and the role played by other actors in the organization. Lastly, operational resilience factors are numerous such as social capital, the governance part of local administrations or the demographic features of the population. Specific attention is paid to decreasing vulnerability and the availability of resources. Resilience is a function of an organization's situation awareness, of the management of Keystone vulnerabilities and the adaptive capacity in a complex, dynamic and interconnected environment.

Conclusion

Sensemaking, situation awareness, and operational resilience are three dynamic processes strongly interconnected. While sensemaking may also be defined as a transition between level 1 and level 2 situation awareness, operational resilience focused on the ability of responders to build a whole frame to leave some room for sensemaking and situation awareness. Although sensemaking and situation awareness are required conditions for an operational resilience, their good levels of understanding is a necessary but insufficient requirement to attain an adequate level of operational resilience.

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THE HURRICANE MATTHEW RESPONSE: VALIDATION OF CIVIL MILITARY BEST PRACTICES IN DISASTER RESPONSE

Jeffrey Miller

Abstract: *Incorporated into the Joint Humanitarian Operations Course taught by the US Agency for International Development's - Office of U.S. Foreign Disaster Assistance (USAID -OFDA) are a set of best practices for U.S. government civil military coordination during a disaster response. These practices include: 1) communicating and linking up personnel, 2) understanding the mission, 3) validating military tasks and 4) planning for transition and phase out. An examination of the international civilian and military response to Hurricane Matthew in Haiti during October of 2016 validates these civil military best practices, both within the US government and for international civil military coordination.*

Keywords: Haiti, Matthew, Civil-Military, Coordination, Liaison, Disaster, Response, Military, Hurricane

Overview and Civilian Response

Hurricane Matthew, the strongest hurricane to impact the Caribbean since 2007, made landfall on southern Haiti on 4 October 2016 with wind speeds of 145 miles per hour[1]. The storm resulted in 546 deaths, effected 2.1 million people leaving 1.4 million in need, destroyed over 104,000 houses, damaged or flooded more than 135,000, and left 1633 schools in need of repair[2]. 61,500 people were displaced by the storm[3].

The Haitian Government coordinated relief efforts through their Direction de la Protection Civile (DPC) which was augmented and assisted by the United Nations (UN), particularly the World Food Program (WFP). The international response to the devastation in Haiti was swift, largely initiated by organizations already present

[1] US Agency for International Development. (2016). *Hurricane Matthew Fact Sheet #1.*

[2] European Commission. (2017). *ECHO Daily Map 09/03/2017 Humanitarian Aid Matthew response in Haiti 2016/2017*.

[3] US Agency for International Development. (2016). *Hurricane Matthew Fact Sheet #3*.

in the country conducting development and reconstruction programs. Within three days of the hurricane the international civilian response included UN entities such as the WFP, the United Nations Office for the Coordination of Humanitarian Affairs (UN OCHA) and the United Nations Stabilization Mission in Haiti (MINUSTAH); donor governments and entities such as USAID, the United Kingdom's Department for International Develop (DfID) and the Directorate-General for European Civil Protection and Humanitarian Aid Operations (ECHO); international organizations such as the International Organization for Migration (IOM) and the International Federation of the Red Cross (IFCR); and non-governmental organizations (NGOs) such as Mercy Corps and Save the Children[4].

Military Response

In addition to the large civilian response to Hurricane Matthew in Haiti, there was also a robust military response. It was comprised of three main components, the Military Component of MINUSTAH, the US Joint Task Force Matthew and the Royal Netherlands Navy. Other countries such as Colombia[5] contributed aid via military means bilaterally to Haiti, but the above three military forces performed civil military interaction relevant to this discussion.

As of October 2016, the MINUSTAH military component had an authorized military strength of 2,370 military personnel, and 2,601 UN police. Per their mandate, UN Security Council Resolution 2313 of 2016, this force was tasked primarily with providing security in Haiti and assisting the operations and development of the Haitian police. Several humanitarian tasks are contained in the mandate as well, such as protecting those who are displaced, building capacity through military engineer engagement and maintaining the ability to rapidly deploy throughout Haiti if required. In the immediate aftermath of Hurricane Matthew, MINUSTAH engineers conducted road clearing and reconnaissance[6]. As the response progressed, MINUSTAH military forces

[4] World Food Program (2016). *Minutes of Hurricane Matthew Logistics Working Group minutes 7 October 2016*. Port-au-Prince, Haiti.

[5] Dialogo. "Colombian ship with humanitarian aid reaches Haiti", 13 October 2016, accessed 4 June 2017. https://dialogo-americas.com/en/articles/colombian-ship-humanitarian-aid-reaches-haiti.

[6] MINUSTAH Military Component. (2016). *MC JOC Daily Sitrep from 13 1700 OCT 16 to 14 1700 OCT 16*.

focused on providing security for humanitarian organizations conducting relief efforts[7].

The US provided Joint Task Force (JTF) Matthew to support the USAID/OFDA Disaster Assistance Response Team (DART) that was leading U.S. response efforts. JTF Matthew primarily provided helicopter support, enabling humanitarians to reach areas inaccessible after the hurricane cut roads throughout southern Haiti. The JTF consisted of a detachment ashore that reached 400 personnel at its peak, supported by another 2,000 afloat on naval shipping, and an aircraft complement that grew to 20 Coast Guard, Army, Navy and Marine helicopters[8]. This US force would conduct 98 relief flights in a two week period, reaching 13 hard to access communities[9] and moving nearly 272 metric tons of relief commodities[10].

The Netherlands sent two naval ships, the HNLMS Holland and HNLMS Pelikaan to support relief efforts. These ships transported cargo for the UN and NGOs from Port-au-Prince to various small ports and beaches around the southern claw of Haiti, delivering 351 tons of relief goods between 11 and 26 October[11].

Examination of Civil-Military Coordination Best Practices

Below is an examination of how the civil military coordination best practices taught in the Joint Humanitarian Operations Course were demonstrated during the Hurricane Matthew response.

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[7] United Nations Office for the Coordination of Humanitarian Affairs. (2016). *Haiti: Hurricane Matthew Situation Report 17, 28 Oct 2016.*

[8] US Southern Command. "RELEASE: Update on Joint Task Force-Matthew Relief Mission in Haiti", 14 October, 2016, accessed 23 May 2017. http://www.southcom.mil/News/PressReleases/Article/1033410/release-update-on-joint-task-force-matthew-relief-mission-in-haiti-october-14-2/.

[9] US Agency for International Development. (2017). *Hurricane Matthew Response and Recovery Fact Sheet April 2017*.

[10] US Southern Command. "RELEASE: Update on Joint Task Force-Matthew Relief Mission in Haiti", 19 October, 2016, accessed 23 May 2017. http://www.southcom.mil/News/PressReleases/Article/1033427/release-update-on-joint-task-force-matthew-relief-mission-in-haiti-october-19-2/.

[11] European Commission. (2017). *ECHO Daily Map 01/11/2016.*

1. Communicate and Linking Up Personnel

Communication between civil and military responders and an exchange of personnel occurred at both the national and international levels during the Hurricane Matthew response. Early in the response, the UN OCHA Disaster Assistance Coordination Team determined the need for a dedicated Civil-Military Coordinator (CMCOORD). A Netherlands Marine Corps officer was assigned this duty, serving both as the UN OCHA CMCOORD, and a liaison between the international community and the Royal Netherlands Navy. This officer had a seat in the MINUTSAH Joint Operations Center (JOC) where he would spend part of his day, enabling coordination between MINUSTAH, OCHA and the Royal Netherlands Navy.

In order to coordinate with JTF Matthew, the U.S. DART was provided with six dedicated Civil Military Affairs Officers (CMAO) who would operate out of the US embassy, the JTF headquarters ashore and on board the US navy amphibious ship supporting flight operations. The DART was able to deploy a CMAO to link up with the first U.S. military air units before their movement to Haiti. This reflected best practices learned from prior responses and allowed tactical level coordination to begin before military units were even in country. The DART also requested that JTF Matthew provide Civil Affairs specialists to act as liaison officers (LNOs) with MINUSTAH. These LNOs had seats in the MINUSTAH JOC and were critical to ensuring that the peace keeping mission was aware of US military operations and could plan security accordingly.

The first week into the response, it was determined that requests from any organization for logistical support, to include military support, would flow through the WFP Logistics Working Group[12]. The U.S. DART sent a CMAO to each meeting to receive any requests for assistance from the international community that could potentially be passed on the U.S. military. The UN OCHA CMCOORD and LNOs from MINUSTAH would also sit in each meeting.

This exchange of LNOs enabled close coordination between civilian responders, international militaries and the UN peacekeepers, allowing all to eliminate redundancy and share tasks in a secure manner.

[12] World Food Program (2016). *Minutes of Hurricane Matthew Logistics Working Group minutes 7 October 2016*. Port-au-Prince, Haiti.

2. Understand the Mission

In the Joint Humanitarian Operations Course, the concept of “understand the mission” is broken out into four parts: 1) the military should only provide unique capabilities; 2) “pull” not “push” logistics should be utilized; 3) military forces should provide “wholesale” not “retail” services; and 4) all should understand local capabilities.

The fact that responding militaries provided unique services during the hurricane Matthew response is clearly seen in the minutes of the WFP Logistics Working Group meetings as the response progressed. On 7 October, the working group noted many areas where communities were inaccessible by road, a lack of available trucks, aircraft and shipping, and a need for security coordination for relief efforts[13]. The responding militaries directly addressed these shortfalls with the US providing helicopters to enable operations in inaccessible locations, the Dutch providing needed ships and MINUSTAH coordinating security. Over the course of the next two weeks, working group meeting minutes show military efforts tapering off as roads are restored and civilian capacities increase (with the exception of security which MINUSTAH provide through April 2017).

The coordination between UN agencies, NGOs and military forces that occurred during through the Logistics Working Group ensured that militaries provided “pull” logistic support and demonstrated the concept of “wholesale” rather than “retail” support. As the Logistics Working Group matured, all military effort was done in response to Service Requests submitted to the working group. In order to be filled, the request had to detail where cargo was to be picked up or delivered to military logistic providers, and then details on a consignee to receive the cargo from the military[14]. Military forces did not distribute aid to

[13] World Food Program (2016). *Minutes of Hurricane Matthew Logistics Working Group minutes 7 October 2016*. Port-au-Prince, Haiti.

[14] World Food Program (2016). *Minutes of Hurricane Matthew Logistics Working Group minutes 12 October 2016*. Port-au-Prince, Haiti.

those in need but rather to other entities; the UN, an IO or NGO would then organize and execute the actual distribution[15].

Unfortunately, there were three notable events that demonstrated why "pull", not "push" logistics should be used in disaster response and why the military should perform "wholesale" and not "retail" type activities. In each of these three instances, a ship with humanitarian cargo attempted to offload directly to recipients, without a humanitarian partner to coordinate or organization a distribution. At each docking location a crowd formed as people sought assistance, and with no organization in place became a security problem as people fought to receive goods. One of these events was resolved when the crew of the ship realized that security was breaking down so they departed without distributing anything. As the ship attempted to unload a crowd gathered, creating an uncertain security situation and forcing the ship to depart with the cargo still aboard[16]. In the other two instances, local security forces were overwhelmed trying to control the crowd and had to resort to deadly force. In each of these cases a civilian was killed[17][18]. These instances tragically demonstrate the unintended consequences that can occur when the military attempts to conduct "retail" operations in disaster response.

Finally, the concept of "understand local capabilities" was demonstrated through the actions and tasking of military engineers. Assessments following the storm revealed several destroyed bridges. Military engineers had the capability to replace these bridges with military assets, but it was determined that locally adapted provisional structures would be used until more permanent civilian

[15] Dutch Water Sector. "Dutch Navy ends relief operations with water supply in hurricane-hit Haiti", 27 October 2016, accessed 23 May 2017. https://www.dutchwatersector.com/news-events/news/21750-dutch-navy-ends-relief-operations-with-water-supply-in-hurricane-hit-haiti.html.

[16] Curacao Chronicle. "Dutch Aid Ship Forced To Quit Haitian Port As Crowd Threatens Security", 18 October 2016, accessed 23 May 2017. http://curacaochronicle.com/main/dutch-aid-ship-forced-to-quit-haitian-port-as-crowd-threaten-security/.

[17] The Express Tribune. "One dead, three injured in Haiti aid distribution chaos", 26 October 2016, accessed 1 June 2017. https://tribune.com.pk/story/1210549/one-dead-three-injured-haiti-aid-distribution-chaos/.

[18] Jamaica Observer. "Haitian boy killed in violent food protest", 2 November 2016, accessed 1 June 2017. http://www.jamaicaobserver.com/news/Haitian-boy-killed-in-violent-food-protest_79204.

structures could be constructed[19]. This decision ensured that a locally sustainable solution was used, and prevented a long term military commitment or investment in building and maintaining a military bridge.

3. Validate military tasks

As described in the section above, the primary means of tasking military units to support the relief operation was via the Logistics Working Group. A task would originate with a Service Request Form submitted to the working group. The working group would then validate and prioritize requests, working closely in conjunction with the Haitian Government's DPC. Representatives of those governments providing military assistance would then determine which tasks they would accept, and forward these to their respective militaries[20]. For the US Government, this was done via the Mission Tasking Matrix (MITAM) process by which the USAID/OFDA DART generated a detailed request to the military to ensure that all parties are clear on the exact extent of what the military unit is to do[21].

Any organization requesting security was asked to submit a Security Escort request to MINUSTAH via the Logistics Working Group. MINUSTAH would then determine if the request could be supported and how; via MINUSTAH military forces, UN Police or the Haitian National Police[22].

4. Plan for transition and phase out

As with other aspects of this response, details of how military capabilities were transitioned to civilian capabilities are best seen in the minutes of Logistics Working Group meetings. For the US military, air operations ceased on 19 October. That same day, the WFP began flying a Bell 212 out of Les Cayes, ensuring that a capability remained that could reach those communities still not

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[19] MINUSTAH. (2016). *JOC MORNING BRIEFING – 10 October 2016*.

[20] World Food Program (2016). *Minutes of Hurricane Matthew Logistics Working Group minutes 12 October 2016*. Port-au-Prince, Haiti., World Food Program (2016). *Minutes of Hurricane Matthew Logistics Working Group minutes 18 October 2016*. Port-au-Prince, Haiti.

[21] Joint Chiefs of Staff. 2014. *Foreign Humanitarian Assistance*. Joint Publication 3-

29. Washington DC., pg C-11.

[22] United Nations Office for the Coordination of Humanitarian Affairs Haiti. (2011). *Guidelines for Civil-Military Coordination in Haiti*, p8.

accessible by road. Additionally, by 19 October two other organizations, the Mission Aviation Fellowship and Airlink, were operating civilian aircraft and supporting request from the Logistics Working Group.

In a similar fashion, the WFP began operating civilian water craft, allowing the Royal Netherlands Navy to transition out of sea operations. The day that the Dutch ceased operations, 26 October, the WFP was operating three ships while the NGOs Handicap International and Atlas Logistique were also operating watercraft[23]. Additionally, while civilian air and sea assets were becoming available, roads were being cleared and repaired, allowing relief operations to transition to truck based supply[24].

The naval character of the military support to the Hurricane Matthew response operation enabled a rapid transition of military forces out of Haiti. When the Netherlands ships had completed operations, they simply sailed back to their home port of Curacoa. As the US military wound down operations, most assets were transitioned to the USS Iwo Jima, which was operating 11 helicopters on the final day of the operation, 19 October[25]. On this date there were less than 100 US military personnel on the ground, and all were able to leave with a few days on commercial and military aircraft.

Summary

The military response to Hurricane Matthew in Haiti provides solid examples of best practices of civil military coordination put to use. Military assets were employed soon after their arrival in Haiti via a host nation government led, civilian coordinated mechanism that made best use of available assets, and allowed for a smooth transition from military to civilian capabilities. The naval character of the supporting international military forces not only provided rapid

[23] World Food Program (2016). *Minutes of Hurricane Matthew Logistics Working Group minutes 27 October 2016*. Port-au-Prince, Haiti.

[24] World Food Program (2016). *Minutes of Hurricane Matthew Logistics Working Group minutes 18 October 2016*. Port-au-Prince, Haiti.

[25] US Southern Command. "RELEASE: Update on Joint Task Force-Matthew Relief Mission in Haiti", 19 October, 2016, accessed 23 May 2017. http://www.southcom.mil/News/PressReleases/Article/1033427/release-update-on-joint-task-force-matthew-relief-mission-in-haiti-october-19-2/.

support to the operation, but allowed for timely transition out of the country when operations concluded. This response can serve as a model for future military support to disasters, and in the end the key beneficiaries were those effected by Hurricane Matthew.

Excerpt

The military response to Hurricane Matthew in Haiti 2016, although a small part of the larger overall humanitarian response, served to validate best practice in civil-military coordination in disaster response. The responding forces included those from the Netherlands, the United States and the United Nations Peacekeepers serving in Haiti. The way that the response was conducted demonstrated the best practices of communicating and linking personnel, understanding the mission, validating military tasks and planning for transition and phase out.

OPTIMAL RESILIENCE PLANNING FOR INTERCONNECTED CRITICAL INFRASTRUCTURES – DEVELOPMENTS OF THE EU-CIRCLE PROJECT

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Abstract: *EU-CIRCLE is a research project with an aim to assess the resilience of interconnected and interdependent critical infrastructures to climate change and especially to climate hazards. As infrastructures have lifetime that span several decades, it is imperative to generate scientifically truthful and validated knowledge on the potential impacts of climate, as a viable pathway for making them resilient to future climate regimes. EU-CIRCLE's aim is to develop a) an innovative generic risk framework and b) the implementation of a Climate Infrastructure Resilience Platform (CIRP) that allows stakeholders to collaboratively 1) assess potential impacts due to climate hazards, 2) analyse and evaluate adaptation strategies and 3) provide monitoring capabilities. The generic risk framework presented in this paper implements a consequence-based Approach. It is based on, and complies with several international standards and recommendations. The paper furthermore outlines the components of the GIS-based CIRP and explains the workflow to assess resilience of interconnected critical infrastructures and adaptation strategies.*

Keywords: resilience, critical infrastructures, interdependencies, strategic planning, climate change, sustainability, crises management

Introduction and Overall Objective of EU-Circle

It is acknowledged and scientifically proven that climate related hazards have the potential to substantially affect the lifespan and effectiveness or even destroy of Critical Infrastructures (CI). The main strategic objective of EU-funded project EU-CIRCLE is to move towards infrastructure network(s) that is resilient to today's natural hazards and prepared for the future changing climate. Furthermore, modern infrastructures are inherently interconnected and interdependent systems; thus extreme events are liable to lead to 'cascade failures'.

The project develops an innovative framework for supporting the interconnected European Infrastructure's resilience to climate pressures, supported by an end-to-end modelling environment where new analyses can be added anywhere along the analysis workflow and multiple scientific disciplines can work together. The collaborative, spatial modelling tool allows understanding interdependencies, validating results, and present findings in a unified manner. It is open and accessible to all interested parties in the infrastructure resilience domain. The design principles, offering transparency and greater flexibility, allowing potential users to introduce tailored solutions and infrastructure data, by defining and implementing customised impact assessment models, and use climate / weather data on demand. The objectives of EU-CIRCLE in detail are:

- Support transition from pure response and prevention towards resilience;
- Scientific support to policies and stakeholders;
- Balancing priorities in objectives between various stakeholders;
- Provide an end-to-end modelling environment, called CIRP, for assessing climate impacts to infrastructures;
- Reduce and handle explicitly uncertainties;
- Contribute to climate impact assessment standards;
- Provide a vehicle to industry growth.

EU-CIRCLE lies on the intersection of several European policies and initiatives spanning across different domains. These include:

The EU Internal Security Strategy, and more importantly the 5th Objective to Increase Europe's resilience to crises and disasters (EC 2010). This calls for an all-hazards approach to threat and risk assessment: guidelines for disaster management will be drawn up, national approaches will be developed, cross-sectoral overviews of possible risks will be established together with overviews of current threats, an initiative on health security will be developed, and a risk management policy will be established.

The EU Climate Adaptation Strategy, acknowledges that climate related hazards will have a defining impact on the status and operational capacity of European critical infrastructures, and society as a whole (EC 2013). More specifically regarding: asset deterioration and reduced life expectancy, increases in operational and capital expenditure, loss of income, increased risks of environmental damage, reputation damage, changes in market demand for goods and services, and increased insurance costs or lack of insurance availability.

The European Programme for Critical Infrastructure Protection (Directive 2008/114/EC), on the identification and designation of European Critical Infrastructures and the assessment of the need to improve their protection (EC 2012). Identified Critical infrastructures, which, if disrupted or destroyed, would have a serious impact on health, safety, security or economic well-being of citizens and/or effective functioning of government in Member States. The directive requested an all-hazards risk framework treating natural hazards and terrorism alike, setting the principles upon which the Member States must ensure that an operator security plan (OSP) or an equivalent measure for each designated CI is devised.

In this publication, the working methodology and first findings of the projects are presented.

Working Methodology

The EU-CIRCLE methodological approach is based upon the working knowledge of the partners through their participation in multiple EU funded projects, and in the organisation of large-scale table top exercises and large-scale events. The proposed methodological framework process, shown in figure Figure, builds upon the strategic context of the project that was agreed in the 1st project meeting and introduced in deliverable D1.3 on the EU-CIRCLE Strategic Context.

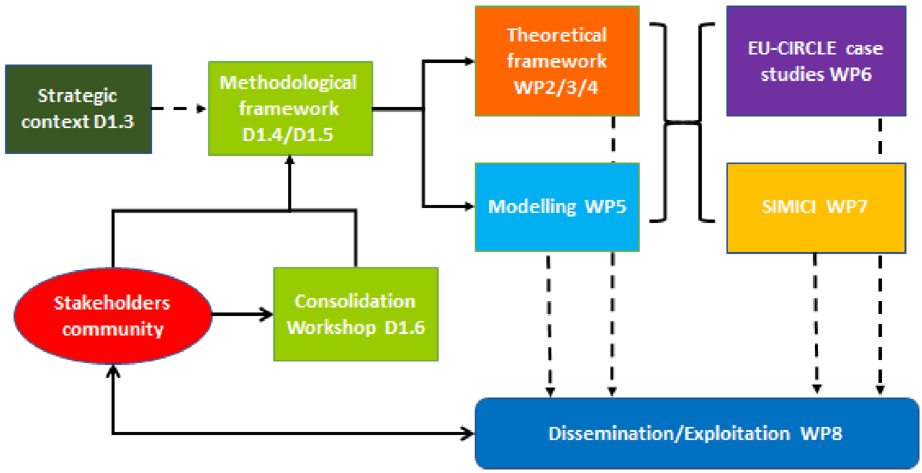

Figure 1. EU-circle conceptual framework process

EU-CIRCLE explores the impacts of projected climate change on CI and how various adaptation options can influence the resilience of CI networks, taking into account the various interdependencies present in modern CI networks. This will be achieved through implementation of the risk model and the resilience and adaptation frameworks through CIRP in five case studies involving: extreme dryness and forest fires on electricity and transport network, storm and sea surge; coastal flooding; cyclonic pressures and flooding and extreme river flooding.

Generic Risk Framework

The first step to improving resilience of Critical Infrastructure (CI) to climate change impacts is the identification of the risks of potential climate hazards to interconnected and interdependent CIs. For this, EU-CIRCLE has defined a holistic framework to identify the risks of multi – climate hazards to heterogeneous interconnected and interdependent critical infrastructures. This integrated concept (Figure 2) includes:

- The EU-CIRCE process of risk management, adapting the U.S. National Infrastructure Protection Plan (NIPP) framework as well as ISO and AS/NZS standards for different temporal and spatial scales (ISO 2009, AS/NZS 1999).

- A multi-hazard risk modelling approach, where an asset based approach is used to identify damages to CI from climate stressor's leading to the identification of the impacts on CI operations using network simulation for the modelling of critical services within interconnected CI.
- The determination of multi-hazard risk, compatible with major national, EU and International initiatives (National Risk Assessments, EPCIP, Sendai Framework for Disaster Risk Reduction) and standards (ISO 31000), accounting for impacts directly affecting the CI and consequences to the society, the environment and other sectors of the economy.
- The identification of resilient capabilities (anticipation, absorption, coping, restoration, adaptation) that feed into components of the risk modelling framework.
- The determination of modular indicators for quantifying risk and resilience that are compatible with the above and that could be used, alongside reports and maps, for conveying information to the end-users and relevant stakeholders.

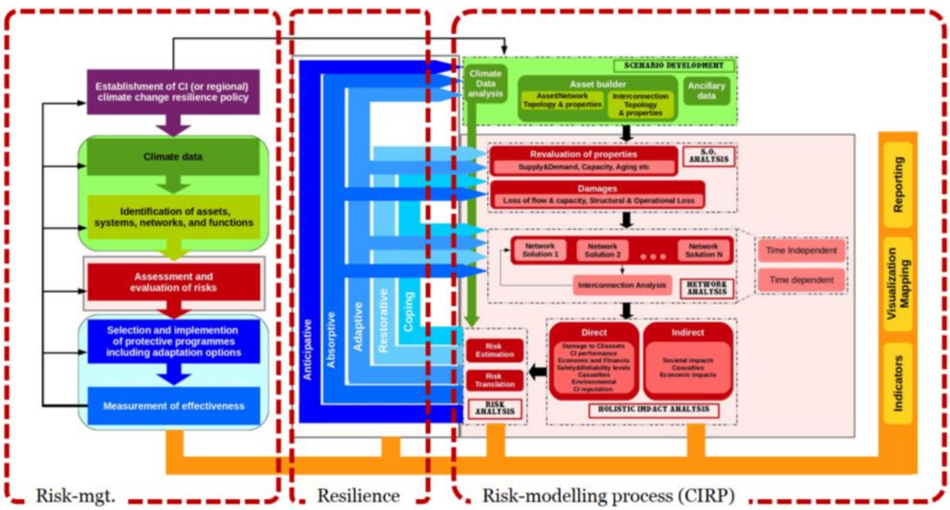

Figure 2. EU-circle risk modelling framework

More in detail, the EU-CIRCLE risk management framework consists of the following steps:

1. *Establishment of CI (or regional) climate change resilience policy, or specific business oriented decision that will be addressed.* Typically, such policies have a timespan of multiple years and their objective may be related to specific issues or cross-sectoral matters. Relative policy questions to be answered can be: What must and what should be protected? Which potential consequences are relevant (economic, social, environmental etc.) for this appraisal? What are the priorities? What is an acceptable risk and what is a non-acceptable risk?

2. *Identification, collection and processing of data related to climate and secondary hazards*. It involves analysis of the historic climate (and secondary hazards) data sets, mid- and long-term projections of climate regime, based on available data and provision of specialised simulations.

3. *Identification of assets, systems, networks, relations and functions*. The following approach is proposed: a) Compilation of a registry of CI assets relevant to the sectors considered in EU-CIRCLE and use an adequate level of granularity, b) Analysis of interconnections, networks and (inter-) dependencies including the various types, such as physical, cyber, geographic, logical or social (inter-) dependencies.

4. *Assessment and evaluation of risks*, through a harmonized interoperable approach. Alternatively, “translating solutions” will be created between the different risk and impact criteria.

5. *Selection and implementation of protective programs, including adaptation options*, to modify risk level and to implement options addressing the following aspects: a) reduce the likelihood of occurrence, b) reduce the impacts / consequences and exposure, c) transfer in full or partly the risk, and d) mitigate and manage the risk.

6. *Measurement of effectiveness*. Once one or more risk reduction measures are introduced, the progress towards achieving the relative objectives must be evaluated regularly. Risks, effectiveness, goals or other circumstances may change after initial implementation.

All research themes are directly tied to the development of the Critical Infrastructure Resilience Platform (CIRP), a standalone and comprehensive software toolbox that facilitates the entire risk-modelling process, accommodating different types of datasets (e.g. hazard, assets, interconnections, and fragilities), file formats, and risk analysis algorithms. The

CIRP is open, modular and extensible in order to support various risk and resilience analysis tools and provide users with access to diverse simulation, modelling and risk assessment solutions. CIRP facilitates also suitable visualization and reporting.

Critical Infrastructure Resilience Platform (CIRP)

Many risk assessment tools and platforms exist. Most, however, lack the flexibility to easily add new algorithms or to extend their base features. This is typically due to a combination of architectural approach and closed-source licensing policies. Such software does not allow the community to actively contribute new algorithms and capabilities and, therefore, allow the software to evolve with the advancements of science. Furthermore, software-licensing fees from proprietary vendors can make such packages unaffordable for many members of the community.

A primary objective for the CIRP is that it is engineered as a pluggable and extensible platform that will enable the risk management community to bring new data and modelling capabilities into practice. From the CIRP policy and decision maker perspective, the platform capabilities offers a toolbox that consists of a collection of diverse analyses of Risk and Resilience of Critical Infrastructures that are exposed to the direct and indirect effects of climate change.

CIRP users will be able to create and store scenarios by means of selection of a chain of analysis tools. Each analysis tool is associated with input and output parameters and relevant datasets that conform to the platform supported types. It is possible to chain analysis tools to form analysis workflows. An analysis will be able to be executed in seconds, minutes or even hours. Each analysis tool within the CIRP is described in the Extensible Markup Language (XML) and transformed at runtime into suitable widgets and user interface controls. The following table summarizes the decisions and strategies regarding the design of the CIRP.

Decision / Strategy	**Description**
Java Coding Language	The Java Language is one of the most popular programming languages in use; particularly for client-server web applications. This choice was informed by both platform independence and the modularity and extensibility offered by the Java Virtual Machine (JVM) based Eclipse Rich Client Platform and Open Services Gateway Initiative (OSGi) technologies. In this decision we traded-off the potentially enhanced performance of other languages against the flexibility, modularity and extensibility offered by Java/OSGI.
Java Enterprise Edition (JEE)	The JEE is a widely used enterprise computing platform developed under the Java Community Process. The platform provides an application programming interface (API) and runtime environment for developing and running enterprise software, including network and web services, and other large-scale, multi-tiered, scalable, reliable, and secure network applications.
Object Relational Mapping (ORM)	ORM enables developers to more easily write applications whose data outlives the application process. An ORM framework is concerned with data persistence as it applies to relational databases (via JDBC).
Web Start based Rich Client application	The Java Web Start is a framework developed by Sun Microsystems (now Oracle) that allows users to start application software for the Java Platform directly from the Internet using a web browser. Some key benefits of this technology include seamless version updating for globally distributed applications and greater control of memory allocation to the Java virtual machine.
Service Platform	The OSGi Service Platform is the de-facto standard for modularised Java Language. It is a framework that provides

	a dynamic environment for the deployment of services and modules (referred as bundles in OSGi terminology).
Eclipse RCP (Rich client platform)	RCP which provides the architecture and framework to build rich client application. RCP's close integration with OSGi makes it one of the only user interface technologies to leverage modularity from the ground up.
Development frameworks – Reuse of existing software components	The CIRP will be based on two distinct frameworks both based on the OSGi. The first one is the CEF (Chameleon Enterprise Foundation), an Enterprise Application Framework developed by Satways Ltd. The second one is the ERGO-CORE platform, an Open Source Risk Assessment desktop software.
Data repositories for Data and Metadata Management	CIRP will provide efficient management and synchronization of different data repositories, either of public domain, of cached locally (local repository). Execution of analysis based on cached/local data provide the necessary speedup and tolerance of low speed networks while the synchronization with public repositories provide the means for scenario input and output results dissemination to other platform members. A semantic content library will track the provenance of data so that users can determine information such as which algorithms were used, the date it was created, the author, which machine was used, etc.
Context Sensitive Help	In the context of CIRP, user assistance will be provided by Developer and User manuals as well as context sensitive help support, where a user can summon help for a particular element in the UI (e.g. by pressing F1 key).

Table 1: Design decisions for CIRP development

The CIRP platform is based on a set of tools and components capable of providing resilience management functionality arising from a dynamic climate risk approach to critical infrastructure. This section provides a high level overview of how the CIRP functionalities and responsibilities of the system are partitioned and then assigned to subsystems and components.

In architectural terms, the CIRP is designed as a pluggable, multi-user, and collaborative n-tier software system that will be accessible to end users either as a Client-Server installation or as a Web start-able rich client application. The first type of installation addressed the EU-CIRCLE partners to develop, in close collaboration with the software engineering partners, new dataset types and analysis plugins. The second type of installation addresses the policy and decision makers and CI owners that need to access the system from a browser, operate in diverse locations, and receive automatic software updates as these become available from the consortium. The high level logical architecture in terms of modules (collection of OSGi bundles) is depicted in the following Figure. This is a layered software approach comprised of multiple and discrete "shells" around the core of the system which is an OSGi specification implementation module (Equinox) and a Widget framework (Standard Widget Toolkit - SWT/JFace).

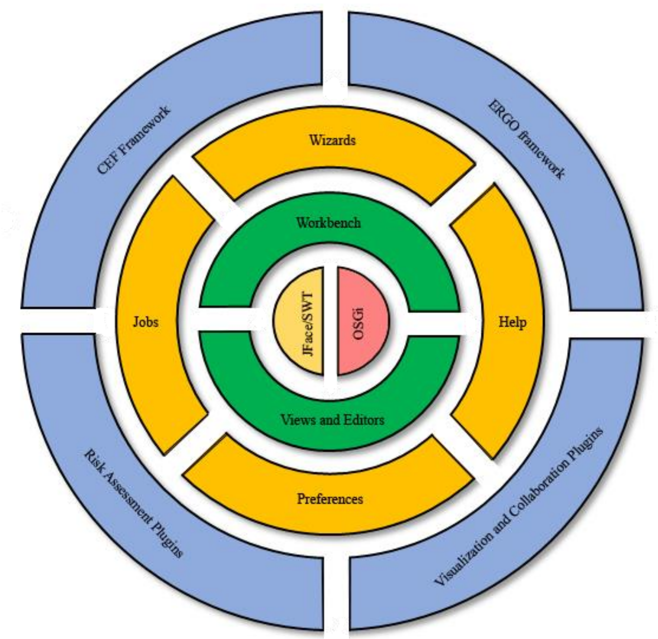

Figure 3. The cirp modular software layers

Each shell expands and provides additional capabilities to the inner shells. As depicted in the outer blue shell the CIRP platform functionality will be based on the collaboration and expansion of two frameworks: the CEF (client & server) and the ERGO-CORE (client only). Each of the two core frameworks provides a set of discrete functionalities that may be exploited independently or in a collaborative manner. The ERGO-CORE framework provides the functionality related to inventory, data and metadata management, and the ability to wrap new analysis types and execute them on the workflow engine. The CEF framework provides functionality including the CEF Core module, the User Management & Roles and Access Rights modules, and the 3D GIS (Geographical Information System) modules. The envisaged logical architecture is depicted in the following Figure.

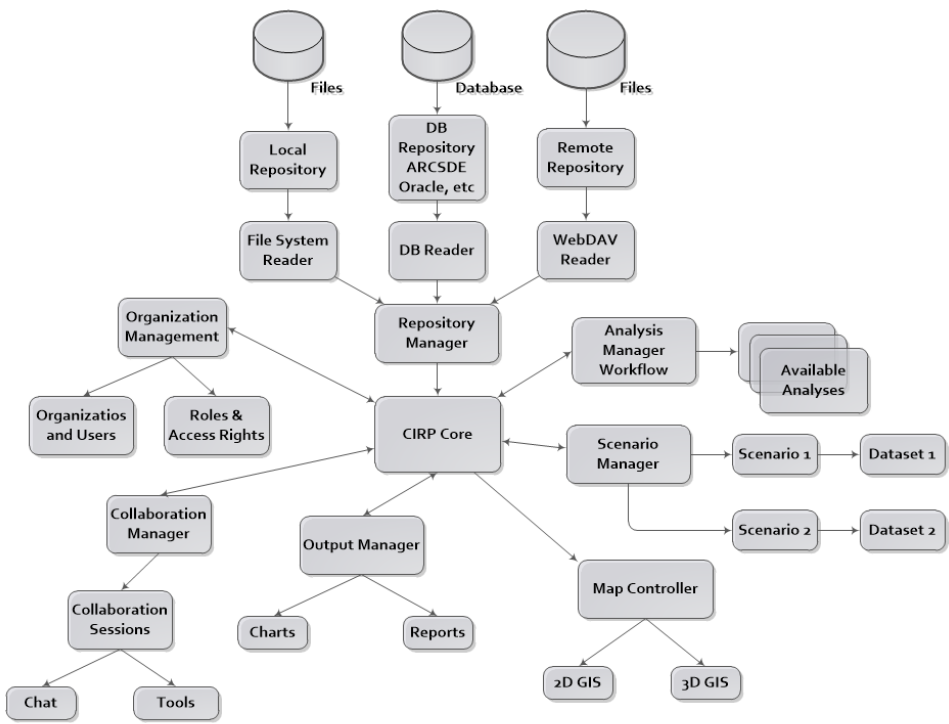

Figure 4. CIRP logical module decomposition

Validation

Five pilot areas have been determined in order to test the developed risk framework and to validate the CIRP infrastructure. The conduction of the case studies involves numerous steps, among them:

- Workshops to connect to multiple stakeholders with the aim to define climate change aspects, relevant climate hazards, time-frames (infrastructure lifetime, climate change impact, hazard duration, restoration time) and impacts, affected Critical Infrastructures, data sources, resilient indicators etc.
- Elaboration on analytical workflows between scientific partners, local stakeholders and software developers.

Region	***France***	***Poland***	***United Kingdom***	***International/ Bangladesh***	***Germany***
	Provence-Alpes-Côte d'Azur	**Baltic sea/ Gdynia**	**Torbay**	**Khulna**	**Dresden**
Climate hazard(s)	Heat wave, extreme drought and wild fires	Storm and sea storm	Coastal flooding	Cyclonic pressure, tidal surge	River flooding
Critical infrastructures modelled	Electricity Highways Civil protection	Port infra-structure Oil pipeline	Sewage, transport	Transport, communication, water, public institutions	Electricity, Drinking water
EU-CIRCLE components to be tested (selection)	Damage and interdependency modelling Risk assessment under different IPCC scenarios Resilience indicators Coupling with external modelling tools	Safety indicators resilience indicators Environ-mental impact analyses	Damage and interdependency modelling Resilience indicators Coupling with external flood simulation models Advanced visualisation tools	Damage and interdependency modelling Resilience indicators Socio economic impact analyses	Damage and interdependency modelling Coupling with external modelling tools for single CI networks Impact assessment: population, commercial activities

Table 2: Case studies

- Selection of appropriate models for assessment of direct and indirect impacts and identification of suitable parameters;

- Data gathering and data preparation;
- Spatial-temporal modelling within the CIRP;
- Compilation of results, including visualisations, presentation and discussion with end-users;
- Training course to familiarise local end-users with the EU-CIRCLE CIRP technology.

EU-CIRCLE aligns the definition of the climate scenarios with this call by the EC to assess the impacts of the 1.5 degree scenario on Europe‘s infrastructure. Depending on the specific needs and initial findings of the case studies preliminary work, other IPCC scenarios could be examined as well and in particular the extreme 8.5 and the 4.5. The following table provides a first overview over the case studies

Case study 1 (wild-fires), is currently the most developed scenario. In the following, we present some of its specifications. The PACA (Provence-Alpes-Côte d’Azur) region is constrained by the specific topographic relief. This has consequences on the organization of the networks under consideration for this case study. The main transportation axis is east-west oriented. Apart from this, there are only secondary road networks serving the eastern part of the region.

Regarding the electricity network, the unbalance is even more obvious. In 2015, PACA region produced 41% of the electricity consumed within the region. It therefore had to import almost 25 GWh, mainly from the nuclear power plants located in the Rhone Valley. 64 % of the electricity production in the region comes from renewable sources, mainly hydropower (Durance and Verdon valleys mainly and to a lesser extent from Nice hinterland). The electricity consumed in PACA is mainly generated in the Rhône Valley and in the mountainous hinterland, while the consumption is concentrated on the seashore. Thus, the eastern part of the region is heavily relying on one main transmission line. In 2015, works were carried out to develop missing links and alternative paths in the network by installing a high voltage buried line north of the Var department. However, this solution may not be sufficient to ensure a robust network after 2025. Indeed, the French electricity transmission network operator RTE estimates that the electricity consumption will increase in the region by around 15 % until 2034. It is also considered that seasonal patterns with stronger peaks are to be expected, linked to warmer summers and more frequent heat waves. The injection of more and more electricity from intermittent renewable sources (in particular solar power) into the network (related to emissions reduction plans) may also influence the stability of the network, as power storage solutions are not yet mature and hydropower is decreasing in hot periods. In recent years, there have been several incidents, in which numerous dwellings lost electricity, e.g. in May 2005: 1.500.000 dwellings, July 2009: 1.200.000 dwellings, December 2009: 2.100.000 dwellings.

In the scenario it is assumed, that in the summer 2040, a heat wave has been striking the south-east of France for a couple of days, causing incidents on the electricity network (temperature alerts reached in some substations) and on the roadway (behaviour modification caused by stress). The forest fire risk index (FWI) is extremely high, especially in the Var department. Simultaneous forest fires ignite, and notably one north of the city of Brignoles and is pushed south west by the wind (its direction and speed is predicted by an established fire propagation model). Soon, the fire reaches the highway (A8) used by thousands of tourists in summer time. Due to the important smoke production, visibility is strongly reduced so that highway has to be closed, leading to an important traffic on the secondary road networks. Tourists are confined on highway rest and service areas, while basic services delivery (drinking water supply, road signalling, radio broadcast, etc.) is threatened. People, blocked on the roads, have difficulties to breathe because of the smoke and leave their cars, scattering into nature. Additional accidents are caused because of the panic of people. In order to facilitate aerial firefighting operations, electricity lines are shut down, and in particular extra high aerial lines serving the eastern part of the region (400 kV). Load-shedding plans have to be applied. The risk of a black out in the eastern part of the region is extremely high, given that the two main power transmission lines are cut. The impact on the general public and on the other CIs may be very severe. In particular, the highway network will suffer from power outage to operate the toll stations, the causeway signs, drinking water in rest areas, the supply of gas in service areas, etc. Other emergency operations are disturbed because of delayed alerts, limited available rescue means and major spatial dispersion of such means. In addition, during the summer, the population highly increases due to the tourist presence, leading to an overloaded flux of person on the highways networks and increasing the consumption of electricity. Moreover, with the presence of tourists during this high risk area period, the fire ignition probability increases too. Emergency operations are challenged due to the delay of alerts, major dispersion of means and decrease in the availability of necessary means. Within this EU-CIRCLE case study, the following CI sectors are spatially modelled:

- Electricity provision:
    - High voltage transmission network (operator RTE);
    - Low voltage distribution network (operator: ENEDIS).
- Road transport on highways (operator: ESCOTA);
- Public infrastructure: rescue means of fire-fighters;

Two different types of dependencies between the two CI networks have been identified:

- Electricity transport / electricity distribution: it is not possible to distribute electrical energy to end-users if high-voltage is not available;
- Electricity distribution / road network: highways needs to be closed, if toll stations, safety/security/rest facilities have no electricity supply.

The electricity infrastructure and its behaviour in case of forest fire and subsequent line-cuts will be simulated externally by a network-modelling tool of RTE, due to the required level of detail and the complexity of the modelling. This external model will provide to the CIRP the position of the power substations together with the remaining capacity and generate a load-shedding plan. Regarding road transport network, it is planned to use and adopt a transport demand model that already exists in the ERGO-core. As the possible speed on highways might be affected by the density of the fire smoke, speed reductions have to be determined and introduced in the transport flow modelling.

The case study also foresees modelling of socio-economic impacts, restoration costs and revenue losses to the operator; these aspects are currently under discussion with regional stakeholders. However, it is obvious, that these impacts depend strongly from the duration of the hazard and the subsequent infrastructure disruption. Therefore, it is foreseen to model the hazard development in multiple discrete time steps, taking into account different fire-contours. For example in the first step, only the road transport is slightly disturbed from smoke. In a next step, both smoke and fire affects the road and electricity network. In turn, highways have to be closed and electricity lines have to be cutted. As a cascading effect, multiple electricity consumers are losing power supply.

The modelling will allow comparing different potential adaptation measures, e.g. to improve the protection of highly critical assets against forest fires and/or to further increase network redundancy by additional lines.

Outlook

After successful finalising the theoretical frameworks and providing the basic functionalities with the CIRP in the first project period, the project consortium now moves on to elaborate the analytical workflows within each case study. In parallel to that, the software developing team implements the required plug-ins for the CIRP.

Beginning in early 2018, the project partner will present to regional stakeholders the results of the case study modelling and offer training courses to familiarize end-users with the CIRP platform.

Also, the project started a process to cluster with parallel projects in order to exchange experience on modelling and identify opportunities to exploit the developed technology in further regions.

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RISK AND VULNERABILITY ASSESSMENTS APPROACHES FOR REGIONAL & NATIONAL DISASTER RISK REDUCTION PLANNING

Joseph Green, Erin Hughey, Steve Recca

Abstract: *This paper and associated presentation focus on the application of risk assessments, successfully employed in a disaster risk reduction environment, for decision support in a broad array of regional, national, and subnational natural and man-made security challenges.*

A risk assessment, as defined by the United Nations Office for Disaster Risk Reduction (UNISDR), is: "A methodology to determine the nature and extent of risk by analyzing potential hazards and evaluating existing conditions of vulnerability that together could potentially harm exposed people, property, services, livelihoods and the environment on which they depend." The paper/presentation provides an overview of the Pacific Disaster Center's (PDC) risk assessment approach that has been validated at global, regional, national and sub-national levels and used by governments and regional organizations in Asia, the Americas, and in Africa.

The approach conceptualizes disaster risk as a function of Multi-Hazard Exposure (MHE), Vulnerability (V) and Coping Capacity (CC). Each risk component (MHE, V, CC), as well as the sub-component themes and sample datasets that can be used to describe them, are discussed. Examples of the application of the approach and the new emergency application of the data and method to support the role of NATO are outlined.

Key objectives of the methods and applications outlined in this paper are to:

- Strengthen NATO capabilities by providing the necessary information and data for evidence-based decision making;
- Provide an alternative view for examining the relationship between each actor and a repeatable approach to understanding the complex relationships towards commonly prioritized disruptors (threats/challenges);
- Enable the partner/friendly nation governments and security forces by identifying opportunities to reduce institutional fragility through building resilience against threat networks; and
- Empower civil society – citizens, the private sector and non-governmental organizations – by reducing vulnerability to natural hazards and influences of threat networks in a cooperative, multi-sector operating environment.

INTRODUCTION

The purpose of this paper and the associated presentation is to provide NATO members engaged in disaster management with decision support mechanisms through the application of a validated and repeatable risk and vulnerability assessment (RVA) methodology. The RVA methodology being presented was originally conceptualized to support the evaluation of threats throughout Africa (HIV/AIDS and conflicts threatening national security[1]) and later to establish a better understanding of global multi-hazard risk to natural disasters. Most recently, the general framework has been applied to support the National Disaster Preparedness Baseline Assessment (NDPBA) program being conducted by the Pacific Disaster Center in coordination with various stakeholders around the world.

This paper will present the Pacific Disaster Center's approach to evaluating and understanding risk. The approach is simple, practical and repeatable, ensuring that it can easily be applied and consistently support evidence-based decision making. This paper will discuss the evolution of PDC's approach to RVA and explores a new conceptualization of existing information into a network approach to directly support the work of NATO and partner nations.

BACKGROUND

Nations face a wide variety of risk. Natural hazards and human-created disruptions to normal function can have lasting impacts on the economy, society and neighboring nations. Therefore, it is important to have a systematic method for evaluating the likelihood of potential disruptions. Utilization of such a method allows for a common understanding and communication of risk.

Risk to disruption of normal function occur at the interface between the potential disrupting event (e.g. natural or technological hazards; human actions) and the established human-environment system within a given geography. It is at this interface that the collective characteristics of a region (example: governance, poverty, infrastructure, etc.) influences the extent of the disruption. A model of

[1] Pacific Disaster Center (2009) Support of Humanitarian Assistance and Disaster Relief Information Needs In Africa Final Report.

the interface between the event and human-environment system can best describe the level of disruption beyond the ability to cope (Figure 1).

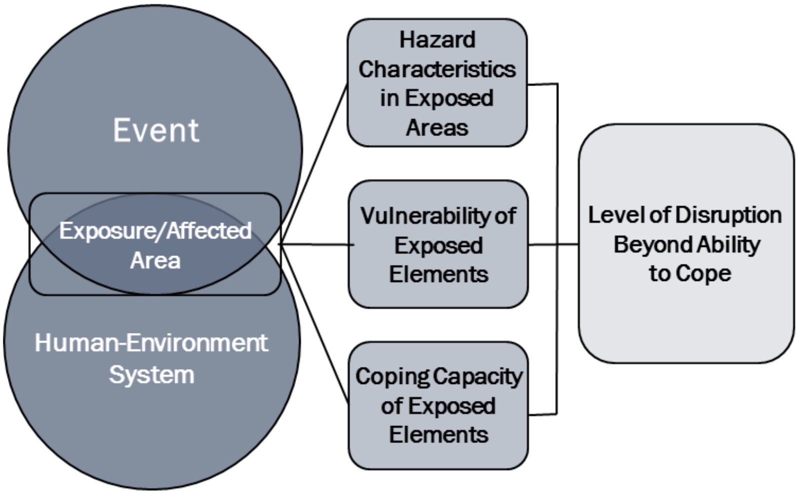

Figure1. Theoretical framework for conceptualizing risk and vulnerability assessments[2]

Risk can be modeled as a combination of an exposure to the potential disruptor, vulnerability to disruption, the capacity to prevent, manage, recover from a disruption. PDC's RVA has utilized this theoretical framework to assess a country's likelihood of disruption of normal function due to natural hazards. The RVA models Multi-Hazard Risk (MHR) as the average of a country's exposure to multiple hazards or Multi-Hazard Exposure (MHE), Vulnerability (V) and *lack* of Coping Capacity (CC). The combination of these results is a robust decision support metric that can be leveraged to:

- Better understand risk;
- Identify where resources may be needed;
- Prioritize action;
- Anticipate potential leverage points to support sustainability;
- Improve understanding of the temporal and spatial elements contributing to disruption;

[2] Pacific Disaster Center (2017) National Disaster Preparedness Baseline Assessment: Risk and Vulnerability Assessment (RVA) Data Sharing Handbook.

- Provide the necessary justification to support policy decisions to protect lives and reduce losses; and
- Establish the foundation for monitoring risk and vulnerability to disruption over time.

Risk and Vulnerability Assessments (RVA)

Global Application: PDC Global Risk and Vulnerability Assessment (RVA)

PDC's Global RVA, originally published in 2010, is constructed as a composite index where indicators measuring the economic, social, demographic, environmental and governmental status of a country are combined to measure sub-component themes that are difficult to directly gauge. The individual variables, or *indicators*, are scaled to a standardized value range so they can be mathematically combined into a relative measure of the theme of interest. These measures can then be combined to represent more complex multi-dimensional concepts. For example, adult literacy, school enrollment rates, average years of school and internet users per 100 people combine to provide a measure of a populations overall ability to access and understand information. These sub-component themes are then averaged into the larger components of V and CC.

The V and CC components can be combined to represent Resilience (R). These components are conceptualized as independent of the exposure, meaning that they could represent the resilience to *any* disruption to normal function. Moreover, the RVA can be scaled to regional, subnational or lower. The geographic extent of the risk assessment is solely limited by data availability. This allows for a high degree of flexibility in the application of the RVA. This flexibility has been utilized in an increasing number of settings as outlined below.

For global application, PDC conceptualizes Risk as a function of Multi-Hazard Exposure (MHE), Vulnerability (V) and Coping Capacity (CC). PDCs Global RVA considers exposure to multiple hazards (flooding, tropical cyclone winds, earthquakes and tsunamis). Vulnerability and Coping Capacity are considered hazard independent. The basic model for the Multi-Hazard Risk Index is R =

[MHE + V + (1-C)] / 3. The Resilience Index, which can be used to represent a countries ability y to prepare for, respond to and recover from a disaster, is calculated as R = [(1-V) + (C)] / 2.

It is important to note that the utility of indices depends heavily on how well the indicators and thematic sub-indices represent the concepts they are intended to capture and on how well the conceptual model captures the relevant dimensions of a complex problem and potential interventions. For PDC, the Global RVA approach has been tested, refined and validated over a ten-year period. Thematic data supporting the assessment is obtained from recognized international sources such as United Nations organizations, World Bank, respected university programs like the Uppsala Conflict Data Program and University of Maryland's Minorities at Risk Project, and international non-profits and organizations such as the Centre for Research on the Epidemiology of Disasters. A total of 251 administrative units are included in the analysis with 170 countries and territories having sufficient data to be included in the final risk index[3].

Subnational Application: National Disaster Preparedness Baseline Assessment (NDPBA)

The National Disaster Preparedness Baseline Assessment (NDPBA) is a PDC program focused on subnational disaster management assessments. The intent of the NDPBA is to document disaster risk reduction (DRR) initiatives being undertaken in the selected country and its communities to help highlight challenges and successes. The project applies a repeatable and measurable approach to examining key elements of DRR, specifically Comprehensive Disaster Management (CDM) [4] and Risk and Vulnerability (RVA). Through this approach, stakeholders receive the necessary information and data to support their efforts to target and prioritize programs and investments designed to improve DRR capacity and capability to build more resilient communities. The overarching objective of the baseline assessment is to identify the conditions

[3] Pacific Disaster Center (2013) Global Risk and Vulnerability Assessment Technical Annex.

[4] Hughey, Erin (2003). Community Size and Response to Hazards: A Case Study of Falmouth, Kentucky.

throughout the country that make regions more or less prepared and capable of effectively responding to and recovering from disasters.

Designed to provide a comprehensive understanding of risk and disaster management capabilities, the program supports evidence-based decision making to enhance disaster risk reduction (DRR) through focused capacity and capability building. Using a stakeholder-driven approach, the NDPBA program facilitates the integration of national DRR goals into the Risk and Vulnerability Assessment (RVA) and Comprehensive Disaster Management (CDM) methodologies.

The goal of the project is to enhance disaster resilience by:

- Scientifically capturing disaster risk within the environmental, social, and economic context of a country;
- Documenting and assessing disaster risk governance with the goal of providing actionable information that can be used to strengthen disaster management and manage disaster risk;
- Better understanding the disaster management capabilities in a country to manage, prepare for, and respond to disaster events;
- Analyzing multi-hazard risk to provide actionable information to guide investments to strengthen resilience; and
- Providing a forum for all vested stakeholders to share and communicate successes and challenges encountered in the understanding and management of disaster risk.

The NDPBA provides a repeatable and measurable approach to examining key elements of DRR. The approach consists of four distinct yet complimentary components, including: 1) focused stakeholder engagements in the form of facilitated knowledge exchanges; 2) a RVA conducted at the subnational level; 3) a CDM assessment carried out at national and subnational levels; and 4) the creation and promotion of a common foundation for data gathering and sharing.

NDPBA components are uniformly undertaken to provide the foundation for short- and long-term preparedness activities through the development of:

- A detailed subnational risk and vulnerability assessment that includes: multi-hazard exposure, vulnerability, coping capacity, resilience, and multi-hazard risk;

- A review of national and subnational CDM capabilities to include the following elements: good leadership by professionally trained officials, foundation of supportive values for government action, legal authority to act, advocacy supporting action, and necessary institutional resources as they apply to the different phases of disaster management (preparedness, mitigation, response and recovery);
- A proposed five-year plan including recommendations to build capacity and capability; and
- Data integration and information sharing.

While the NDPBA comprises both CDM and RVA, and the overall value of the assessment process is a function of the integration of the CDM and RVA results, this paper focuses on exploring the use of PDC's *RVA* approaches to support NATO member disaster management. Risk, Vulnerability and the related sub-elements described below, provide the necessary temporal and spatial data to serve as the underpinning of effective DRR decision-making. Furthermore, the PDC approach ensures that all analyzed data (tabular and spatial) are provided to stakeholders in easy to access formats. The net result is a necessary common foundation (baseline) for data gathering and evaluation to help support:

- Identification of targeted intervention programs;
- Program monitoring and evaluation;
- Robust data holdings to examine trending and develop projections; and
- Development of repeatable metrics for progress.

RVA Framework

Regardless of scale, PDC's conceptualized approach to risk and vulnerability is flexible enough to apply if uniform data is available. To better understand how NATO could benefit from PDCs approach, the core components are detailed below.

Multi Hazard Exposure

Exposure information characterizes the hazards that are likely to occur within a given study area, and provides some quantification of the people and assets that could be affected by those hazards. Figure 2 provides a simplistic example of how hazard information and asset data can be combined to help characterize exposure. Five colored *hazard* zones representing different levels of intensity are shown along with satellite imagery of building *assets.* When asset information is overlaid with the hazard zones, it is possible to see what may be subject to varying degrees of potential impacts, and from this information the level of *exposure* can be estimated.

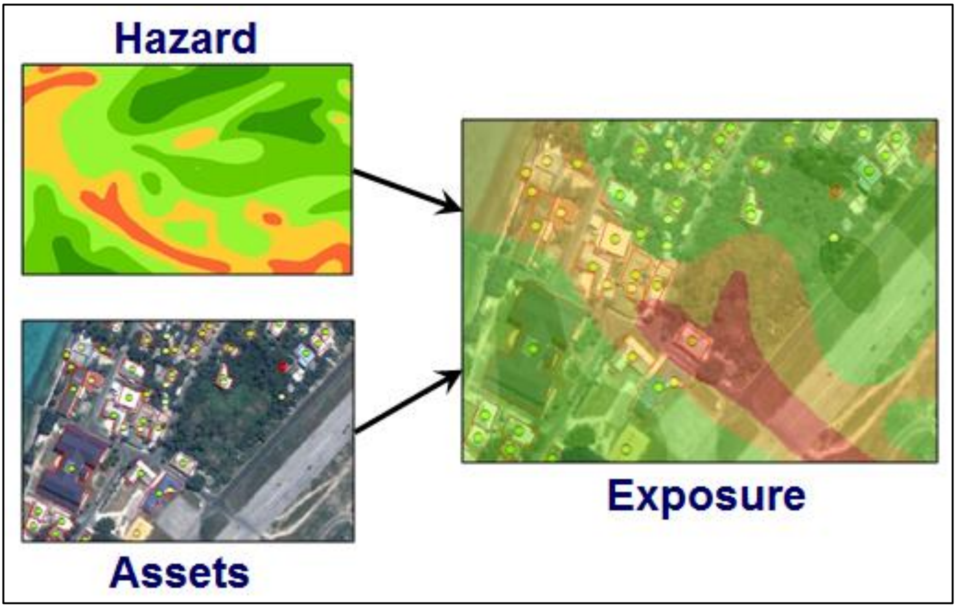

Figure 2. Example of multi-hazard exposure

CHARACTERIZING HAZARD ZONES

Hazard zones represent areas in which certain hazards are likely to occur. Hazards zones may be derived from historical events and impacts, probabilistic models, environmental susceptibility, or a combination of sources. Variations within the hazard zones may then be characterized by event frequency, probability of occurrence, relative susceptibility (ex. high, medium, low), event severity, magnitude, or intensity.

Typical hazards of interest include events that threaten people, livelihoods, and assets within the study area. Some sample hazards include, but are not limited to:

- Earthquake;
- Tsunami;
- Flood (inland and coastal);
- Tropical Cyclone Wind;
- Landslides;
- Drought;
- Extreme Temperature.

PDC's Global RVA considers four hazard types: tropical cyclone winds (Categories 1-4), tsunamis, earthquakes (MMI 7 and above), and floods. PDCs Risk Assessment of Africa looked at HIV/AIDS and conflicts threatening national security. The NDPBA for El Salvador looked at seismic, flood, landslide volcanic ash and tsunami hazards. These hazards selected for each analysis were chosen because of their extent, potential impacts (or damage) and data quality/availability.

CHARACTERIZING ASSETS OR ELEMENTS OF INTEREST

Assets or elements of interest, consider the population, socio-cultural, economic, or environmental resources and systems that could be exposed to hazard events. Examples of potentially exposed assets or elements include:

- Population (fine scale);
- Infrastructure (energy, health, communications, transportation, education, etc.);
- Critical facilities and key resources;
- Water supply;
- Food supply;
- Economic assets;
- Environment.

The Global RVA considers population and economic exposure. Both raw and relative exposure are combined. The raw exposure gives an estimate of how many persons are exposed and how much economic exposure occurs. This is useful in planning operations however, it penalizes smaller populations and economies that may be more highly exposed. The relative hazard exposure calculates exposure as it relates to population or GDP of a country or region. This aspect of exposure highlights the importance of exposure to a population or economy and highlights smaller countries or regions. Raw and relative exposure are averaged to allow for a balance assessment of overall exposure.

VULNERABILITY

In the context of the assessments, Vulnerability is the result of pre-event conditions that increase the likelihood that an area will suffer damage as a result of a hazard event. Nine general sub-component themes are typically considered, including several representing various dimensions of poverty.

Each of the nine themes used to describe Vulnerability are listed below, along with the rationale for inclusion, and examples of the types of datasets typically applied to the assessment.

VULNERABLE HEALTH STATUS

This theme reflects the population's general health as an outcome of multiple factors (e.g., health care processes and practices, physical and socio-economic environment). Poor health contributes to increased susceptibility to injury, disease and stress associated with disasters and may complicate activities like evacuation.

Sample Datasets

- Life expectancy;
- Infant mortality;
- Maternal mortality;
- Undernourished population;
- Disabled population;
- Non-communicable disease prevalence or incidence;
- Infectious disease prevalence or incidence.

ACCESS TO CLEAN WATER

This theme represents the general state of water-related infrastructure. Poor distribution and containment systems contribute to poor water quality (and associated potential for spread of disease) and increased labor required to fill basic household needs (limiting resources available for other activities that would reduce susceptibility to impact).

Sample Datasets

- Access to improved sanitation
- Access to improved water source

Access to Information

This theme represents the ability to access and comprehend hazard and disaster related information before, during and after an event. If channels and formats for information exchange are limited, exposure to information on mitigation options, preparedness measures, available resources and impending hazard events will be reduced. Limited familiarity with somewhat technical information will also constrain decision making. Access to information may also help increase and diversify skill sets and opportunities for individuals and countries before and after a hazard event.

Sample Datasets

- Adult literacy
- Enrollment in education (public and private schools)
- Average years of schooling
- Households with internet
- Households with television
- Households with radio

Economic Constraints

This theme represents limitations on resources available to invest in mitigation and preparedness measures at the individual, household, and country levels.

Sample Datasets

- Population at working age
- Economically dependent population
- Population with unmet needs
- Households receiving program benefits
- Unemployment rates
- Poverty rates
- Household income and expenditures

MARGINALIZATION AND INEQUALITY

Represents group-based differences regarding access to resources, services, opportunities and formal economic and political structures. Marginalized populations are less likely to have their needs met under "normal" conditions, and therefore become more susceptible to harm during times of disaster. They may be excluded from and/or overlooked in mitigation and preparedness planning and subsequent response and recovery activities. Exclusion also limits the pool of ideas from which effective innovations emerge. Substantial inequality may indicate the need for more tailored interventions prior to an event and specific arrangements during mass care operations (e.g., sheltering, health care delivery).

Sample Datasets

- Proportion of government leadership positions held by females
- Number of females and males enrolled in secondary school
- Economically active population (female and male)
- Ethnic minority, religious, or indigenous groups facing economic or political discrimination

POPULATION PRESSURES

Rapid changes in the size and distribution of a population are more difficult to plan for and can destabilize social, economic, and environmental systems. In addition to altering patterns of exposure, the resulting mismatches in needs, existing institutional structures and available resources can diminish resource quantity and quality and strain infrastructure and service delivery before, during and after an event.

Sample Datasets

- Population change over time (e.g., past 5 years)
- Population in urban areas over time (e.g., past 5 years)

ENVIRONMENTAL STRESS

Environmental stressors such as substantial water withdrawals and deforestation can degrade habitat and reduce quantity and quality of resources required to maintain human health and livelihoods. Additionally, these stressors increase the likelihood and magnitude of hazards such as flooding, landslides, and subsidence and can exacerbate impacts.

Sample Datasets

In general, indicators of land degradation, fresh water quality and quantity, desertification, salinization, and deforestation, including:

- Use of freshwater resources (e.g., household use, agricultural use)
- Water stress
- Forest loss over time
- Number of grazing animals
- Use of fertilizers or pesticides on arable and crop land
- Areas of degraded or salinized land (e.g. severe erosion, saltwater intrusion)

Recent Disaster Impacts

Countries that have recently been affected by disaster may still be recovering and more susceptible to additional stressors.

Sample Datasets

- Number of deaths caused by natural disasters in recent years (e.g., last 5 years)
- Total losses (damages) that have resulted from natural disasters in recent years (e.g., last 5 years)
- Number of people affected by natural disasters (e.g., last 5 years)

Conflict Impacts

Countries affected by conflict may be more susceptible to additional stressors. Populations displaced as a result of conflict may lack ties, connections, or support systems and may have special needs associated with the impacts of recent conflict. These populations can present a challenge to host countries in terms of service provision and integration. These populations may not be included in disaster management related plans.

Sample Datasets

- Number of deaths resulting from conflict in recent years

- Number of refugees and asylum seekers
- Internally displaced persons (IDPs) displaced by conflict

Coping Capacity

Coping Capacity intends to capture those social, economic and environmental factors that contribute to disaster outcomes. In the case of coping capacity, the indicators and themes chosen represent factors that influence the ability of those affected to effectively absorb or "handle" and respond to negative impacts associated with a hazard event. Infrastructure represents critical resources and mechanisms for coordinating and delivering required services during response and short term recovery.

PDC examines four themes to describe Coping Capacity; the themes, rationale for inclusion, and examples of the kinds of datasets that help describe each of the themes are provided below.

Strength of Governance

Represents the political will to learn about impacts and needs, to provide relief or enact programs equitably, and engage outside organizations if necessary. The theme also reflects the stability and effectiveness of the institutional structures required to do so. Governance is often cited in the literature as influencing other measures of coping capacity and/or vulnerability.

Sample Datasets

- Delivery of government services (e.g., garbage collection)
- Crime rates
- Crime clearance rate
- Number of violent protests
- Gang activities
- Control of corruption
- Voter participation

Economic Strength

Represents the ability to absorb immediate economic losses and quickly mobilize financial assets to provide needed assistance.

Sample Datasets

- Local GDP
- Local disaster reserves per capita
- Income per capita
- Local contingency funds
- Households receiving remittances
- Local taxes collected

INFRASTRUCTURE

This sub-index represents the resources that enable the exchange of information (Communications), and physical distribution of goods and services to the population (Transportation and Health Care).

Communications

Represents the density and variety of communications infrastructure available to support coordinated action among local, national, and international actors.

Sample Datasets

- Households with fixed telephone lines
- Mobile phone coverage

TRANSPORTATION

Denser transportation networks provide more options for bringing outside resources into a country (ports and airports) and increase the likelihood of alternate routes for reaching impacted populations.

Sample Datasets

- Seaports
- Airport runways
- Railroads
- Major roads

HEALTH CARE

If the availability of skilled caregivers and dedicated facilities is limited, timely and effective treatment of sickness and injury is less likely, potentially leading to increased casualties and financial burden.

Sample Datasets

- Hospitals and health center locations
- Number of hospital beds per population
- Number of nurses and/or midwives per population
- Number of physicians per population
- Vaccination Rates

Environmental Strength

Represents the ability of the environment to recover from a shock and maintain species health, biodiversity and critical ecosystem services after impact.

Sample Datasets

- Natural protected areas
- Reforested areas or reforestation programs

RVA Emerging Applications: Network Approach

An emerging use of the RVA is in the assessment of security threats. The basic RVA framework is expanded to capture the influence of specific networks of interest within partner nations. The foundation of this approach was developed in conjunction with US Southern Command (SOUTHCOM) J7. The networks framework includes the white network, which represents civil society; the green network, which represents the partner nation's government; the red network, which represents a national or transnational security threat; and the blue network represents the military counter to the red network. Because the V component of the RVA is a measure of relative socio-economic stability across geography, the addition of further components representing expanded dimension of civil society would adequately capture and describe the white network. Similarly, CC measures aspects of governance and the ability of a government to effective operate and provide for its citizens, and a small number of components could be added to adequately capture the green network. The red network can be modeled as the exposure of interest and would replace the MHE in the RVA. The blue network represents an additional component that could be leveraged to counterbalance exposure to the red or insufficiencies in either the white or green.

The composite index approach utilized in the RVA is currently being leveraged to assess the green and white networks of nations of interest. Existing components, indices, and indicators are being utilized as a baseline representations with the addition of relevant indicator and thematic areas. For example, in the PDC Global RVA, population pressures indicator is represented by the change in 5-year in average urban population growth. Population pressures for the white network has been designed also to include the so-called youth bulge and unemployment rates. This adds an additional dimension to population pressures to capture potential population dynamics that have been associated with radicalization and gang membership[5].

The flexible nature of the RVA approach has allowed for its reconceptualization by SOUTHCOM. The joint work between SOUTHCOM and PDC has taken a tool for disaster risk reduction and reimagined it for assessment for the potential for influence by transnational threat actors. This illustrates the power of a simple, easily understood methodology for the creation of a model for decision support.

HOTSPOT IDENTIFICATION

A benefit of the PDC RVA approach is the ability to identify hotspots and explore the drivers or underlying causes, helping to better understand the dynamic nature of risk. Hotspots are defined here as areas of high human vulnerability and/or low capacity coinciding with the occurrence of geophysical and/or human-induced hazards. The term hotspot usually implies an event/location requiring immediate attention due to the severity of degrading conditions and/or the potential effects of the situation if left unattended. Hotspots represent the impacts of regional *stressors* to the social and physical fabric of community leading to extreme or catastrophic effects to 1) physical health and safety and 2) the effective operation of social/governmental institutions. Conventionally, natural hazards, such as flooding, typhoons, fire, and drought are considered the stressors, but human induced hazards also can and should be considered. Identifying regional hotspots and their drivers might improve the effectiveness of comprehensive HA/DR activities for NATO.

[5] Council on Foreign Relations (2007). The Effects of "Youth Bulge" On Civil Conflicts

Conclusion

The PDC RVA is a dynamic and flexible model leveraging existing open source, regularly updated data to represent aspects of the partner nation government and civil society networks to enable consideration of a wide assortment of attributes that are relevant to assessment of resilience and vulnerability. The outlined approach (and many adaptations) can support NATO members engaged in planning for natural hazards or human-induced security events.

Powerful decision support tools are easily understood and able to be used by a wide variety of practitioners. The PDC RVA approach provides such a tool. It can be leveraged for prioritization, analysis of potential drivers of risk and vulnerability, and generate hypotheses for further examination. No model perfectly captures reality, but the RVA approach allows for adaptation as new information becomes available and continued refinement ensuring continued relevance to practitioners and ensuring that it can easily be applied and consistently support evidence-based decision making.

For access to the any of PDC RVA products or data contact response@pdc.org. To view the data in PDCs DisasterAware System, you can request access at www.emops.pdc.org.

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The authors of this paper would like to acknowledge the contributions of Mr. William 'Ike' Clark Chief, HA/HMA at US Southern Command. His contributions, insight and vision have helped to shape the PDC National Disaster Preparedness Baseline Assessment and the Network Approach to understanding risk.

DISASTER RELIEF AND HUMANITARIAN AID AT SEA. THE BULGARIAN EXPERIENCE

Vyara Zhekova,

Abstract: *In the contemporary reality the separate national countries are indeed facing many challenges. The safety issue is now especially important and topical, compared to the preceding decades: the safety of the state, of the institutions, of the individual citizens, the alliance safety, the safety of the whole world are all at stake in the modern global world. Safety has many dimensions today, one of which is the safety of the sea and seaside territories. This issue is especially topical also for Bulgaria, considering its Black sea coast and adjacent aquatory. The present article will be dealing namely with this aspect of safety*.

Introduction

Considering that Republic Bulgaria belongs to the Black sea countries community, the issues of safety at sea, search and rescue of people and vessels, protection of the seaside infrastructure are not new issues for Bulgaria. However, nowadays, in view of the increased level of worldwide insecurity, the fugitive waves, flooding all Europe and protection of the borderline regions of illegal raids, the safety of our Black sea borders is a matter of special importance for the country. Beside the usual dangers, stalking our seaside territories, now we have to be ready to respond also to the contemporary challenges. Another question is whether our country is ready for that.

Safety at Sea. National and International Priorities

Search and rescue (SAR) service are the performance of distress monitoring, communication, coordination and search and rescue functions, including provision of medical advice, initial medical assistance, or medical evacuation, through the use of public and private resources including cooperating aircraft, vessels and other craft and installations. Governments must fulfill their obligations and carry the responsibilities set forth in international regulations, procedures and practices contained in the documents of International Maritime

Organization (IMO) and other relevant binding documents, participants who represented them, and also to take whatever measures may be necessary to ensure their observance. Above all the National coordinator for SAR should be defined on a base of specific competency. Correction of this state will contribute for enhancing SAR efficiency and will release controlling activity from conflict of interests. The competent authorities of each country in which the law applies to Agreement On Cooperation Regarding Maritime Search And Rescue Services Among Black Sea (Coastal States (Ankara Agreement) 27 November 1998) are set out in Annex 1/Article 1 (Table 1).

Bulgaria:	Ministry of Transport
Georgia	Maritime administration of Ministry of Transport; (Change in 2007 - Ministry of Economics and Development)
Romania	Ministry of transport
Russia	Maritime Administration to Ministry of transport of Russian federation;
Turkey	Under secretariat for Maritime Affairs to the Prime Minister;
Ukraine:	Ministry of transport (Change in 2011)

Table 1. Agreement on cooperation regarding maritime search and rescue services among black sea, Annex 1

According to a scientific research the possible probability for death of people in distress in a mass incident in the Black sea area is about 300 people every year. Upon appearing big passenger ships after 2005, enlarging the passenger terminals in the area of the Black sea, this probability will not be real and should be considered as minimum. The minimum upon which the necessary resources for our national SAR system should be estimated, is readiness for immediate search and rescue, as 1/3 of the people in distress should be accepted on board, and for the other 2/3 of them alternative emergency assistance should be provided by ships passing by the scene of event or in the responsible SAR area of the country (Figure 1). On the other hand more serious attention should be paid to The International Convention for the Safety of Life at Sea (SOLAS) requirements for SAR plans, between Maritime Rescue Coordination Centre

(MRCC) and traveling companies whose ships enter or pass by Bulgarian Maritime Search and Rescue Region (BMSRR) (SOLAS 74, regulation V/7.3.).

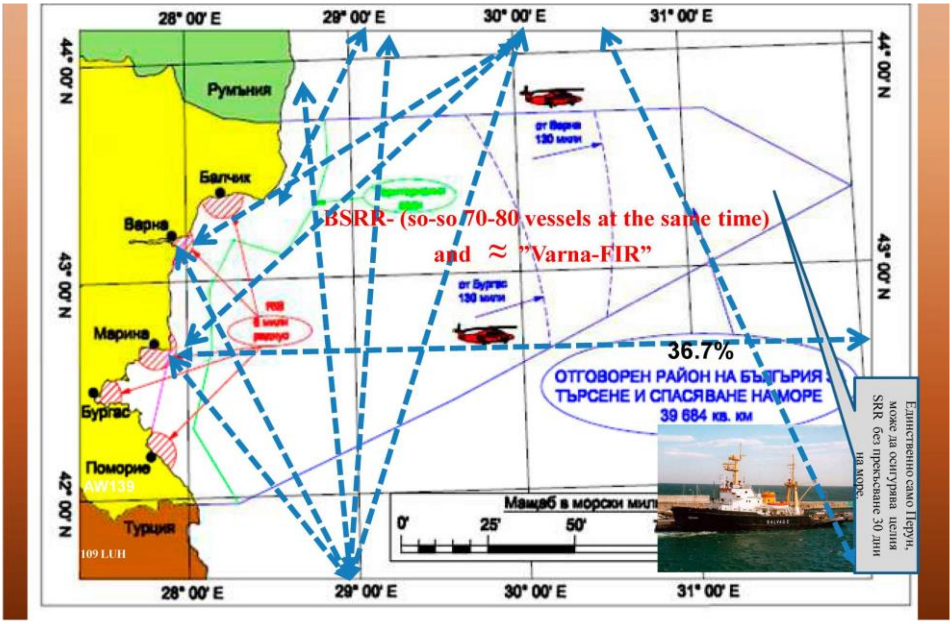

Figure 1. Resource characteristics of the SAR region

Maritime Politics, Principles and Directions

The state maritime politics should be the regulating connection with the public, as for the internal and external attitudes appearing upon carrying out the maritime activity. The state maritime politics should be the leading and main factor for realization of the national interests of Bulgaria in this area. The state maritime politics should contribute for building the country as a sea country, to create favorable conditions for achieving the aims and goals upon developing maritime activities. The state maritime politics should be the controlling unit for applying the principles of the maritime transport safety (MTS).

State Politics for Sea Safety Goals

The state politics for protection of human life at sea, the ecology of the sea and the protection of the critical sea-shore infrastructure including the cultural and material valuables upon disasters, are organizing connected and are very important priority, originated from the constitutional obligation of the country, to guarantee safety of people and fulfilling its international engagements. The most important goals of the state politics for protection of human life at sea, ecology and protection of critical infrastructure are:

• building an united rescue system for distress, incidents and crisis;
• classifying the responsibilities according to precautions;
• preventing developing risk factors upon threats;
• using the most efficient combination of regular and volunteers' organizations;
• guaranteeing visible governing of programs for restoring.

Maritime Transport Safety

The functions of Maritime Transport Safety are: Providing safety of shipping: people, ships and their load, sea route safety and protection of environment.These functions appear in the process of ships' movement from one port to the other and in the time of a sea accident. From the latter it is necessary to create and maintain maritime specialized forces and means to prevent disasters and finishing their sequences. This requirement define an important place and role of search and rescue activity in the system of Maritime Transport Safety. It is not efficient to create a system for protection upon disasters, if the function “search and rescue” doesn't exist.

The Public Priorities For Bulgaria Are:

Balance of interests between:

- Personality;
- Society;
- Country.

The Main Features Of Maritime Safety Are:

- Safety at Sea - Search and Rescue;
- Protection of the Marine Environment of the intervention of human activity;
- Competent government oversight to effectively implement the objectives of these activities;
- Interaction between the subjects from maritime transport, infrastructure and organs of state power (local self-government), regional specialized citizens'

formations and other ones, connected with international and national administrative and moral engagements to the activity availability of civilian control.

An Integrated Maritime Policy for the European Union

The seas are Europe's lifeblood. Europe's maritime spaces and its coasts are central to its well-being and prosperity - they are Europe's trade routes, climate regulator, sources of food, energy and resources, and a favored site for its citizens' residence and recreation.

Increasing competition for marine space and the cumulative impact of human activities on marine ecosystems render the current fragmented decision-making in maritime affairs inadequate, and demand a more collaborative and integrated approach.

Shipping is vital for Europe's international and domestic trade and remains the backbone of the maritime cluster. However, this industry will only continue to prosper if the Union keeps working to establish a high level of maritime safety and security, helping to safeguard human lives and the environment while promoting an international level playing field.

Responsibility for Politics in Area of Disasters, Maritime Search and Rescue

According Disaster Protection Act. The Council of Ministers shall formulate the state policy in the area of disaster protection. The Council of Ministers shall:

1. Ensure overall management of disaster protection.
2. Adopt a National Disaster Protection Program and the annual plans for its implementation.
3. Adopt a National Disaster Protection Plan and a National Plan for Performance of Rescue and Emergency Repair and Recovery Works.

Within the scopes of their competencies, Ministers and bodies under Article 19 (4) of the Administration Act, shall:

1. Analyse potential sources of risks and implement preventive activities, in order to eliminate or limit the impact of risk factors, which could cause occurrence of disaster.

2. Participate in the elaboration of disaster protection plans, of plans for performance of rescue and emergency repair and recovery works and of external emergency plans. 3. Maintain prepared forces and means and ensure the participation of the structures, reporting to them, as component parts of the integrated rescue system, in accordance with the plans for performance of rescue and emergency repair and recovery works. The indicated law treats the matter for responsibilities and politics for all national systems for safety (land, sea and air).

We are trying to regulate everything in our world with the help of normative acts, sticking to the dictum of placing law above everything, but when comes to search and rescue at sea activities, I believe human life should be treasured above all!

National Maritime Saving System

The basic task of a seaside country is to ensure the safety of navigation. This brings to normal maritime business conditions and guarantees the human rights, regarding life and health at sea. The necessity of a reliable navigation system and the requirements thereto are regulated by multiple international and national legal acts. In this reference, beside the effective Bulgarian constitution and other national legislative acts, during the decades Bulgaria has ratified various international agreements and acts on this issue. All these must not contradict each other.

Being a party per the International Search and Rescue Convention, 1979, Republic Bulgaria has a number of engagements, regarding the establishment, maintenance and administration of an adequate system for search and rescue of people in distress at sea. When related to a threat to human life, search and rescue is obligation of all countries, parties per the above convention. Besides, it is a duty of each person, having dedicated his life to the sea, one way or another. Therefore, this activity should be among the basic priorities of the governmental policy in the field of sea transport. The search and rescue system includes a number of offices, means and events, used to ensure timely and efficient response of the government is case of distress at sea. Naturally, such a system must be corresponding to the specific peculiarities of the country and specifically to its search and rescue region of responsibility (Figure 2). Factors such as size and configuration of the region, navigation intensity within and near to this region, the coastal strip peculiarities, the rescue capacity of the neighboring countries, etc. are determinant for the establishment of the search and rescue system of Republic Bulgaria.

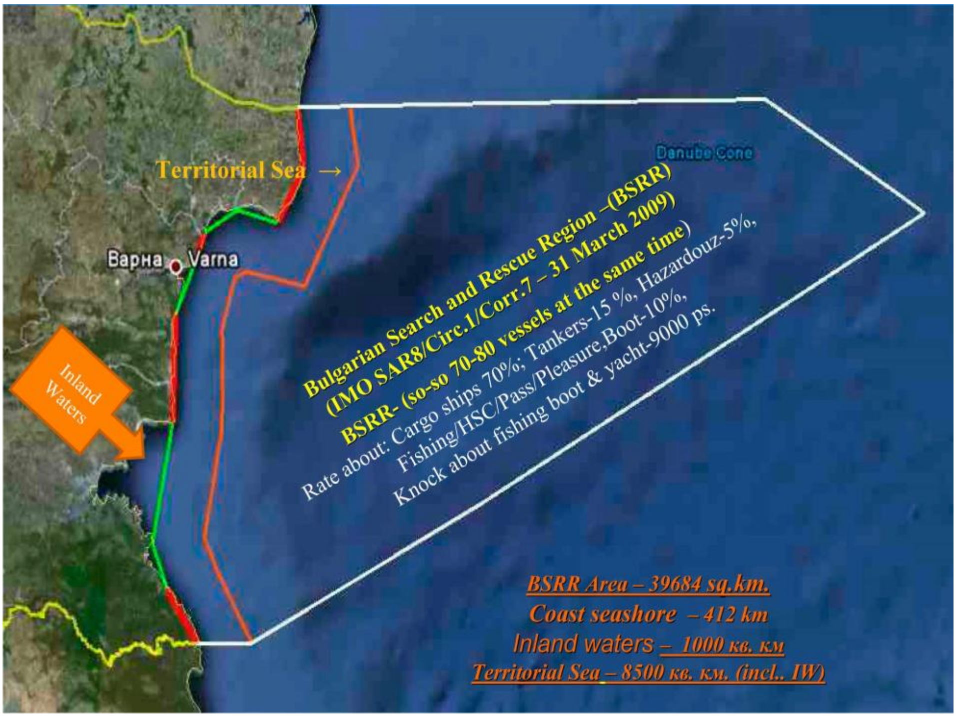

Figure 2. Bulgarian Maritime Search and Rescue Region (BMSRR)

On the territory of Republic Bulgaria the Executive Agency "Maritime Administration" (EAMA) is entrusted with the functions and responsibilities for ensuring the navigation safety, as well as the search and rescue at sea activities. It is a legal entity, supported by the budget of the Ministry of Transport of Republic Bulgaria. The statute of EAMA is regulated in the Merchant

Navigation Code, art. 360, par. 1. The activity, structure, organization and personnel of the Agency are fixed in the Structural regulation, approved by the Council of ministers. The basic functions of the Agency are:

- organization and coordination of the activities, relate to the safety of navigation at sea and inland waterways of Republic Bulgaria;
- ensuring real connection between the country and vessels, sailing under Bulgarian flag;
- exercising control on:

  a) observance of navigation safety requirements by the Bulgarian and foreign ships;
  b) observance of the working and living conditions of the seafarers;
  c) rendering services on the traffic management and information services to navigation at sea, inland seaways, channels and ports of Republic Bulgaria and other regions, specified per the respective procedures;
  d) observance of the quality requirements to the ships fuels.

- organization and coordination of the search and rescue of people, vessels an aircrafts in distress;
- exercises control and organizes protection of the water environment of the Danube river from pollution by ships;
- organizes and holds examinations for seafarer's competency;
- issues certificates of competency to seafarers;

- keeps registers of the ships, seafarers, ports and port operators in Republic Bulgaria, etc.

At the Maritime rescue coordination center (MRCC) there is a continuous 24-hrs watch by two experts - duty officer and deputy duty officer, held in shift. Since April 2015 the watch on weekends and holidays realized by two officers. The duty ship crew comprises a navigation officer and an engineers, per a monthly schedule. In 2015 MRCC submitted three cutters to voluntary organizations: in Kavarna, Sveti Vlas and Kiten in support of the activity in remote regions, far from Varna and Burgas. Annually scheduled drills are held (jointly with MRCC and the rescue cutters) every week, aimed to maintain the readiness for immediate actions and SAR operations.

MRCC and the crews of the cutters “Spasitel 1” and “Vyara” participated the search and rescue part of the navy drill “Breeze 2015”, held in July in the region of Varna Maritime Administration.

March	signals	Of them Confirmed/unconfirmed/false	At BMSARRR YES / NO
January	5	1 / 1 / 3	2 / 3
February	5	0 / 0 / 5	1 / 4
March	8	4 / 0 / 4	6 / 2
April	2	0 / 0 / 2	1 / 1
May	5	2 / 0 / 3	2 / 3
June	3	1 / 0 / 2	1 / 2
July	20	10 / 0 / 10	16 / 4
August	20	11 / 0 / 9	16 / 4
September	14	10 / 0 / 4	14 / 0
October	4	2 / 0 / 2	4 / 0
November	6	2 / 0 / 4	3 / 3
December	4	2 / 0 / 2	3 / 1
Total:	**96**	**45 / 1 / 50**	**69/27**

Table 2. Distress signals, received at MRCC - Varna in 2015, Annual report SAR 2015, EAMA

In 2015 were received and processed a total of 96 distress signals, of which 45 confirmed, which is 47% of the total number. 22 SAR operations were organized, bringing to the rescue of 59 people. The number of received signals annually is of constant character, slightly lower, compared to 2014 (100 signals). Regarding the number of actual SAR operations, in 2015 22 operations were organized. Their annual number is also comparable (21 operations in 2014). As is evident from the table, the main number of distress signals is registered during the summer season (July - September) - 54, which is over 50% of all signals received (Table 2).

From the MRCC statistics it is evident that the main part of the incidents (60%) have happened near to the coast (respectively 60% of the distances are within

500 m, and 20% - between 500 m and 5 miles). The efforts an SAR unites were directed to these cases. The conclusions from the processing of the real distress signals show that for a timely reaction the rescue cutters must be deployed in the critical regions of the incident (Kaliakra, Golden sands, Byala-Obzor, cape Emine and south from Sozopol). In 2015 the rescue crafts for the northern region were deployed only in Varna and Kaliakra, and in the end of the summer cutters was deployed also in Byala. Duty vessels were also available in the southern region - Burgas, Primorsko and Sveti Vlas. It is necessary to deploy cutters also north from cape Kaliakra, as this region has specific weather and sea conditions. The number of incidents in this region is of constant character, yet there are no crafts in the neighborhood to ensure a fast reaction.

MRCC participates the international project for navigation control and activities of international organizations and European structures in maritime SAR, as well as international forums like the one, held in October in Istanbul and the eleventh SAR conference of the Black sea countries.

In Bulgaria, beside Executive Agency “Maritime Administration” also active is the “Bulsar” non-profit association, established in 1996 for coordination, search and rescue of people in distress and shipwreck survivors in the Bulgarian SAR region of responsibility. The name of the association is an abbreviation from the name of the country (BULgaria) and the sphere of activity (SAR in Bulgarian = ТИС). The association was first registered on 20.04.1996 in Varna, re-registered per the Non-profit legal entities Act as “non-profit association to the public benefit”, and entered at the central register of the Ministry of Justice (Figure 3). The basic principles of the association are:

- Volunteering - the association is a voluntary, selfless organization, the members of which participate various forms of rescuing human life at sea at their own risk.
- Humanity - under all circumstances to assist the people in distress and shipwreck survivors to their successful rescuing. Such assistance must be ensured promptly, effectively and to provide high professional protection during the search, rescue and upon completion of the incident.
- Impartiality - to ensure help to any person in distress at sea, irrespective of his nationality, race, religion, status or the circumstances when such person is found.

- Prevention - using precise, professional oral propaganda of the SAR activities to enhance the feeling of responsibility of the people, not only as moral and enlightenment of the society, but also as public control.
- Cooperation - with all structures in Bulgaria and abroad, recognizing the SAR-79 Convention and Enclosures 1 and 2 thereto, the other conventions, related to protection of human life at sea and the Geneva Convention of the Red Cross organizations.
- Independence - the association is an independent, non-political non-profit organization to the public benefit. The association expenses are not bound to any political purposes, propaganda, or canvassing in favor of any political party.

Figure 3. Special register of associations

Bulsar, being a civil movement, registered in the special register of associations to the public benefit at the Ministry of Justice, does continuously conduct events for propaganda of the maritime safety, does sharply criticize any manifestation of non-professionalism or irresponsibility during maritime rescue operation, as the association members are of the opinion that each human life is an unique gift from God and no one has the right to behave disparagingly or unprofessionally in case of distress at sea. During its twenty years of existence Bulsar has completed many actions at sea, managed to save a lot of governmental expenditure, participated meetings, seminars and conferences on the topic of maritime transport safety. Bulsar ensured 50,000 USD for purchasing, delivery and fitting of two satellite terminals in the Inmarsat system for the purposes of out navy. Per draft project - know-how of Bulsar, submitted free by Capt. Nikifor Guerchev, the association took part in the surfacing of the sunken “Mehmet Aslav” vessel, successfully overcoming this challenge, followed by a number of other achievements. In 2005 Varna Technical University submitted and equipped per Bulsar project a large premise to the “Volunteers' rescue coordination center” so well as telephones, internet access and other of considerable value. The Center is designed for training of all Bulsar members and applicant navigational staff, such as “SAR coordinators” and “SAR administrative personnel”.

At the end of 2015 the government of Republic Bulgaria has approved amendments in the Regulation on traffic movement, reporting and management of the traffic and information services to navigation in the Bulgarian sea waters, due to the introduction of European requirements on the creation of an Union system for control of the ships' traffic and information, as fixed in Directive 2014/100/EC. All this is meant to facilitate the information exchange and access to the integrated information system (SafeSeaNet) and of a platform for ensuring the uniformity and operative compatibility of the maritime systems and applications. The SafeSeaNet system was created to enhance the maritime safety, port and sea safety, protection of the environ and readiness to undertake actions in case of pollution, as well as providing possibility for exchange of additional information in order to facilitate the efficiency of maritime navigation and transport.

Conclusion

In order to start a process for correction and/or amendment of the current SAR system and organization and elaboration if a strategy or conception for the future SAR activity in Republic Bulgarian, necessarily must be made: general assessment of the so-far activity, incl. the risk, analysis of the maritime accidents in the Bulgarian Black sea region of responsibility, assessment of the navigation and its tendencies in the following ten years, and last, but not least, analyses and perspectives of the development of the so-fat SAR participant: EAMA, the Navy, border police, etc.

The development of our national maritime search and rescue system must be focused on solving the main problem: what a system must Bulgaria create and maintain, so as to be able to adequately solve the current and future activities on coping with incidents at sea in the specific Bulgarian region of responsibility, who will be responsible for the organization, functioning and development of the maritime SAR system.

There are different organization models around the world: military, mixed and civil. Each of them has its advantages and shortcomings. It is important for Bulgaria not to invent a new model, rather unite with a one that is optimal in organization, functioning, efficiency and financing. Also an overall review must be made of the national legislation and international acts treating search and rescue at sea, aimed to solving the contradictions and reaching harmonization.

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I do sincerely hope that article will be paid serious attention both by the Bulgarian government and the Union authorities, so that Republic Bulgaria could be adequately assisted it the efforts to make the necessary in order to reach a modern level in the maritime search and rescue both for the country and as an allied partner.

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NATO MILITARY CONTRIBUTION TO DISASTER RESPONSE AND HUMANITARIAN ASSISTANCE OPERATIONS – WHY IS EDUCATION AND TRAINING AN IMPORTANT PART OF CAPABILITIES MAINTAINING

Colonel Milen Milkov, Chief of Education and Training Branch in CMDR COE.

Abstract: *NATO's robust crisis management capabilities allow it to deal with a wide range of emerging crises in an increasingly complex security environment. NATO's role in crisis management and disaster response goes beyond military operations and includes crisis and disaster response operations, meant to prevent and protect against natural or human induced disasters. What is more, training is one of the main activities of the pre-disaster phase, in strive to be ready for all of the potential catastrophes, and ensuring the right capabilities and materiel are on hand. This is intended to help the understanding of the importance of converting the requirements for military involvement in NATO disaster response and contribution to humanitarian assistance into NATO specific E&T in order to prepare the specific training audience for the effective contribution to holistic disaster response efforts on the all levels, as soon as possible. NATO military authority should consider to pay more attention, and to put more efforts on the training for military contribution to disaster response.*

Keywords: NATO, military, disaster response, humanitarian assistance, education and training, capabilities.

Introduction

There is a trend of increased frequency and scale of natural disasters in many areas of the world. Climate change, population growth resulting in pressure on natural resources, together with urbanization, industrial activities and environmental misuse, combine to form the major root causes of this phenomenon. At the same time, other challenges include a rising number of fragile states at risk of instability and civil conflicts and the looming threat of terrorist attacks. New conflicts along with protracted complex emergencies continue eroding the coping mechanisms of millions of vulnerable civilians leading to humanitarian crises. With this upsurge in natural disasters, and armed conflicts continuing in different regions of the world, military assets can have an important role in supporting the international community humanitarian assistance (HA) and disaster response (DR) efforts. Military assets can be deployed rapidly and can provide certain unique capabilities not readily available in the civilian sector, satisfying in a timely manner needs otherwise difficult or impossible to fulfil.

Despite NATO is not a major humanitarian actor and has no aspirations to become one its involvement in disaster response and humanitarian operations has a history dating back almost 60 years. NATO's interest in and capabilities to protect the populations have served to protect civilian populations. However, the collective use of military capabilities under NATO command in a humanitarian operation has happened only a few times since then.

NATO can be involved in humanitarian operations through the EADRCC, and / or through the use of military assets and capabilities available in the Alliance's Command and Force Structures. The two options are not mutually exclusive. In other words, NATO military contribution to Disaster Response and Humanitarian Assistance, is seen as usage of NATO owned assets or controlled mil assets in support of a coordinated disaster response. Out of this contribution is the military and/or civil defence forces use within national emergency response mechanisms.

Military contribution to Disaster Response, includes Disaster Relief as well as military activities in support of Disaster prevention and preparedness. Military forces should look on the preparedness activity to maintain their capabilities. Moreover training as one of the elements necessary to implement capabilities by itself shows how we prepare to operate in order to achieve desired effect.

NATO Military Contribution to Disaster Response and Humanitarian Assistance Operations

NATO has a unique and robust set of political and military capabilities to address the full spectrum of crises – before, during and after conflicts. NATO will actively employ an appropriate mix of those political and military tools to help manage developing crises that have the potential to affect

Alliance security, before they escalate into conflicts; to stop ongoing conflicts where they affect Alliance security; and to help consolidate stability in post-conflict situations where that contributes to Euro-Atlantic security.

NATO has unique conflict management capacities, including the unparalleled capability to deploy and sustain robust military forces in the field. It derives this capability from its experience, tried and tested procedures and integrated military command structure. NATO's primary contribution in case of disaster is the coordinating, liaising and facilitating functions. Within and outside the Euro-Atlantic area, NATO is working with other major actors, including Governmental and Non-Governmental Organisations. By combining civilian and military crisis management and disaster response instruments NATO is effectively contributing to a Comprehensive Approach. The goal is to anticipate and enhance the Alliance and Nations' civilian and military capabilities for crisis management and disaster response.

In crisis response operations, the military often will either be required to perform tasks which are normally the responsibility of a civil authority or humanitarian organization or will specifically provide military support to these organizations. Crisis response in today's Alliance increasingly require the employment of joint forces in pursuit of NATO goals and objectives. The primary objective of HA is to save lives and provide immediate relief and urgent aid during and after disasters and crises. It may therefore be distinguished from stabilization and reconstruction, which seeks to address the underlying socio-economic and political factors which may have led to a crisis or emergency.

NATO military contribution to DR and HA will generally be conducted in the NATO or NATO-led operation or in a framework not connected to any NATO military operation. This contribution in the NATO or NATO-led operation framework, will be executed either by force generated troops, or by NRF. When NATO-led forces are conducting another type of operation, they may be tasked to deal with humanitarian emergencies. In that case, the military assets will be given finite tasks, within means and capabilities, through the military chain of command.

However in the framework not connected to any NATO military operation military assistance to International Disaster Relief Operation (IDRO) may be provided by EADRCC on request by allied, partner or other nation or by appropriate international organization (IO) upon decision on North Atlantic

Council (NAC). In the case of a disaster relief operation or other humanitarian emergency not connected to any NATO operation, NATO military capabilities may be deployed in support of civil authorities overseeing the emergency. NATO assistance to IDRO will be by exception and will not occur without the consultation of the Strategic Commanders, recommendation by the Military Committee (MC), and approval by the NAC. In other words, this contribution could include: first, assistance and advice by NATO military authorities (NMAs) to the EADRCC, second, military assistance on request an allied, partner or other nation or an appropriate IO. This option should be MC consulted, and followed by NAC decision, and third, NATO assistance with NATO owned assets or controlled military assets. This option is exceptional, after consultation of SACEUR, followed by MC advice, and consequently NAC decision.

NATO's policy lists three clear principles. Firstly, the policy stresses that the use of military assets in response to humanitarian situations should, as appropriate, be in line with the relevant UN guidelines, namely the Guidelines on the use of MCDA in Complex Emergencies and the "Oslo Guidelines", in particular to safeguard compliance with the humanitarian principles of neutrality, humanity and impartiality.

Secondly, the responsibility for disaster response rests with the stricken country. However, when the magnitude of a disaster exceeds the national response capability, there may be a need for international assistance, including, if requested, assistance by or through NATO.

Thirdly and finally, the policy highlights that NATO's role and added value is likely to be in respect of short term disaster relief. NATO's support, at the request of a stricken nation should be aiming at improving the conditions for recovery, a task to be implemented by other more appropriate actors.

The use of military means under civilian lead as a last resort may constitute an important contribution to disaster response. Any use of military resources should follow the "Oslo Guidelines" on the Use of Military and Civil Defence Assets (MCDA) in Disaster Relief, as well as the "MCDA Guidelines" on the Use of Military and Civil Defence Assets to Support United Nations Humanitarian Activities in Complex Emergencies. These guidelines aim at ensuring that the humanitarian space is not endangered and that humanitarian assistance abides by the principles of humanity, neutrality, impartiality and operational independence. According them, the key role of the military is as follow:

- Military support should be complementary to the effort of civilian organisations;
- Any use of military assets and capabilities should be limited in time and focus on initial immediate relief;
- Military assets and capabilities should be used as a last resort, when there are no other available civilian alternatives to support urgent humanitarian needs in the time required.

Military will play a supporting role, as a tool complementing the existing relief mechanisms, across all levels including the political-strategic. Military capacities can supplement humanitarian assistance and disaster relief by filling certain critical capacity gaps in natural disasters and complex emergencies. While military assets will remain under military control, the operation as a whole must remain under the overall authority and control of the responsible civilian authority. This does not infer any civilian command and control status over military assets.

Provided that conditions are respected, military capacities can play a role in very specific circumstances:

- It can contribute to the provision of relief through infrastructure support and indirect assistance;
- It can contribute to the provision of security.

It results that the military can only act in a relatively minor supporting role in the circumstances of large scale disaster response effort. Military forces might also be mandated to play a relevant role in conflict situations, including through the provision of safe and secure environments for the civilian population and for humanitarian actors to operate in.

Education and Training for Military Support to Disaster Response and Humanitarian Assistance- Important Part of Capabilities Maintaining

To accomplish their tasks allies will more frequently be working in areas of disaster response and humanitarian assistance, which will require fully comprehensive (military, governmental and non-governmental) interoperability.

That brings me to the question – Why is education and training an important part of capabilities maintaining? Answer on this question is even more complex.

Trained personnel are key for success and influence on the effectiveness of foreign military assets in an overall DR. Alliance use of military forces to support civil authorities in their respond to disasters and complex emergencies, is going to have a subsequent effect on military training, readiness and availability. Although Humanitarian Assistance/Disaster Relief is part of the assigned tasks to the NCS and NFS (e.g. NRF) these military activities in support to civil authorities often remains a secondary training objective. The deficiency of trained personnel (specialists, SMEs, etc.) along with limited HA and DR related education and training, brings a heavy burden to commanders. Instead of focusing on the actual response, staffs are wasting time “reinventing the wheel”. Take the case of NATO DRO – Pakistan earthquake relief operations 2005. Timeliness is the main factor affecting the effectiveness of foreign military assets in a natural disaster response, especially in the first days and even weeks of the operation. The Pakistan earthquake operation was NATO Response Force first major involvement, although it was first deployed in response to Hurricane Katrina. Despite the fact that disaster relief is one of NRF tasks this force is primary design to fight, not to conduct humanitarian assistance activities. The NRF package at that time was not fully prepared for humanitarian assistance and disaster relief. In addition to the available NRF capabilities, there was a need for additional force generation to fit the requirements. This additional forces needed to be trained and prepared as well, which also took time.

Besides, it is a way to enhance Civil-Military Interaction and Interagency Cooperation in order to build confidence and trust among all actors. IDRO has a strong civil – military dimension, and to achieve NATO’s goals, NATO staff must to interact with other national and international agencies especially those actors involved in security and crisis management related issues and decision-making. Disaster Relief Operations in NATO member and partner countries that are affected by disasters also fall under the scope of crisis management. However some of humanitarian actors were often reluctant to work closely with military due to the fact of their mandate and possible mission militarization (military involvement could damage the humanitarian principles) and loss of image. The reluctance is most from civilian site than the military. What is more, although the Oslo Guidelines are supposed to serve as the major framework both civilian and military actors were not very much aware of the content of the Oslo Guidelines, which was the case in beginning of Pakistan earthquake relief operations 2005. NATO authorities, both military and civilian, should take steps to improve military commanders and forces ability to support humanitarian actors within overall disaster response. This could be done through, for instance, military education, individual and collective training and ensuring that military doctrines, standard operating procedures and field manuals adequately reference humanitarian principles and elements of the Oslo Guidelines. In addition, humanitarian actors should be involved in the design of military training on humanitarian assistance and disaster response. Moreover including militaries with humanitarian actors in common training, both civilian and military training, can help humanitarians to understand military and vice versa. Coordination is a shared responsibility facilitated by liaison and common training, as stated by UN OCHA. Training together is another way to enhance civil -military cooperation in case of disaster. Taking into consideration military use in case of disaster, as complementary to the efforts of the civilian organizations and their interaction, civilian training requirements should also be considered.

On top of that, training solutions should be considered for decision makers (working meetings, informal discussions, etc.). As it was mentioned, NATO assistance to IDRO will not occur without the consultation of the Strategic Commanders, recommendation by the MC, and approval by the NAC. When key leaders lack crucial knowledge and understanding of the military role and tasks in disaster response and how they, relate to the overall disaster response, policies mechanisms; directives; guidelines etc., on this issue it limits their ability to lead, guide and facilitate the implementation and to draw the right conclusions. In addition at the military strategic and operational levels, personnel working on the situational awareness analysis and planning have to be trained from the disaster response perspective, as well. The knowledge and skills to analyse and to evaluate information in support of military contribution to DR and HA that can contribute to the overall situational awareness have to be enhanced for experts. Allies will need to consider disaster management in their situational awareness and their risk-based planning processes.

In fact, to deliver the necessary capability, NATO plans and conducts E&T based on the political and operational requirements, at the strategic, operational and tactical levels. For the proper E&T organization NATO has an effective, efficient and affordable NATO E&T management system called Global Programing. It converts political and military requirements into specific E&T needs arranged in disciplines and develops solutions to meet those requirements.

Having in mind, Military contribution to NATO DR and HA, in order to deliver the right training for to the right people at the right time on the right place NATO training authorities and experts should answer also the question WHAT TO DO?

First, Military training requirements, aimed at sustaining the desired level of operational effectiveness, should be defined from the operational requirements described by the generic military tasks, available concepts, mission requirements and job descriptions. In addition new training requirements should be derived from the best practices and lessons learned from missions and operations, as well as from the trend of increasing necessity for the military to conduct disaster relief and / or humanitarian assistance operations. The new training requirements required new competencies to be developed and/or existing competencies to be improved.

Second, based on the analogy on the expected functional duties and the level they are performed, the Targeted Training Audience should be characterized.

Third, Analysis should be done, by matching the existing opportunities with the NATO specific requirements, leading to determination of training gaps, deficiencies and redundancies for the specific training audience.

What is more NATO is using the concept of disciplines to unify and synchronize the efforts of the requirements generators and the E&T Solution Providers in the fulfilment of these requirements. A discipline captures the E&T requirements across the education training and exercises in support of an existing or evolving capability. Even though the requirements for NATO Military contribution to disaster response and humanitarian assistance operations are not covered of particular discipline of the Bi-Strategic Command Comprehensive List of Disciplines, they are have already been allocated to ETEE training discipline. Hence, the approved ETEE STP captures also other requirements that are related to education of NATO military personnel and to a specific competence necessary to successfully work on a NATO billet, such as International Relations and Defence and Security Policy. There is no doubt that the respective NATO military authorities should start working on defining specific requirements and relevant training solutions for military support to HA/DR in order to cover defined requirements. Moreover in accordance with Global Programing, the TRA for each discipline should start as soon as possible after the STP receives MC approval.

Last but not least In contribution to NATO ETEE discipline, use of experienced experts from IOs, GOs, NGOs, NATO COEs, etc., concerning disaster response, is essential – e.g. UN, EU, CMDR COE

Conclusion

In conclusion, having considered all said, the trend of increased frequency and scale of natural disasters in many areas of the world will continue. At the same time military assets can have an important role in supporting the international community HA/DR efforts. Furthermore, with the increased probabilities of civilian/military cooperation being required, enhanced understanding and trust will be needed between civilian and military entities, including non-governmental stakeholders, to ensure effective and efficient strategic coordination, planning and execution of humanitarian assistance /disaster relief operations. As a result, these requirements will affect future military education and training. Moreover, when in NATO ETEE discipline STP, it is planned to collect the NATO E&T requirements that are not part of the other disciplines and support their solutions. CMDR COE, as a focal point for expertise in this domain, could use its experience concerning disaster response in contribution to NATO education, training, exercise and evaluation discipline, if needed. Education and training curricula will need to include humanitarian assistance and disaster relief in order NATO to have proper capabilities in pursuit of defined goals and objectives. The preparation of appropriate training audience should bring them necessary knowledge, skills and attitude to operate, to communicate and, where appropriate, effectively interact with all actors involved on the disaster response and humanitarian assistance field.

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MILITARY MEDICAL TRAINING – TOOL FOR DISASTER MEDICAL RESILIENCE

Rostislav Kostadinov[1], Alexander Dimitrov[2]

Abstract: *Contemporary world is facing unprecedented increase in both frequency and severity of natural and man-made calamities. The most valuable society assets that are affected by the disasters are the human life and health. Therefore, the society disaster resilience directly depends on disaster medical response adequacy and efficiency. The contemporary trends in medical society are not favorable for building disaster medical capacities.*

The aim *of this study is to analyze the military medical training capabilities to enhance the healthcare system readiness for disaster medical support.*

Materials and Methods - *By the means of descriptive and comparative methods the disaster medical support requirements are analyzed. Cluster analyzes was implemented to match the military medical training outcomes with disaster medicine needs.*

Results and Discussion - *Obtained results highlight several medical shortages – knowledge, skills, human and material, for disaster medical support provision. Military medics are trained primary to operate in hostile and dangerous environment similar to the disastrous one. A lot of the military medicine standard operating procedures could be easily utilized into disaster medical support.*

As conclusion the plausibility of military medical training for amelioration of disaster medical resilience is noted.

Keywords: Disaster Medical Support, Military Medicine, Medical Training, Disaster Medical Resilience

Introduction

Contemporary world is facing unprecedented change into disasters behavior – every following decade the records are presenting data that confirms one steady trend of increase into number of disasters, both man-made and natural. Along with this increased frequency the sequels of the occurred disasters are becoming more extensive – not only in the amount of money required for repairing and replacing damaged elements of the critical infrastructure in order to allow society to restore the normal daily activity, but also in the number and the structure of casualties within affected population. fig. 1 (1)

Analyzing the possible explanations of the above mentioned trends, the role of the human activities have to be noted. Recorded increased frequency in the natural phenomena could be linked to the climate changes caused by the industrial pollution of atmosphere. The process of industrialization is leading to continuous demand for more and more natural resources to be extracted and new markets to be conquered. Therefore, the growth in the number of local and regional conflicts that lead to man-made disasters (war, famine, mass people movement, social unrests etc.) is expected outcome. Despite this negative impact, industrialization is related to the increased income of the population, resulting in unprecedented high speed of the population growth leading to increase in the population at risk (number of people that could be affected by the disasters' damaging factors). (2)

Another prerequisite for the increased severity of the calamities is the process of urbanization. The high density of population in the megacities is increasing extremely the population at risk, or the exposure to the risk. (3, 4, 5, 6) In order to accommodate all population in the growing cities and respond to the shrinking living area, the contemporary buildings are adding additional stores, thus transforming the living area of one family into abode for hundreds (in the skyscrapers). How this fact is affecting the disasters frequency and severity? The answer is obvious - a lot of people living in limited living space is favorable for area of biological damage development - easy spread of every communicable disease. What is more, in such highly dense communities the risk of domestic fires is greater. Looking at the means of transportation of this mass of people are not surprising the traffic jams we are facing at rush hours every day. These transport congestions lead to increase probability of traffic incidents with big number of vehicles and people involved. (7)

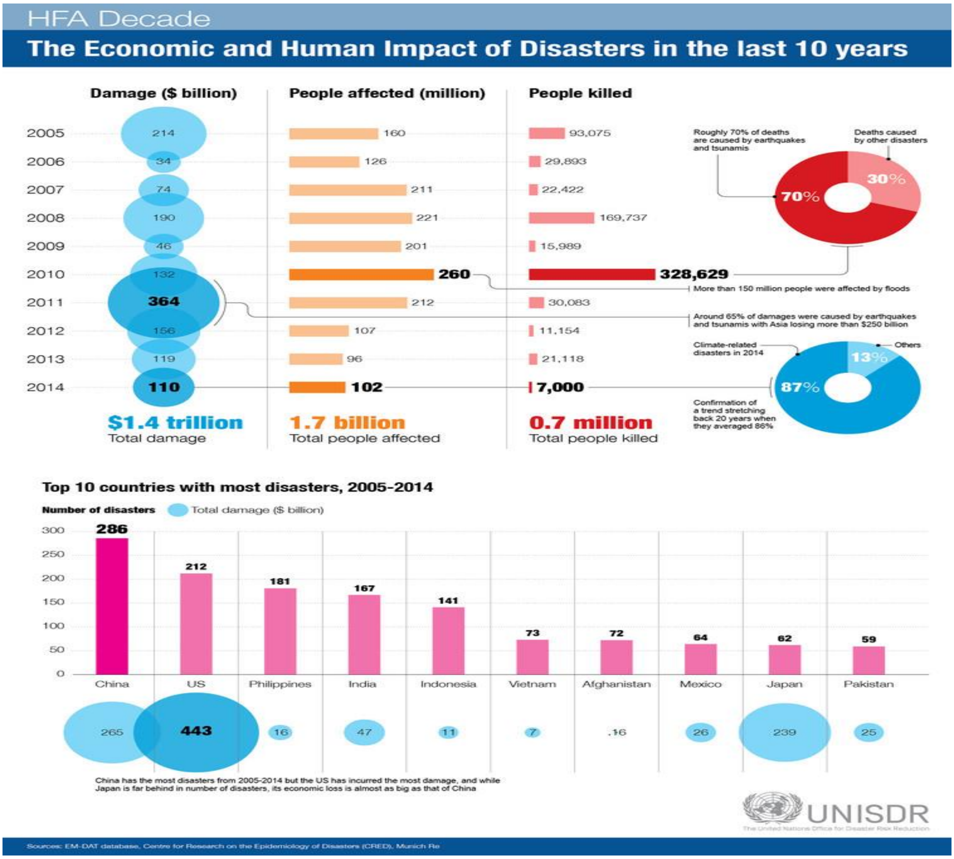

Figure 1. The economic and human impact of disasters in the last 10 years (1)

Other factor that could be explanatory for the observed trend in disasters is related to the implementation of extremely sophisticated apparatus and equipment. These require high specialization of operators and dependence on technique and robots. Processes are such complicated and interdependent that one failure (human or technical) could trigger devastating industrial disaster.

Unfortunately, the disaster medical support planners and managers have to face and other challenge - they have to confront increased number of more severe disaster with less resources. Last decades into medical community a process of sharp change is recorded. First, the number of medical specialists is becoming relatively insufficient, notwithstanding the constant and even higher number of students. This is directly related to the unprecedented population growth. In Bulgaria we are observing and another threatening trend - more than half of newly graduated medical specialists are immigrating to other countries due to the better working conditions offered abroad. Moreover, junior physicians are not attracted to specialize (to follow resident programs) medical specialties required for adequate and prompt disaster medical support - the number of young physicians on trainee post-graduate specialty programs in anesthesiology, emergency medicine, general surgery, internal medicine, epidemiology, toxicology, radiobiology, infectious diseases is in constant decrease. Number of physicians on postgraduate training for disaster medicine is less than the number of the both hands fingers. Even the requirement for mandatory post-graduate specialization in emergency medicine for all working into Emergency Medical Centers and Emergency Departments is not effective in regards increasing number of specialists in the pre-hospital emergency health care provision. What is more the observed trend is really appalling - the percentage of physicians under age 30, working into Emergency Health Services is only 5% (3)". The prevailing is group of those close to age of retirement (fig. 2) that presents one future of uncertainty - increasing calamities and decreasing medical force to confront them with expectable increased demand from greater number exposed population.

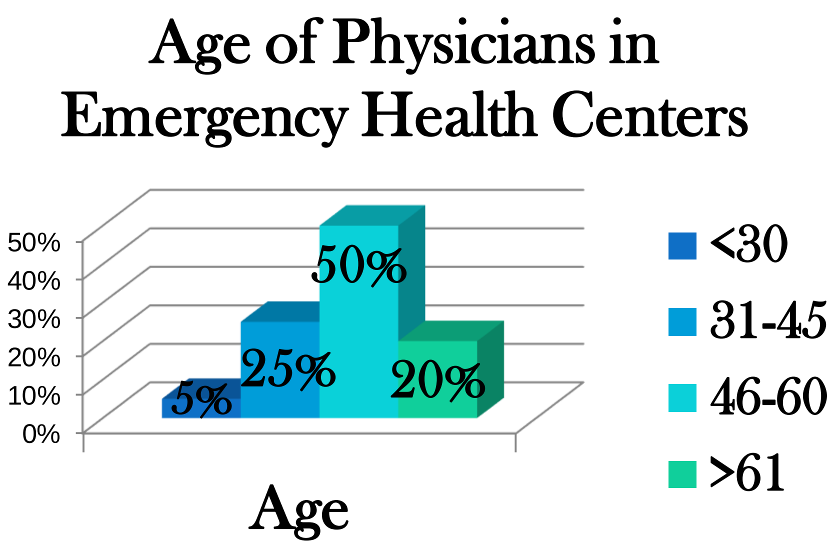

Figure 2. Average physicians' age ()

The aim of this study is to analyze the military medical training capabilities to enhance the healthcare system readiness for disaster medical support.

Materials and Methods. In order to fulfill the set goal by the means of descriptive and comparative methods the disaster medical support requirements are analyzed. Cluster analyzes was implemented to match the military medical training outcomes with disaster medicine needs.

Results and Discussion. The disaster medical resilience could be defined as the ability of healthcare system to plan for adequate and efficient measures and for effective preparedness assurance in order easily and swiftly to absorb, recover from, and if needed to adapt successfully to disastrous events and their negative consequences. The disaster medical resilience, if paraphrased, is the anticipation of the disasters impact, planning and implementing measures in order to reduce the expected loses rather to start activities after the calamity occurrence. (8) For increasing disaster medical resilience, based on the above mentioned definition, fulfillment of several task is implied - what could be the possible impact of disasters on healthcare system operability, what are the main challenges; do we have solutions and what are the required actions to be performed, to mention just a few.

After thoroughly performed analyses of the recorded disaster medical support operations in Bulgaria and abroad throughout last decades, (9) the main impact on healthcare system is the sharp disparity between required in the area of damage medical support means and capabilities and the available ones in the area and its vicinity. This disparity is caused from the unpredictability of the event - notwithstanding the developments into applied and theoretical sciences and related implementations of highly sophisticated technical equipment no one could predict on 100% the type, place, time and magnitude of the calamity. The technical and scientific achievements into hurricanes and floods development and movement are enhancing disaster managerial capabilities in order to reduce the population at risk, thus reducing the span of required medical support. Despite these achievements the healthcare system have to face during the disaster impact phase and its aftermath the following challenges:

- Unpredictable casualties' number, type and severity;
- Sudden appearance of a number of casualties in a magnitude that exceed available medical means and capabilities;

- Affected geographical and demographical areas are diverse in means of location, size, political or economical importance;
- Communication and transport means are often destroyed in the affected region;
- Sanitary and hygiene in the affected area usually are affected by disaster that leads to epidemiological situation change;
- Damaged critical and medical infrastructure, to mention just a few.

All these lead to increased demand for urgent life, limb and eye-sight medical assistance. Unfortunately, the time lapse interval required by the system to relocate and dispatch adequate to the needs medical teams and capabilities often exceeds significantly the time frame for casualties survival limited by the type of injuries sustained. Therefore, a specific, particular organization and medical support management has to be implemented. This disaster medical support organization and management is diverse and in some of its aspects even contradictory to the standard operating procedures and algorithms applied into the routine daily medical practice and emergency medicine protocols. (10)

The diversity is in the principles, objectives, sequence of activities etc. This diversity imply a different organization and structure of the healthcare provision, where the imperative is to save as much as possible lives in the shorter period of time. A specific theoretical knowledge and practical skills are required for execution of disaster medical assistance. As it was analyzed above, the trained for such activities medical specialists is constantly shrinking, while the probability for disaster occurrence is in raise. No one could stop the free specialists' movement or to increase their interest to invest time and efforts in postgraduate specialty training and education in the fields, where good future income is not foreseeable, therefore, in order to assure the healthcare resilience in case of natural or man-made calamity, with the given shortfalls different approach has to be found.

Military medical training could be part of this approach. (11, 12) A lot of the principles and standard operating procedures established by the military medicine correspond to what is required in disaster medical support:

1. Disaster Medical Support is a specific system established in order o provide the required life, limb and eye-sight saving to greater part of the affected population and what is most important into the limited time-frame set by the

severity of the injuries and the austere environment caused by the impact of the disaster's damaging factors. Therefore, the medical support starts with casualty finding and it is constantly provided till its healing process is completed.

Military medical doctrine establishes an integrated health services support system to triage, treat, evacuate, and return the casualty to duty in the most time-efficient manner. The system begins with the casualty on the battlefield and ends in hospitals, where definitive care related to the sustained injury could be provided. Provision of care begins on the field, where the first responder acts (self-aid, buddy aid or combat saver aid), rapidly progresses through tactical combat casualty care (basic trauma life support under fire, tactical field care, and tactical evacuation care) and advanced trauma management to stabilizing surgery, followed by critical care transport to a higher medical installation where more sophisticated treatment can be rendered. The most significant for the injured is stopping of the bleeding procedures in first minutes after wounding and the so called Damage Control Surgery that has to be performed within one hour after wounding. (13)

It is obvious the similarity of the systems applied, therefore military medical education and training could benefit the disaster medical preparedness of the medical specialists.

2. The basic, underlying principle of disaster medical support is medical teams' safety and security. (14) In order medical specialist to be prepared for assuring his/her own and the rest of medical team safety and security, rapid and elaborated medical intelligence has to be performed as a first step of disaster medical support. (15, 16, 17) In Bulgaria, only in Military Medical Academy has established structure dedicated to medical intelligence execution and training.

3. Setting the Temporary (Forward, Advanced) Medical Station close or within area of damage, depending on the type of disaster and the medical intelligence product, is only taught during the University or College undergraduate course in Disaster Medicine in one single lesson. (18) Within time this lesson is forgotten and the principles, the basic considerations, structure, casualties flow, etc., could not be easily recalled, especially under the stress and time limitation that characterized the disaster medical support in its first hours. On the other hand within the mass casualty event management the

setting of forward medical station is always taught and trained into military medical curriculum. (11)

4. One of the greatest challenges into post-graduated disaster medicine training still remains the triage. It is hard to explain to the experienced medical providers why the most severely injured have to be triaged and managed as expectant and not as immediate. This obstacle is due to the triage system established into emergency prehospital and hospital care units. Once again the system of triage education and training set into military medicine could be of use for disaster medical purposes. (11, 12)

5. The real "Achilles heel" of the post-graduate disaster medical training is the role of stabilization of the disaster affected instead of the treatment. Almost every one of the medical specialists is arguing against the imperative of casualty stabilization for the following evacuation as a standard in disaster medical support. It is time consuming and not always the participants are fully convinced after completion of the training in the rationality of this principle. Only those who have participated in real mass casualty incident management could easily accept the plausibility of this approach - when the number of patients with life-threatening injuries is overwhelming the capacity of the available medical team, it is pure waste of the insufficient resources, in means of human force, technical equipment and time, to perform the complete treatment required from the type of injury. Of course in great majority of cases the medical equipment needed for this treatment is not present into Temporary medical station, where the casualty is receiving the physician aid. In such circumstances the medical aid (physician's aid included) has to be focused only in following:

- To restore respiratory and cardiac function;
- To suspend bleeding;
- To prevent infectious complication;
- To start shock management;
- To stabilize general status;
- To prepare and execute medical evacuation.

The principles of Damage control surgery, designed to restore normal physiology prior to normal anatomy and to control hemorrhage and contamination, followed by resuscitation are sufficient to prevent or limit the lethal triad through rapid control of bleeding and shortened operative time, thus saving the life and assuring the casualty safety during the medical evacuation. These principles have to be applied to entire spectrum of possible life-threatening traumas in case of disaster - the head, abdomen, thorax, extremities traumas. As it was already mentioned the Damage Control Surgery is the core element of the military medical support doctrine.

6. Last years the terrorist attacks are becoming imminent threat all over the world. For the time being the preferable modus operandi of the terrorist is the attempt to affect as much as possible citizens by implementation of improvised explosive devices and different types firearms. Analyzing recent military conflicts from the World War I onwards, it will be surprise to no one the fact that military medicine is focused on management of injured by firearms and blasts. The particularities of the first medical procedures in case of blast trauma and or gunshot injury are significant for the treatment outcome - they are a must in order to save the life, limb and ability of the casualty. This is another evidence on why and how the military medical education and training could benefit the medical specialists' preparedness for prompt and efficient disaster medical support.

With the shrinking number of medics dedicated to disaster medical support and with no clue about the location and time for the next coming calamity, it is more than desirable everyone of the medical specialist to enhance his or her capability to react in accordance with the disaster medicine principles, in order to save greater part of those affected that could survive received injuries.

All presented results from performed analyses note that one cooperation between military medicine and disaster medicine post-graduate education and training of medical specialists could only enhance their capability to react adequately in case of calamity. The implementation of the correct measures that could reduce the number of fatalities and people with residual disability due to injuries suffered during the disaster, with the paucity of the medical means and capabilities is increasing the capacity of the healthcare system to react swiftly and rapidly to recover and adapt to the challenges of the disastrous event, thus increasing medical community resilience.

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INTEGRATING SPATIAL ANALYSIS, DISASTER MODELLING AND SIMULATION FOR RISK MANAGEMENT AND COMMUNITY RESILIENCE IN URBANISED COASTAL AREAS

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Matteo Agresta, Fabio Lana, Pierluigi Martinesi,
Raffaele Richetti

Abstract: *Urbanisation is rapidly changing the human landscape and it has been identified by NATO as a cause of potential instability with increased requirement for the military to operate in crowded urban and littoral environments as response to disasters, social unrest or conflicts.*
In this context, spatial and network analysis on ***the ad hoc built Archaria metropolis*** *Geographic Information Systems (GIS) inclusive of military forces data and political, military, economic, social, information and infrastructure information has been used in 2016 NATO urbanisation wargame. Archaria-like GIS tools, integrated by historical data like in SPARC and disaster simulations like* **ST-CRISOM, provide** *insight to research challenges and implications of instability situations by supporting disaster risk management and resilience requirements in large vulnerable coastal cities.*
Indeed ST-CRISOM is a stochastic discrete event simulator able to process the different GIS data layers for the simulation of a disaster and to correlate the impact on affected civilian population in real time as well as in fast time.
Web apps allow exporting maps for emergency managers and military commanders thus supporting training and operations enabling also Staff virtual meeting from remote to emergency actors without access or availability to military command and control (C2) systems. Initial Experimentation was carried out on Flooding Disasters and CBRN Scenarios.
Further, a wider architecture will integrate the GIS, military and civilian C2 systems and federated virtual and constructive simulation systems like ST-CIPROS, Sword and Virtual BattleSpace 3, in order to simulate the dynamic evolution of disasters, instability events, movement of civil and military response assets and to produce outcomes for emergency plans for training, mission rehearsal or course of actions analysis.

Keywords: Spatial analysis, Urbanisation, Model, Simulation, Crisis, Disaster, Climate change, Food security, Conflicts, Risk, Resilience,

Global Trends and Threats

Urbanisation is a global trend rapidly changing the human landscape. For the first time, since 2008 more than one half of the world population lives in urban areas. According to UN prospects, by 2030 the world will have at least 41 megacities with more than 10 million inhabitants (UN, 2014), mainly located on the littorals in Asia and Africa and likely vulnerable to the growing impact of climate change. In fact, the effects of global warming are likely to become significant, with more frequent and large-scale extreme events. Most of the countries are not prepared to deal with the climatic impact that will be stronger in some regions rather than others (David, 2016). The increased temperatures, precipitations and the rise of sea level threat essential natural resources and basic needs such as drinkable water. food, health and shelter (NRC, 2010). The link between food insecurity, migration and civil conflict is complex and multidimensional**.** Conflicts can destroy infrastructure and crops and limit access to food. While **civil conflict** as a cause of **food insecurity** is well established, the reciprocal relationship is complex and ambiguous (Brinkman and Hendrix, 2011) However, it appears that **food insecurity greatly increases the risk of conflict (FAO 2010),** in some cases leading to civil unrest (Brinkman and Hendrix 2011). In general terms, areas more affected by natural hazards are also the those that are most conflicts prone and it seems reasonable to say that when natural hazards struck an area the reduction of food could lead to subsequent conflicts" (Lana, 2015).

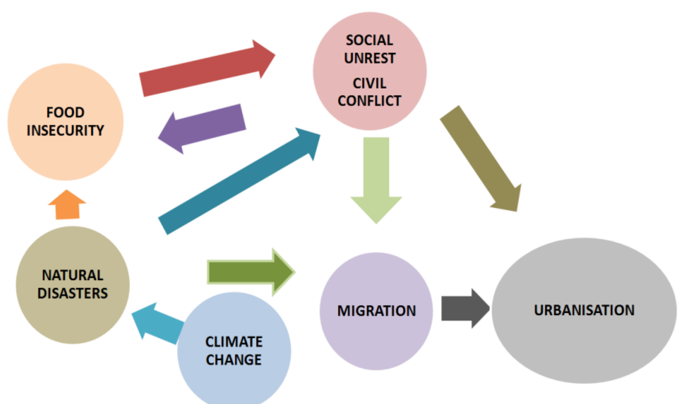

Figure 1. Relationships among trends and threats

The effects of climate change on world ecological systems are already severe and maintaining food security in times of climate change is a very demanding challenge (FAO, 2016). In fact the impact of the climatic shock on food security depends not only on the magnitudo of the shock itself but also on the vulnerability of the food system, (IPCC, 2012). According to the definition of food security: “Food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life” (World Food Summit, 1996). But many risks can cumulate or amplify the impact, not only the climate itself, are influenced by climate change and can impact directly the four aspects of food security: agriculture (availability of food), access to food (moey to buy), utilization (nutrition, quality), and stability (FAO, 2016).

As a leading player in responding to food insecurity, the World Food Programme (WFP) produced the study “At the root of exodus: food security, conflict and international migration, WFP May 2017” to determine the role of food security in the context of migration caused by conflicts in countries of departure and ‘transit’ countries. Food security can play a role in triggering migration but also the migration itself may cause food insecurity and influence a migrant’s decision to continue the travel.

The two trends of climate change and urbanisation jointly influence stability where the largest part of the world population reside. Urbanisation is going to increase the requirement for the military to operate in large urban and littoral environments in response to **instability situations**:

- **Man-made disaster** (CBRN contamination, etc.);
- **Large scale natural disaster** (earthquake, flooding, tzunami);
- Disruptive impact of **mass migration;**
- **Inner city turmoil** (social unrest, riots);
- **Civil armed conflicts.**

More and more frequently the city is becoming the battlespace (in Libya, Syria, Iraq, etc.) The **human domain,** with the city size, its connected and networked population and the fragile and complex infrastructures can be regarded as a distinctive domain of operations, beyond the five domains of military operations (*land, maritime, air, space* and *cyber*). In cities, the technological superiority is not so decisive fighters and civil population are networked, connected on social media, civilian technology is re-used for fighting. In case of armed conflict, the military forces have to deploy many soldiers, consume time and resources. Conflicts in cities result in large civilian casualties and destruction to buildings, service infrastructures and public facilities. The “NATO Conceptual Study on Urbanisation”, 2015-2016, focused on analytical findings for potential future NATO operations and capabilities in an urban environment out to 2035, informing doctrine, organization, training, material, leadership, personnel, facilities, interoperability (DOTMLPF-I approach) (Pendleton, 2015 p. 51) in order to identify capability gaps on military operations in future urbanised and littoral areas and provide direction and guidance. An ad hoc scenario was created on the virtual metropolis ‘Archaria’ placed in the year 2035 to support analysis. With the support of subject matter experts three tactical ‘vignettes’, specific playable course of battle extracted from a larger scenario (Evensen and Bentsen, 2016), were created to address potential instability situations in a metropolitan area:

- Inner City Turmoil (riots);
- Large scale natural disaster (earthquake, flooding, tzunami);
- Disruptive impact of mass migration.

Disaster Risk Management and Resilience

Where risks are identifiable the first step in Risk analysis is ***hazard identification***, but in the context of complex systems and emergent threats the identification of all the hazards could not be simple and a Resilience approach, is needed (Holling, 1973) and requires **preparing for the *unexpected*.**

According to Holling, social-ecological systems have the capacity (Resilience) to absorb or resist perturbations and keep their regime, structure and functions. Finally Resilience allows such systems self-organization, learning and adaptation (Holling 1973, Gunderson & Holling 2002). According to the National Academy of Sciences (NAS) report on “disaster resilience”, **resilience** can be defined as the ability of a system to perform four functions with respect to adverse events: ***planning*** *and* ***preparation, absorption, recovery,*** *and* ***adaptation***.(Linkov et als, 2013).

Both types of analysis, Risk and Resilience, are important to organizations, and are applicable in different situations. But Resilience requires flexibility, adaptation, improvisation and innovation, rapid accommodation to the evolution of conditions and new available information and may involve multiple organizations (Park et als, 2013).

So while risk assessment methods aim to reinforce a vulnerable component of the system, resilience analysis instead aims to ensure that an important shock (climate change, cyber attacks, disease, etc.) does not reduce significantly the functionality and efficiency of the system. (IRGC, 2016).

The integration of spatial and network analysis in Geographic Information Systems (GIS) with historical data for different geographic regions with disaster models and simulation systems can provide an environment for supporting ***disaster risk management and community resilience requirements in the large urbanised coastal areas.***

Integration of GIS with Historical Data for Disaster Risk Management

In World Food Programme (WFP) and the humanitarian community, simulation exercises have recently gained increasing prominence in humanitarian preparedness. In WFP, simulations serve to test plans, rehearse procedures, identify gaps and solve problems. In Functional Simulations, participants simulate their actions in a coordinated matter (i.e. within an Emergency Operations Centre) and must make immediate decisions, but real equipment and personnel are not deployed. Functional simulations are adopted when running the WFP Emergency Preparedness and Response (EPR) simulation as well as in External government and Inter Agency (IA) simulations. The objectives are:

- To test the proper implementation of the WFP internal preparedness actions;
- To identify preparedness gaps, challenges and corresponding mitigating actions.

In disaster risk reduction it is important to locate spatially the historical dataset in order to have understand which are the most troubled (Lana, 2015).

A **Geographic Information System (GIS)** comprises hardware and software for storage, retrieval, mapping and analysis of geo-spatial data. The spatial

features are stored in a coordinate system (latitude/longitude, state plane, UTM, etc.) and have descriptive attributes in tabular form (Lana, 2015). The two major components of a GIS are the graphical component (dealing with representation of real world terrain features and infrastructures as point, line, polygon type geometry) and the database component dealing with the attributes connected to the graphical component and describing it.
Spatial and network analysis on GIS tools can be integrated by historical data (e.g. climatology, etc.). Real time feeds (twitter, other social media updates, etc.) can also feed the GIS.

Armed Conflict Location & Event Data (ACLED) is the most comprehensive public collection of political violence data for developing countries, providing data and analysis information on specific dates and locations of conflict, types of event, groups involved, fatalities, territorial control. Information about battles, killings, riots, and recruitment activities of rebels, governments, militias, armed groups, protesters and civilians. Maps can feature various types of information, such as areas of conflict, ethnic/linguistic boundaries, economic statistics, and population density. The result is a graphic representation that can better inform disaster, relief, and transition programming. (Lana, 2015).

Emergency Events Database (EM-DAT), maintained by the Centre for Research on the Epidemiology of Disasters (CRED) is a very useful dataset providing since 1988, support to humanitarian action at national and international levels. In order to rationalise decision making for disaster preparedness, as well as providing an objective base for vulnerability assessment and priority setting. EM-DAT contains essential core data on the occurrence and effects of over 18,000 mass disasters in the world from 1900 to present. The sources of database include United Nations agencies, research institutes, press agencies, non-governmental organizations, insurance companies.

Web scraping ad geocoding EM-DAT historical data. The collection of data from web pages, download, cleaning and mapping is a time consuming process. In addition, web pages often update their data thus requiring a new iteration of the process. Python, a language with a simple syntax, is very useful for geospatial and data analysis and can perform all those tasks in automatic fashion. For example, to use the records of EM-DAT database, the python code

(Lana, 2015) is composed of one graphical window and one package containing four classes:

1. **ScrapingEMDAT**
2. **GeocodeEMDAT**
3. **CreateGeocodedShp**
4. **ManagePostgresDBEMDAT (object)**

Spatial Analysis Risk Calendar SPARC. Geospatial based model for natural hazard assessment tool SPARC developed for the WFP Emergency Division/ Emergency Preparedness and Response Branch in Rome mixes spatial analysis and historical data to assess people at risk of flooding. SPARC combines hazard frequency, population density and other vulnerability data to provide an estimate of exposed population, useful as a baseline for planning and preparedness. In addition, SPARC provides forecast data. These data, contextualized with the baseline population at risk, can be used for early warning and emergency response. SPARC also contains information on longer-term trends of land degradation, which can aggravate the impact of natural shocks. This information highlights areas that are becoming/may continue to become more vulnerable to repeated shocks, which may benefit from longer-term programming designed to build resilience and mitigate risks.

The SPARC web interface allows to query:

How many people with poor/borderline food consumption are affected by floods in May, within each region of Haiti?

From the interface, we see the population at risk of flooding with poor & borderline Food Consumption Score (FCS) - a composite score based on dietary diversity, food frequency, and relative nutritional importance of different food groups.

Clicking on the district with the highest number of people at risk, we can see the specific number of people and the monthly breakdown of people at risk in that department by month. These baseline figures can then be used to inform **early warning risk assessments** and drive targeted preparedness.

A return period, also known as a recurrence interval, is an estimate of the likelihood of an event (such as an earthquake or flood) occurring. It is a statistic typically based on historic data, and denotes the average expected time interval between events of a similar intensity.

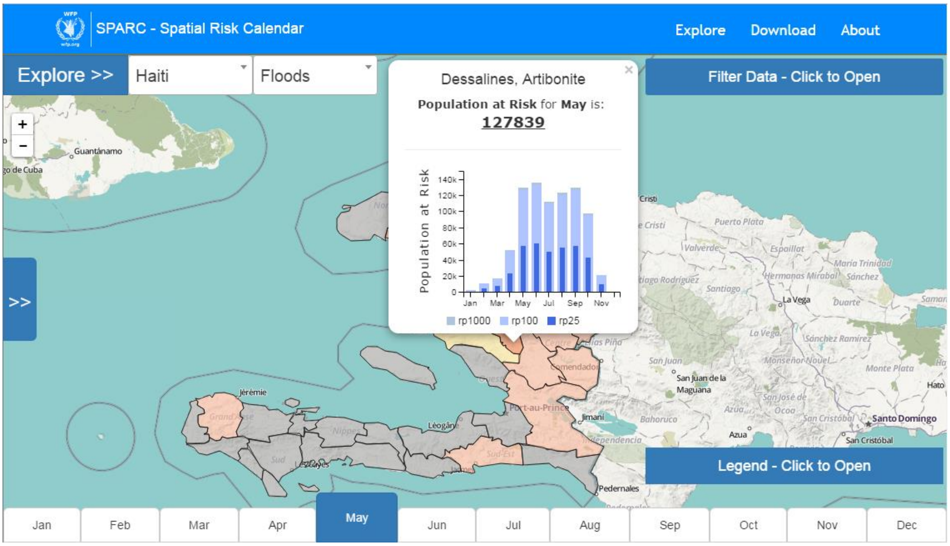

Figure 2 – SPARC (Source: World Food Programme)

The general methodology for quantitative risk is based on the equation:

$$\mathbf{R_S = P_T * P_L * V * A}$$

Where:

P_T is the **temporal** (e.g. annual) **probability of occurrence** of a specific hazard scenario (Hs) with a given return period in an area

P_L is the **locational or spatial probability** of occurrence of a specific hazard scenario with a given return period in an area affecting the elements-at-risk

V is the **physical vulnerability**, specified as the degree of damage to a specific element-at-risk E_s given the local intensity caused due to the occurrence of hazard scenario Hs

A is the **quantification (value)** of the specific type of element at risk evaluated. If the value is expressed in monetary terms, the risk may also be expressed as potential damage. (Lana, 2015)

Disaster Modelling: The Case of Flooding

Floods can have a strong impact in urban environment; indeed they may affect people and the environment including activities, buildings, infrastructures, cultural heritage and the ecosystem leading risks to safety and economy.(Giupponi et al. 2014; Henderson et al. 2001). There are at least two factors to be considered:

1) **Climate Change:** the probability and the intensity of heavy rains is rising due to climate change effect

2) **Urbanization**: the overbuilding phenomena increases the effect of heavy rains because of the low terrain drainage power, facilitating flash floods. In addition, the high density of population living in urban area increase the risk since the number of people involved is statistically higher compared to the ones involved in the same event but in a rural area.

Since from ancient times, cities were settled in strategic places near rivers, in coastal areas or near mountains for trade and/or defence reasons; these places are also the most vulnerable against natural disasters. This is why Disaster Management in urban environment is so critical in all the phases, from prevention up to mitigation (Kingsley 1955; Knox & Martson 2013; Knox & McCarty 2012; Detwyler et al. 1972). In particular considering tools for supporting the decision makers in the different phases off the emergency (Coppola, 2006). Since a real disaster is quite impossible to be reproduced in reality, Modelling & Simulation (M&S) can result very helpful for training and supporting decision makers, military and civilian staff with virtual and constructive tools. (Bruzzone et al. 2016, 2015; 2014 a, b; Massei et al. 2014; Tremori et al. 2016).

Simulating natural disaster such as flooding in urban environment is not so trivial since in the city there are at least three different systems interacting one each other:

- **Environment**: it represents physical geography, and urban doman including residential;
- **Economy:** it represents the human activity inside the city in terms of jobs, activities etc.;

- **Population:** it considers the inhabitants of the city, both as individual and as a “system” of social networks and connections.

Considering flood simulation there exist a number of simulators commercially available, and the topic is quite consolidated; in addition, the topic is also pretty complex due to complex mathematical models used that is often based on Navier Stokes equations. Indeed these models can reproduce in detail the behaviour of the water flow in a river or in a well defined environment but they can become ineffective when it is considered a big hydrological area like a city or there is the need to overlap the hydrological information with other layers, such as Population as well as Economy. (Merkuryeva et al. 2015)
Existing flooding simulators focus on “water path” but in an urbanized environment the use of “pure” hydrological have some limitations:

1) **High Computational Need**: (simulation may runs for several hour or days in particular if the simulated area is large);
2) **Data Elaboration**: for simulating in detail the behaviour of the water in a river a flooding in a group of buildings it is necessary a huge amount of information like composition of terrain, absorbion of the buildings itself;
3) **Data availability**: complete data of drainage network of the city are often not available;
4) **Complexity of the model**: the water flow inside a city and among the buildings may be described by a really complex reticulates;
5) **No possibility to support the real time simulation**; increasing the size of the model a real time simulation will not be possible;
6) **Low scalability**;
7) **High effort for setting the scenario**;
8) **Difficulty to simulate the urban layer and the population in the same simulator** – no interaction with “outside water world”.

Considering all these factors, it is undoubted that dealing with disaster simulation is quite challenging; for this reasons it is important to understand what is the final scope of the simulation tools in order to balance the realism of the simulation itself with the cost and the effort required for its development and use. In particular, it is important to understand the following points:

I. ***Extension of the area****: Do we need a whole country, the entire urban area or only some part of the city?*
II. ***Maximum effort for scenario generation:*** *What is the maximum acceptable effort to prepare the scenario?*
III. ***Level of detail****: What should be the granularity and the level of details in each zone that is considered in the simulation?*
IV. ***Real information & GIS****: Do we need GIS information, and what is the level of detail required?*
V. ***Time****: Do we need a real time simulation or other?*

Disaster Models in Training and Operation

The ST-CRISOM project is devoted to carry out R&D activities with the aim of understanding at which extent interoperable simulators could be used for disaster generation to address and solve specific problems where human factors and GIS information are also relevant. ST-CRISOM, developed by Simulation Team, DIME University of Genoa, Mast srl is a “suite” of different simulators for Disaster Emergency Simulation HLA based. The proposed solution allows to use a multilevel and scalable approach (tactical/operational/strategic) in a single interface. Indeed it is possible to simulate from an entire country up to the single unit with a different level of detail, according to the users' needs.

The area considered for this experiment is a whole country and there is the possibility to visualize in detail a 3D flooding simulation in a smaller area.

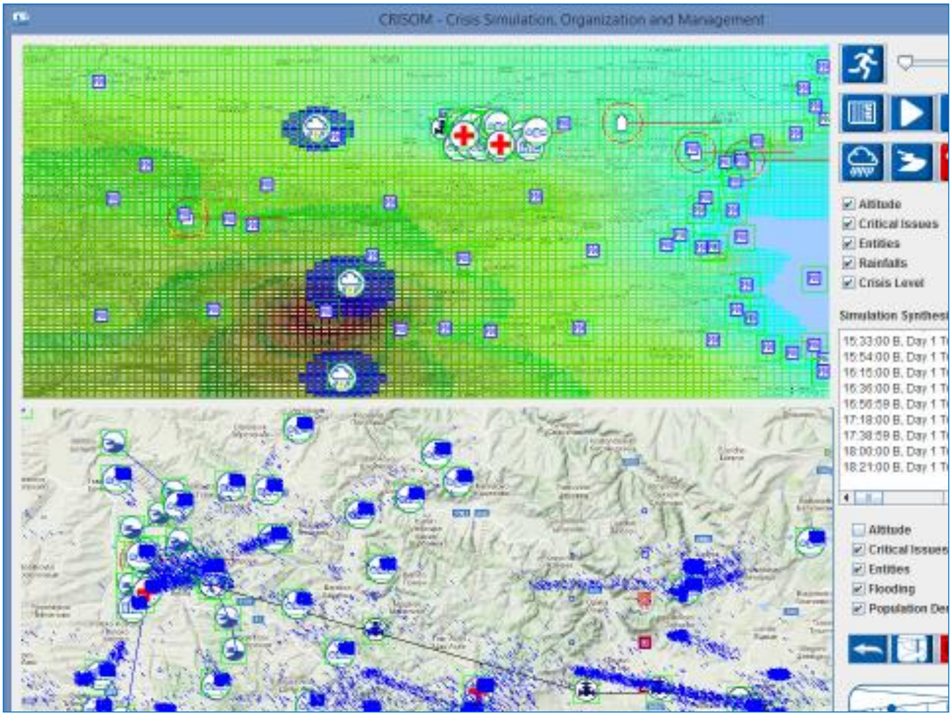

Figure 3 – ST-CIPROS Main Interface

ST-CRISOM can import GIS terrain and elaborate it with different "granularity level" for simulating the effect of the rain in a certain area. Rains are computer-generated and are based on a given probability of rain and predicted mm/h in a given area. Wind determine the speed and direction of the perturbation.
ST-CRISOM have different layer that have been imported from GIS and:

- **Hydrological and Horographic**: river, mountains, sea, etc.;
- **Urban**: household, hospitals, power plants, point of interest etc.;
- **Human**: individual data in term of different parameters such as Age, Sex, Income, level of instruction, and other social parameter like marital status, religion etc.

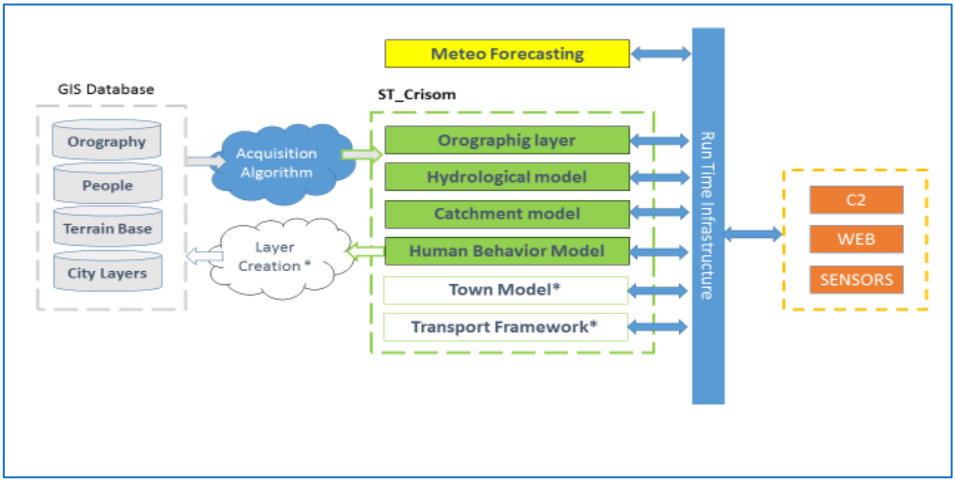

Figure 4 – ST-CRISOM Architecture

Indeed ST-CRISOM can simulate the **human behaviour** reproducing the single individual, his social network, considering the different parameters by means of an Individual Generation Model.

Individuals are simulated by means of IA-CGF, **Intelligent Agent Computer Generated Forces** and their **emotions like fear, stress, aggressiveness** evolve dynamically during the simulation according to the events during the simulation run. The events can be stochastically computer-generated or can be the result of the users' choice.

When a disaster occurs, ST-CRISOM calculate the list of the entities that are involved in the flooding in a certain area, providing their details (i.e. sex, age, health status etc). Such information can also be aggregated when the area considered is large, and a lower level of detail is required.

ST-CRISOM can also visualize units, up to the level of the single entity inside the map tool. ST-CRISOM can run real time and faster-than real time, it is HLA compliant and it can be integrated with other simulators developed by DIME-Simulationteam; (i.e. IDRASS, DIEM-SSP, IA-CGF, NCF EQ, TRAMAS Katrina Like, DIES IRAE, SIMCJOH VIS & VIC).

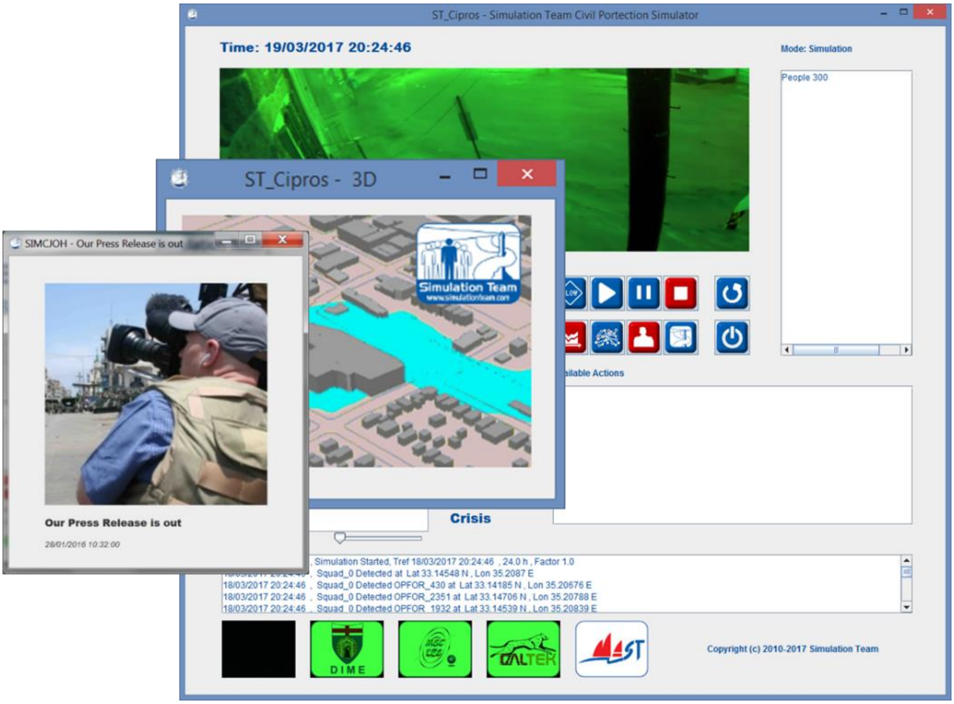

Figure 5 – ST-CIPROS Main Interface

In addition, ST-CRISOM can be federated with ST-CIPROS that can reproduce events by means of pop up to the user (i.e. media presence on the flooded area). Finally, In ST-CIPROS control panel the user can also take decisions from a set of possible alternatives; the simulator is stochastic in order to provide a high level of realism to the user.

Interactive Model for Operations in Metropolitan Areas (IMOMA)

In the near future, **Decision Support Systems (DSS)** for crowded urban and littoral areas will be much required for civilian and military decision-makers. The metropolis GIS allows to wargame the potential critical elements in support of training and planning processes. The Archaria GIS comprises 250 information layers, many of which have been interconnected to build useful and realistic network systems with their attributes in the hierarchical way describing the taxonomy of the urbanized area. GIS can support planning in the context of civil protection, for real awareness of the urban area situation, during a great event, providing the situation of city traffic, hospital beds, emergency room, police stations, main barracks etc. on a Common Operational Picture (COP) available to the emergency agencies. Active citizens' contributions to the information cycle can feed the decision support system with their reports, post, chat, tweet etc. (Aknai and Segalini, 2016).

The **Interactive Model for Operations in Metropolitan Areas (**IMOMA) builds from the experience of Modelling & Simulation Centre of Excellence (M&S COE) and Fabaris srl experience in building the year 2035 Archaria metropolis for the NATO Urbanisation Experiment 2015 and the Wargame 2016. The GIS for metropolitan areas can include civil and military forces and political, military, economic, social, information and infrastructure information. Data layers and sublayers describe the complex 2D urban system and are grouped for the users in **macro structures ORBAT** (Blue, Green and Red Forces) and Political, Military, Economic, Social, Information and Infrastructure (PMESII). The model comprises:

- **Geographic Information Systems (GIS):** with the graphical component (vectors - point, line, polygon geometry - in Esri shape file format, raster as ortofoto, matrix altimetry data sets and the database component (attributes in tabular form);
- Civil and military forces (ORBAT);
- Political, military, economic, social and infrastructure information (PMESII);
- Web application for 2D/3D visualization;
- Ad hoc scripts for the interconnection of utilities networks (electricity, water, gas);
- Integration with JCBRN COE HPAC and with hearthquake model.

The city is considered as a system with an urban core, a transitional zone, a peri-urban zone (characterised by rapid unplanned urbanisation) and the rural hinterlands. Some layers represent the near future reality: aerial space use for logistics (drones), service networks adjustments and interconnections (Smart Grids), artificial islands, fish farms, flying gondolas and solar farms. Together with skyscrapers, shopping centres, the future metropolis will include marginal settlements on the periphery, slums for excluded poor people. The GIS was built around an area of about 1700 km^2 of Naples and Caserta provinces, with heterogeneous urban structures, complex and interconnected service networks. Real data were extended with a new strip of urban area to bring the population up to six million, then transformed to get different features from those of the real Naples.

Initial used cartographic data consist of data on resident population, Informative Territorial System (SIT) data of Campania region, digital elevation model DTED level 2. Other resources were provided by the national geo-portal, by Open Street Map and GPS points of interest (school, banks, ATMs, etc.). The procedural reconstruction of the virtual city used Esri suite (ArcGIS, ArcMap, Esri City Engine, ArcGlobe, ArcScene, etc.) for spatial analysis and visualization.

Widget tools and **ad hoc elements** have been developed for 2D web app like ***Edit Blue Forces Management Tool*** (to allow wargame teams to move the Blue Forces on the map), ***Population Count, Service Area by distance and by time, Resilience Factor Dashboard***. An added value of the model is the ontology based on the interconnection of selected geo information layers (Hodicky et al., 2016) that can support the analysis. Buildings are interconnected with transportation networks (roads, railroads, etc.) and allow to find the specific buildings inside that specific service area: hospitals, governmental building, schools and estimate how many people live in that area, thus allowing complex analysis on distribution of the population.

A specific vignette describes the population distribution in a three months' period and the **mass migration** phenomena. Another vignette represents the damaging effects of an **earthquake** on buildings, in order to aid with damage assessment. The system can calculate and weigh quantitatively the effects of each vignette on the examined territory's population. ***Utilities Network Analysis*** **allows** to analyse on a specific network just specifying the point of service disruption. The interconnection between the service networks and the outage area allows to analyse the damaged network points and understand the parts of the network that shut down.

Such detailed analysis of damages and systemic failures that may be triggered by the disaster helps to design specific actions for emergency preparedness purposes (Menoni, 2005).

The Result GDB layer contains the data **results from the interconnection analysis** between electric, gas, hydric and telecommunication networks and represent service interruption areas of each system after a disastrous event (explosion, earthquake, etc.). It collects all the layers about damaged buildings and infrastructures after an earthquake “Damage Polygon” and “Damage Raster” layers are the vector and raster representation of areas where structures result, or not, damaged by the earthquake.
The 3D model, as an aid to the decision-making, was created using Esri City Engine procedural generation. The 3D web app layers include Buildings, Trees, Roads, Points of Interest, Beach Landing Zone, HLZs Building, HLZs land, ORBAT. Maps can be explored using a web interface on pc and mobile devices.

GIS and Simulation

Archaria GIS did not allow to run simulation over the data implemented in the megacity model, *de facto* a static representation of the urban area. (Hodicky et al, 2015). In order to run the metropolis model over the time, the GIS can be integrated with ***constructive* simulation** (e.g. military simulation systems).

From the simulation perspective, there are two categories of data, the geo-spatial data, known in the simulation domain as **the Settings**, include all static layers like buildings, roads, infrastructure, etc. while **Scenario** data describe the situation evolving with time as the position, structure, attributes of military and civilian units, vehicles, groups, individuals, etc.

- **Geo-spatial data (Settings):** all static layers (buildings, roads, infrastructure, etc.);
- **Scenario data** describe the situation evolving with time (position, structure, attributes of military/civilian units, vehicles, groups, individuals, etc.).

The creation of the urban terrain within a simulation system enables the interaction directly with planned tactical actions performed by deployed civil and military units.

The results (outcome) of Simulation system could be represented back on the GIS by new layers to support analysis ad/or the outcomes of simulators can feed a Command and Control (c2) system.

NATO has categorized simulations as: live, virtual and constructive. *"While in simulation for training the choice between virtual and constructive simulation depends on the training audience and the training goals, in simulation for analysis and experimentation, the desired fidelity, the resources available and the size of the scenario are important factors that must be considered when making this choice"* (Evensen and Bentsen, 2016).

Constructive simulations offer the ability to analyse concepts, predict possible outcomes, stress large organisations. New constructive simulators coming from the defence and now adapted to the emergency market include JTLS, GESI-EM and MASA Sword.

The geo-spatial data can be used as the input for the simulation using the de facto standard Esri shape files (shp). Or, better,it could be possible to use the Synthetic Environment Data Representation and Interchange Specification (SEDRIS) standard. This infrastructure technology enables information technology applications to express, understand, share, and reuse environmental data. SEDRIS provides the means to represent environmental data (terrain, ocean, air and space), and promote the unambiguous, loss-less and non-proprietary interchange of environmental data intended to enable the interchange of synthetic data including terrain, features and models in the simulation environment.

MASA SWORD Simulation

The MASA Sword terrain generation process regroups vector data layers and delimitation of terrain area and builds the land use (forest, urban, farms...). It allows to import in the Sword simulator 19 basic types of terrain, in automatic mapping mode from VMAP, NAvteq, IGN BD, TOPO. On the contrary. the Esri shape files can be imported via manual mapping using mapping tables, by adding an integer code (MASACODE) in the attribute table of vector data, within the shapefile by using a GIS software.

Figure 6 – From IMOMA GIS to Sword Simulation Terrain

Other geo data from in shape format (in WGS 84 without MASACODE) can be imported in the following phase, during the **Scenario preparation**.

However due to the large amount of information layers, the conversion from shp file to the xml format of the simulation objects produced and used by Sword must be standardised and done in automatic fashion.

Scenario data can be used to initialize the simulation tools, to set up the starting position for the simulation execution. The **Military Scenario Definition Language (MSDL)** enables the creation of military scenarios that can be shared and reused between a variety of simulations, between simulations and C4I adapter technologies, and between C4I devices.

The output of the simulation system(s) should be replicated, using a High Level Architecture (HLA) interface, in the GIS 2D/3D environment used as a visualizer or decision support system, in the way of a new layer and in MSDL-compliant military and civilian Command and Control (C2) systems ,

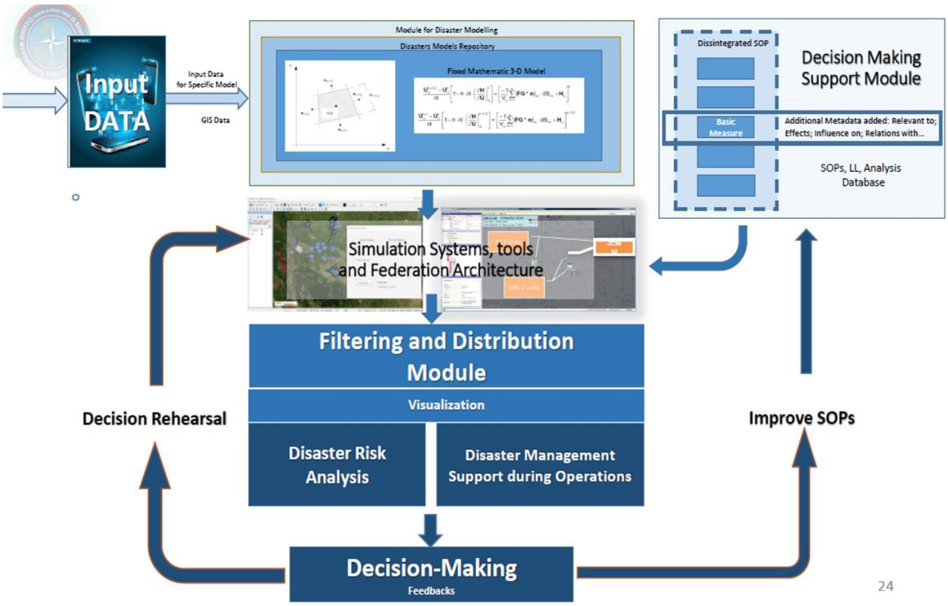

Figure 7 – MSG-147 Architectural framework

Conclusions and Way Ahead

The military rely on digital systems for Command and Control (C2) and Situational Awareness (SA) and a shared, Common Operational Picture (COP). Terrain and weather effects represent fundamental aspects of the theatre of operations supporting SA and the decision-making processes within the C2 domain.

The integration of Metropolis IMOMA GIS with Sword simulation is ongoing. We are addressing the use of MSDL standard for the civil/military units position and conversion of Esri shape geodata to xml simulation objects. The simulation system outcomes could feed back to the GIS and feed also the operational C2 systems.

In this paper an example of application disaster simulation within a complete GIS environment has been presented in particular by integrating orographic profile and population layer from a GIS in ST-CRISOM software. Next step will be performed for Verification and Validation of the flooding model and for the generation of new layers for the GIS resulting from the elaboration of ST-CRISOM.

The IMOMA model can be used as an operating environment for experimentation and training, as model for a Crisis, Disaster, Emergency Management (CDEM) modelling and simulation architectural framework integrating different constructive, live, virtual simulations in a federation by using DIS, HLA standards or web services and to extrapolate possible scenarios to support the decision-making for crisis disaster management processes and climate change implications.

The work can support the development of innovative models for scalable solution to simulate megacities, pilot project for rapid urban terrain generation, as a prototype of decision support tool in future urbanized area (David, 2016).

Further, the wider NATO Modelling and Simulation MSG-147 group ***architecture (Figure 7) can integrate, the GIS model,*** mathematical disaster models ***military and civilian C2 systems and federated simulation systems in order to simulate the dynamic evolving of disaster or instability events, the movement and logistics of civil and military response assets and produce outcomes for supporting emergency plans for training, mission rehearsal or course of actions analysis***. The integration of GIS, disaster modelling and constructive simulation can provide an environment for experimentation and training, decision support for crisis and disaster management processes.

Such interoperability requires the efforts to develop a Federation Object Model (FOM) for Disasters required for information exchange and its implementations by models developers and simulation industry.

Situational awareness could be updated in near-real time by Input data supplemented by sensors' data and damage information and emergency requests data provided by virtual communities, using crowd mapping platforms and other social media (Mejri et al., 2017) thus supplementing official available data.

This architecture model supports applications for emergency management simulation in a comprehensive innovative framework implementing Virtual Command and Control capabilities to support an agile Emergency Management approach. The training audience (disaster managers, military commanders and other decision makers) could be trained remotely in a Virtual Emergency Operations Centre. Remote users will be able to participate within a common synthetic environment.

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EARTHQUAKE STRUCTURAL DAMAGE ESTIMATION

Mihaela Kouteva, Krasimir Boshnakov

Abstract: *Timely engineering estimation of structural damage is a feasible way of avoiding significant losses resulting by earthquake excitations. Structural damages might be assessed by two general approaches: field methods and methods, based on modelling and analyses of the structural response. This study deals with the issue of correlating observational field methods, e.g. macroseismic intensity, and the results of numerical tests of structural models. Marcoseismic intensity is a descriptive measure of the earthquake ground motion. It is considered as robust parameter, related to seismic hazard and seismic risk description. Setting correlations between the earthquake damage potential and macroseismic intensity is a challenging issue in bridging engineering seismology and earthquake engineering.*

This paper is aimed at presenting an attempt on correlation of observational damage states to ground motion parameters and selected analytical damage indices. Structural damage is estimated through damage indices in result of nonlinear time history analysis of test reinforced concrete structure, characterising the building stock of the Mediterranean region designed according the earthquake resistant requirements in the 50-60s years if the XX century. The performed analyses of the earthquake resistant behaviour of structures is based on the strong motion data, available through the publically assessed databases.

Introduction

Most of the earthquakes are unavoidable events that might be devastating natural **disaster** causing loss of human life and billions of dollars in property damage (Insurance Information Institute, 2017). Earthquakes are still unpredictable in time and space. This phenomena might be more successfully prognostic estimated as severity of the loading at which structures are exposed. Although their irregular occurrence, the manifestation of this geological hazard present every year in the worldwide statistics of the Insurance Information Institute (2017). Last year different areas around the world trembled from seismic activity marking 2016 as the year of the earthquakes (Kacey Deamer, 2016). Those are the five severe earthquakes occurred on February 6 in Taiwan, M_w= 6.4; February 19 in Fukushima, Japan, M_w=5.1; August 26 - 30 in

Central Italy, M_w= 5.5, 5.1, 6.6; November 14 in New Zealand, M_w =7.8 and December 7 in Indonesia quake, M_w = 6.5. Brief data on these events is shown in Table 1.

No	Earthquake name / location	Date, 2016	Focal depth, km	Magnitude M_w	Epicentral Intensity, I_o	Victims, injured
1	Taiwan 22.94°N, 120.59° E	Feb. 6	23	6.4	VII	117 died, 550 injured
2	Fukushima 37.392°N, 141.403° E	Nov. 21	11.4	6.9	VII	15 injured
3	Central Italy 42.706°N, 13.223° E	Aug. 24	4±1	6.6	VIII	299 died, 388 injured 4500 homeless
4	New Zealand 2016 Kaikoura earthquake 42.757°S, 173.077° E	Nov. 14	15	7.8	IX	2 died, 57 injured
5	Indonesia Aceh earthquake 5.283°N, 96.168° E Sumatra earthquake 4.908°N, 96.275° E	Dec. 7 March 2	13 24	6.5 7.6	IX III	104 died, 1273 injured None
						*https://en.wikipedia.org/wiki/

Table 1. The 2016 earthquakes

Earthquakes are classified as disasters according to the losses and damages caused by given seismic event. Usually, larger losses are associated with more severe ground shaking - an earthquake classification consider the seismic events as disaster, when there are 10 – 1000 human losses (https://commons.wikimedia.org/wiki/File:Earthquake_severity.jpg).

Earthquakes severity is measured on magnitude scales, based on instrumental observations on the amplitude of the shock taking into account the seismic moment M_w and (2) macroseismic intensity scales based on observed effects, the strongest ones, I_o (Table 1) is documented in the epicentral zone. The magnitude scales, Richter and MMS, measure the energy released by an earthquake. The intensity scales, e.g. MMI, MSK-64, EMS98, classify earthquakes by their *effects*, from detectable by instruments but not noticeable, to catastrophic. The damages and losses reflect not only the severity of the earthquake action, but a large set of factors, including also the quality of the design and construction of the building stock and infrastructure, the population density, etc. The data, given in Table 1, indicate that the earthquake energy and effects are not necessarily strongly correlated; a shallow earthquake in a populated area with soil of certain types can be far more intense in effects than a much more energetic deep earthquake in an isolated area.

Earthquake damages might be classified in two major groups: (a) direct and (b) indirect damages. Direct damages are associated with ground failure and instabilities - ground cracking, ground lurching, lateral spreading, soil vibrations and ground cracking (landslides, liquefaction, differential settlements) and soil vibrations transmitted to the structures (site response). Indirect damages are associated with co-seismic manifestations - tsunamis, floods, seiches, fires, explosions, other co-seismic effects. Some data on the approximate energetic equivalents to the earthquake Richter magnitude and relevant examples are shown in Table 2. Structures exposed to the transmitted soil vibrations might receive different degree of damages or even collapse due to torsion, bending, shear or combined action. Soft storey, pounding, bad quality of materials and / or construction are often reasons for heavy damages. While the soil vibrations are transmitted to the structures, the latter might suffer the particular site response – structures might fall in resonance, or suffer the soft ground effect or the irregular site amplification due to the seismic waves' interaction.

Approx. Richter magnitude	3.00	3.50	3.87	3.91	6.00	7.90	8.35	9.15
Joule equivalent	2.0 GJ	11 GJ	40 GJ	46 GJ	63 TJ	45 PJ	210 PJ	3.3 EJ

Approx. TNT equivalent for seismic energy yield	480 kg	2.7 tonnes	9.5 tonnes	11 tonnes	15 kilotons	10.7 megatons	50 megatons	800 megatons
https://en.wikipedia.org/wiki/Richter_magnitude_scale								

Table 2. Approximate energetic equivalents to earthquake magnitude

Structural Damage Estimation Criteria

Estimating structural damage is very important and responsible tasks during the whole disaster cycle, fig.1. Structural damage is defined as "damage that impairs the structural integrity of the building"(Hegel, 2015), therefore for each disaster phase there are different methods, used for structural damage estimation. Aging of structures and critical infrastructure is going in parallel with the current urbanization processes. New codes for design and construction development of new seismic codes have been developed, or are currently under progress other. Usually, there are significant differences between design and assessment and thus the newly elaborated codes are not appropriate for damage assessment (W. Rücker, 2006).

Structures are designed to have adequate resistance, serviceability and durability. Structures are supposed to be designed and executed in such way, that they will not be damaged by earthquake with certain magnitude, explosion, impact and consequences of human errors. Structural assessment aims to determine how reliable the existing structure is able to carry current and future loads and to fulfil its task for a given time period through: (i) assuring the structural safety and serviceability and (ii) providing cost effective solutions. This paper deals with damage estimation related to the structural safety and serviceability that is part of the task to make sure that the investigated structure or parts of it do not fail under the design loading. The assessment is carried out for two limit states, LS (EN 1990) (i): ultimate limit states and (ii) serviceability limit states. The ultimate LS concern safety of people and safety of structure. The serviceability LS include: (i) the functioning of the structure or its members under normal use; (ii) the comfort of people and (iii) the appearance of the construction works. A reduction of serviceability may lead to a limitation of use and therefore serviceability assessment might become necessary. Serviceability might be violated by occurance of local damage, which may reduce the working life of the structure; (ii) unacceptable deformations which affect the efficient use and (iii) excessive vibrations (earthquakes, explosions, terrorism, etc.) which cause discomfort to people.

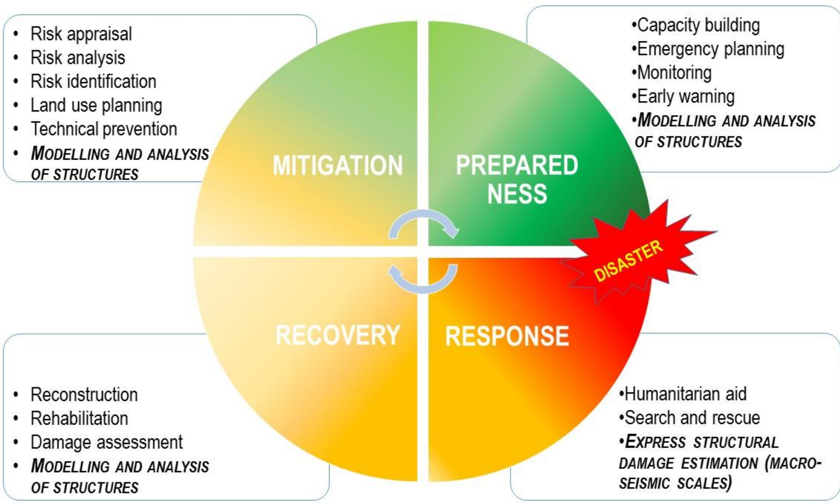


Figure 1. Phases of disaster management and relevant activities

In general structural assessment procedures might be classified into three groups - measurement based assessment, model based assessment and non-formal assessment. These different structural assessments are related to different level of damage of the structures, which can be estimated based on observations (field investigation or experimental lab studies) or modelling and relevant computations. Field investigation provide qualitative estimation of structural damage, based on preliminary set instructions and description of the damage – pictograms, tables, scales. Model based assessment provides quantitative damage estimation based on experimental studies on physical models and / or numerical studies on computational models of the investigated structures.

Structural Damage Assessment

The disaster management cycle proceeds in four phases (fig.1), that often cycles overlap and the length of each phase greatly depends on the severity of the disaster. During the mitigation phase major efforts are targeted on minimizing the effects of disaster through updating and improvement of building codes and hazards zoning; vulnerability analyses and public education. The preparedness phase is devoted to planning how to respond - preparedness plans; emergency exercises/training; warning systems. These two phases provide the time for performing structural analyses for damage estimation, setting correlations between recorded earthquake excitation and damage level for different structural systems, design of early warning (shut down) systems, etc. The attention during the response phase is focused on the efforts to minimize the hazards created by a disaster and do document reliably the occurred damage - search and rescue; emergency relief, qualitative structural damage estimation. This phase is followed by the recovery phase, which task is to return the community to normal function providing temporary housing; grants; medical care and quantitative structural damage estimation, fig.2.

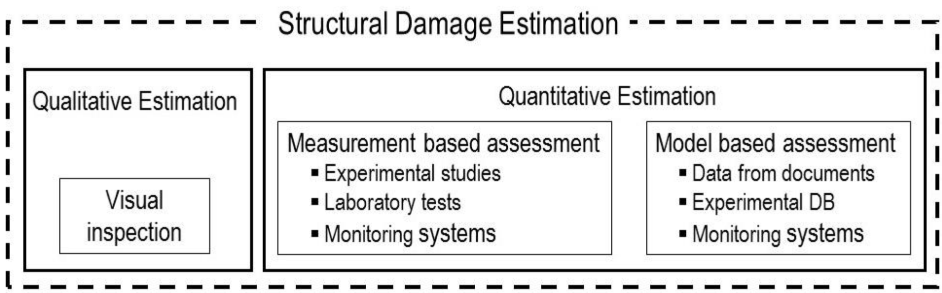


Figure 2. Structural damage estimation methods

EARTHQUAKE DISASTER RESPONSE AND RECOVERY PHASE – FIELD INVESTIGATION

Emergency response aims to provide immediate assistance to maintain life, improve health and support the morale of the affected population. The focus in the response phase is on meeting the basic needs of the people until more permanent and sustainable solutions can be found. This phase includes express damage estimation of buildings and structures, usually in green (safe) – yellow (caution) – red (access denied) in order to specify their serviceability. It also may involve initial repairs to damaged infrastructure. The immediate relief gradually changes into recovery and then into long-term sustainable development. Different activities during the recovery period enhance prevention and increase preparedness, thus reducing vulnerability. Both short and long term recovery measures, include returning vital life-support systems to minimum operating standards (e.g. temporary strengthening of damaged structures); temporary housing; public information; health and safety education; reconstruction; counselling programs; and economic impact studies. Information resources and services include data collection related to rebuilding, and documentation of lessons learned. Earthquake structural damage during the response and recovery phase are estimated via field investigation, most of which are based on documenting damages based on pictograms classifications.

Macroseismic intensity (MSI) express the effect of the seismic phenomena on buildings and structures – it is used for classification of the severity of ground shaking on the basis of observed effects in a limited area (EMS98). Any intensity scale consists of a series of descriptions of the effects of different degrees of earthquake shaking on a number of things that may be found in an everyday environment. These things can be considered as sensors, since their response to the shaking is used to measure the strength of the shaking. In the EMS98 these sensors are distinguished in four groups: Living things (people and animals), Ordinary objects (crockery, books, etc), Buildings and The natural environment (cracks in embankments, rockfalls). EMS98 is the only intensity scales that deals with building types and relevant vulnerability classes. This scale deals with four types of structures (masonry, reinforced concrete, steel, wood) according the building material and different sub types according the structural systems. Most likely vulnerability class (among 6 classes A-F), probable range and range of less probable, exceptional class are proposed for each sub type of structures. This is done graphically in the Vulnerability Table (EMS98). The building response under earthquake loading depends on the building type. All damage to buildings of a particular type are grouped together irrespective of the strength of the building damaged. Structural damage are estimated in five grades (1 to 5), accordingly graphical illustrations (pictograms) and example photographs provided for the different damage grades. These estimations are only approximate, and are heavily influenced by the need to describe classes of damage which can be readily distinguished by the operator. The estimating operator should be able to distinguish between engineered and non-engineered structures, since locations of damage and damage patterns may also be different. The operators are also supposed to note the difference between structural and non-structural damage, and carefully distinguish between damage to the primary (load bearing/ structural) system and damage to secondary (non-structural) elements (like infills or curtain walls). Immediately after the disaster, often it is difficult to estimate the special case of buildings with ERD distinguishing the damage in the plastification zones – e.g. coupling beams in wall structures, joints in buildings of prefabricated wall elements or beams in joints of frame structures. Problems with the damage estimation might be provoked by the necessity to examine buildings both inside and out, as outward appearances may be misleading - sometimes it is difficult to do this for safety reasons. Damage caused by earthquake-related phenomena other than the actual strong shaking should not be taken into consideration – e.g. damage caused by mutual pounding of adjacent buildings with insufficient separation, landslides, slope failure, and liquefaction. By contrast, damage which is greater than expected due to such factors as resonance conditions, or the strength of the seismic load exceeding the expected level provided for by the level of ERD is still a direct product of seismic shaking and can be taken into consideration.

Major engineering doubts concerning classifying and quantifying structural damage using MSI can be characterized by high degree of approximation to qualitative description of observed damages. The correlation between the structural typologies and the corresponding damages is predominantly based on historical experience rather than on structural response estimation, accounting for particularly applied structural earthquake resistant measures at construction. The significant increase of building stock, constructed under improved structural codes and standards implies the need for constant amending of this scale. The lack of convergence might be coped in various ways – e.g. looking for correlation between MSI and the ground motion characteristics based on acquired observations; using intensity compatible accelerograms (Klugel, 2016) for engineering analysis of structural behavior and response due to earthquake excitation; or via performing full nonlinear dynamic structural analysis of representative buildings and structures combined with use of suitable engineering tools for damage estimation (Boshnakov & Kouteva, 2016). Development of a mobile application with on-line questionnaires, connected with relevant databases, might be very useful for express in-situ damage estimation for both, military and civil purposes.

DISASTER PREPAREDNESS AND MITIGATION PHASE – MODELLING AND ANALYSIS OF STRUCTURES

Mitigation activities aim to reduce the effects of unavoidable disasters, including earthquakes. Mitigation's effectiveness strongly depends on the availability of information on hazards, vulnerability, emergency risks, and the countermeasures to be taken. Mitigation measures include elaboration or updates of building codes and vulnerability analyses; zoning and land use management; building use regulations and safety codes; preventive health care; and public education. Successful mitigation is a result of reasonable incorporation of appropriate measures in national and regional development planning. The urbanisation progress has pushed the real estate development and management industries, and thus the earthquake engineering community faces new challenges. Proper evaluation of seismic performance is essential for decision making towards managing the seismic risk of building, bridges, and other infrastructure. Damage estimation takes very important part of the seismic performance evaluation of buildings and other structures with respect to multiple performance objectives. The safety of buildings and other structures used to be the main concern of designers, owners, and regulators. The development of modern building codes and their enforcement, e.g. the Eurocodes in Bulgaria, has provided society with guidelines that serve well for achieving the required safety levels. It is interesting to be capable to answer the question about the damage accumulation due to different events at which the infrastructure might been exposed during its life /earthquakes, blasts, rock bursts, explosions/. Other relevant questions concern the cost for retrofitting, repair or design of shut down system. These questions relate to the economic aspect of the structural seismic performance. Given the multiple performance objectives, accurate damage estimation becomes more important than ever. Building's seismic performance can be evaluated on different levels of accuracy that meet the different tasks, set by the decision makers.

A rough performance estimate can be obtained by category-based techniques, where all facilities are subdivided into classes that are specified by some formal feature and/or parameters. Then a performance prediction model is built on the observed seismic performance of all available samples within the category (Risk EU, 2004). More advanced techniques include specific building information in the damage analysis, such as particular design features and the site seismic hazard. The information about structural design is usually included in a finite element structural model. The structural models are used for carrying out a structural analysis. Damage analysis is performed either during the mechanical analysis stage by the use of capable software or as a separate analysis stage. If better performance prediction is desired by the decision maker, then more site-specific information can be incorporated in the structural analysis and the analysis can be closer to the real-life structural behaviour. In the initial phase static nonlinear (pushover) analysis can be performed for model checking and preliminary assessment with dynamic time-history simulation. Accordingly, the damage progress estimation technique should match the accuracy of the structural analysis.

The performance of structural elements and interconnecting joints can be assessed by studying their mechanical models, based on the basic approaches a) macro modeling through hysteretic dependences and parameters, and b) modeling of material properties for finite element method based analysis.

The use of damage indices based on structural analysis results despite the comparatively high scatter of measured laboratory test results and thus difficulties in calibration is an acceptable technique for structural damage prediction and/or estimation. The damage index in general is numerical value that gives information about the ratio between the demand and the capacity of the structure or structural member.

The performance of structural element, sub-structural assembly or of the whole structure can be predicted (or investigated) by the established relation between the damage index value to damage state, e.g. Table 3, at particular level of seismic excitation.

The damage index (DI) is a numerical damage indicator obtained from the functional dependency between the particular ground shaking severity causing consumption of structural resource (that can be described by some parameter) used for damage description (D) and the available capacity of that resource (C), (DI=D/C). The damage indicators based on linear or angular deformations, structural rigidity or hysteretic energy can be used. The DI numerical range is between 0.00 - undamaged state, to 1.00 - total damage or collapse. The practical applicability of the Damage index can be assessed on the basic factors influencing the results: (i) structure analytical model, (ii) analytical model of the seismic action, and (iii) the considered damage model (formulation).

Degree of damage	DI range	Damage description
Slight	0,00 - 0,20 (0.25)	Minor cracks
Moderate	0,20 (0.25) - 0,40 (0,50)	Severe cracking
Severe	0,40 (0,50) - 1,00	Crushing of concrete, exposure of reinforcement
Collapse	> 1,00	Partial or total collapse
Note: Values in parenthesis are possible interpretations		

Table 3. Values of DI for various degree of damages (Willians and Sexsmith, 1995;. Park and Ang, 1985).

Case Study - Damage Index Application for Estimating Damage of Reinforced Structure

Some numerical experiments were carried out on a model of 4-sterey, 3-bay RC frame structure that was laboratory tested in ELSA (European Laboratory for Seismic Assessment), Italy at the ISPRA ((Institute for Protection and Security of Citizens) within the ICONS project financed by the EU commission. The investigated model contains features that are specific to buildings constructed in the Mediterranean region about 60 years ago. These structures were designed to withstand gravity loads mainly without considering special earthquake resistant provisions and can withstand equivalent lateral actions up to about 8% of their weight. The mentioned specifics is approximately corresponding to building constructed in Bulgaria during the same period of time and before the 1964 norms for design of aseismic structures were introduced.

The numerical investigation was carried out upon a plane frame structural model, composed of 1-D frame finite elements with distributed plasticity. The Mander and the Menegotti and Pinto models were used to describe concrete and reinforcement performance. Rigid supports were used for foundation modeling. A total number of eight numerical tests were conducted by implementing the nonlinear static (pushover) analysis. The seismic action was adopted to comply with the applied laboratory loads and corresponds to return period T_R=*475*yrs and Type 1 spectrum with reference acceleration $a_{gR}=0.23g$ for a rocky site with ground type *A.* The time history analysis was conducted under the action applied during the laboratory test with total duration of $t=57.5$s.

NONLINEAR STATIC ANALYSIS (PUSH OVER ANALYSIS)

The analysed frame was subjected to different initial load distribution patterns and procedures for incrementation under nonlinear static analysis, available in the SeismoStruct software (Seismosoft Ltd). The obtained results, shown in fig.3, demonstrate stable behaviour of the adaptive load incrementation (both force and displacement) approaches.

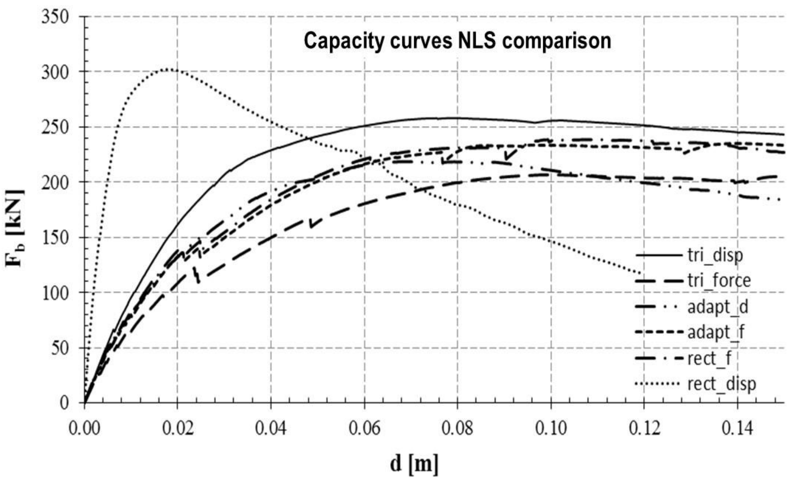


Figure 3. Structure capacity curves obtained by nonlinear static analysis with unconstrained target displacement

The applied formulation for storey damage index is based on normalization to the plastic part of the deformation capacity of the plastic deformations. Storey displacements are obtained through the top level displacement by applying the hypothesis of linearization (rigid body rotation). The obtained idealized bi-linear curve and the yield limit is obtained by applying the equal absorbed energy preposition. Both storey and global damage index values obtained in result, fig. 4a-4d, are just indicative and preliminary. The applied global damage index formulation contains weighting factor that is taking into account the vertical weight distribution and the influence of the storey damage index to the whole structure.

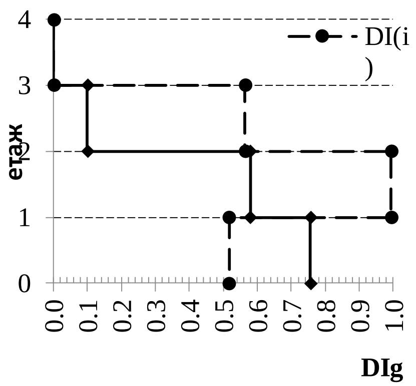
<table>
<tr><td></td><td>Storey (DI(i)) and Global (Dig) damage indices</td><td>Response spectrum of the 475 yrs return period part of the test loading</td></tr>
<tr><td>Adaptive Displacement</td><td>

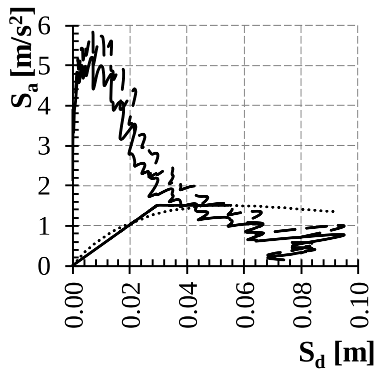
Fig. 4a</td><td>

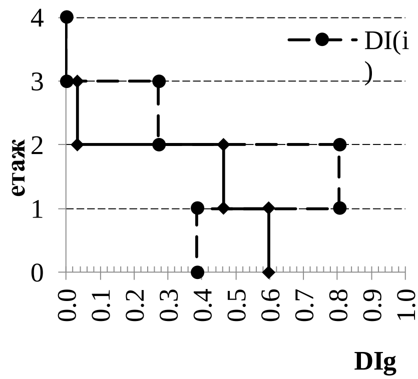
Fig. 4b</td></tr>
<tr><td>Adaptive Force</td><td>

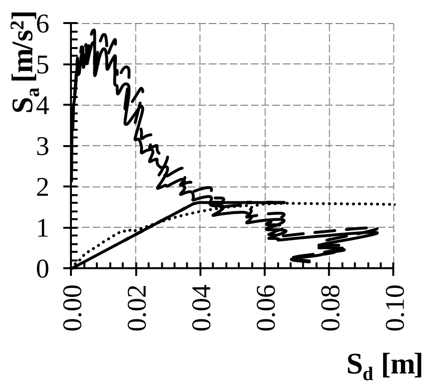
Fig. 4c</td><td>

Fig. 4d</td></tr>
</table>

Figure 4. Global DI result values at action equivalent to seismic excitation with 475 yrs return period

NOTES:

1) IN THE DI GRAPHICS THE DASHED LINE (- -) REPRESENTS STOREY DAMAGE INDEX AND THE CONTINUOUS LINE (–) GLOBAL DAMAGE INDEX.

2) IN THE NONLINEAR STATIC ANALYSIS GRAPHICS THE DASHED LINE (- -) REPRESENTS STANDARD ELASTIC SEISMIC RESPONSE SPECTRUM AND THE CONTINUOUS LINE (–) THE RESPONSE SPECTRUM AT THE REACHED DUCTILITY UNDER THE ACTION. THE DOTTED LINE (…) DESIGNATES THE CAPACITY CURVE OF THE EQUIVALENT OSCILLATOR AND THE CONTINUOUS LINE (–) REPRESENTS THE CAPACITY CURVE OF EQUIVALENT OSCILLATOR WITH PRESCRIBED IDEAL ELASTIC-PLASTIC PERFORMANCE.

The combination of storey damage index and the incrementation of the global damage index can be used for locating of soft storeys and such with increased deformability, storeys with expected increase of damage concentration, storeys with increased importance to structural performance and can give preliminary estimate of expected collapse mechanism.

NONLINEAR DYNAMIC ANALYSIS

By using nonlinear dynamic analysis for the purpose of damage estimation significant improvement of predictions precision of can be achieved. As a matter of fact cyclic degradation is part of the model implemented through the cyclic envelope curves used (Deierlein et al., 2010; PEER Report 2010/111). This explains the necessity of careful parameter values selection for achieving best possible model to structure initial calibration and thus reducing model parameters and uncertainties. By using standardized or measured mean or median values in backbone relationships between characteristic forces and deformations of structural components to define their performance the significant scatter in real structure characteristics is taken into account. Reduction of the uncertainties in the seismic excitation are substantial part too.

Conclusive Remarks

The results of numerical analysis for different damage index formulations based on nonlinear static and dynamic analysis reflect the major aspects of structural performance corresponding to the adopted preconditions and hypothesis. The results are substantially sensitive to the adopted limit values regarding damage. This feature allows the use of damage indices as both damage indicators as well as indicators for structural performance in the context of building regulations and standards. Considering the development of communications and information technologies, the availability of reliable data from structural monitoring becomes necessary, important and valuable. Providing connections between theoretical results, experimental data and field inspection might be very useful for both, prognostic and real-time, structural damage estimation.

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ADVANTAGES OF GIS-INTEGRATED MARITIME DATA IN THE BLACK SEA REGION FOR MULTIPURPOSE USE

Lyubka Pashova, Anna Kortcheva, Vasko Galabov, Marieta Dimitrova

Abstract: *Nowadays, the role and significance of geospatial data are of vital importance for marine/maritime environment management in the Black Sea region at all government levels. An appropriate data organization, systematization and interoperability of marine data sets with in GIS environment allow their efficient managing and usage for different operational needs. This paper address the issues related to: international standards and recommended practices and procedures for the representation of spatial data and associated metadata; an effective integration and visualization of available marine multi-source data provided by research organizations in Bulgaria; online access to marine data using recognized standards; developing marine geoportals and services, which have to meet requirements of the Marine Spatial Data Infrastructure (SDI) considered as a part of National SDI according to the INSPIRE Directive 2007/2/EC/. Capabilities of a web GIS-based information system for the Black Sea, that is elaborated in the framework of the project "Monitoring and Information System of the Black Sea" (MISBS) coordinated by the Bulgarian Ports Infrastructure Company will be demonstrated by visualization in near real-time of the sea state for the Black Sea area. The wave parameters calculated by means of the SWAN wave model and wave forecast are provided by the National Institute of Meteorology and Hydrology - Bulgarian Academy of Sciences. Potential applications of geospatial maritime data integrated into GIS environment are discussed; e.g., for the purposes of Early Warning & Crisis Management (EW & CM), for operations the European Border and Coast Guard Agency FRONTEX to prevent irregular migration at the external EU borders, and for NATO naval operations in the Black Sea.*

Keywords: marine geospatial data, marine forecast, wind waves, SDI, INSPIRE, SWAN, GIS, EW & CM, MISBS, Black Sea

Introduction

The role and significance of geospatial data sets are of vital importance for the purposes of maritime environment management in the Black Sea region.

Implementation of EU Directives (i.e. Water Frame Directive 2000/60/EC, INSPIRE Directive 2007/2/EC, Marine Strategy Framework Directive 2008/56/EC) and the related marine / spatial planning processes require systematization of available and qualitative multi-source data and information, as well as their appropriate organisation and interoperability in unified data bases. One significant part of them comprises geospatial data, which according to some estimates up to 80% of all government data are geographically referenced or related (Saxby, 2006). Data production, storage, synchronization and integral management into GIS-environment greatly increase the utility of geospatial information for different purposes. The GIS tools make easy the data analyses assisting the decision making process at all governing levels (e.g. for Integrated Coastal Zone Management, Early Warning & Crisis Management), applying an Ecosystem Based Approach for better maritime environment management, and supporting the EU policy for sustainable Blue Growth. The practical solutions to overcome existing barriers and risks associated with multi-use development in European Seas would be facilitated through integrated representation of different data and information in GIS environment. Following the EU recommendations to achieve a sustainable operation of the geosciences' observations systems at sea-basin level, this paper address the issues related to international standards, practices and procedures for the representation of data and associated metadata. A short overview of available marine multi-source data provided by research organizations in Bulgaria and available online accessible marine services, which have to meet requirements of the Marine Spatial Data Infrastructure (SDI) as a part of National SDI according to the INSPIRE Directive is outlined. Capabilities of a web GIS-based information system, that is elaborated in the framework of the project "Monitoring and Information System of the Black Sea" (MISBS) coordinated by the Bulgarian Ports Infrastructure Company is pointed out as one example demonstrated in near real-time visualisation of the sea state for the Black Sea area. The followed development of the GIS-established monitoring and information system, possible multi-purpose usage and recommendations for collaborative between different stakeholders in the region are shortly discussed.

Inspire Directive and Marine Spatial Data Infrastructure

Efficiently and effectively usage of the geographic information can achieved following the INSPIRE Directive adopted in 2007 by the EC, the Parliament and the Council (Directive INSPIRE, 2007). The Directive ensures the compatibility with adaptation of common Implementing in specific areas as Metadata, Data Specifications, Network Services, Data and Service Sharing, Monitoring and Reporting. It aims to enable the formulation, implementation, monitoring activities, and evaluation of Community environmental policies at European, national and local level, and to provide publicly accessible information. The main initiative that foresees the maintaining a quick access to, sharing and exchange of geospatial information to support more effective action in all spheres of the public life is establishment of National Spatial Data Infrastructure (NSDI). It includes technologies, policies, standards, and human resources. With the advances in information and communication technologies, a lot of users can access the geospatial data remotely. But, if the problem related to coordinate systems and transformation services is not appropriately resolved, it not is possible to use the full potential of the spatial data and information diversity. The SDI model usually encompasses different categories of components which can be formed based on the variety of interactions within the SDI framework. SDI encompasses two main categories: 1) the human resources that provide for integrated management of spatial data, information, and services; 2) the policies, standards and networks as key technological components.

Bulgarian NDSI

An overview of the Directive implementation and challenges that faced to different INSPIRE & SDI stakeholders in Bulgaria is presented by Pashova and Bandrova (2017). The INSPIRE transposition process has brought the various stakeholders in this domain closer, and this fact has led to the creation and development of an interoperable framework capable of contributing to the creation of a national spatial data infrastructure (National Report of Bulgaria, 2016). A possible approach to that end appears establishment thematic SDIs involving the most active institutions in this field of activity. Still, the lack of a metadata system, the permanent ignoring of any standards (OGC, ISO, etc.), time-consuming bureaucratic procedures related to data sharing / exchange between participating institutions, significantly slow down the implementation of INSPIRE on practice. Since the beginning of 2016 a temporary national portal for spatial data infrastructure connected to the Geoportal infrastructure for spatial information in the EU is functioned. It provides a public access to a small part of spatial data and services for the Bulgarian territory through the web portal http://www.inspirebg.eu/.

Marine Spatial Data Infrastructure

Recently, a marine spatial planning (MSP) concept was adopted by several EU countries that facilitates the effective management of ocean/sea near-shore areas and avoiding conflicts among various actors in this complex environment of competing claims for land-sea space. On 24 March 2017 a "Joint Roadmap to accelerate Maritime/Marine Spatial Planning processes worldwide" was adopted by the Intergovernmental Oceanographic Commission of UNESCO and the Directorate-General for Maritime Affairs and Fisheries of the European Commission. This roadmap set up main priorities and concrete actions to be implemented to triple the area of territorial waters benefiting from marine spatial planning worldwide by 2030. The Directive 2014/89/EU adopted on 23 July 2014 sets up a framework for MSP including Integrated Coastal Zone Management (ICZM) (Directive MSP, 2014).

As regard to the Black Sea region some options for the realisation of marine spatial data infrastructures to implement MSP through the European Marine Observation and Data Network (EMODnet), and the potential for EMODnet sea basin portals to help coordination of MSP at a regional level are provided in (MSP/EC, 2017). An overview of data and information categories and datasets commonly used in MSP processes shows that Bulgaria has not Maritime Plan, Maritime Policy Framework, and MSP Data or Evidence Strategy. Only the ongoing project of transboundary mapping issues, which are focussed on a combination of specific sectorial interests, is MarsPlan: Cross-border MSP in Black Sea – Romania and Bulgaria led by the Romanian Ministry of Regional Development and Public Administration.

MSP process can regulated more efficiently and effectively both from spatial and temporal perspective if based on a national Marine Spatial Data Infrastructure (MSDI) as an integral part of National SDI and services provided for operational needs. Such infrastructure should provide for the land and marine areas an interoperability or information connectivity of national reference datasets for their joint modelling, georeferencing and data exchange (Fig.1).

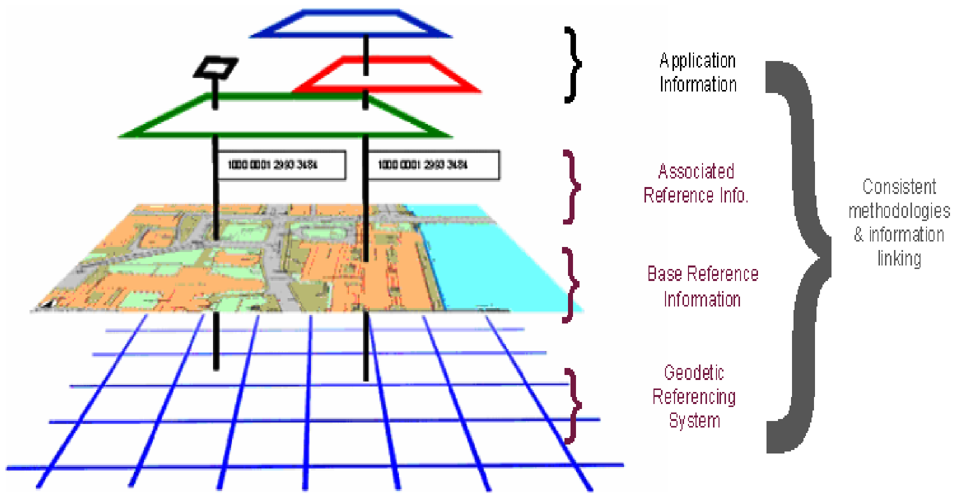

Figure 1. A framework to integrate all kinds of geoinformation (Source: DNF, 2004)

An efficient management of geospatial datasets and related information for sea space is based on well-built MSDI. It contributes to the maintaining a quick access to, sharing and exchange of geospatial information supporting more effective governing activities in marine domain. As a good example for a concept, models and stages for establishing a marine SDI in Germany can pointed this one which is suggested by Rüh and Bill (2012). The authors suggest a framework for evaluation of MSDI based on the experience of other countries that have already built their maritime spatial infrastructure. Within the framework of MSDI the information concerning the fields hydrography and surveying, coastal engineering, protection of the marine environment, maritime conservation, regional planning, sustainable management of natural resources and coastal research can merge.

Multi-Source Data for Marine Environment in Bulgaria

According to the INSPIRE Directive, the relevant themes addressing the marine information community are generally presented in Annex III (Directive INSPIRE, 2007). Marine spatial data specifications related with implementation of European MFD includes themes like Agricultural and Aquaculture Facilities, Area management/restriction/regulation zones and reporting units, Biogeographical Regions, Energy Resources, Environmental Monitoring Facilities, Habitats and Biotopes, Land Use, Mineral Resources, Natural Risk Zones, Oceanographic Geographical Feature, Species Distribution, and Sea Regions. The data specifications of these themes should follow common set of standards (e.g, WMO, ISO, OGC), technology and policies for data, metadata, and data quality. Interoperability between marine data sets is assured through applying the INSPIRE Directive common metadata standards and XML schemas, standard data transport formats, common QC methods and quality flag scale, common Vocabulary Web services, Unified user interfaces for querying Discovery services, etc.

The National Institute of Meteorology and Hydrology at the Bulgarian Academy of Sciences (NIMH-BAS) is one of the organisations providing operational 24/7 hydro-meteorological services, various forecasts and data products (http://www.meteo.bg/en). NIMH-BAS is a member of the World Meteorological Organization (WMO), which Information System (WIS) is the coordinated global infrastructure responsible for the telecommunications and data management functions. WIS provides an integrated approach, suitable for all WMO programmes, to meet the requirements for routine collection and automated dissemination of observed data and products, as well as data discovery and access and retrieval services for all weather, climate, water and related data, produced by member countries and organisations. WIS is built upon ISO 19115/19139 XML metadata standards to be interoperable. All metadata records are also conforming to the EU INSPIRE directive. Thanks to WIS, the data and derived products are available and exchanged freely and in an unrestricted manner every day between WMO centres and weather offices in each country.

NIMH-BAS has Government’s mandate to issue early warnings for weather, water and climate hazards, warnings for public and marine safety. Of particular importance for the meteorological service of the Department “Marine forecast” is the ability to provide forecasts of different parameters concerning wind, waves and storm surges for the Black Sea area (Kortcheva et al., 2012; Galabov et al., 2015). The combination of models covering different processes and spatial scales provides a comprehensive picture of the physical state of the Black Sea. An operational NIMH-BAS marine forecast system is based on four numerical models: two wave models SWAN and WAVEWATCH III, storm-surge model

SLBUL and oil spill model MOTHY. NIMH-BAS numerical wind, waves and storm-surge operational products have been used to identify the areas vulnerable to the natural hazards along the coastal zone of Bulgaria and are the main parameters of the Multi-Hazard Early Warning Systems and the European map METEOLARM.

The wave modeled parameters have been validated using all available measurements including the Earth Observation satellite altimeter and scaterometer data. The quality of the results provided by the forecasting system is analysed statistically. The validation of the modeled parameters provided by the forecasting system is carried out by performing comparisons with both wind and wave measurements from the coastal hydro-meteorological stations and satellite altimeter data from Jason 2/3 and SARAL Altika satellites over the Black Sea area. The scatterometer wind data from the Advanced Scatterometer on board the Metop-A satellite used for the validation of the regional numerical weather prediction model ALADIN. The comparison between modeled and satellite altimeter data indicates a good quality of the forecast products provided by the operational marine system of NIMH-BAS (Dimitrova at al., 2013). Fig.2 shows the along-track significant wave height measurements from available satellite altimeters Jason-2, Jason 2 and Saral ALTIKA over the Black Sea on 30 December 2016.

Besides NIMH-BAS, several research organisations and universities (e.g., IO-BAS, NIGGG-BAS, IBEI-BAS, etc.), ministries and governmental institutions (e.g., MoEW, EEA and Black Sea Basin Directorate, MoRDPW and AGCC, MoTITC, National Agency for Fisheries and Aquaculture, State Enterprise Port Infrastructure, Maritime Administration Executive Agency, etc.), municipalities, NGOs, and Private companies collect, processed and distribute marine/maritime geospatial information. Pashova et al. (2016) have outlined still existing obstacles for provision of geospatial information from monitoring stations along the western part of the Bulgarian Black Sea coast. Some of the marine data holders have developed their own thematic portals to provide electronic services with available spatial data. In the general, the geoportals are built inconsistently with the requirements of the INSPIRE Directive, including on the possibilities of providing standardized services in a network information environment.

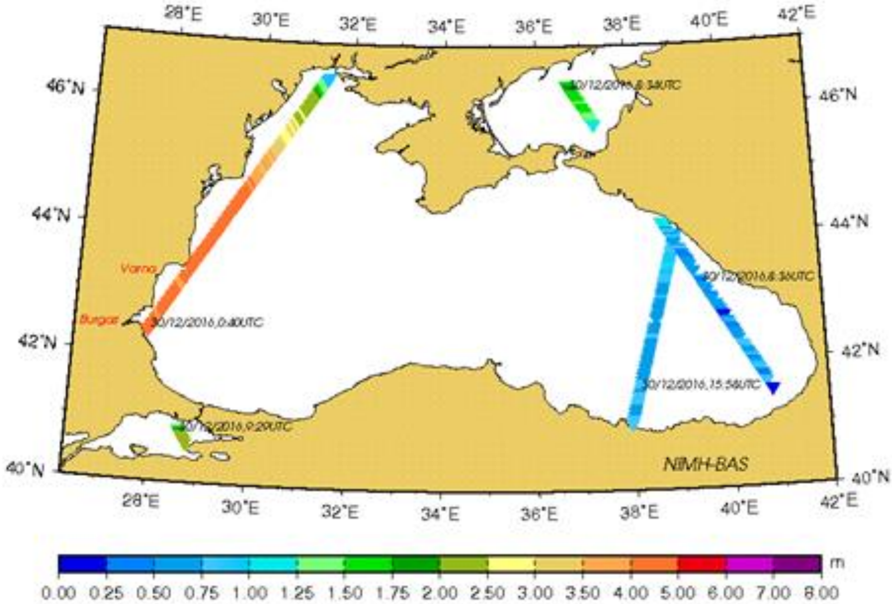

Figure 2. Satellite tracks over the Black Sea from Jason2, Jason 3 and SARAL ALTIKA on 30 December 2016.

Lately some public authorities involved in the INSPIRE Directive implementation and acting in their capacity as creators, administrators, holders, users or having other function seek to follow its recommendations. Separate state institutions provide public access to spatial data they administer or provide relevant services facilitating the exchange of spatial data. The national report of Bulgaria published on the INSPIRE geoportal (http://inspire.ec.europa.eu/INSPIRE-in-your-Country/BG) includes achieved results of the implementation of the Access to Spatial Data Act / INSPIRE Directive for the period 2013-2015. Information on spatial data sets from three Annexes (I, II, and III) in the Monitoring Table for 2016 does not include the following topics of the INSPIRE Directive: I.2. Geographical Grid Systems; III.6.Utility and governmental services, III.8. Production and industrial facilities, III.9 Agricultural and aquaculture facilities, III.15. Oceanographic geographic features, III.16. Sea regions, III.17. Bio-geographic regions.

Thematic Department's Geoportals

There are already some geoportals in Bulgaria that provide access to spatial data at national level (see e.g. Pashova et al., 2013). Usually such geoportals are elaborated within the framework of funded projects or under the EU programs with national co-funding. Some of them provide an access to network services for discovering, viewing and downloading the geoinformation following the INSPIRE requirements.

Recently accomplished project related with the establishing of integrated information system for real-time monitoring of the Black Sea is the project "Monitoring and Information system of the Black Sea - MISBS" (https://misbs.bgports.bg/) of the Bulgarian Ports Infrastructure Company (BPIC). The system is implemented with the financial support of the Norwegian Financial Mechanism 2009-2014 as part of the Innovation Program in the Green Industry in Bulgaria. MIS of Black Sea is realized by consortium STEMO - ESRI in the form of web portal, supporting multiple specialized web-based GIS applications. One of the main objectives has been the establishment of a spatial data infrastructure for monitoring the environment in the Black Sea and the coastal area for the Bulgarian institutions. NIMH-BAS through department "Marine prognoses" is one of the partners in the project, which contributes to the integrated system through providing real-time data and prognosis for the next three days for the sea state (MISBS, 2016).

An example of an integration of sea state parameters (significant wave height and direction of wave propagation) and a dynamic visualization of the SWAN wave model results in the GIS environment using ArcGIS tools is presented on Fig.3 (Kortcheva et al., 2017). Fig. 3 demonstrates visualization of dynamical wave model results in the GIS environment and basic GIS functionality. The significant wave height at the required location can be retrieved and displayed from the GIS map with a single mouse click on any point of interest. The visual expression of Black Sea numerical wave forecasts through the integrated MIS system enables end-users to view, analyze and manage the results of the simulation in a geospatial context. The numerical wave forecasting system allows the spatial and temporal expression of forecast parameters in GIS environment by visualization of sea states dynamically represented in the time and space in innovative way.

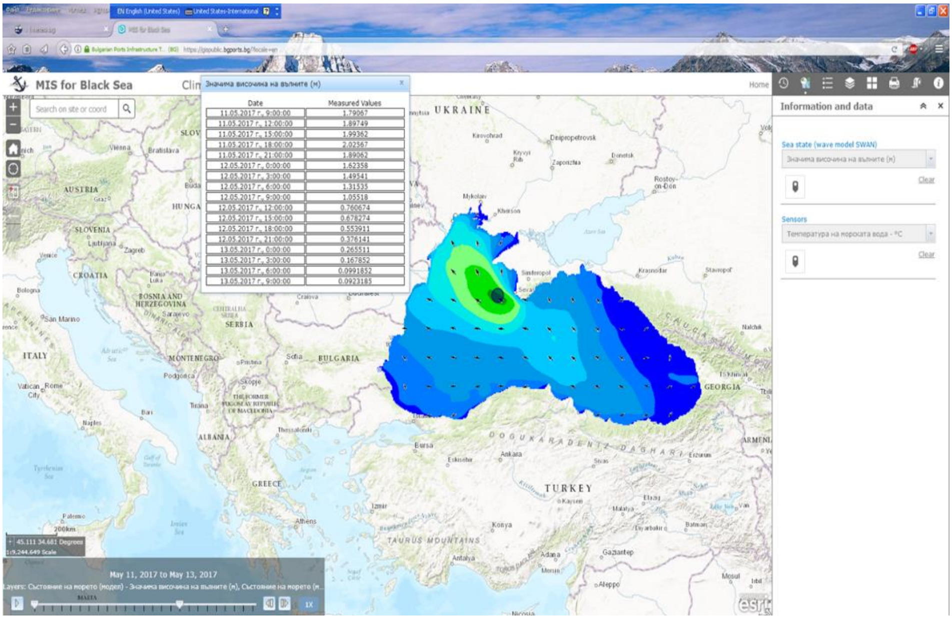

Figure 3. User interface of web GIS based application in MISBS showing SWAN simulation results for the Black Sea (at the bottom left is the Time Slider window and on the top is the table with time evolution of significant wave height at selected point)

A fully automatic process converts the vector data into maps using GIS techniques. An interactive map algorithm allows the user to explore the map at any location and to view the model output information in an efficient manner. The GIS platform features a visual expression of the information and geospatial analysis making it the useful tool for visualization information system for marine forecast. The results of the numerical forecast of significant wave height and wave directions the Black Sea become spatially comparable and directly accessible for analogous GIS-based systems.

Discussion

Spatial datasets in Bulgaria are decentralized, created, stored, and administered by various governmental structures under specialized national laws and requirements of European directives (National Report of Bulgaria, 2016). Their analysis shows that the information contained in them covers a large part of the themes of the INSPIRE Directive but does not comply with the required standards and specifications. Many spatial data holders have developed their own thematic portals, which usually are not linked to a single network structure. In many cases, the electronic services with available spatial data are inconsistent with the Directive requirements. Recently, at national level some initiatives and programs are underway to intensively bring available spatial data in line with the specifications and regulations for interoperability of data and services related to the INSPIRE implementation.

Following the international geospatial standards for service interoperability and sharing, integration and visualization of huge datasets in web-based GIS environment considerably facilitate discovering, visual analysis, exchange and effective usage of data. Achieving harmonization between datasets requires compliance with metadata formats, data access interfaces, and data content models provided by GIS tools. The built web-based GIS system for the Black Sea by the BPIC is one of the examples, which demonstrates the "bottom-up" approach in creation of thematic geoportal in the framework of one national project. This approach is imposed in the country as a rule, due to a number of circumstances determining the delay in the establishment of Bulgarian national spatial infrastructure (Pashova and Bandrova, 2017). As public authority responsible for creating spatial data sets on the relevant themes (or parts of the themes) of the Annexes to the INSPIRE Directive the BPIC develop, maintain and manage services for the spatial datasets related to the Black Sea region according to the standardization requirements. Beyond the Project MISBS activities can directed to:

- Regular reviewing of the warning system performance, receiving the user feedback, and identifying problems and actions needed for an improvement;
- Improvement the basic set of standard operating procedures between NIMH, end users, and communities at risk;
- Building institutional capacities for the application of warning information products in decision-making;
- Interagency interaction and collaboration is a very important task to narrow gaps and to develop disaster risk management plans using a coordinated approach.

The system realization by MISBS project allows its further developing by integrating new spatial data from multiple sources. Future development of this work could be adding layers, e.g. bathymetric and remote sensing satellite data for the Black Sea area, overlaying the wave data with other geospatial data on the same GIS map, etc. Public entities responsible for creation and maintenance of the spatial data sets under the themes related to MSDI, which they administer in compliance with the requirements of relevant state regulations, can provide access to them by network services. Such institutions at the Bulgarian academy of Sciences are the Institute of Oceanology – Varna and the National Institute of Geophysics, Geodesy and Geography. The MISBS can upgrade and broaden as part of operational multi-source geospatial platform for the Black Sea region, which then can be linked to the national geoportal. A few potential applications of the geospatial marine information integrated into web-based GIS platform are listed bellow:

• In coastal search and rescue operations and for the EW & CM purposes the access to timely and reliable weather-oceanographic forecasting products is of crucial importance. The geospatial wave data are generally more useful than information in ASCII format for maritime rescue and search operations of Executive Agency Maritime Administration, Maritime Rescue Coordination Centre and other users;

• Integrating the information on the environmental conditions at sea into the GIS platform provides a useful tool for mariners to optimally execute their activities avoiding areas of high waves and selecting the propriety ship routes;

• The geospatial sea state forecast together with the satellite information can support the European Border and Coast Guard Agency FRONTEX (Malinowski, 2016) in its operations for constantly monitoring of the western part of the Black Sea and prevention of irregular migration at the external EU borders;

• Maritime geospatial information can support the NATO operations in the Black Sea region of all levels of strategic decision making through operational planning to the tactical conduct of operations and trainings;

• Local governments and decision makers can not only visualize but also manipulate and integrate the geospatial sea state information necessary for coastal flood hazard and risk assessment (MFHRA, 2013). The new geospatial marine data will contribute to implement the EU Directives in Bulgaria and expand the opportunities for their multi-use, including the scope for innovation and Blue Growth potential.

There are some difficulties regarding colleting the geospatial data for the Black Sea region that should to overcome including:

- Usage of different coordinate systems;
- Data gaps or missing basic information for data sets;
- Missing documentation;
- Incompatible spatial data sets;
- Varying standards to the sharing of spatial data;
- Ensuring sustainable funding, etc.

An essential difficulty to be overcome at national level is to ensure the sustainability of positive results from the implementation of projects related with establishing MSDI. An example, due to lack of sufficient resources and funding for maintaining an infrastructure that collects geospatial data for the western part of the Black Sea is the system POMOS (http://www.bgodc.io-bas.bg/ma/DefaultENG.aspx), which is currently not fully operational. As regard as MSDI some recommendations for further developing of integrated web-based information systems, that should follow the INSPIRE Directive rules, can stipulate.

• To increase the use of GIS tools for the management and integration of climatological, meteorological and other environmental data obtained from different sources;

• To increase the availability of relevant, harmonized and high quality geographic data at EU and national level to support implementation, monitoring and evaluation of community policies;

• To insure an interoperability, integration, open-data;

• To undertake steps toward open data policy (country policy, group policy);

• To elaborate web-based GIS oriented products (vector, shape, etc.).

Concluding Remarks

The EC and ESA undertake a joint strategy to establish a European capacity to provide operational information for monitoring and management of the environmental and for civil security. To respond to this strategy Bulgaria should accelerate the pace of development of NSDI/MSDI and to tackle the challenges of providing holistic open-access environmental marine / maritime data. The activities in this direction can include:

- Reducing geospatial data acquisition duplication;
- Effective use of EU and national funds and cost savings;
- Usage common reference data, standards and procedures to ensure interoperability;
- Facilitating cooperation among the stakeholders and other information providers;
- Improved decision making for coastal management, fisheries management, alternative energy development on the outer continental shelf, hazards mapping, oil spill tracking, maps mapping benthic habitats, ecosystem monitoring;
- Promoting geospatial data sharing and facilitates data use;
- Improving the coherence and interaction at national level of all institutions involved in the implementation of INSPIRE Directive 2007/2/EC, Marine Strategy Framework Directive 2008/56/EC and Maritime Spatial Planning Directive 2014/89/EU to ensure that Black Sea is safe, secure, conserved and sustainably used and managed.

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MANAGEMENT OF COMPUTER ASSISTED EXERCISES IN CRISES MANAGEMENT AND DISASTER RESPONSE

Irena Nikolova, Nikolay Tomov

Abstract: *The article presents an approach for managing computer assisted exercises in crisis management and disaster response – environment development, planning, execution and analysis of the exercise. Unified management structure of a CAX project based on project management practices is described.*

Keywords: Computer Assisted Exercises, Crises Management, Disaster Response, Project Management

Introduction

Crisis management is a relatively new field of management. Proactive crisis management activities include forecasting potential crisis and planning how to deal with it and mitigate the negative consequences. Crisis management comprises of identification of the nature of a current crisis, intervening to minimize damage and recovering from the crisis.

Planning for emergencies and crisis situation and disaster response cannot be considered reliable until it is exercised and has proved to be workable. Practicing and testing of all the elements of disaster and emergency plans, politics and procedures within continuous learning processes play important role in capabilities development.

Training exercises and evaluating crisis management process are fundamental for the improvement of crisis management.

Computer Assisted Exercise Approach

As information technologies have become an integral part of our daily lives, the field of education and training could not possibly stay unaffected. Thus, more and more traditional training methods and tools are being substituted by simulation and the training techniques are radically changing.

Applying modeling and simulation methodologies and tools during training and exercises is a new form for capabilities development. Current technologies bridge the training needs and improve the personal capabilities and the capacity of the authorities.

Modeling and simulation in crisis management and disaster risk assessment are applied with the aim to recreate imaginary critical situations in a controlled environment that might occur in real life. Modeling and simulation are becoming even more popular nowadays given the current level of societal development and the power of the technologies in academic, applied and socio-economic areas. Modern technologies enable the recreation of the reality into virtual reality with training purposes. Virtual reality is used to recreate specific events (terrorist attack, hazardous events, natural disaster, social anomaly) which is to serve the users to assess and be prepared in case similar potential real events occur. Simulation becomes one of the most effective method for education and training, which allows, with the use of minimum resources, the evaluation of the current level of preparedness and readiness of the national and institutional authorities and resources.

In the recent years, as a very powerful approach for testing the level of preparedness of the responsible individuals and authorities in case of Crises Management and Disaster Response (CMDR) events the Computer Assisted eXercises (CAX) are used. In its nature CAX is a "synthetic" exercise, where the forces and resources are generated, operated and managed in a simulated environment [1] [2].

CAX is one of the valuable tools for enhancing the effectiveness of training and achieving interoperability at low cost and reduced risk, in comparison to field exercises. CAX is especially applicable in situations where the "recreation" of similar crises management situations in real environment is too complex, economically ineffective and sometimes infeasible.

Considering the important role of CAX for enhancing the training capabilities in the CMDR sector, a deficiency of unified CAX management for developing specific CAX environments has been identified. Such environment needs to form organizational system of concepts, approaches, methodologies, tools and means for effective realization of processes. The design, development and utilization of unified CAX environment is a multidiscipline systematic approach for CAX management and afford opportunity for planning, execution and results assessment of Crisis management CAX projects.

CMDR Computer Assisted Exercise Concept

The Computer Assisted Exercise is an effective tool for individual and collective training for the achievement of a certain level of knowledge for an effective response in case of CMDR events. The CAX reduces the risk level, enables 'time jumps' and repeating scenarios for a short time interval, as well enables scenario simulation which practical implementation is very difficult to achieve with unexpected negative consequences.

The typical CAX has 4 main purposes:

- validating plans (validation);
- developing staff competencies and give them practical experience in carrying out their roles in the plans (training);
- testing well-established procedures (testing);
- experimenting various approaches and tools (experimentation).

CAX is the most cost effective approach for providing joint training for complex exercises. There are some elements of training at the tactical level that can only be provided by Field Training Exercises (FTXs). Therefore a combination of CAX and FTX is required with both elements ideally being present in a single exercise [3].

The proven advantages of CAX are as follows:

- enables an inexpensive game environment for great number of scenarios;
- enables simulation of scenarios and missing players;
- enables modeling of various process;
- eases the communications and mediation among all levels of public, private and authority relationship;
- creates conditions for quantitative measurements of group work and analysis;
- enables "stimulation" of thinking and experimentation, as well good furnishing of documentary evidence trough the experimentation process;
- enables knowledge gathering for various groups of participants;

- enables concept experimentation, technological demonstrations and testing of processes for decision making.

Conducting a CAX in any organization usually aims to validate the contingency plans, the specific measures that should be undertaken or procedures that have to be followed during or after an emergency situation. The advantages of CAX find expression in the experimentation and validation of strategies, concepts, policies and procedures for crisis management before their practical implementation. Each exercise is unique, designed to test specific elements of a crisis and disaster response. CAX for CMDR is beneficial for all the participants – from the high level authorities, responsible for decision making, to the level of the first responders.

CAX Management Methodology

For the successful implementation of CAX as an efficient tool and effective approach for CMDR training, it is necessary to be developed a detailed plan for building and utilizing the exercise environment, as well how the CAX will perform and the results will be analysed. All these are complex activities, which require specific knowledge and experience in the planning and management area. That complex methodology combines the philosophy of project management, understanding of the innovative training procedures with the extended use of live, virtual and constructive simulations and the experience of exercise development. In that regard the CAX is proposed to be planned, executed and analysed according to the Project Management Approach – as a specific project dedicated to deliver the desired results and achieve its objectives. The managers of the project need to have an appropriate toolkit comprising management techniques for planning, executing, assessing and controlling the project activities. The idea is to have cost effective and efficient training and planning processes that will enhance the achievement of training objectives, which could be ensured by good project management, which defines the exercise goals, organises the work packages and assigns the workload to highly motivated, qualified and experienced teams.

The design, development and utilization of unified CAX environment is a challenging multidiscipline systematic approach for CAX management and enables the opportunity for planning, execution and results assessment of CAX projects in the CMDR domain. This environment should form organizational system of concepts, approaches, methodologies, tools and means for effective realization of processes and their improvement.

Adding a structured framework for project management enables monitoring and control on finances, tasks, resources, information, quality, risks and guarantees successful accomplishment of the CAX projects. The specific benefits are as follows:

- Projects implementation in scope, in time and in budget;
- Transparency, distinct distribution of responsibilities and assessment of deliverables and achieved results at each project stage;
- More effective and efficient resource management;
- Storing data and knowledge gained.

CAX Project Management Lifecycle

Every CAX project enrols one and the same basic project management lifecycle, but the degree of control, the volume of utilized resources, the documentation generation and the coordination required depend on the size and complexity of the project. Also, different scales of project require different levels of project management competence.

The project management process or lifecycle is a 'tactical' view of the project management work – it defines not only 'what' have to do; but also 'how' you will do the work.

Considering the CAX specific features and the best practices, the CAX management methodology is recommended to follow the five phases of the project management lifecycle: **initiation, planning, execution, monitoring and control, and finalization**.

Typically, a project management process follows a flow similar to the "Plan-Do-Check-Act" cycle, defined by Shewhart and modified by Deming (from the ASQ Handbook, pages 13-14, 1999). Simply said, the phases or steps of the PDCA cycle are linked together by results – the result of one step becomes the input to another.

Alignment between project management processes and the project lifecycle is driven by project work, deliverables, and milestones.

The usual lifecycle of CAX project is a period between six months to a year and a half and in some cases, depending on the scope and objectives – more than 2 years. All activities and resources during the lifecycle should be planned and accessed against CAX project goals and objectives.

Taking into consideration the above mentioned, it is obvious that management of the CAX projects will be streamlined significantly if there are software automation tools with implemented appropriate methodologies inside, as follow:

- Software for Resource and Tasks Planning during the Project Life-cycle period;
- Software for Budget Planning and Controlling of resources;
- Software for CAX management itself;
- Software for assessment of the players' performance and achievement of the goals and objectives of the projects, as well as the strategic goals of organizations involved in the project.

The integration of those software tools for management, reporting and evaluation could increase the effectiveness of the project management team.

Initiation Phase: Preliminary Analysis, Identification of Alternatives and Initial Planning

Usually, this phase starts several months before the exercise. During the phase the main structure of the project should be defined, as follow:

- CAX objectives, participants, scope and environment;
- Identification and schedule of the activities;
- Assigning tasks and responsibilities;
- Allocation of resources needed;
- Identification of the possible funding sources and programmes.

After these steps the Initial Plan should be created and presented for approval to the stakeholders. If there are two or more sponsoring organizations – the whole Project Plan should be presented according to the requirements to all these organizations.

Planning Phase: Exercise Planning

One of the crucial factors for the CAX project's success is working out an accurate and detailed project plan. Following the basic steps in planning the project ensures that there is a clear purpose as well as good coordination and control throughout the project development.

The project plan contains the following elements:

- Goal –oriented approach (focus on results);
- Definition of tasks;
- Allocation of resources;
- Maximizing results through an appropriate time management.

A well worked-out plan should be used as a tool for:

- Costing;
- Evaluation;
- Reporting;
- Management.

After approval of the Initial Plan the project planning team should develop detailed plan for tasks, resources, responsibilities and time-line of the CAX project. The detailed plan have to be developed within the limits of the resource framework approved in the previous phase and according to the specific requirements for planning, documentation and reporting of the sponsoring organizations.

That phase also includes Exercise Development Plan and CAX specification documentation that is defined by a set of documents, including scenario creation, role assignment, system and network specifications and architectures, simulation environment specification, logistic support plan, etc. The final outcome is the Exercise Plan and fully documented Scenario (where MSEL is also included).

Preparation Phase: CAX Environment Preparation

During the Preparation Phase the entire CAX environment should be deployed according the detailed planning documents prepared and approved in the Planning phase, including the network, IT systems and simulation software tools. Systems and network testing have to be performed also and pre-exercise training of the participants is strongly recommended to be held. In that phase

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Execution Phase: CAX Execution and Reporting

The phase starts with CAX execution and continues until the end of the last activity of the Exercise. All participants are fully aware of their roles, as they have already been trained and the Exercise Start time determines the beginning of the scenario unfolding. During the execution phase of the CAX is absolutely necessary to control and adjust the scenario, if required, to achieve the exercise objectives. Managing the human resources, facilities, ICT systems and logistics in the most proper way will ease the CAX realization and will allow the participants and stakeholders to focus on the exercise goals and objectives rather than resolving issues that disturb the smooth CAX execution.

The reports on the CAX performance have to be provided to all organizations involved, in order to collect and structure the needed information and data for the next phase. It is important to have the information on time thus to ensure fast and appropriate reaction of the management to the environmental changes.

Evaluation Phase: CAX after action review and analyses

After Action Review is one of the most important activities after the CAX execution, which provides to the participants initial results from the exercise. Then detailed analysis of the collected observations and information is made and lessons learned are presented.

The project closing processes ensure formal finalization and acceptance of the achieved results and deliverables. The project finalization is connected with the evaluation of project outcomes and feedback from the participants and stakeholders after the CAX.

Finally, by the means of lessons learned analyses and comparison of the outcomes with the initially planned goals and objectives, conclusion and suggestions for future CAX project improvement are listed.

At that project stage complete archiving of documents and results is necessary to be done and reports and other important documents are delivered to the involved parties.

Monitoring&Control Phase

The Project management of CAX depends on the identification of the appropriate measurements and criteria for successful CAX project realization.

The complete aggregation of activities during the project execution, imposes control from the operative level management in all aspects: Scope management, Time management, Resources management, Cost management, Quality management, HR management, Knowledge management, Communication management, Risk management and Procurement management.

In the frame of controlling processes, through observation and measurement of the performed activities and

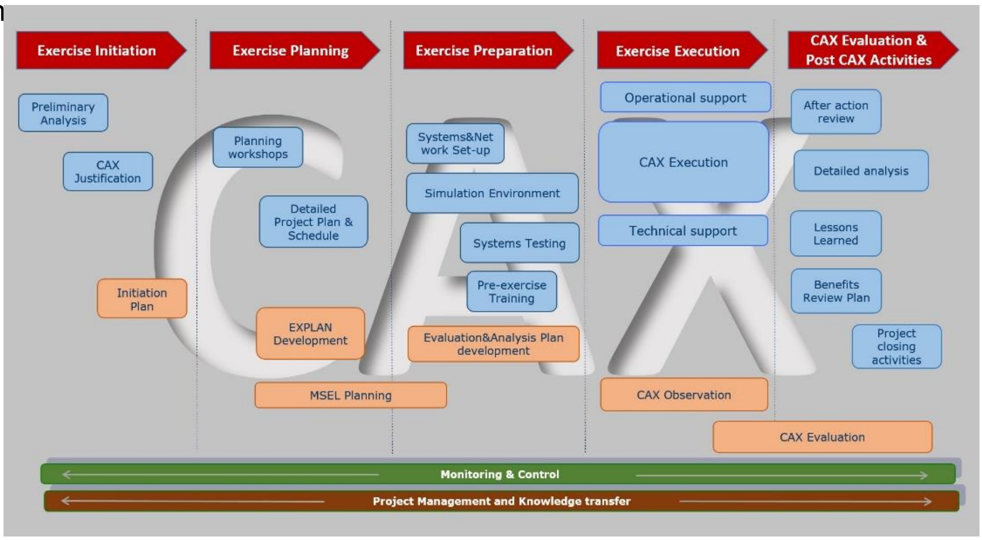

Figure.1. Phases in CAX Management

CAX Management Structure

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- Strategic Level, where strategic decisions are taken;
- Management Level, where operative decisions are taken, tasks

assignment is performed, risk is estimated and reporting to the Strategic Level is provided;

- Operational Level, where the assigned tasks are executed, work packages are developed and the group efforts are joined;
- End Users Level comprises EXCON Level and Training Level, where the CAX players are involved and benefits from the results achieved by the upper levels.

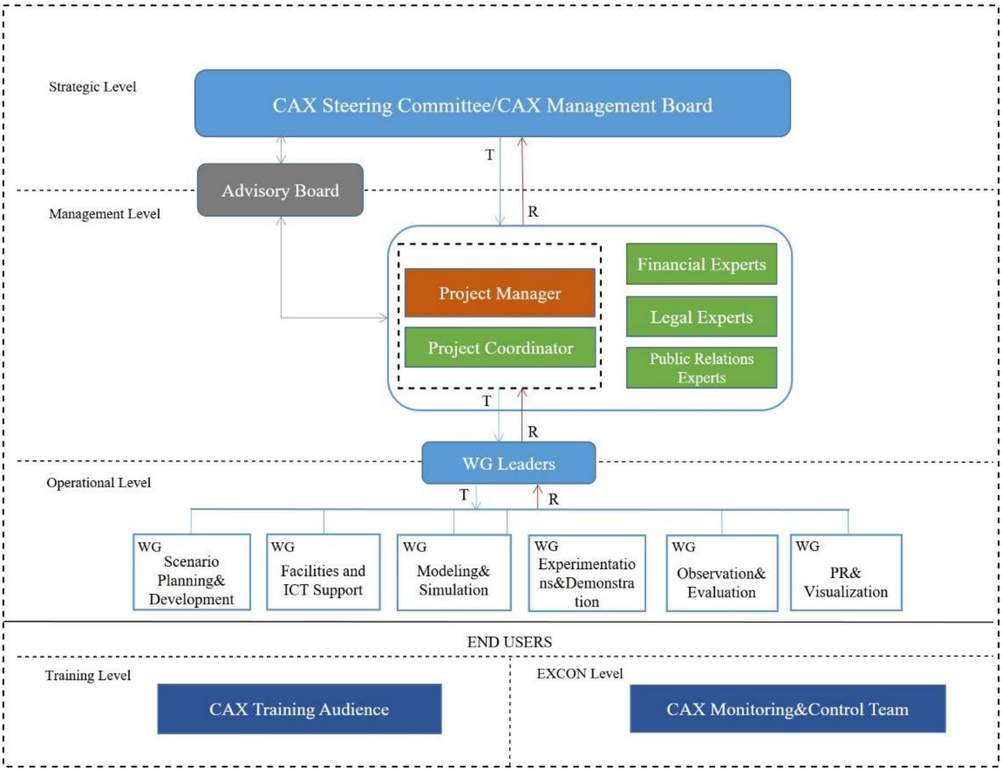

Figure 2. Organizational Chart for CM&DR CAX Management

The management structure could be tailored to the project work plan for any CAX and to any specific requirements and team expertise, in order to provide successful CAX implementation.

Each level of the organizational chart for CAX management comprises different units as follows:

- **CAX Steering Committee/CAX Management Board** – it is the strategic level decisions making body.

The CAX Steering Committee (CAXSC) or CAX Management Board (CAXMB) comprises of nominated representatives (or their designated deputies) from the Sponsors, Stakeholders and Principals, the Project Manager and other members, suggested by the Stakeholders and approved by the Committee. It forms the communication platform concerning the management issues of the work plan implementation and is in interaction with the Management Team.

The CAXSC take decisions on the following matters, but not limited to them only:

- Strategic orientation of the project;
- Approves or rejects the project deliverables;
- Manages scope;
- Manages costs;
- Ensures funding;
- Manages project operational and political issues and risks;
- Considers the relation with other projects and programs;
- Disseminates the project results.

- **Advisory Board** - formed by experts and representatives of the end users organizations. Advisory Board should assist and guide the project activities towards a successful implementation.

Advisory Board is an external group of experts with specific areas of expertise related to the CAX project, ranging from experienced crisis management experts to policy high-level experts and authorities. The utilization of such expertise provides additional quality assurance in the form of high-level guidance for achieving the CAX goals and objectives.

- **Management Team** is the operational management level.

The Management Team comprises a Project Manager and a Project Coordinator (in some cases) supported by financial experts, legal experts and public relations experts. The Management team is responsible for the day-to-day management, administration, coordination, monitoring and control of the project.

- **CAX Project Manager** is the individual who has the overall responsibility for the effective planning, design, execution, monitoring, controlling and closure of the project. In his/her key responsibility is the risks identification and theirs mitigation that could directly impact the project success.

The Project Manager is responsible for:

- The successful realization of the entire project;
- Applying relevant project management methodology and processes;
- Leading the project team;
- Reporting to the CAX Steering Committee / CAX Management Board.

- **Project Coordinator** is an optional member of the project team supporting the projects delivery and that role depends on the scale and complexity of the project. The Project Coordinator is responsible for organizing and controlling project activities under the guidance of the CAX Project Manager.

- **Work group (WG)** – work group team members execute the project tasks assigned by the CAX Project Manager, the Project Coordinator and the Work Group Leader.

  - **Work Group Leader** is responsible for the completion of the work package tasks, quality of the deliverables and managing the dependencies on the other work groups tasks and activities.

The Work Group Leader's obligations include:

- Organization and conduct of regular workgroup meetings;
- Demonstration and reporting of the progress of workgroup tasks;
- Collaborate with the other Work Group Leaders;
- Provide feedback and reports to the CAX Project Manager;
- Maintaining open communication with the CAX Project Manager;
- Participation in the project review process.

- **End Users** are the main consumers of the project deliverables. They are not directly hierarchically dependent by the other levels.

  - **CAX Training Audience** comprises the exercise participants (individuals or teams) responsible for performing actions and responding to simulated incidents during the exercise.

  - **CAX Monitoring&Control Team** comprises representatives from the Sponsors, Stakeholders, CAX Project Manager and additional experts (CAX Observers) who have to monitor and control the exercise to achieve its goals and objectives.

- **CAX Observers** team consists of experts trained to observe and record participant actions. These individuals should be familiar with the exercising jurisdiction's plans, policies, procedures, and agreements. The Observers have no role to play in the exercise but witnesses events either to assess the performance of the players.

The unified project management approach for CAX management ensures a „preventive barrier" within a set of constraints and procedures, which guarantee that the CAX project will not come out of the predefined plan and will achieve its goals [4].

Conclusions

The entire process of the environment development and conducting computer assisted exercise in CMDR is a large scale multidisciplinary challenge that requires adequate management based on best project management practices and methodologies. High effectiveness, transparency and attaining the desired objectives of the exercise could be achieved by applying unified approach for CAX management.

The presented CAX management structure could be adapted to the specifics of CAXs in various scale and complexity in the field of CMDR. That approach has been successfully implemented in two already completed cybersecurity CAXs at the Bulgarian government authorities.

Applying the project management methodologies and tools within the entire process for CAX management is a key approach for enhancing the exercise effectiveness, team efficiency, minimizing the project risks and provides quality control. A key factor for success in the CAX management is the clear understanding of the project goals and objectives and also the open and active communication between all stakeholders and participants involved.

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MICROWORLD GAMES: BEING BETTER PREPARED FOR THE COMPREHENSIVE APPROACH[1]

Johan de Heer

Abstract: *Modern operational environments require awareness on and insight in the comprehensive approach at all levels viz. technical, operational, tactical, strategically, and political. Moreover, professional 21 century leadership skills and competencies are a sin-qua-non in these crisis and disaster management scenarios. Here we focus on two game based learning solutions for training purposes that aim the development of those skills. The first game – Fog of war – is a single-player digital game, in which players are confronted with series of dilemma's that unfold a storyline based on their judgment and decision making skills. The second game – Coalition of the willing – is a multi-player board game based on a simplified dynamic model of the comprehensive or 3D approach, in which players need to bring their collaboration skills to the table. Both game based learning solutions are available for training purposes.*

Keywords: Game based learning Leadership development

Introduction

This paper sketches two 'game-based-micro-worlds' for elucidating Dynamic Decision Making (DDM). "Microworlds" are used to observe and study how people make decisions over time and learn from that. Microworlds become the laboratory ana- logues for real-life situations and aid DDM investigators to study and train decision-making by compressing time and space while maintaining experimental control. Elucidating the dynamics of human reasoning and behaviors, however, is an enigma and requires a theory of mind, appropriate theoretical concepts, methods and techniques for studying and train DDM. Both tools have been used in extensively in the Netherlands. For example, a variant of the Fog of War game is the Mayor Game, which has been used for the last 4 years to train mayors in crisis management skills. Also, the Coalition of the

[1] The part on the Coalition of Willing Game appeared also at ITEC2017 [1]. Variants of the Fog of War game have been described in AHFE2017 [2] and CDSM2016 [3].

Willing Game aka GO4IT is part of the CCOE curriculum since 2011. Both tools nicely fit professional training programs and are highly evaluated by its users. In the next two paragraphs both tools are described.

Fog of War Game

The game flow of this single player turn-taking narrative game based microworld is as follows. First, the player – inhis role as commanding officer - is presented a context scenario, in which the scenario is briefly explained (Figure 1).

Figure 1. Context scenario

Related to this context scenario, a series of dilemmas are introduced that end with a question where the player has to make a 'yes' or 'no' decision. The dilemmas appear over the course of (playing) time. Dilemmas are depicted in bottom left corner in the form of envelopes that can be opened with a simple mouse click - (Figure 2).

Figure 2. Dilemmas

A typical game scenario is a possible drug transport in Caribbean. An example of a dilemma in this scenario is: 'You receive information that some known smugglers are preparing their boat '. You question to answer is: Will you scramble an airplane to start surveillance? Note, there is no right or wrong answer. In the game (virtual) team members are gathered around a command & control system, and may let the player know that they have potential relevant information (depicted by a text balloon above their heads) that may possibly alter the decision if taken into account by the player. The player is free to select and read information from his team advisors, and may even ask them for advice what they would decide (Figure 3).

Figure 3. Asking information and/or advice

Once, the dilemma has been answered, the game pauses and the player is firstly asked to indicate , which information provided by a virtual team member was taken into account and considered relevant regarding the decision he took. Secondly, he needs to indicate his perception with respect to the effect of his decision on the local population and his/her home front (see Figure 4). After he provides this in-situ feedback, the player returns to the game.

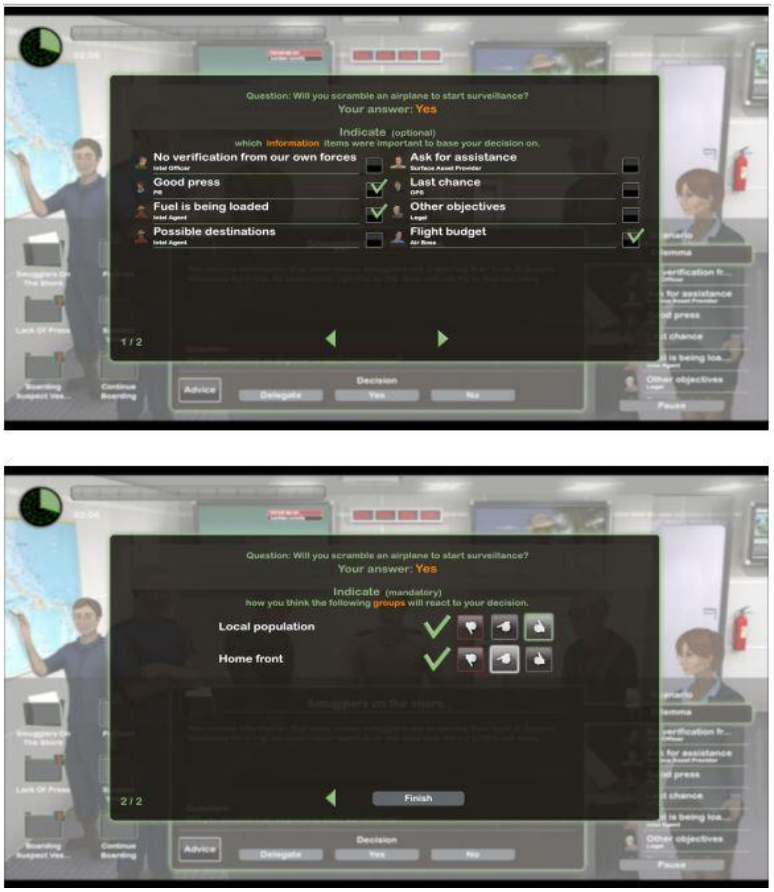

Figure 4. In-situ feedback

The game ends when all dilemmas have been answered or the time limit has been reached (15 min). The player may read all dilemmas first before answering any of them. The player is free to choose which dilemma he will answer first. The player may even delegate the dilemma if he thinks that it is not his responsibility to answer. Besides that, extra information and even advice what to decide from team members is available per dilemma, but again, it is up to the player to decide if and when he uses this information. In other words, the player has several degrees of freedom in a rather constrained environment. A typical training sessiosn with this game based microworld takes about 60 min. It starts with a 5 minutes' introduction on the goals of the training.

Then several game scenarios are played, which will take about 15 minutes for each scenario. The remaining time is spent ondiscussing in hindsight their thoughts and considerations while reaching their decision. The current version of the game based microworld generates the following player models . First, we generate simple descriptive statistics about the time needed to answer dilemmas, the number of dilemmas answered, the number of times advices of various team members were indicated as important (Figure 5).

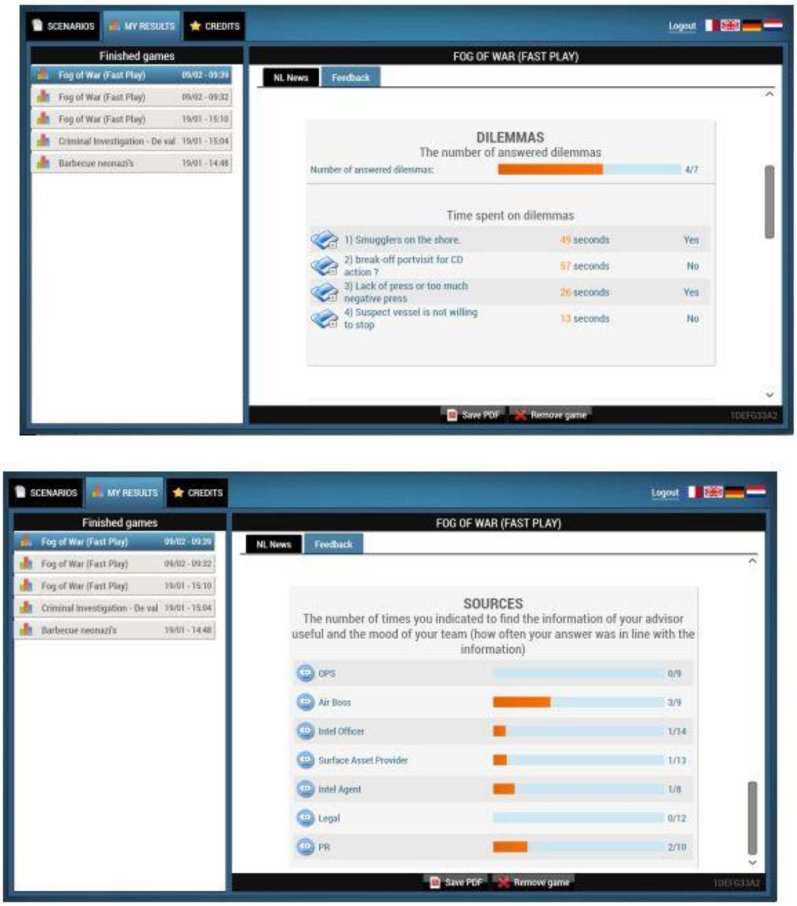

Figure 5. Game statistics

Second, we generate a newspaper article where the narrative (basically, the story the player tells) is based on the choices made during gameplay (Figure 6).

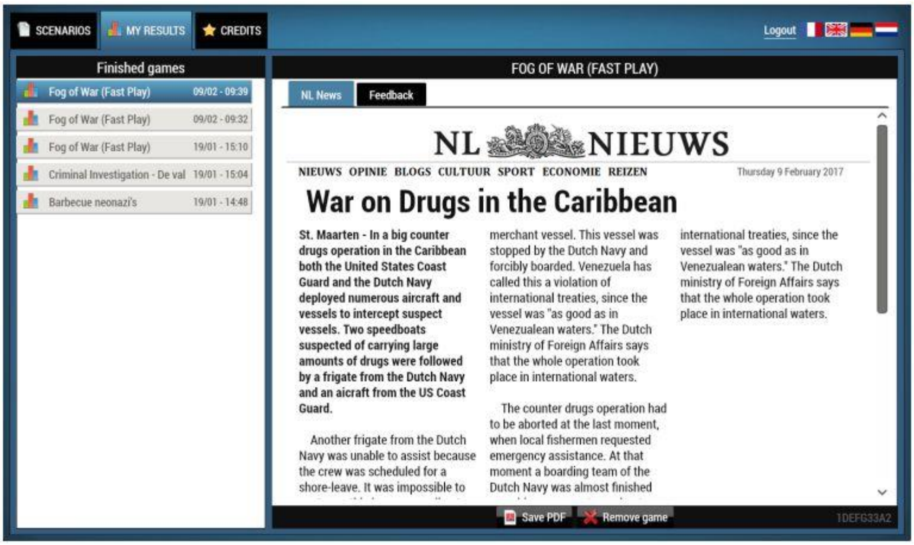

Figure 6. Newspaper article

Third (see Figure 7), player' decisions are related to three different leadership dimensions, (1) 'Diplomacy ', (2) 'Development', and (3) 'Defence'. A graph shows how their answers (in %) are related to each of three dimensions.

In sum, this single player dilemma game aims to make players aware of their 3D leadership style. From a didactical point of view, the game is played individually at first, and the results are discussed at group level. Trainees are encouraged to rationalize their reasoning and sense-making and start a dialogue to discuss this together. This peer-to-peer learning scheme is greatly appreciated by the players. The role of the trainer is to moderate the debriefing session and make references to real world phenomena. The game can be played in multiple ways. For example, with the objective to optimize one of the three leadership styles or balance them out.

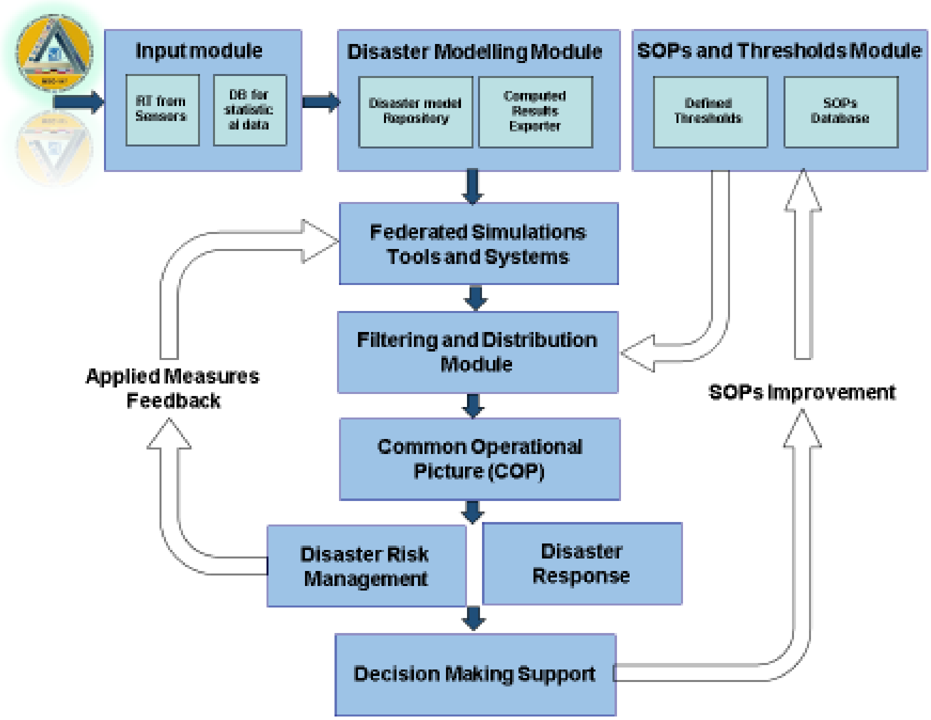

Figure 7. Leadership style

Coalition of the Willing Game

The second Microworld game (Figure 8) is a multi-player board game. The game knows four roles (2 or 3 players per role): TF = Task Force; Blue; OPFOR = OPposing FORces; Local opponent (depending on scenario), Red; NGO = all NGOs together; Green; LG = Local Government; Yellow. And, the location is in sub-Sahara Africa. The conflict is characterized by an eruption of violence after a bomb-attack on the alternative government, militias are on the loose. The present situation: humanitarian crisis; displaced persons, no functioning camps; no functioning government, agriculture nor economy; violence against population, recruitment of child soldiers. The effect indicator board in the middle of the play area represents the current situation in terms of human development (HD), government and rule of law (G), living conditions (LC), safety & security

(S). The tokens are placed on the starting positions of effect indicators mentioned in the scenario.

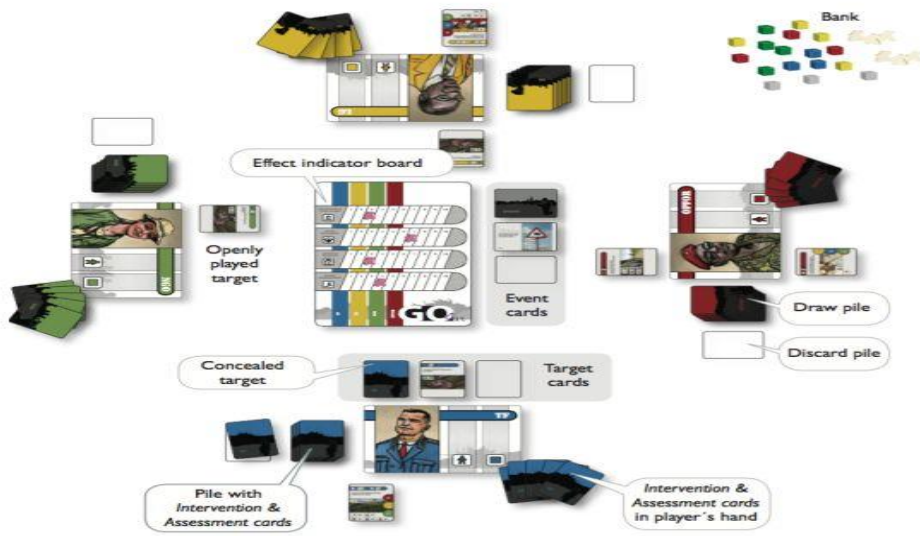

Figure 8. Coalition of the willing game

Each player role has a deck of cards , including target, assessment and intervention cards (Figure 9) . During the planning phase players are asked to choose their targets they wish to play. They can make this choice on their own, or coordinate with other players. The choice should depend on the current situation indicated by the effect indicator board. The players are then asked to choose a set of intervention and assessments cards to reach their targets. Most cards will only become effective if their conditions are met. The players must anticipate this and make their choices accordingly. After a few initial rounds, the players are once again asked to choose their targets and pick out their assessment and intervention cards. Targets have different levels of complexity. If the players choose more targets they also will have a broader choice of interventions to play. This also means that achieving targets will require better planning and will make the game more challenging. Target cards may be played open (face up) or concealed (face down), making them unknown for other players.

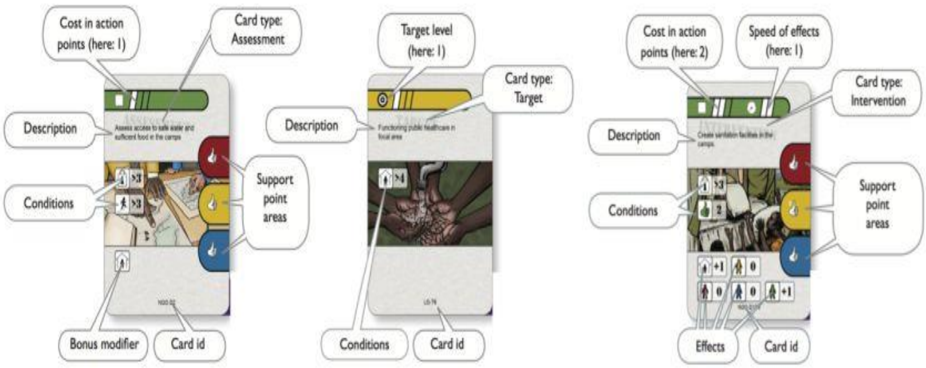

Figure 9. Target, assessment and intervention cards

The game consists of several phases.

Phase 1.

o Each player receives 5 action points from the bank (as long as the supply lasts) and places them on the action point area located on the player's board (see Figure 4).

Phase 2.

o Now it is the first player's turn. The trainer randomly selects the player by drawing a colored player token from a bag. A turn consists of the following steps:

o ***Slow effects***. All effects of the played cards with speed of 1, played the previous round, have effect now, as long as the conditions on the card are met by the values on the indicator board. Required action points to play this card are returned to the bank.

o ***Discard assessments***. The assessments played in the previous round are discarded now and placed on the discard pile. Also, all action points spent on these assessments are returned to the bank.

o ***Play***. The player may spend action points to play a card from his hand. The cost is indicated on each card. The player puts an equal amount of action points on the card when it's played. It is allowed to play cards that do not meet their conditions at the moment they are played. Only when the effect has to take place the conditions have to be met or their action points are lost.

o ***Support***. The other players may now support the played cards by placing their own action points on the support area of the played card. The amount of the support points must be equal to the cost of the card. Each player may support a card only once. For each supporting player, the effect of the support is denoted near the "thumb up" icon. This amount can vary per card and role. The effects of the intervention card are strengthened by this amount. The supporting player may freely distribute this amount over any effects of the intervention card. Supporting assessments allows the player to benefit from its effect when playing their own cards in their turn. See Figure 10 for an example. The player may choose to repeat the Play and Support steps given that there are enough action points available.

o ***Fast effects***. All effects of played intervention cards with speed of 2 have effect now. All action points and influence points are removed from these cards and put in the bank.

o ***Discard***. The player may discard any cards he chooses from his hand. The player then picks cards from the draw pile to fill his hand up to 5 cards.

o ***End of turn***. The next player's turn begins with step 1.

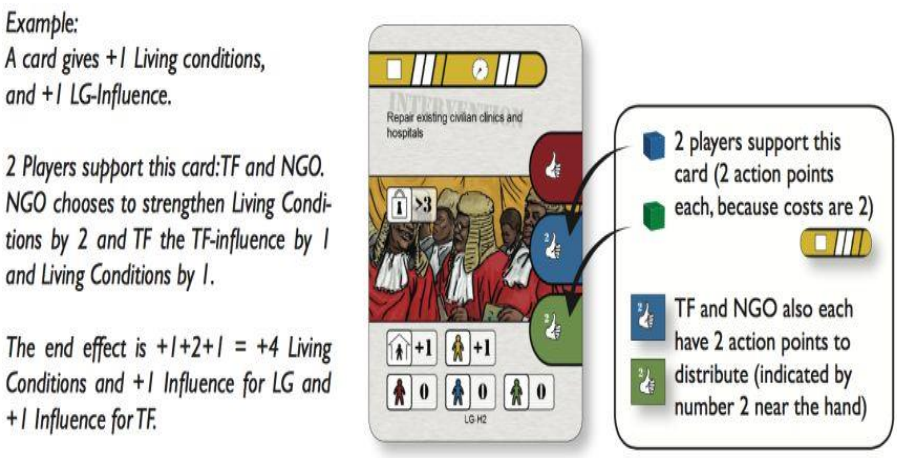

Figure 10. Cooperation

After all players had their turn, the game continues as follows:

Phase 3.

o All players get one victory point for each target card that meets all conditions at this moment. The victory points are placed on the target card and remain there till the end of the game. Concealed targets are revealed permanently once they receive a victory point.

Phase 4.

o Draw 1 event card from the event deck and execute the effects denoted on the card.

Phase 5.

o All played intervention and assessment cards without action or influence points on them are discarded and placed on their respective discard piles. Target cards always remain on the table.All player tokens are placed back in the bag. The next round starts with step 1 of phase 3. The game can be continued for as many rounds as long as there are any victory points left. It is also possible to agree on a certain maximum number of rounds to be played before starting the game.

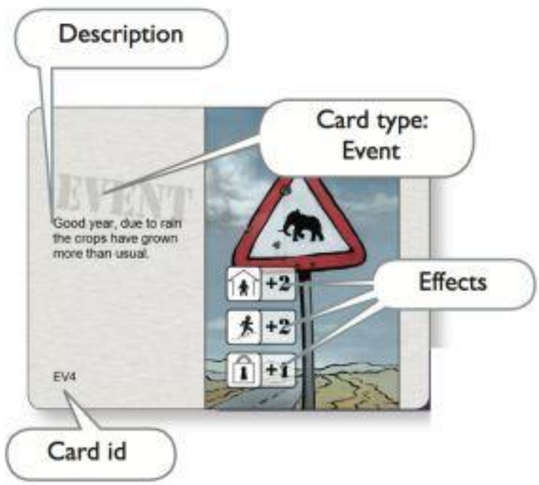

Figure 11. Events

When the game is finished, victory points may be counted. In addition to already collected victory points for valid targets, players receive 1 victory point for each 2 influence points collected (rounded down). The player with most victory points wins the game.

The main objective of this game is getting students acquainted with the "comprehensive approach" in a playful manner; emphasizing the need for cooperation. Therefore, one of the essential competencies of the comprehensive approach is to identify key players and to cooperate with them. Cooperation, coordination and communication are therefore important aspects of the game. When cooperation is properly performed, it can lead to a more rapid realization of victory points. The following cooperation competency dimensions are included: liaise, identify key players, coordinate, pan, set goals, prioritize and assess.

Note that: The game has a specific didactical manual for instructors dealing with the brief, gameplay and debriefing phases.

Conclusion

We presented two game based microworlds for training purposes. A single player on-line game and a multi-player board game. Note that the digital game solutions also offer a scenario editor to develop organizational specific game scenarios.

Acknowledgments

Both games are developed by T-Xchange; a research collaboration between Thales Netherlands Research & Technology and University of Twente in the Netherlands.

GO4IT won the Dutch MOD award 2009 and the prototype was developed in collaboration with TNO, NLR and CCOE. The game scenario for the Fog of War game was co-developed with Frank Koudijs (Thales).

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IMPLEMENTATION OF THE IMPRESS PROJECT PLATFORM IN REAL TEST CASE SCENARIOS

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Abstract: *ICT tools are everywhere in the nowadays world. They play a vital role in many spheres of theeveryday life and support the decision makers to improve their care towards the general population. IMPRESS project has such goals in its ideas when it comes to disaster management and resource allocation in cases of mass emergencies where many injured people are affected. The IMPRESS project system which had three years to be developed, tested and validated with real users involvement DEMO's is going to be presented in our article. The information about the system structure and outcomes is structured in three main sections. The first gives the introduction about the system and its components, the second represent the components and the third sate the overall conclusions and future work for the IMPRESS project system.*

Keywords: IMPRESS system, WARSYS, LOGEVO, SORLOC, PATEVO, INCIMAG, INCIMOB, DSS module of IMPRESS system project DSS

Introduction

The IMPRESS project, which has been a FP7 funded initiative, has run for three years stating from 1st of May 2014. The project main goal was to create a source location and decision support tool in one platform providing the responsible stakeholders with powerful ICT based solution supporting them in the different phases of decision making. The system structure can be summarized with the following components:

- Reference Semantic Model, which defines an ontology related to the health emergency management domain;
- Data Harmonization Component (DHC), which achieves the harmonization and the homogenization of the data provided by the WARSYS component with the use of the Reference Semantic Model – this is necessary

due to the diversity and different structure, format and nature data coming from a variety of external systems or the Web;

- WARSYS is a database, which provides the interfaces to import data from medical and logistics repositories (such as hospital information systems); further it can be used to store and view the extracted data and information generated inside the IMPRESS system;
- LOGEVO is the module that forecasts the evolution of the provision of resources to the hospital and to the field (Hospital Surge and similar) determining the time-curve of the amount of resources that can be provided to the system by exploiting the incremental capacity of the health structures directly involved in the crisis, as well as by utilizing external resources at national or international level: the ability to acutely increase available medical evaluation and care during events that exceed the limits of the normal hospital infrastructure represents indeed a very crucial point;
- SORLOC as a component of the platform provides a tool to estimate one or more of the following: time, location and spatial extent (SOuRce LOCalization) of a biological release, based on data from the first few cases presenting at hospitals or other health-care facilities, of the resulting disease outbreak;
- PATEVO is a stand-alone simulation platform focused on the patient physiological status, able to follow the victim from the very beginning of the crisis event to the end of the patient's observation period (due to death, discharge, assignment to definitive care or conclusion of the simulation);
- Recommendation Engine combines current patient data with the forecasts from LOGEVO and PATEVO to calculate the optimal distribution of patients to nearby hospitals;
- INCIMAG component includes the tools and environment to manage emergency incidents (it is a desktop solution);
- INCIMOB is the mobile extension of INCIMAG for on-field operations, patient tracking, receiving notifications and recommendations calculated by DSS components, sending situation reports and exchange text messages with INCIMAG operators;
- INCIcrowd is a public mobile application that allows citizens to connect to the IMPRESS system by submitting observations, receiving public alerts, and furthermore to self-organizing resource exchange between them during emergencies;

- Training Component is used for online training purposes of potential users of the systems.

The components architecture and development has been divided between the so-called “technical” partners within the IMPRESS project consortia. All tests and validations have been done by the rest of the partners within the so-called “DEMO’s” on the territories of Italy, Montenegro and Bulgaria. Both Italian and Montenegro Demos have been done as real field exercises and the Bulgarian as a table top one with invited users from the different involved authorities from Greek and Bulgarian countries’ side. Each component has its basic philosophy and additional tools that can support the users during the implementation of the system into their everyday work. The following section provide us with the basic descriptions of the system architecture.

Impress System Components Brief Description

WARSYS Component

WARSYS is responsible for the importing and management of structured data in the IMPRESS system. It provides an interface for importing data from medical and logistics repositories, such as hospital information systems. This data is made available to the Data Harmonization Component and then to other IMPRESS components through the IMPRESS Messaging Bus (AMQ).

WARSYS incorporates technologies and knowledge extracted by various national Database projects in the past, but it’s a totally new component designed and implemented for the IMPRESS Platform.

The innovation in WARSYS lies in the cooperation of various licensed and open source products integrated to a database system that support many different kind of data sources. In addition, this capability of WARSYS gives the opportunity to handle many different types of resources and data in the future.

The EDXL files family exchange is another innovation of IMPRESS, and WARSYS consumes this data within the IMPRESS application framework.

WARSYS architecture is represented in *Figure 1*.

WARSYS architecture core component is the WARSYS Database where storage utilities are provided, that make stored data available to the rest of WARSYS subcomponents as well as to other IMPRESS components. To support the operation of WARSYS Database the WARSYS DB Tools component is used. This component provides several administration tools that are used by authorised database administrative personnel (DBA) in order to manage import and export processes, provide maintenance, check WARSYS system health and connections to other IMPRESS components.

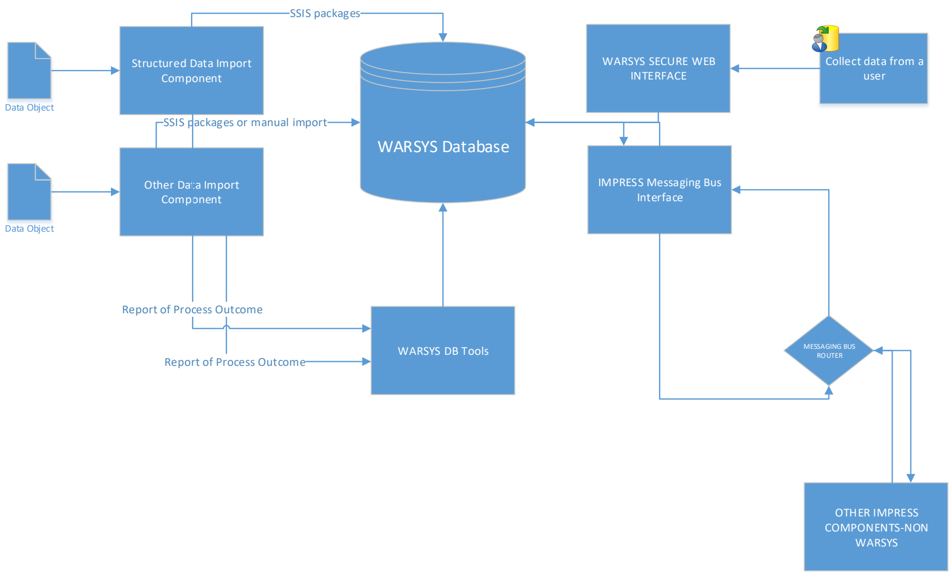


Figure 1. Warsys architecture

The rest of WARSYS architecture components are used to import (manually or automatically) and store data from different sources, as well as communicate with the other IMPRESS components through the message bus interface.

The Structured Data Import Component (SDIC) component is a set of visualised import stored procedures, called on demand by a user who has the relevant access privileges, in order to insert Hospital data into to the WARSYS Database. The SDIC component can be automatically called when data on the messaging bus become available.

The data import process is mainly handled by SSIS (SQL Server Integration Services) packages procedures. The first step is to validate the integrity of the files to be imported and append timestamp information for security, validation and tracking purposes. Then the system identifies what this file is about and triggers the relevant import stored procedure. The stored procedure calls, the WARSYS SSIS mechanism and the file content is imported to the database on tables specified in the stored procedure. Apart from structured data, WARSYS can import data from other sources without using SSIS packages. This capability is mainly supported by python scripts. These scripts accept an XML as input, use the XSD schema file and insert data in MySQL tables. Using MSSM for MySQL or other python scripts, data from the MySQL databases are inserted to the MS SQL database.

Beyond the data import of EDXL files and other sources, WARSYS provides two more interfaces: one of the communication with the end user through the WARSYS Secure Web Interface and one for the interconnection with other IMPRESS components through the WARSYS IMPRESS Messaging Bus Interface.

Through the WARSYS Secure Web Interface component, and upon successful authentication, hospital personnel are able to connect to WARSYS and upload files or provide data manually regarding Hospital Availability, through web forms.

The WARSYS IMPRESS Messaging Bus Interface is the WARSYS subcomponent, which handles, incoming and outgoing information to and from the IMPRESS Messaging Bus. WARSYS listens to the Message Bus through a specific queue or topic, and may posts back through the same queue/topic, when needed.

WARSYS incorporates an internal database structure that is used for the storage and retrieval of extracted data and generated information. This information is made available to authenticated components/systems, within the IMPRESS architecture, while WARSYS ensures both internal and external security and data protection. Moreover, WARSYS also allows dynamic access to patient information and medical care facility information; the level of detail in retrieved information depends on user privileges.

FILOLAOS system is the Greek National hospital availability system where hospitals nationwide currently report. The previous FILOLAOS system was a Microsoft Access Database, fed manually from EKEPY personnel, with information received by fax. This system was replaced in September 2015. Data from both the old and new FILOLAOS system are stored in WARSYS. The new FILOLAOS system, in service from September 2015 and on, supports the online publishing of Hospital states. EKEPY provides interfacing through JSON featuring online update of hospital availability.

This JSON output is captured by WARSYS and transformed to XML with a Python script, called by an SSIS package. The output xml is then imported into WARSYS tables, using the same SSIS package.

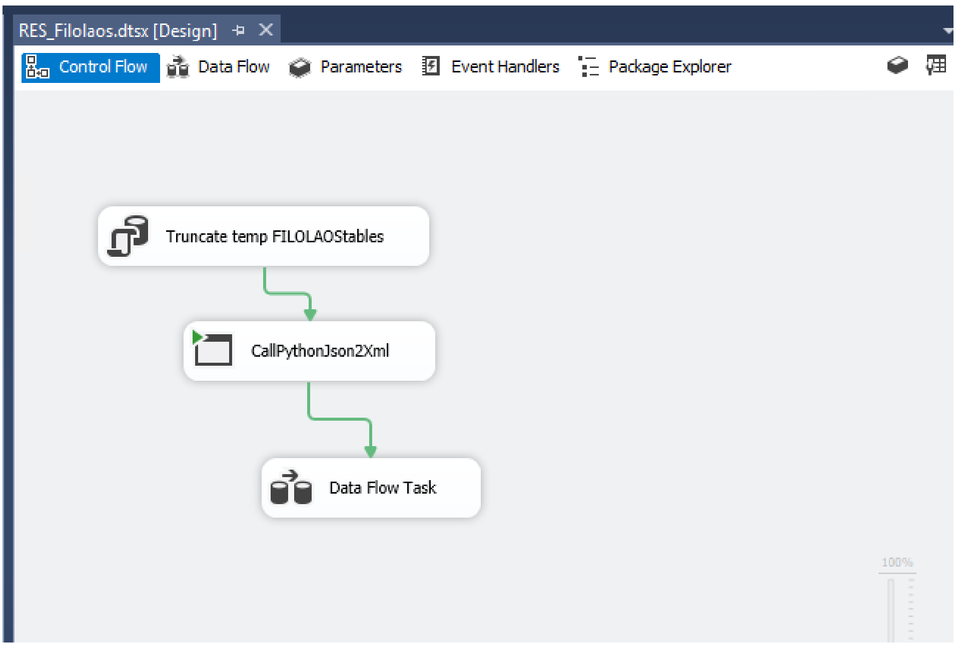


Figure 2. Import process from external sources

The last Data Flow Task, shown in the figure above contains the homogenization of data and the insert into query that inserts the EKEPY data to the WARSYS tables.

The data are then made available to the rest of IMPRESS components through the DHC Messaging Bus.

WARSYS Web Applications Collection

WARSYS incorporates a set of Web Applications in order to provide “human” readable information to its users (internal or external). The following figure 3 provides a view of the WARSYS Web Interface Catalogue.

Figure 3. Warsys web services catalogue

HIS Web Interface for IMPRESS

One of the potential users of IMPRESS solution and therefore WARSYS mechanisms is hospital personnel. To facilitate the procedure and provide a simple operational framework to such users, where the knowledge and the ability on working with database systems is limited to basics, WARSYS provides a secure web interface. This interface is accessible only from a specific static IP and the authentication will be done by providing credentials (at the minimum username and password) accompanied with a certificate. Once the user is granted access to the WARSYS Database, they are offered the ability to:

1. Upload a file. Various file types are allowed to be imported. Such formats can be EDXL xml, csv, excel, etc.
2. Provide the data through a web form. Information will be imported through a number of predefined fields including bed availability, doctor/nurse workforce, facility types etc.

The data from the above-described process will be stored in the WARSYS database and posted to the IMPRESS Messaging Bus in EDXL format.

IMPRESS LLT

IMPRESS Lessons Learnt Tool (LLT) is a web interface where WARSYS information regarding past incidents are managed. The LLT features an interface for domain experts to view, edit of mass casualty incident information, provide their opinion, attach past cases, comment and assign actions based on Key Performance Indicators (KPI) such as:

KPI	***KPIvalue***	***Notes***
DT, The time the scene was declared safe by the fire brigade is t_end and the time of initial notification call is t0, therefore DT=t_end-t0		value in minutes
T1stTg, Time to first triage: Time until the first ill/injured victim has been triaged in the field		value in minutes
TLstTg, Time to last triage: Time until the last ill/injured victim has been triaged in the field		value in minutes
T1stMv, Time to first move (CA/AMP)*: Time until each victim was transported in CA or AMP		value in minutes
T1stTx, Time to first treatment: Time until first treatment was performed		value in minutes
LosSc, Scene length of stay (LOS): Time until victim is evacuated from scene		value in minutes
TtED, Time to ED arrival: Time until victim arrives to emergency department ED		value in minutes

KPI	*KPIvalue*	*Notes*
TtMedMgr, time to notification of the first appropriate staff person who assumes medical management coordination role		value in minutes
T1stAmb, time to arrival of the first EMS ambulance on scene		value in minutes
TLstEvac, time to transportation/evacuation of the last ill/injured survivor from the scene		value in minutes
T1stEDtr, Time to first ED triage: Time until first triage assessment in emergency department		value in minutes
TLstEDtrAss, Time to last ED triage: Time until last triage assessment in emergency department: Time until initial medical ass		value in minutes
TOnSc, Average Time on Scene: average time spent by victims on the scene		value in minutes
TInTrans, Average Time in transit: average time spent by victims on ambulances and helicopters		value in minutes
NoVictEvac, Number of victims evacuated from scene		number of people
NoVictTr, Number of victims that receive first triage		number of people
NoVictED, Number of victims transported to emergency department		number of people

Table 1. WARSYS LLT KPIs

IMPRESS SIMULATOR

IMPRESS SIMULATOR is a web interface to create EDXL CAP alerts and post them to the IMPRESS messaging bus. This interface triggers the IMPRESS simulation process and is used for IMPRESS training purposes.

WARSYS ReportServer
This is the WARSYS reporting system were all preconfigured reports are stored and served to WARSYS internal/external users, based on their credentials.

Admin Reporting Web Interface for IMPRESS
This web interface is for WARSYS import processes and overall system health administration.

IMPRESS AMQ interface log
A log for the IMPRESS AMQ.

Bed Availability Web Service (XML)
A web service providing bed availability in XML format.

Bed Availability Web Service (JSON)
A web service providing bed availability in JSON format.

LOVEGO component
LOGEVO is the DSS component responsible for the forecast of the evolution of the provision of resources to the hospital and to the field (Hospital Surge and similar) determining the time-curve of the amount of resources that can be provided to the system by exploiting the incremental capacity of the health structures involved in the crisis. By means of interconnections with other DSS components, in particular with PATEVO and the Recommendation Engine, LOGEVO becomes a useful instrument for providing the decision maker with a strategy about patients dispatching, striking a balance between resource availability, resources deployed, expected resource provision, current and expected needs. The overall description of LOGEVO is depicted in *Figure 4*.

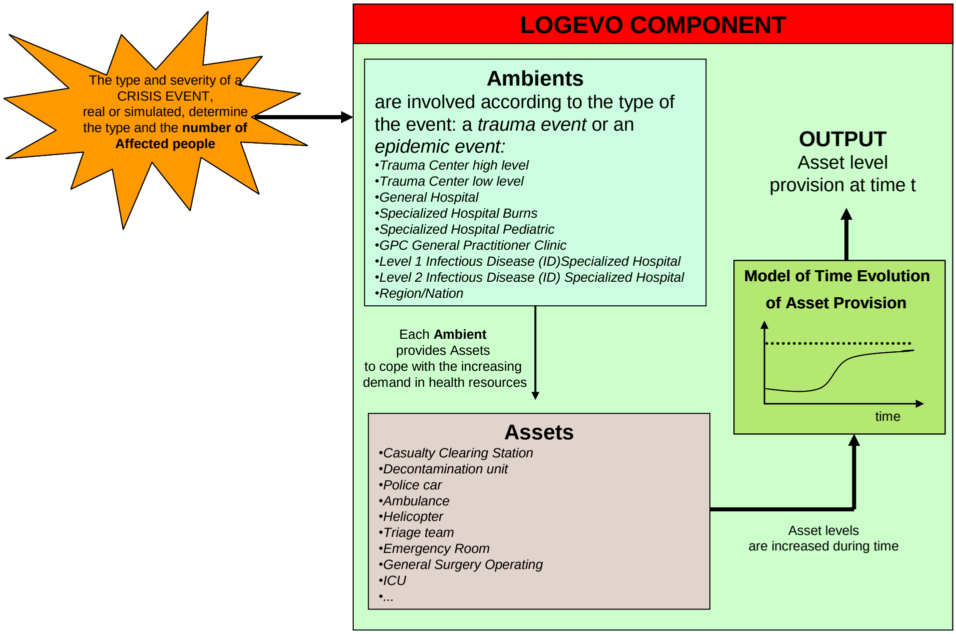


Figure 4. General architecture of the logevo component

LOGEVO is composed of Libraries and mathematical formulations. The Ambient Library contains the most important categories of structures delivering resources (human and material). Each Ambient delivers one or more important resources (called "asset"). The mathematical model predicting the evolution over time of the provision of a certain "asset", incorporates by means of its formulation, the dependency of surge capacity on the type and severity of the event. The function therefore returns the prediction of the amount of each "asset" A at time t during the crisis, in correspondence of each ambient type, given the number of the people involved in the crisis scenario, and the level of the asset at time t_0. To be noted that while LOGEVO makes a best-guess forecast about the theoretical ability of each of the involved health care facilities in the crisis theatre to provide increased levels of resources, this theoretical forecast is balanced, within IMPRESS, against the concrete limits, which the context imposes on the effective utilization of such resources, under the current crisis severity and conditions. So for example, while LOGEVO may predict that, under the current crisis severity conditions, an hospital of a given type could triple its offer of Operating Rooms within twelve hours, if one specific Hospital of that type has been put out of operation by the crisis itself (damaged by the earthquake, contaminated by toxicants…) other components of the IMPRESS system will exclude or limit recourse to that facility, and its theoretical increment of resource provisions will therefore be totally or partially ineffective.

SORLOC COMPONENT

Modern epidemiological practice, when investigating the outbreak of a disease, often involves the construction of mathematical or computation models. Frequently, these models are used to answer operational questions such as forecasting where further cases are likely to occur, what the total number of casualties are likely to be, and perhaps even where the likely source of the disease may be found. To be of greatest value such estimates need to be made from a small number of cases early in the course of the outbreak and so allow public health officials to prioritise resources.

The fundamental concept used in many of these models is that the outbreak may be modelled as a probability density function and that samples from this function will produce a similar spread of cases to a real outbreak. Usually these probability density functions are parametrised by a fixed and finite number of parameters e.g. spatio-temporal location, climatic conditions, transmission rates, demographics of the affected population etc. Optimisation of the output of such a probability density function based model by manipulation of the core parameter values allows us to calculate the most likely value for the real parameters based on known cases of the disease. Such optimisation is a very well known problem within mathematics and computer science with a huge literature.

SORLOC therefore has a single scope: determine a SOuRce LOCation. This determination has two facets, one temporal and one spatio-temporal [2]. Each facet has two subcomponents:

- Locate a source in time or time and space;
- Provide an estimate of epidemic progression.

In order to facilitate the SORLOC module demonstration within the Greek-Bulgarian table top exercise a scenario for aerosol released agents of Anthrax has been run in parallel. The location used for source of the disease released which caused overwhelming of the Bulgarian health system in combination with the Kresna gorge situation, was located in Sandanski town area. This place was chosen because of its closeness with Kulata – Promahon border control zone, which is the official entrance from North Greece to South-West Bulgaria. This entrance is used by refugees to enter on the territory of Bulgaria and their first stop is the town of Sandanski, because of its former military facilities that gives them shelter. The pharmacy factory branch in Sandanski and the local weather conditions of constant winds and warm temperatures gave us the opportunity to simulate Anthrax aerosol dispersion over the area and we took data for such simulation located in UK – Shoreditch London. We presented the available resources and victim's illness progress over time giving predictions in the evolution of the disease and affected people in the scope of ten days, having in mind that time frame of a natural disaster is a lot shorter than a biological disease spread. We overlapped both scenarios evolutions (the natural disaster one and the biological agent released) in order to face the Bulgarian and Greek authorities participating in the Sofia table top exercise with a problem that need fast reactions and official international procedures activation. The outcome of the simulation was a decision of a special equipped team's deployment in the affected areas of Anthrax and ERCC mechanism with its special procedures for CBRN activation.

PATEVO COMPONENT

PATEVO is the DSS component responsible for the forecast of the evolution of the vital physiological functions of the victims (individuals involved in the mass casualties incident) of the crisis, determining the time-curve of each Physiological State Variable (PSV), on the basis of a modelling analysis through which both the effect of injuries and the effect of delivered treatments are described. PATEVO is embedded into the DSS component of the IMPRESS solution with the aim of proving a mean for an efficient decision making in emergency health operations, giving suggestions and improving the quality of the services provided to citizens. The main goal of PATEVO is that of assisting health service professionals in the care of affected individuals, providing patients with the most effective treatment possible, even in case of resource shortage. With this aim in mind, PATEVO, including a series of complementary functions and algorithms all represented in figure 5, is able to work as stand-alone simulation platform operating into two different and separate modalities of work: a MONO mode and a FULL mode. In the MONO approach, each patient's physiology is described by means of a victim's Physiologic Point State (PPS), that is, a vector of values for the PSV levels and a vector for the related rates of worsening. The MONO mode can be used in a simulated crisis for the purpose of training or subcomponents testing. In this occasion, patients are generated by the system with their injuries and physiological state and the system knows therefore the exact physiological situation of each victim. In this case therefore, the Physiological Point Status of the patients is unknown to the caregivers who must treat them and who can evaluate the patients only on the basis of the observed symptoms. The discrepancy between the triager evaluation, on the basis of which all further decisions are taken, and the real patient status, which might possibly require a different management, will help the trainees to develop better patient management skills.

In the FULL approach, instead, each patient is characterized by a Physiologic Distribution State (PDS) that is a collection of (numerically approximated) density functions, one for each of the levels of the physiological variables as well as for each of the relative rates of worsening. In the FULL modality, the IMPRESS system does not know where the patient is in the physiological space, rather, it has uncertain information, formalized as a set of appropriate probability density functions, about where the victim is likely to be in Physiological State Variable space. This is the case, for example, when IMPRESS is used to deliver decision support during the actual course of a real crisis, which is when the actual evolution of the patient's physiological state must be predicted. Despite the fact that the FULL approach is much more computationally intensive, it is, however, the most appropriate approach to follow in presence of uncertainty and in absence of deterministic and certain relationships among the numerous variables playing a role in the evolution of the incident, at least with respect to the knowledge about the physiological status of the involved victims.

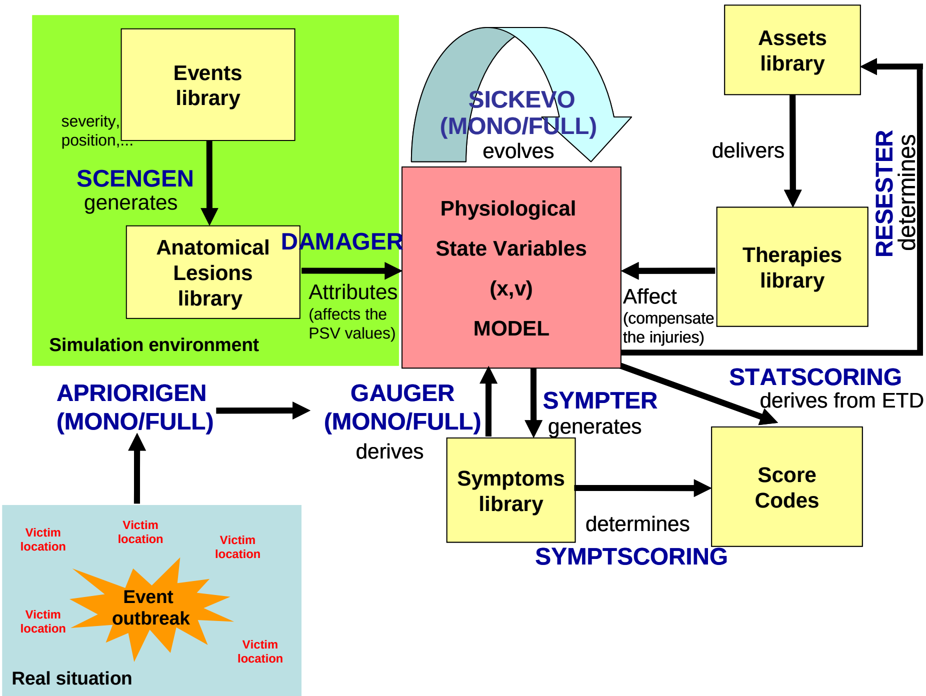


Figure 5. General architecture of the PATEVO component and its collaborative functions

The simulation approach is useful above all for the purpose of training people operating in a crisis situation. Figure 5 reports all the functions and libraries developed in PATEVO, describing their interconnections. In a simulated situation, the user chooses a type of crisis event from the Event Library. The Event Library is a pre-compiled library including both the Palermo incident and the Cross border Greece-Bulgaria incident, the two IMPRESS test cases. All the libraries are dynamics, so they can be modified and updated to remove or include new incidents. A call to SCENGEN generates a new, original event of the type selected from the library (i.e. an earthquake). The event is generated in terms of number of "Affected" people characterized by a series of Lesions extracted with a certain probability (depending on the type of selected event) from a pre-compiled library of Lesions. The number of victims and the types of lesions depend on the type and the severity of the event (quantifying, for instance, the dimension of the incident). The anatomical lesions determine (via the DAMAGER function) the occurrence of physiological defects along some of the physiologic dimensions (the Physiological State Variables, PSVs). All this process is represented in the green box.

Then, the SICKEVO component, in its MONO version, predicts the evolution over time of the PSVs, starting with the initial variable status (the initial defect) and the initial rate of worsening. Over time, the evolution is also determined by therapeutic manoeuvres (therapies), if any, delivered by the considered Assets. The system, by means of the RESESTER function, provides support to the decision maker suggesting what assets in what quantities (expressed in the unit of measurement of the considered asset) are to be employed to restore or improve the PSV's values by delivering the appropriate therapies.

Within the purpose of train trainees, from the values of the PSVs, signs and symptoms detectable from the field are derived by means of the SYMPTER function. This gives the possibility to compute well known scores from a very limited set of fundamental symptoms. The function taking in input the symptoms and returning the scores is SYMPSCORING. From the generated symptoms and signs, the trainee can both assigns its own code and calls SYMPSCORING for an automated computation. The performance of the trainee can be therefore tested and results can be compared. The same scores are computed by the function STATSCORING, starting from the values of the PSVs, assuming that the system knows the "true" status of the affected victim's.

In a real situation, the process starts from the light-blue box. The system knows nothing about the victim; the first responder arrives at the place of the incident, meet the victim who is positioned at a certain distance from the incident location and has not any other information about what happened yet. In this situation, the system is able by means of the functions APRIORIGENFULL and APRIORIGENMONO to reconstruct the case by deriving one plausible apriori probability distribution or Physiological Point State of the Physiologic State Variables for a victim given only the type of event and the position of the victim with respect to the event location. Afterwards, further observations on the victim (signs and symptoms recordable on the field) will enrich the knowledge about the patient and will be used to update (by means of a Bayesian approach) the apriori information to obtain an aposteriori estimate of the physiological status of the victim. This updating has carried out by the GAUGERFULL function. It must be noticed that the triple APRIORIGENFULL, SICKEVOFULL and

GAUGERFULL implements a full Bayesian approach, generating a first (non-informative or limited information) set of probability density functions (pds) on the PSVs and updating these pds with the time passing and given the acquisition of new data. On the other hand, the triple APRIORIGENMONO, SICKEVOMONO and GAUGERMONO uses a much simplified, much faster, but statistically very approximate algorithm to allow IMPRESS to follow a real patient using more reduced computational resources. All the functions and libraries have been therefore summarily presented to highlight their interconnection and to give a description of the entire architecture.

The last new function, not included in the scheme of figure 3, because not integrated with the other functions of the PATEVO architecture, is RESOVERVIEW. This function, taking in input the list of the current physiological states related to all the victims provides the number of minimal necessary quantity of each asset at the current moment given an optimal (possible unattainable) distribution of available resources and the desirable quantity of each asset at the current moment, desirable being defined as the quantity that would be necessary to take care of each patient independently from the availability of other resources addressing the same needs.

Reference Semantic Model

The Reference Semantic Model is an ontology defined as the IMPRESS Ontology, whose objectives are interoperability, data harmonization and linked data provision. The IMPRESS Ontology design and implementation process follows the METHONTOLOGY [3] steps and is implemented in OWL. The IMPRESS Ontology upper layer contains the following four main concepts:

- **EOPHC** (ExtraOrdinary Public Health Challenge): The concept refers to the emergency events and incidents that take place and require response.
- **Person**: The concept refers to the human individual.
- **Resource**: The concept refers to anything that is used to support or help in the response during a health emergency.
- **Activity**: The concept refers to any activity that takes place in order to reduce the impact of an emergency event.

The temporal aspects of the ontology have also been taken under consideration describing the evolution of the data through time. The data fact includes various sets of code lists described in SKOS as well as properties that are associated with user roles and geospatial data. The IMPRESS Ontology is further aligned with the TSO standard.

DATA HARMONIZATION COMPONENT

The Data Harmonization Component implements the data harmonization procedure that is required in order to harmonize the multidisciplinary and heterogeneous datasets of the IMPRESS Platform and provide a semantically homogenized view of the data. Also, these data are provided as linked data to the rest of the IMPRESS Components. Thus, Data Harmonization is also responsible for the linking of the RDF data [4] with other third party linked data resources.

The Data Harmonization Component implements data harmonization using the IMPRESS Reference Semantic Model, which covers the respective domains of knowledge of the domain of health emergency management.

The main tasks that are realized by the Data Harmonization Component are the following:

1. Provide a real-time RDF view of the IMPRESS data stored in the WARSYS database, based on a specific mapping file.
2. Provide access to RDF data views via a SPARQL endpoint.
3. Execute SPARQL queries to RDF data and process the results, if necessary.
4. Links the IMPRESS RDF data with specific linked data resources using a specific mapping file.
5. Handle and serve the requests for data from the Message Bus.

Based on the above, Data Harmonization Component includes four main subcomponents: the Mapping Generator which is responsible to generate the mappings between the database data and the RDF view, the RDF Viewer which provides access and exposes the RDF views, the Query Handler subcomponent which handles the requests for data and the Data Linker.

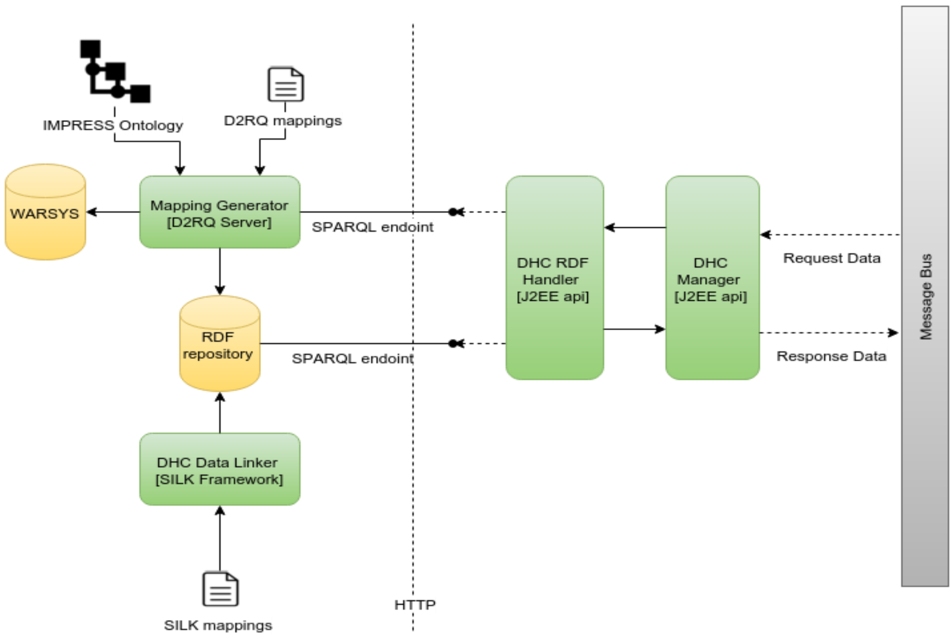


Figure 6. Architecture of the DHC component

As shown in figure 6, the DHC Manager receives requests for data from the Message Bus and based on the type of request calls the DHC RDF Handler which is responsible of querying the Mapping Generator for native RDF data or the RDF repository for linked data, through a SPARQL [5] endpoint. The Mapping Generator produces the dynamic harmonized view of the data that exist into the WARSYS database, while the DHC Data Linker generates RDF data linked with other Linked Data provided online. The results of the linking process are stored into an RDF repository in order to resolve issues of resources unavailability or low performance due to network latency issues.

The Data Harmonization Component uses the D2RQ server [6], an RDB2RDF technology, as well as, the SILK framework [7].

Recommendation Engine

The Recommendation Engine produces recommendations/ suggestions on how to distribute the patients over hospitals. The component, based on the patient status (and status forecast, using the PATEVO component) and on available resources (ambulance vehicles and hospitals bed availabilities in different categories; also forecast of availabilities using the LOGEVO component), gives a recommendation about the order of patients, the destination hospitals, and optimal routes to the hospitals. This component can be used in every day incident patients dispatching and in case of mass casualty incidents (MCI).

The Recommendation Engine consists of the Distribution Service and the Optimisation Services: The distribution computation is based on routing on a street network that will be loaded from a database (the street network parameters used for the routing can be adjusted manually, to reflect traffic information like max speed or road closures). Each patient has a transportation priority that determines the order of transport. In addition, patients have a set of needed Assets that determine the hospitals that come into consideration. The amount of available Assets of a hospital may increase over time, so additional patients can be brought to it subsequently.

The optimisation computation tries to find an optimal order for the patient transport. For this, it uses LOGEVO to determine the increasing Asset availabilities of the given hospitals. In addition, PATEVO/STATSCORING is used to get the health status of the patient, how its health status will evolve over time and how the treatment (Assets) will influence the health status. Based on this an initial priority and needed Assets for each patient is determined which is used to compute the prehospital time of each patient via the distribution computation explained before. Based on the resulting prehospital time PATEVO is used to check the health status at arrival time. If a patient would be dead or if other constraints are not met, several adjustments on the patient priorities are done and the computations are repeated. This is repeated several times to find optimal patient priorities based on a Greedy algorithm.

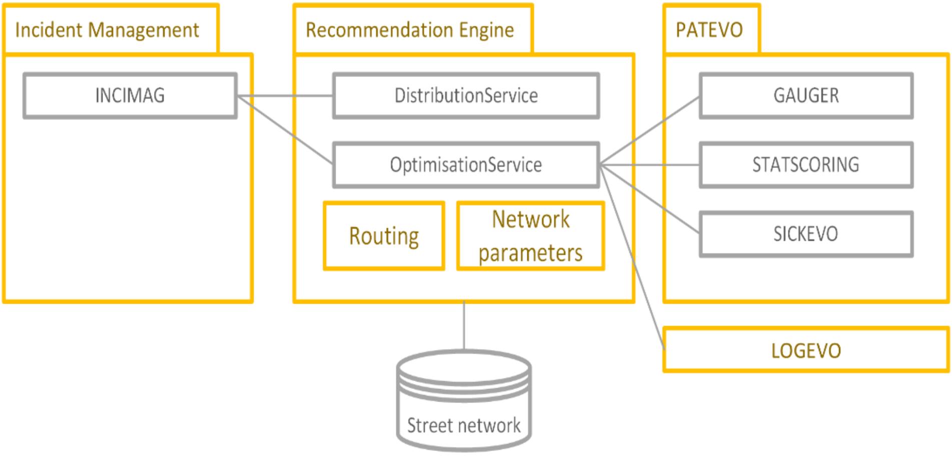


Figure 7. General architecture of the recommendation engine and relation to other components

INCIMAG COMPONENT

The INCIMAG component is a fully-fledged Integrated Command and Control Incident Management System. Its purpose is to interconnect stakeholders, decision makers, operators, first responders through standardized data interoperability for incident coordination and shared situational awareness. Although the system capabilities support different Public Safety Agencies (Health, Police, Fire, Sea) the primary focus is for Emergency Medical Services by implementing payloads that include data specific to Emergency Medical Services and Hospital Emergency Department's such as incident representation, unit tasking, triage, bed availability, treatment and transport tracking of emergency patients. The INCIMAG platform was built on the following key design principles:

- Daily use and during EOPHC situations;
- Supporting the Three Layers of Command – The system can be used by all the various levels of command such as strategic, tactical and operational;
- Support field operations;
- Multi-Agency Coordination – to ensure that multiple agencies can coordinate during an EOPHC.

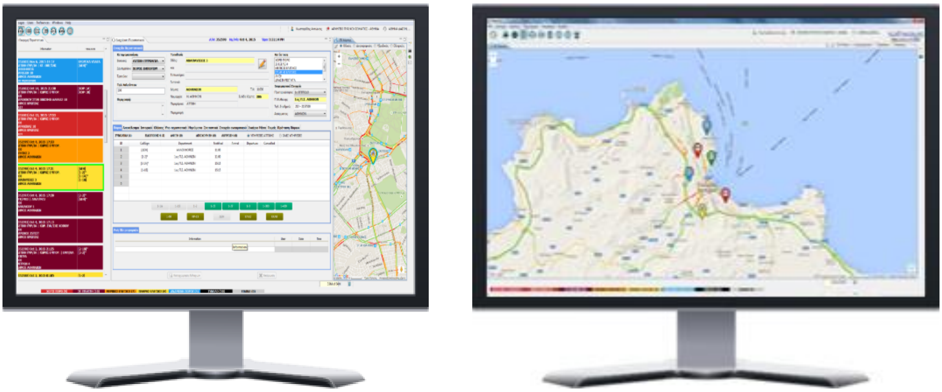


Figure 8. A typical dual-monitor INCIMAG configuration

The INCIMAG is based on the core existing geospatial platform (CEF - Chameleon Enterprise Foundation) of Satways Ltd., which in turn is built upon the Enterprise Application Open Service Gateway Initiative (OSGi) framework and which additional modules in the form of OSGi bundles were developed to cater for the medical domain. To demonstrate Multi-Agency Coordination (MAC) between INCIMAGs the following editions were developed and packaged:

- EMS Edition - This is the edition that targets emergency medical services EC&DC as well as National, Regional and Local EMS EOCs. It is the primary edition of the IMPRESS system.
- Hospital Edition (HIMS) - This is the edition that resides at a hospital emergency department (ED). Along with some basic incident/resource management functions, its major component is the HICS. It manages a mass emergency from a hospital viewpoint by tracking patients, providing hospital availability information to EOC centers and by providing hospital resources when requested by the EMS.
- Fire Brigade Edition (FB) - This is the edition that resides at the various hierarchical levels of a Fire Brigade. It has a more feature rich resource management component, which caters for very unique resource identification mechanisms and a more efficient incident management system.

- Law Enforcement Edition (LE) - This edition resides normally at police stations and call centers. It focuses more on resource dispatching and incident reporting.
- Coast Guard Edition (CG) - This edition resides at the Coast Guard. It has more input from external resources (not owned) and sensors than the other editions. It also includes a richer border incident management system.
- Civil Protection/Crisis Edition - This edition is more suitable for public health and at ministerial levels. Its function is to be activated when an incident from the other editions has been escalated to a crisis. It provides a good common operational picture and can request resources from other parts of a country or even other neighbouring countries.

A subset of the OASIS the Emergency Management Exchange Language (EDXL) family has been implemented: The Distribution Element (EDXL-DE) [12], the Common Alerting Protocol (EDXL-CAP) [1], the Hospital Availability Exchange (EDXL-Have) [14], the Situational Reports (EDXL-SitRep) [16] and the Tracking of Emergency Patients (EDXL-TEP) [15] and Resource Messaging (EDXL-RM) [15]. These protocols enable information sharing between INCIMAGs and between INCIMAG and the field mobile device.

The architecture of an INCIMAG instance is based on a number of components working together to provide to the operators the required information and meet the UC and BPMs. There are as follows:

- Application Server – handles all the backend work and interacts with the client application and the back-end server. Connector Services run on this server to handle various tasks and communicate with external systems.
- Database Server – Stores all the information and handles CRUD operations.
- Client Application – The application is executed from a link in a webpage which the browser will download and execute the application on the desktop workstation. Provides support for multiple monitors.
- 2D GIS Server – Handles the serving of 2D map data to the field mobile devices and to INCIMAG.
- 3D GIS Server - This accesses geographical data (3D terrain databases and vector layers), used for visually presenting geographical information to the

EOC client application. It will comprise the basic component of the Common Operational Picture.

Each INCIMAG has certain modules, which are common across all INCIMAGs developed on top of the CEF. The term module refers to the combination client side OSGi bundle and backend operations. These modules are stated below in brief:

GRAPHICAL USER INTERFACE

Consists of one or more (in the case of using multiple workstation monitors) main application windows designed to ensure the minimum number of user actions and options for processing an operation.

ORGANIZATIONAL MANAGEMENT

This module manages the organizational structure of a PSA or Hospital. The hierarchical structure refers to the different departments that make up an Agency in National, Regional and Local level. The INCIMAG manages users, their roles and access rights for various operations. Each user can be assigned multiple roles and role-selection occurs during the authentication process.

CALL TAKING

The call taking module consists of a graphical user interface which provides the necessary forms as well as a variety of tools to capture a call's information (Call data entry), caller and incident position (combined with geo-positioning subsystem), priority assignment, addresses geocoding and reverse geocoding, quick incident characterization and prioritization and directing the incident to the right dispatcher groups depending on the type, location and radio areas of dispatchers while timestamping and recording all actions.

INCIDENT MANAGEMENT

A user with the proper role and access right can manage incidents pertaining to their area of responsibility. The core incident management module offers the possibility of processing incidents by multiple users simultaneously and incident separation according to the groups and organizations that have entered the system. The INCIMAG implements a flexible business logic, which allows the transition of the operational status of an incident to another with corresponding options available to the dispatcher, which is dependent on the current status of an incident. Throughout the GUI, dispatchers have direct supervision of the incident (via graphics and audio alerts), the resources, the actions that have been executed and the measures taken.

Operational Resource Management

The INCIMAG Operational Resource Management Module (ORM) manages one or more organization's resources for incidence response. The module provides the capability to register, plan, allocate and assign resources to specific incidents through its interconnection with the Incident Management Module.

These resources refer to assets that alter their characteristics in time and space (status, location, duty rostering) and are suitable for responding to an incident. In this respect, resources can be considered personnel, vehicles and equipment that may have a certain location or can be on the move.

Resource Tracking

The resource tracking module integrates tracking data from GPS equipped mobile equipment (either black box GPS devices or GPS equipped mobile phones). This module provides the immediate tracking of moving resources (vehicles, personnel and vessels), their historic routes, stops, alert notifications etc.

Resource Exchange

The resource exchange module has been implemented to provide the necessary protocols and mechanisms to enable requesting and exchanging resources between agencies. It works closely with EMCR to handle resource request, status, loans and returns.

Computer Telephone Integration

This module provides the so-called Computer Telephony Integration (CTI) by allowing the connection to a Private Automated Branch Exchange (PABX). The current INCIMAG implementation supports the Open Source Asterisk call center. It provides each operator with a phone extension that enables voice-calling to other users, to other extensions and to outside calls should the underlying PABX allow these to occur.

Radio over IP Communications

This module implements the Radio over IP functionality by interconnecting INCIMAG operators, INCIMAG operators and mobile devices and both of them with Radio devices in the field through a gateway device. In addition, it provides voice-interconnection with other INCIMAGs as demonstrated in the Palermo, Italy demonstration. In that demonstration, it provided much-needed synchronization between agencies.

Message Distribution Module

One important aspect of INCIMAG implementation for the IMPRESS project is the open standards usage, regarding the information exchange either about alerts, or about health infrastructure status and patient's condition. This module handles the integration with the EMCR for that INCIMAG instance.

Situation Reporting

Once the field mobile devices have been assigned to an incident and are located in the field, they can send messages to their INCIMAG containing information related to the incident and provide a situational awareness for an INCIMAG operator.

Source Localization Module

This module's function is to create cases for biochemical release with associated affected patients and discover their temporal and spatial nature. It accomplishes this by gathering the selected patients and sending them to the SORLOC module for processing.

Reporting

A reporting module was built to allow for better post-crisis investigation into the performance of concluding incidents, resource utilization and possibly for any legal investigation. It provides tabular and printable output.

Electronic Protocol

The Electronic Protocol Module offers the ability to record all action performed within the client application with a timestamp and the specific action the user carries out.

Mapping Modules

Feature-rich 3D and 2D mapping modules are available to support the core workflows throughout the system. These modules can also drive a user workflow, for example, by right-clicking on the map an incident can be created at that map location. They provide the necessary visualization foundation to support geographical data from various online (the 2D Map module) and offline map providers (the 3D Map module). Besides static maps, the INCIMAG generates dynamic layers that depict dynamic information such as the current callouts and their locations, resources and their locations (latest or historic or routes travelled by the resource), alarm notifications and their locations. The way these layers display this information is customizable (colour and shape).

HEALTH AND MEDICAL RELATED MODULES

To meet the requirements of the emergency medical services domain particular focus was given on hospital availabilities and tracking of patients. The INCIMAG EMS and HIMS Editions contain modules, which enable tracking of patients and bed availability status reporting (unsolicited or requested).

Upon the encounter of medical personnel with a victim, the victim is assigned a unique identification that follows them from that point onward until their release from medical care. At each encounter their medical status is collected and a message is generated providing the current status of patient which help first responders, allow for control center dispatch personnel in decision making and provides an early-warning to hospitals in close proximity. Information kept on a patient is limited to what is required to provide adequate medical care.

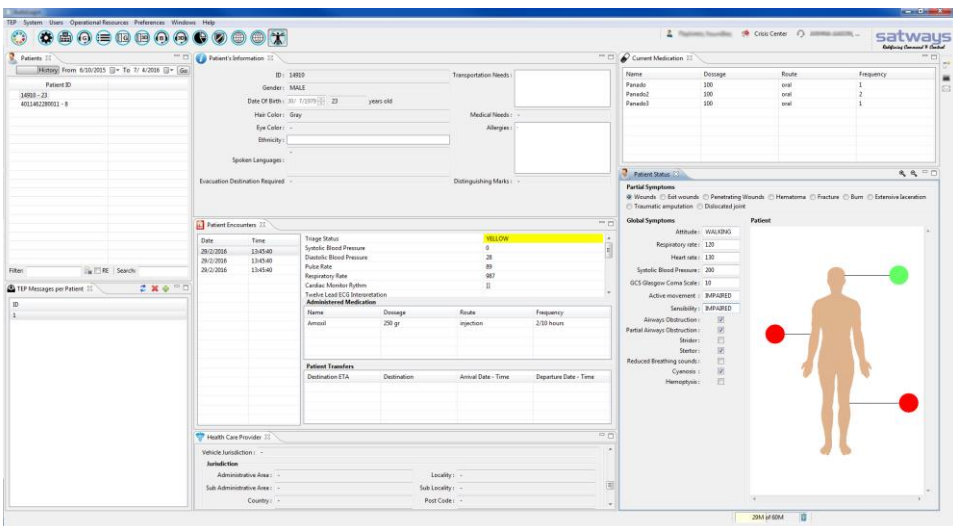


Figure 9. The user-interface of the Patient Tracking Module

One the main functionalities of the HIMS, according to the end user requirements, is the ability to monitor and communicate its available services in real-time in order to assist a system/region's ability to care for a surge of patients in the event of an extraordinary public health emergency / mass casualty incident. Each Hospital can provide their bed availability in unsolicited mode to interested medical/health organizations or they can be requested for this information. A typical exchange of this information would be between a hospital and the emergency medical services.

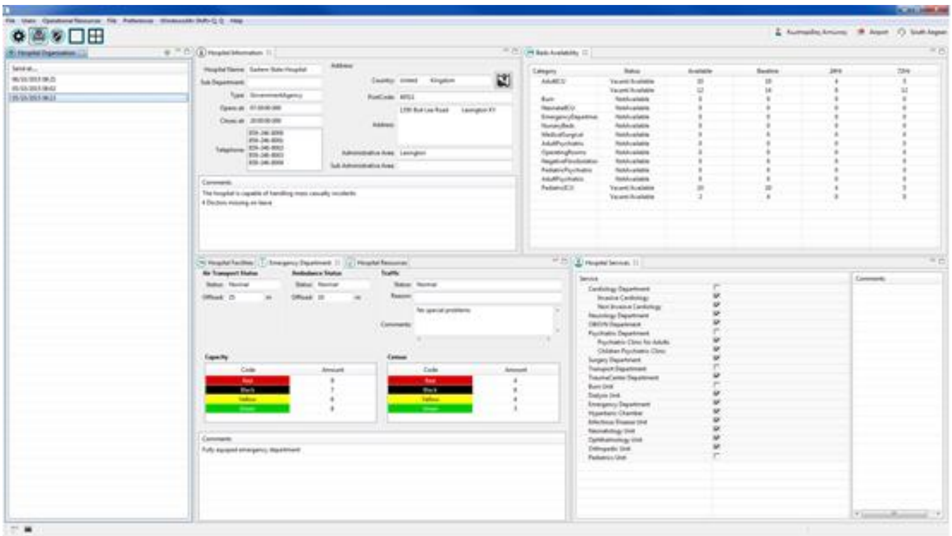


Figure 10. The user-interface of the Hospital Availability Module

COMMUNICATION WITH FIELD DEVICES

One of the key design principles was for interaction and integration of field mobile devices. To meet this requirement a service was developed which allows communication between INCIMAG and the field mobile device and provides:

- Authentication for the field mobile device against its associated INCIMAG;
- Location Tracking of the field mobile device so INCIMAG operators are visually and textually aware of where the field units are located;
- Panic-SOS Handling is incorporated in the case where responders face some danger and need to notify the dispatch center;

- Patient Information Submission for sending patient information to the associated INCIMAG for further analysis and propagation to other INCIMAGs;
- Patient Information Request ensures the INCIMAG will return to the field device the latest patient information as captured by the same or other field device;
- Incident Assignment of field units to an incident for immediate dispatc;
- Status Updates from the field devices is received thus enabling operators to understand what the field unit's availability and status inside the incident;
- Situational Reports incl. photos provide operators with textual and visual information of what is happening on the ground;
- Recommendations that have been accepted by the dispatch operators to be propagated down to the field units for action;
- Tasking Orders sent and acknowledged to mobile devices for specific tasks within an incident with location information;
- Text Messaging provides quick communications between control center and field units;
- Incident Information is propagated down to the field devices.

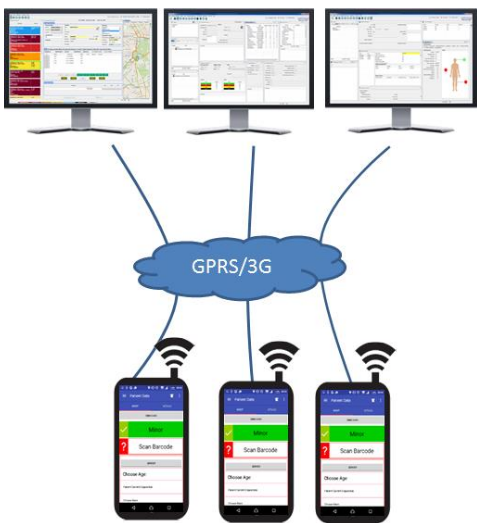


Figure 11. Field Units communicating with their INCIMAG

The interaction between agencies during normal operations and in mass casualty incidents takes place through the Emergency Message Content Router, designed and implemented for this purpose. Its aim is to route messages to the proper recipients who have declared their interest in particular messages, roles, keywords or geographic areas. Recipients subscribe and connect with authentication ensuring only known recipients receive particular messages. The operators can select directly which INCIMAG to send particular information based on their subscription criteria. Alternatively, the message is broadcasted and INCIMAGs that match the message's criteria vs their subscription criteria will receive the message.

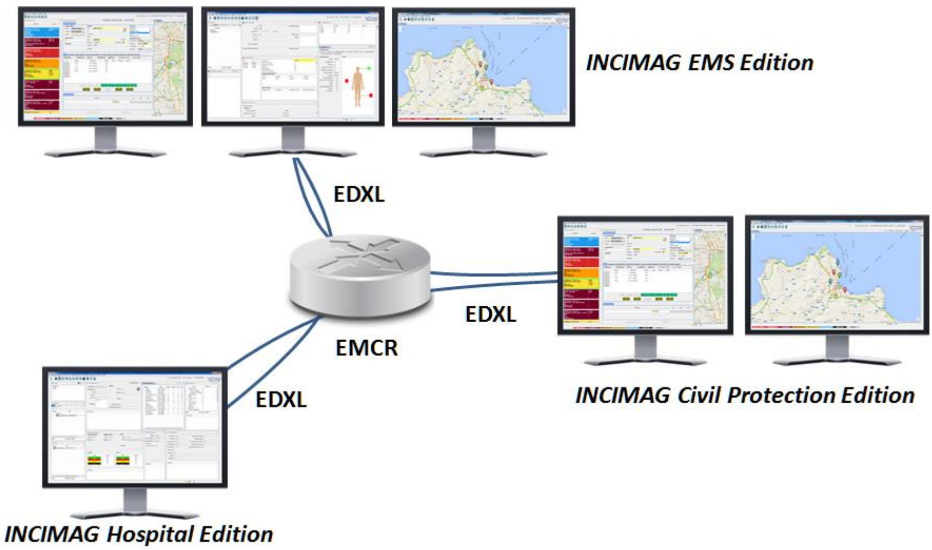


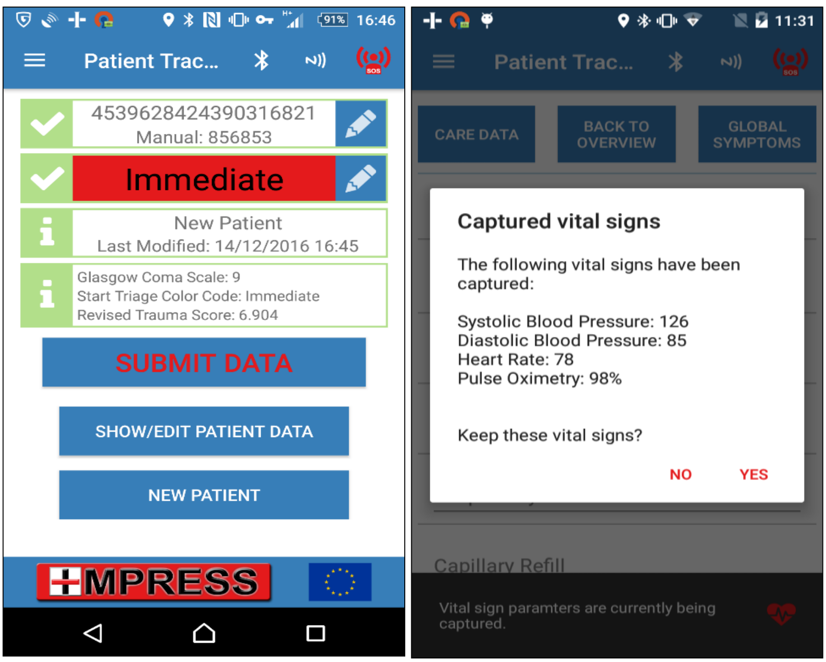
Figure 12. An example of EMCR-Usage

INCIMOB COMPONENT

The IMPRESS system includes two mobile applications, INCIMOB and INCIcrowd. The first, INCIMOB, is defined as mobile extension for INCIMAG and is therefore only connected to this system. INCIMAG provides an SDK-API to INCIMOB, which defines data exchange formats and communication channels. Each INCIMOB only communicates with the connected INCIMAG instance; there is no direct connection between two INCIMOBs.

INCIMOB comprises multiple functionalities. It handles status updates, situation reports, patient tracking, text messaging and it provides information send by the INCIMAG. The status update function allows to send updates about the own availability and the activity during emergency response operations. On the other side, INCIMAG operators can assign each connected INCIMOB to current incidents and tasks and therefore allow dispatching the INCIMOB units.

The major function of INCIMOB is the registration and tracking of emergency patients. The registration of patients starts with the triage and the assignment of a patient-ID. INCIMOB supports several triage algorithms: START/JumpSTART, Sieve and Sort, or simple selection of a triage colour. It also supports multiple possibilities of patient-IDs: electronic NFC-Tags, scanning of barcodes or simple manual entering of numbers. After the first registration of the patient, there are multiple ways of entering detailed patient data, vital signs and symptoms (see Fig. 13). Vital Signs can be also captured using Bluetooth enabled medical devices, which support the Bluetooth Health Device Profile.



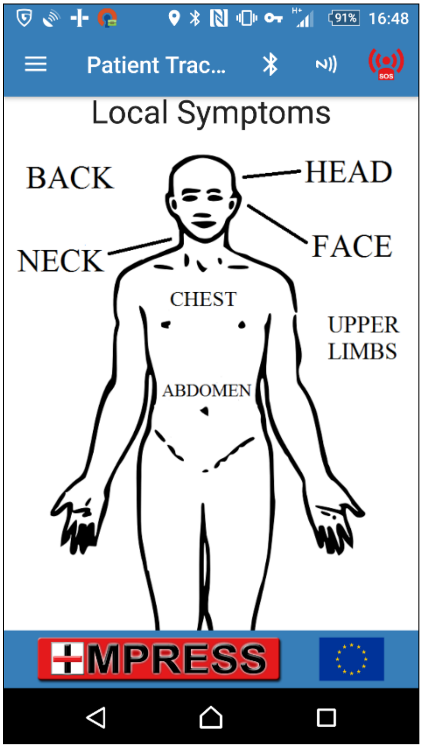


Figure 13. INCIMOB: Patient Tracking

Recorded data will be submitted and processed by INCIMAG and forwarded to the IMPRESS integration layer and also used as input for the PATEVO/LOGEVO components.

After registering some patients using INCIMOB, an INCIMAG operator can trigger the Recommendation Engine to calculate an optimal distribution of patients to hospitals. The results will be forwarded to the related INCIMOB instances and INCIMOB allows to display them. With the help of this information, the INCIMOB unit knows which patient is to be transported to which hospital.

In addition, the application has a function to submit situational reports to INCIMAG. These reports can be enriched with a photo. This information gives the INCIMOB operators a better overview about the ongoing incident and the situation in the field.

The architecture of INCIMOB is depicted in Figure 14. The application contains of a set of modules (functions). Furthermore, each module provides a set of features and uses a set of interfaces to communicate with the IMPRESS system. To switch between the modules, the application uses a design pattern that is called 'navigation drawer'. This pattern is used in a wide range of mobile applications and is intuitive for persons that are using smartphones in their everyday life.

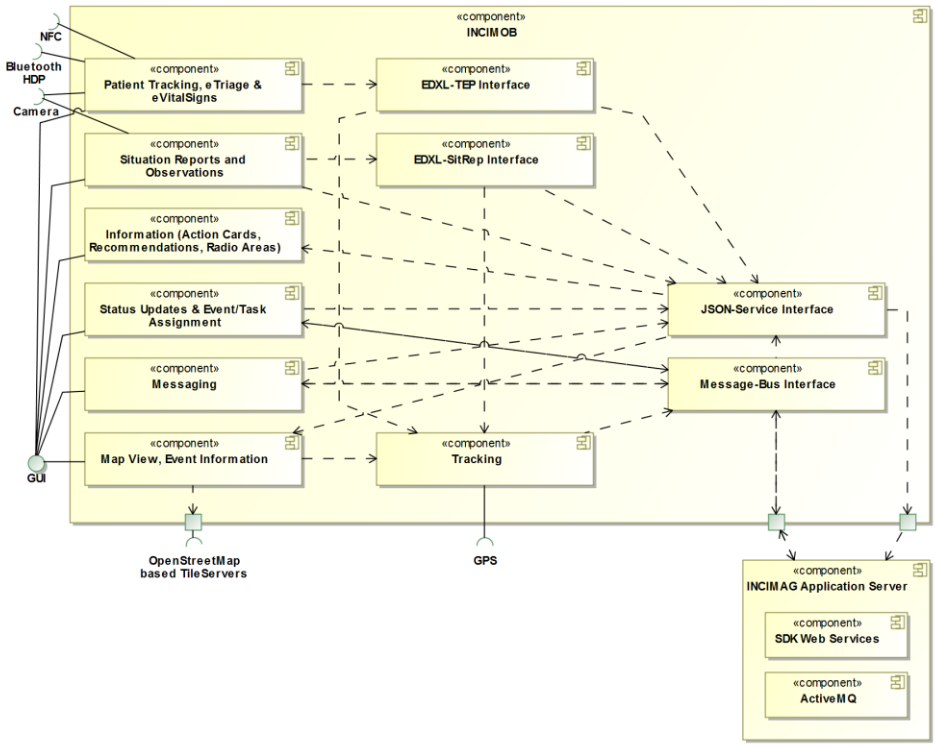


Figure 14. General architecture of INCIMOB

The modules, and with that the application, use a set of communication channels to communicate with the rest of the world, in this case with the IMPRESS systems. To get data from the application to a server, a RESTful- or SOAP-Service is used to transfer data messages serialised in JSON or XML format. To get data from the server to the application without the need for the application to permanently asking for new data, another communication channel is necessary. This channel has to provide the possibility of pushing messages to the application. A message bus is used as solution for sending messages to the mobile application devices (smartphones). Furthermore, the application needs access to a map tile server, to display features on a map. All these communication channels need an internet connection. Therefore, access to WLAN/Wi-Fi or 3G/4G/5G mobile networks is mandatory. However, using smartphones in the field can always lead to connection interruptions from time to time. For this reason, INCIMOB temporarily stores data that has to be send to INCIMAG and resends it, once the internet connection is back again.

INCICROWD COMPONENT

The IMPRESS system comprises also a public available mobile application, called INCIcrowd, which enables the public to support the IMPRESS system in terms of crowdsourcing. INCIcrowd is a light version of INCIMOB that enables the public to receive alerts, submitting observations and exchanging resource offers/needs. INCIcrowd is connected to the IMPRESS system via a dedicated server and the IMPRESS message bus. The architecture is very similar to INCIMOB, as it uses the same framework. Nevertheless, the functionalities are much reduced compared to INCIMOB.

Unlike INCIMOB, INCIcrowd works completely anonymous and without a user account. Sending observations and receiving alerts is completely anonymous and should therefore lower the threshold to use the application. Observations will be collected and bundled by the dedicated Crowdsourcing Server who forwards the observations to INCIMAG. There it is up to the operator to display and use the information. The other way around, all CAP alerts that are published by INCIMAG and marked as public are collected by the Crowdsourcing Server and forwarded to the INCIcrowd applications. INCIcrowd can be configured for several regions to display related alerts.

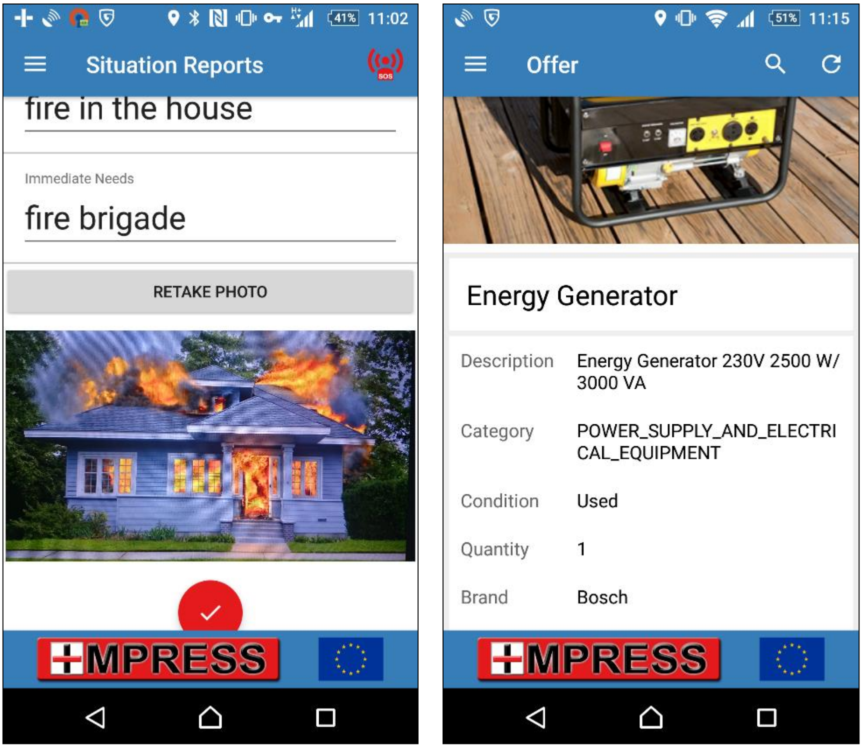


Figure 15. INCICROWD: sending observations and displaying offers

An additional feature of INCIcrowd is to share offers and needs between citizens, without the need of coordination by official organisations. It is designed as bulletin board and allows to search for items and to send private messages to the authors of offers or needs to negotiate the transfer.

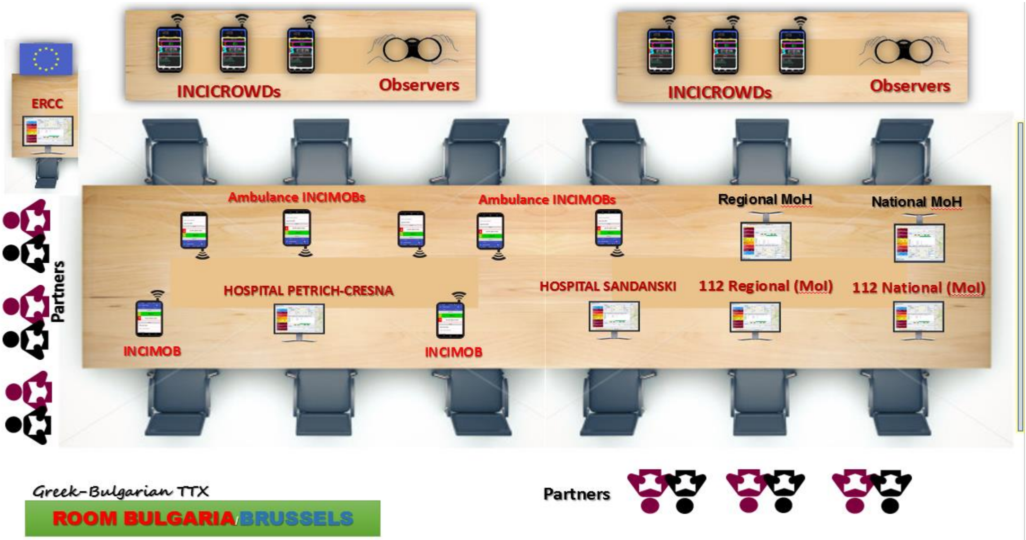
Impress System SOFIA Table Top Excercise

The Table Top Exercise (TTX) in Sofia, Bulgaria was the final test of the IMPRESS system. It was held on 15th and 16th of March 2017, where on the first day the users where educated to use the system and on the second day they could operate with it. The exercise was organized by IICT-BAS, KEMEA, EKEPY and INTRASOFT and hosted by NATO CMDR Center of Excellence in Shipka Hotel, Sofia. The IMPRESS system was operated by Greek and Bulgarian actors representing public services and hospitals.

The scenario of the exercise was based on a combination of heavy rainfall and a strong earthquake that stroke Southern Bulgaria. As a result, extended damages to buildings and infrastructures along with a landslide damaging the roadside pavement in Struma (BG) / Strimon (GR) River and overflow of the river over part of the E79 Highway were recorded. These incidents were coupled by multiple car accidents due to rock falls along the respective segment of the E79 near the Greek-Bulgarian border. The critical situation caused a large number of fatalities and injuries requiring immediate response, pre-hospital medical intervention and transportation of casualties to nearby hospitals. Victim's transportation via the collapsed E79 connecting the southern part of Bulgaria with the rest of the country caused the Bulgarian authorities to request international medical assistance, activating the standard procedures via the European Emergency Response Centre (EERC) in Brussels.

Having this background the IMPRESS system's components have been used in different configurations aiming to simulate field data gathering from multiple incident scenes and prove the capability of the system to strengthen coordination between the response organizations and the involved emergency medical services, including the international support request.

For the needs of the tabletop exercise, the IMPRESS infrastructure was arranged in two adjacent rooms simulating the respective system implementation in the Greek and Bulgarian operational rooms.



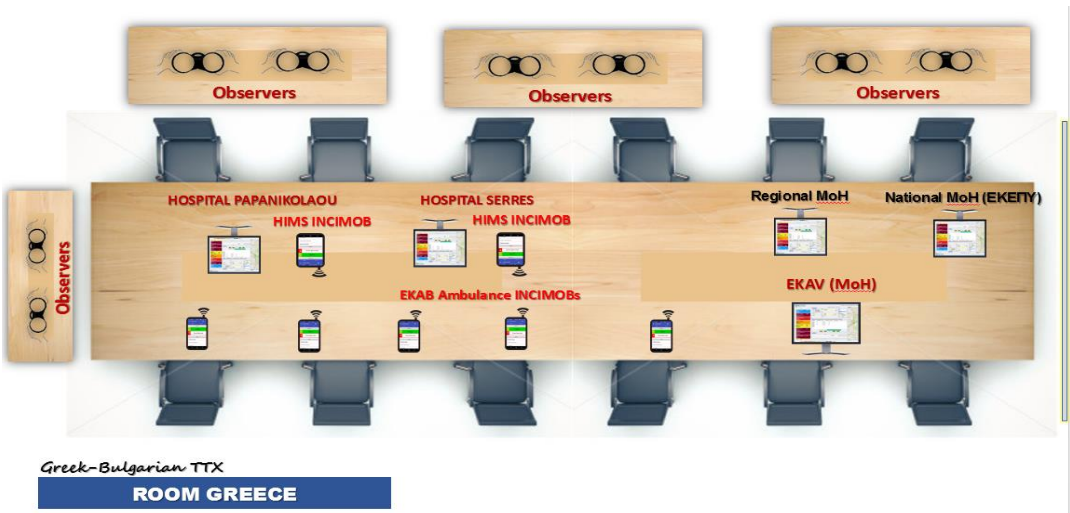


Figure 16. The respective system implementation in the Greek and Bulgarian operational rooms

The following organizations were actively participated in the GB TTX:

Bulgarian stakeholders and actors

The Regional Emergency Medical Center of Blagoevgrad, the Emergency Departments of the Hospital of Sandanski and Petrich, the EMS branch of the Blagoevgrad Hospital Unit located in Kresna and the Bulgarian Red Cross headquarter in Sofia as well as representatives of organizations of the Ministry of Interior.

Greek stakeholders and actors

National Center for Health Operations (EKEPY) under Ministry of Health; General Secretariat of Civil Protection; National Emergency Center (EKAV) both Athens HQ and Northern Greece Branch; Hellenic Center for Disease Control & Prevention (KELPNO); General Secretariat of Civil Protection (GSCP); two large hospitals in Thessaloniki ("Papanikolaou" General Hospital and "Ippokratio" General Hospital) along with the General Hospital of Serres (backup hospital).

Observers of the TTX

Bulgaria: Bulgarian Ministry of Health; Bulgarian Ministry of Interior; NATO CMDR Officers.

Greece: Ministry of Health; Post-Graduate Program on "Health Crises", Athens Medical School; Athens Assistance Medical Air Transport Co.

Italy: Italian Civil Protection – Palermo, Sicily.

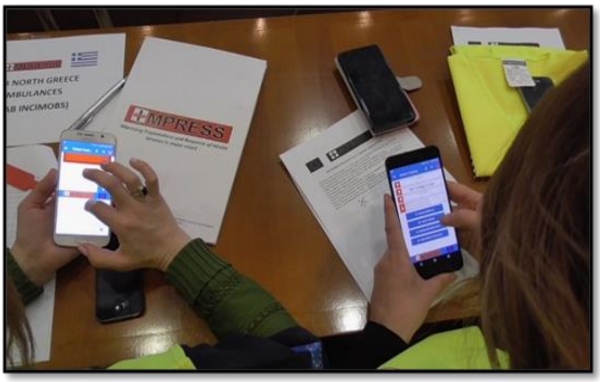
The TTX in Sofia addressed the needs of the scenario using the IMPRESS resources deployed in the CMDR-COE facilities. According to the scenario, due to very heavy rainfall and snow melting in the upper regions of the watershed of Struma (BG) / Strimon (GR) River, the National Institute of Meteorology and Hydrology-BAS released a warning for increased risk of rapid rising of the river water level in the lower parts of Kresna Gorge, where the river bed tapers between the mountain cliffs. A red alert was issued for the international E-79 Highway, which runs parallel to the riverbed and which is extremely narrow in this segment of the road due to the mountainous nature of the area. All alerts were broadcasted through radio and TV.

Later on, an earthquake sized 6.7R was registered by the IGGG-BAS, 10 km. northeast of Kresna town. Information was sent to the National and Regional Civil Protection Authorities by fax/email.

Due to the described alerts, IMPRESS modules have been activated in National and Regional Emergency Services and Health Departments. At the same time, dedicated volunteers using the **INCIcrowd** mobile application send observations, comments and photos/videos from the affected areas.

Pic. 1. Bulgarian actors, separated in various operational impress operating teams representing different public organizations

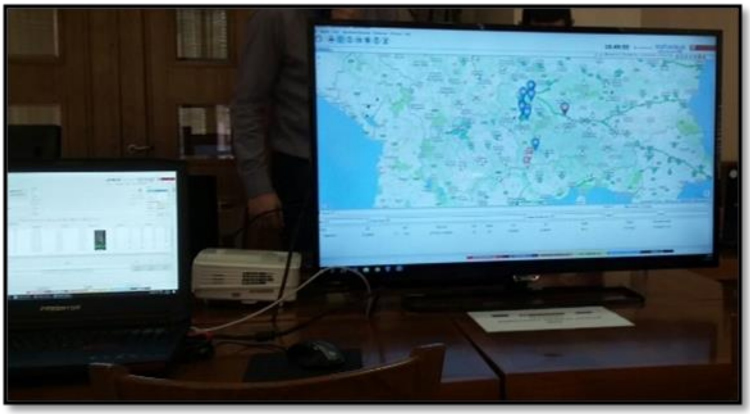
The call-centers of the Fire Brigades and the Regional EMS were overwhelmed by calls, received via the 112 Service, asking for S&R teams and traffic police officers in the affected area. In addition, the National Health Organization Center checked for hospitals' availabilities (through WARSYS and Data Harmonization Component) and dispatched available ambulances. Ambulances arrived at the incident area, made an initial triage and transferred the most critical cases into local hospitals (Kresna, Sandanski, Petrich). Due to the earthquake, hundreds of buildings have been collapsed and people were trapped into elevators. Power lines were also damaged and some health facilities activated their backup generators. More ambulances were requested to arrive at Kresna railway area crossing the city.



Pic. 2. and 3. Regional health services (ambulance crew) conducting triage using INCIMOB

IMPRESS tools and functionalities supported on-scene medical teams, first responders and agencies involved in the exercise, during the overall procedure, aiming to optimize the response and deployment of resources and timely dispatching the victims to hospitals. Following the triage and recommendation for dispatching, the receiving hospitals were informed to be prepared to receive fatalities, using their relevant INCIMAG and INCIMOB versions.

Due to the size of the disaster, the Bulgarian Ministry of Defence supported the Ministry of Interior to implement the National Plan for Disaster Protection and participated in the National Crisis Management Joint Committee formed. Furthermore, and due to the need for additional medical assistance, an advanced medical post was set up in the area of Kresna and secondary transport by air ambulances was organized towards nearby hospitals.

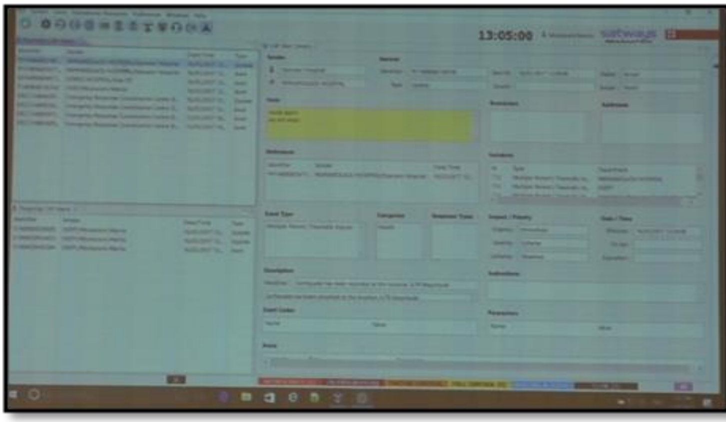


Pic. 4. and 5. Implemented iNCIMAG editions for the bulgarian public services (MOI and MOH)

Given the collapse of the regional capabilities of the health emergency system and due to the excessive number of trauma patients, including patients with neurotrauma, crush injuries and severe burns, the Bulgarian National Authorities decided to request international assistance since road connection collapsed in the north side of Kresna (due to Struma (BG) / Strimon (GR) river erosion of the E79 sand foundations resulting in consequent traffic disruption) and thus patients transportation to northern hospitals was not possible. The request was sent via INCIMAG to EU-CPM ERCC and then was shared among the EU Civil Protection Agencies of the member states. Positive feedback to the Bulgarian request was provided by Greece and a joint crisis center set up in both countries.

Pic. 6. Introducing the scenario to the greek actors

The emergency service of the Greek Ministry of Health (EKEPY) checked hospitals' availability in Northern Greece (Thessaloniki and Serres) and requested to initiate a limited surge capacity process. Moreover, EKEPY contacted Thessalonikis' Police authorities to provide escort and traffic control to ambulance fleet all the way to border station. EKEPY assigned EKAV (National Emergency Center) to mobilize a number of ambulances of pre-hospital type properly manned for the occasion. EKAV confirmed availability and ordered the ambulance fleet to deploy towards the border crossing of Kulata-Promachon.



Pic. 7. and 8. INCIMAG version of national emergency center (ekav) of north Greece dispatching ambulances to the greek borders

Bulgarian authorities provide casualties' information to EKEPY through INCIMAG, and gather confirmation through this infrastructure, informing EKAV in the same way. Greek pre-hospital ambulances of EKAV North Greece and mobile medical teams were dispatched (the communication between Greek Coordination center, EMS and Health Services, was conducted through different INCIMAG installations) to the Greek-Bulgarian border (Kulata/Promachon border crossing station), to receive victims delivered by Bulgarian ambulances.

Pic. 9. and 10. North greece hospital (papanikolaou) declaring availability through warsys (impress component) to ekepy (left), national emergency center (ekav) of north greece conducting the secondary triage at the border (right)

The Greek medical teams conducted a secondary triage on site; transferred injured people to the ambulances of EKAV and then transported them to Greek hospitals, taking into consideration the suggestions of the IMPRESS recommendation engine, using the DSS tools. The hospitals' INCIMAGs received the medical information of the arriving patients and their ETA and confirmed these data during the patients' reception at the hospital's ED (using INCIMOB).

The exercise closed formally with the EKEPY reporting to the Bulgarian MoH about the safe transportation of the Bulgarian casualties to the Greek hospitals along with details about their status and contact information. ERCC was also informed about the overall details of the trans-border medical operation.

With the Sofia TTX the IMPRESS solution, proved its high technology readiness level (TRL), which is capable to address the operational needs of health emergency services and the requirements of mass casualty incidents. The solution is flexible enough for supporting diverse organizational structures in routine operation and support multi-agency coordination.

Conclusions

The IMPRESS project has ended in April 2017, achieving a robust integrated mass-casualty health emergency management, multi-agency coordination and collaboration, and decision support system, which has been tested in two real-life pilots in Palermo, Italy, and Podgorica, Montenegro, and one demanding tabletop exercise in Sofia, Bulgaria. Stakeholders experiencing the system in these occasions have been positively impressed by its extent and capabilities in optimally and effectively managing health emergencies, combining a variety of backend data processing and decision support tools, for the optimal utilization in decision making of external open sources or other hospital information systems, for the timely dispatch of victims to hospitals, for the prediction of the evolution of the physiological status of victims and logistics, etc.

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