

In the focus: NATO Alliance Ground Surveillance System

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NATO plans to acquire an Alliance Ground Surveillance (AGS) system that will give commanders a comprehensive picture of the situation on the ground. NATO's operations in Kosovo, Afghanistan and Libya showed how important such a capability is. A group of Allies intends to acquire five unmanned aerial vehicles (UAVs) and their associated command and control base stations. NATO will then operate and maintain them on behalf of all 28 Allies.

At the May 2012 NATO Chicago Summit there were several important topics discussed. The broader public learned the Smart Defence and Alliance Ground Surveillance System (AGS) expressions as frequently repeated issues in the politico-military environment. This paper shall highlight the AGS's necessity, to be set up as a Joint NATO capability giving historical background as well as creating a state of the art Intelligence, Surveillance, Target Acquisition and Reconnaissance (ISTAR) solution for the Alliance.

Keywords: Alliance Ground Surveillance System, Electronic Intelligence, Synthetic Aperture Radar, Ground Moving Target Indicator.

Introduction

At the Chicago NATO summit in May 2012 there were several important issues discussed. The wider public has learned the terminology of Smart Defence and Alliance Ground Surveillance System (AGS), frequently mentioned in the military. In this paper I would like to introduce AGS, underlining its necessity, historical background as well as its possible technical implementation.

Since the end of cold war era NATO transformation has been an ongoing process in order to meet future challenges. Recently this has been a painful road, highly affected by the global financial crisis. There are only three member states² in the Alliance to fulfill the expected 2% of Gross Domestic Product (GDP)³ spending on military.(NATO, 2012a) In Hungary this figure would be constant at 0,8 %, until 2015. This figure, guaranteed by the Government, gives us only a minor scope for action in order to develop the HUN MIL systems. Several allies of ours are facing the same problems and barriers. For the Alliance's sake the EU Pooling and

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2 In 2011 USA (4,8%), UK (2,6%), Greece (2,1%)

3 "Gross Domestic Product is the market value of all officially recognized final goods and services produced within a country in a given period of time. GDP per capita is often considered an indicator of a country's standard of living." http://en.wikipedia.org/wiki/Gross_domestic_product (downloaded: 12 01 2013)

Sharing⁴ (Möllig, 2012) and NATO Smart Defence (SD)⁵ (NATO, 2012b) comprehensive approaches have been introduced.

In Chicago, NATO member states agreed on a document called the Summit Declaration on Defence Capabilities: Toward NATO Forces 2020 to aim an enhanced, better manned and equipped structure based on SD concept.

According to the 4th point of that concept: “We are deploying a highly sophisticated Alliance Ground Surveillance system, so that our forces can better, and more safely, carry out the missions we give them; in this regard, a number of Allies have launched an important initiative to improve Joint Intelligence, Surveillance and Reconnaissance (JISR) more broadly.” (NATO, 2012c)

Why does NATO need JISR capabilities?

Originating from the Defence Planning Committee in 1992, the AGS programme was defined as a capability acquisition effort in 1995, when the NATO Defence Ministers agreed that the Alliance should pursue work on a minimum essential NATO-owned and operated AGS core capability, supplemented by interoperable national assets.

The AGS programme was to provide NATO with a complete and integrated ground surveillance capability that would offer the Alliance and its nations unrestricted and unfiltered access to ground surveillance data in near-real-time and in an interoperable manner. It was to include an air segment comprising airborne radar sensors and a ground segment comprising fixed, transportable and mobile ground stations for data exploitation and dissemination, all seamlessly interconnected and linked through high-performance data links. (Sondergaard, 2012)

From the outset, the AGS capability was expected to be based on one or more types of ground surveillance assets either already existing or in development in NATO nations, an approach that later also came to include proposed developmental systems based on US or European radars. However, all those approaches failed to obtain sufficient support by the NATO nations to allow their realisation. In 2001, the Reinforced North Atlantic Council (NAC[R]) decided to revitalise AGS through a developmental programme available to all NATO nations and a corresponding cooperative radar development effort called the Transatlantic Cooperative AGS Radar (TCAR). (NATO, 2013)

4 Sharing: One or more countries provide their partners with capability or equipment (such as airlift) or undertake a task for another country. If this occurs on a permanent basis, the partners can cut this capability – and save on costs. For example, Germany provides maritime surveillance for the North Sea, thus relieving the Netherlands of this task. NATO states take turns to police the Baltic airspace so that the Baltic countries can save the cost of having their own air forces.

Pooling: Here too, national capabilities are provided to other countries. A special multinational structure is set up to pool these contributions and coordinate their deployment. The European Air Transport Command is one such example. Pooling can occur in the development, procurement or subsequent operation of shared equipment. This enables countries to either obtain a higher number of units or to co-acquire a capability that a state could not supply alone for cost reasons. Examples of joint procurement and operation include AWACS aircraft and NATO's command structures.

5 Smart Defence: It is a renewed culture of cooperation that encourages Allies to cooperate in developing, acquiring and maintaining military capabilities to undertake the Alliance's essential core tasks agreed to in the new NATO strategic concept. That means pooling and sharing capabilities, setting priorities and coordinating. Smart defence is based on capability areas that are critical for NATO, in particular as established at the Lisbon summit in 2010. Ballistic missile defence, intelligence, surveillance and reconnaissance, maintenance of readiness, training and force preparation, effective engagement and force protection.

In 2004, the Alliance decided to move forward to choose a mixed–fleet approach. The air segment was to include Airbus A321 manned aircraft and Global Hawk Block 40 UAVs, both carrying versions of the TCAR radar, while the ground segment was to comprise an extensive set of fixed and deployable ground stations. (NATO, 2013)

Due to the global financial crisis, that has stricken European defence budgets, NATO decided in 2007 to rethink the mixed fleet approach and a simplified AGS system where the air segment was based on the US Global Hawk Block 40 UAV and its associated multi–platform radar technology insertion program MP–RTIP⁶ sensor instead. The ground segment, which would largely be developed and built by European and Canadian industry, remained virtually unchanged as its functional and operational characteristics were largely independent of the actual aircraft and sensor used.

“In February 2009, the NATO nations participating in the AGS programme started the process to sign the Programme Memorandum of Understanding (PMOU). This was a significant step forward on the road towards realising an urgently required, operationally essential capability for NATO. NATO Alliance Ground Surveillance System Management Agency⁷ (NAGSMA, 2010) was established in September 2009, after all participating nations had agreed on the PMOU. The PMOU serves as the basis for the procurement of this new NATO capability.

Another important milestone for the AGS programme was the 2010 Lisbon Summit, where the strong operational need for a NATO owned and operated AGS capability was re–confirmed with NATO’s new Strategic Concept. AGS also featured in the Lisbon Package as one of the Alliance’s most pressing capability needs.” (NATO, 2013)

The year of 2011 was an important and enlightening period for the Alliance itself facing severe military, political, economical challenges because of the Arab Spring. Based on the No. 1970, No. 1973 UN Resolutions, NATO and its wider temporary Allies, such as Qatar, interfered in Lybia to protect the civilian population from Gaddafi’s militias terror. In the very beginning (with no full NATO consensus) the USA, UK and France took care of the No Fly Zone over Lybia with OP Odyssey Dawn.

At the end of March 2011 NATO took over responsibility to launch Operation Unified Protector (OUP). Supreme Headquarters Allied Powers Europe (SACEUR) delegated his rights to lead OUP to Joint Forces Command (JFC) Naples’ Commander. Intentionally stepping back the USA let NATO do the business without major US support. After the very first

6 “MP–RTIP — The Multi–Platform Radar Technology Insertion Program, a U.S. Air Force project led by contractor Northrop Grumman to develop the next generation of airborne air–to–air and air–to–ground radar systems. While initially planned for multiple platforms, the MP–RTIP is currently intended only for the RQ–4B Global Hawk UAV. The MP–RTIP is a “modular, active electronically scanned array radar system” designed to be scaled in size in order to fit on board different platforms. The system is being developed from earlier Northrop–Grumman radar systems, including the Joint Surveillance Target Attack Radar System (JSTARS) and the existing Global Hawk system. The next–generation system will improve the Air Force’s ability to track slow–moving ground vehicles and low–flying cruise missiles. The primary improvements are a dramatic increase in resolution and an ability “to collect ground moving target indicator imagery and synthetic aperture radar still images simultaneously.” The Global Hawk, which currently is an air–to–ground radar platform, was originally due to receive air–to–air capability through the MP–RTIP. That capability was subsequently removed from the test program’s budget, however, in a reversal, funding for air–to–air capability is being restored.” http://en.wikipedia.org/wiki/Multi-Platform_Radar_Technology_Insertion_Program. (downloaded: 12 01 2013)

7 “As NATO’s newest agency, the NATO Alliance Ground Surveillance System Management Agency (NAGSMA) is responsible for procuring the NATO AGS core. NAGSMA was set up in September 2009, after all 15 Participating Nations had signed the Programme Memorandum of Understanding. NAGSMA is a growing agency and will, once fully manned, comprise more than 60 staff.”

days of OPS there were several serious insufficiencies, such as poor intelligence, air refuelling capacity as well as running out of precision guided missile stockpiles very soon. The USA needed to give NATO the free run of its inventory to mitigate the case.

European Command US Forces (EUCOM – Stuttgart, Germany) and African Command US Forces (AFRICOM – Stuttgart, Germany) increased intelligence efforts to provide information to NATO. There were also several national caveats and the lack of interoperability causing delay to share info and minor confusions. The dynamic operational environment simply overwrote the peacetime regulations to prove their inflexibility in crisis. Simply there was not enough time for sanitization⁸ so the raw intell material was delivered to customers in its original form.

These lessons learned (and recent regional conflict managements such as in Kosovo Afghanistan, Iraq etc.), led to the conclusion that NATO would speed up to get an AGS Joint ISR capability as an Alliance's asset.

“On 3 February 2012, the North Atlantic Council (NAC) decided on a way ahead to collectively cover the costs for operating AGS for the benefit of the Alliance. The decision to engage NATO common funding for infrastructure, satellite communications and operations and support paves the way for awarding the AGS acquisition contract by 13 Allies. In addition, an agreement was reached to make the United Kingdom Sentinel⁹ system and the future French Heron¹⁰ TP system available as national contributions–in–kind, partly replacing financial contributions from those two Allies.” (NATO, 2013)

The AGS system is expected to be acquired by 13 Allies (Bulgaria, Czech Republic, Estonia, Germany, Italy, Latvia, Lithuania, Luxembourg, Norway, Romania, Slovakia, Slovenia and the United States), and then will be made available to the Alliance in the 2015–2017 timeframe. This important procurement contract was signed by 13 participant nations representatives (Bulgaria, Czech Republic, Estonia, Germany, Latvia, Lithuania, Luxemburg, Norway, Romania Slovakia, Slovenia, Italy and USA) and Northrop Grumman officials at the Chicago Summit in May 2012.

8 Sanitization: Revision of a report or other document in such a fashion as to prevent identification of sources (e.g. HUMINT, SIGINT, IMINT etc.) or of the actual persons and places with which it is concerned or of the means by which it was acquired usually involves deletion or substitution of names and other key details to protect information sources. (writer)

9 The Raytheon Sentinel is Bombardier Global Express modified as an airborne battlefield and ground surveillance platform for the British Royal Air Force. Originally known as the ASTOR (Airborne STand–Off Radar) programme the aircraft is operated by a RAF squadron manned by both air force and army personnel. The Sentinel is interoperable with other allied systems such as JSTARS and the NATO Alliance Ground Surveillance (AGS) system. The UK government's Strategic Defence and Security Review (SDSR) announced its intention to “withdraw the Sentinel airborne ground surveillance aircraft once it is no longer required to support operations in Afghanistan. Sentinel has supported the British Army in Afghanistan.” One Sentinel aircraft was deployed to assist the French military in Mali on 25th January 2013.”
http://en.wikipedia.org/wiki/Raytheon_Sentinel (downloaded: 12 01 2013)

There was a new outcome for Sentinel's high performance in Lybia that forced UK officials to revise 2010 SDSR. It may as well be that RAF Sentinel would remain in the UK in order of battle for performing ISTAR.

10 Heron: The IAI Heron (Machatz–1), is a medium altitude, long endurance unmanned aerial vehicle (UAV) developed by the Malat (UAV) division of Israel Aerospace Industries. It is capable of Medium Altitude Long Endurance (MALE) operations of up to 52 hours' duration at up to 35,000 feet. It has demonstrated 52 hours of continuous flight, but the effective operational maximum flight duration is less, due to payload and flight profile. There is a new version, Heron TP, also known as IAI Eitan. On 11 September 2005, it was announced that the Israel Defense Forces purchased US \$50 million worth of Heron systems. France operates its own special version of the Heron, called Harfang.
http://en.wikipedia.org/wiki/IAI_Heron (downloaded: 12 01 2013)

“The NATO owned and operated AGS core capability will enable the Alliance to perform persistent surveillance over wide areas from high altitude, long endurance, unmanned aerial platforms operating at considerable stand-off distances and in any weather or light conditions. Using advanced radar sensors, these systems will continuously detect and track moving objects throughout observed areas and will provide radar imagery of areas of interest and stationary objects.

The main operating base for AGS will be located at Sigonella¹¹ Air Base in Italy (Northrop Grumman Corporation, 2012), which will serve a dual purpose as a NATO Joint Intelligence, Surveillance & Reconnaissance (JISR) deployment base and data exploitation and training centre.

Just as NATO’s Airborne Early Warning & Control (NAEW&C) aircraft – also known as AWACS – monitor Alliance airspace, AGS will be able to observe what is happening on the earth’s surface, providing situational awareness before, during and, if needed, after NATO operations. (NATO, 2013)

According to AJP 2.1 NATO Intelligence Procedures, (NATO, 2002) intelligence is every member nation’s independent responsibility on its own. Each of the allies needs to have an intelligence system as a nation’s asset. NATO has limited JOINT capacities as Allied assets.

Northrop Grumman will be the prime contractor of the 1.3 million Euro project for the NATO AGS program, and build five (5) Global Hawk High Altitude Long Endurance (HALE) UAVs, supporting systems and payloads including the MP–RTIP radar, which is capable of detecting and tracking moving objects as well as providing radar imagery of target locations and stationary objects.

The company’s primary industrial team from the 13 nations will include Cassidian, Sel-ex Galileo and KONGSBERG, as well as leading European defense firms such as EADS Deutschland GmbH (Cassidian), ICZ, A.S., Retia, A.S., Aktors OÜ, Komerccentrs DATI group, Elsis LTD., Konstrukta–Defence, A.S., ComTrade D.O.O., BIANOR, Technologica, Zavod Za Telefonna Aparatura Ad (ZTA AD), SELEX ELSAG, Elettra Communications, UTI Systems and SES. (Northrop Grumman Corporation, 2012)

The ground element, which provides real-time data, intelligence and target identification to commanders within and beyond line of sight, will be exclusively produced by European industry, offering direct work in the program for the participating nations.

France as well as UK still have strong intentions to join the program later on (2015–17) with their national ISTAR systems (HERON, Sentinel). This will be supplemented by additional interoperable national airborne surveillance systems from NATO nations, tailored to the needs of a specific operation or mission conducted by the Alliance. So it means that the system itself can integrate several other systems’s outputs via NATO C2 channels. Not only airborne but ground based ISTAR assets can join AGS. The figure below depicts the system architecture after set up.

¹¹ “Sigonella, Sicily (Italy). NATO AGS will be co-located with the U.S. Air Force Global Hawks and the U.S. Navy Broad Area Maritime Surveillance unmanned aircraft systems, further advancing synergies across the three programs in operational capability, life cycle logistics and sustainment.”

AGS overviewfor JISR

The AGS will be an integrated system consisting of an air segment, a ground segment and a support segment. The Figure 1. is displaying how essential elements attach each other to maximize system power. As it seen not only AGS core elements can work as a whole but there are several other national systems possibility to join via NATO standardized communication means. The final result is a Recognised Surface Picture (RSP) that gives players an outstanding possibility to see a common real time 'screen shot' for a joint situational awareness.

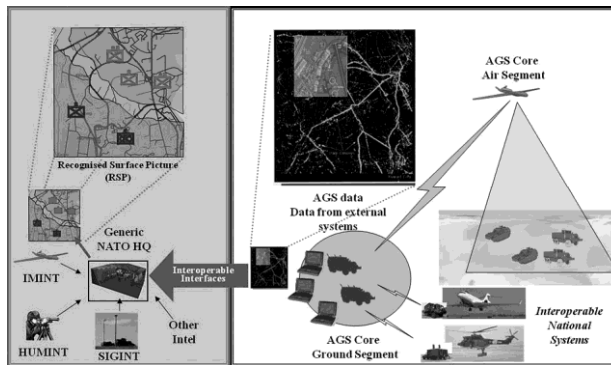


Figure 1. The essential elements of the AGS architecture (NATO C3 Agency, 2010: 3)

The air segment consists of five Global Hawk Block 40 high altitude, long endurance UAVs. The UAVs will be equipped with a state of the art, multi-platform radar technology insertion program (MP-RTIP) ground surveillance radar sensor, as well as an extensive suite of line of sight and beyond line of sight, long range, wide band data links. The air segment will also contain the UAV flight control stations. (NATO, 2013)

Global Hawk Block 40

The Northrop Grumman (formerly RyanAeronautical) RQ-4 Global Hawk (known as Tier II+ during development) is an unmanned aerial vehicle (UAV) used by the United States Air Force and Navy and the German Air Force and soon NATO as a surveillance aircraft.¹²

12 http://en.wikipedia.org/wiki/Portal:Robotics/Featured_robot/5 (downloaded: 12 01 2013)

The Global Hawk is able to provide high resolution synthetic aperture radar¹³ data (SAR) – that can penetrate cloud cover and sandstorms – and electro–optical/infrared (EO/IR) imagery at long range with long loiter times over target areas. It can survey as much as 40,000 square miles (103,600 square kilometers) of terrain a day.¹⁴

It is used as a high–altitude platform for surveillance and security. Missions for the Global Hawk cover the spectrum of intelligence collection capability to support forces in worldwide military operations. According to the United States Air Force, the capabilities of the aircraft allow more precise targeting of weapons and better protection of forces through superior surveillance capabilities.¹⁵

*RQ-4B*¹⁶

General characteristics

- Crew: 0 onboard (3 remote: LRE pilot; MCE pilot and sensor operator)
- Length: 47.6 ft (14.5 m)
- Wingspan: 130.9 ft (39.9 m)
- Height: 15.3 ft (4.7 m)
- Empty weight: 14,950 lb (6,781 kg)
- Gross weight: 32,250 lb (14,628 kg)
- Powerplant: 1 × Allison Rolls–Royce F137–RR–100 turbofan engine, 7,600 lbf (34 kN) thrust

13 “Synthetic–aperture radar is a form of radar whose defining characteristic is its use of relative motion, between an antenna and its target region, to provide distinctive long–term coherent signal variations, that are exploited to obtain finer spatial resolution than is possible with conventional beam scanning means. It originated as an advanced form of side looking airborne radar (SLAR). SAR is usually implemented by mounting, on a moving platform such as an aircraft or spacecraft, a single beam forming antenna from which a target scene is repeatedly illuminated with pulses of radio waves at wavelengths anywhere from a meter down to millimeters. The many echo waveforms received successively at the different antenna positions are coherently detected and stored and then post–processed together to resolve elements in an image of the target region. Current (2010) airborne systems provide resolutions to about 10 cm, ultra–wideband systems provide resolutions of a few millimeters, and experimental terahertz SAR has provided sub–millimeter resolution in the laboratory. SAR images have wide applications in remote sensing and mapping of the surfaces of both the Earth and other planets. SAR can also be implemented as “inverse SAR” by observing a moving target over a substantial time with a stationary antenna.”
http://en.wikipedia.org/wiki/Synthetic_aperture_radar (downloaded: 12 01 2013)

14 http://en.wikipedia.org/wiki/Northrop_Grumman_RQ-4_Global_Hawk (downloaded: 12 01 2013)

15 Ibid.

16 Ibid.



Figure 2.
A German Global Hawk RQ-4E (EUROHAWK)^{17 18}

Performance

- Cruise speed: 357 mph (310 kn; 575 km/h)
- Range: 8,700 mi (7,560 nmi; 14,001 km)
- Endurance: 28 hours
- Service ceiling: 60,000 ft (18,288 m)¹⁹

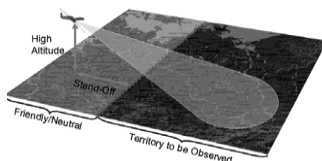


Figure 3.
Air segment in use in general (NESSE, 2007: 1)

The air segment will be equipped with state-of-the-art MP-RTIP and ground moving target indicator (GMTI)²⁰ radars. The communications will provide connectivity even beyond line of sight with broadband data link.

The AN/APY-2 MP-RTIP radar uses active electronically scanned array (AESA) technology and commercial off the shelf hardware to deliver long range, very high resolution SAR, GMTI capabilities and air target tracking. Fundamental to the radar is its modular scalable design, which allows it to be applied to multiple airborne platforms.

17 Earlier the German Strategic Reconnaissance Command (Trier) used to operate Dassault Breugot Atlantic 1150 (Old Lady) recce aircraft. In 2009 Global Hawks (RQ-4E, Eurohawk) were introduced. SIGINT payloads are being produced by EADS.

18 http://en.wikipedia.org/wiki/File:Luftwaffe_99-01_RQ-4B_EuroHawk_ILA_2012_1.jpg (downloaded: 12 01 2013)

19 <http://www.northropgrumman.com/Capabilities/NATOAGS/Pages/default.aspx> (downloaded: 12 01 2013)

20 Ground Moving Target Indicator is a mode of operation of a radar to discriminate a target against clutter. In contrast to another mode, stationary target indication, it takes advantage of the fact that the target moves with respect to stationary clutter. The most common approach takes advantage of the Doppler Effect. For a sequence of radar pulses the moving target will be at different distance from the radar and the phase of the radar return from the target will be different for successive pulses, while the returns from stationary clutter will arrive at the same phase shift.

http://en.wikipedia.org/wiki/Moving_target_indication (downloaded: 02 02 2013)

MP-RTIP will provide war fighters improved combat identification, target tracking and time critical targeting, while adding an impressive new air-to-air capability to support cruise missile defense. This powerful combination can aid commanders in developing predictive battlespace awareness and targeting solutions.

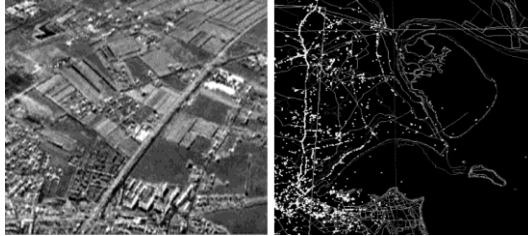


Figure 4.

A SAR image of an urban territory of Southern France²¹ and an example of GMTI (HONG et al., 2004) imaging.

The ground segment will provide an interface between the AGS Core system and a wide range of command, control, intelligence, surveillance and reconnaissance (C2ISR) systems to interconnect with and provide data to multiple deployed and non-deployed operational users, including reach-back facilities remote from the surveillance area.

The ground segment component will consist of a number of ground stations in various configurations, such as mobile and transportable, which will provide data-link connectivity, data-processing and exploitation capabilities and interfaces for interoperability with C2ISR systems. (NATO, 2013)



Figure 5. A Ground Control Station (MQ-1) (CRYPTON, 2012)

21 <http://www.onera.fr/onera-offre/005-radar-surveillance-observation.php> (downloaded: 02 02 2013)

The AGS Core support segment will include dedicated mission support facilities at the AGS main operating base (MOB) in Sigonella, Italy.

The composition of the AGS Core system and these contributions—in-kind will provide NATO with considerable flexibility in employing its ground surveillance capabilities.

The engagement of NATO common funds for infrastructure, communications, operation and support will follow normal funding authorisation procedures applicable within the Alliance. (NATO, 2013)

Data distribution: Alongside the aerial and ground segment data distribution it is important in the whole system to deliver pieces of information to whom it may concern.

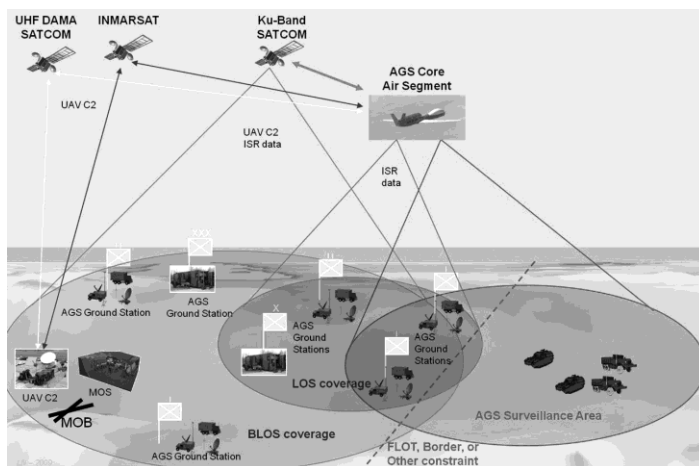


Figure 6. AGS CORE Internal Dissemination (NATO C3 Agency, 2010: 2)

The mission of the AGS Core is to support civilian and military authorities at multiple echelons with continuous information in NRT in order to enhance situational awareness concerning friendly, neutral, and opposing ground forces with a level of quality adequate to support targeting operations.

The AGS Core will be an integral part of the Combined Joint Task Force (CJTF) or NATO Response Force (NRF) commander's intelligence, surveillance, and reconnaissance (ISR) battle plan at the operational and tactical levels.

Collection requirements apportioned to the system will include standing, ad-hoc and dynamic requirements. The AGS Core will be expected to provide information for processes ranging from intelligence to targeting, and to simultaneously support multiple commanders. (NESSE, 2007)

How Hungarian Defence Forces (HDF) would be benefited by AGS?

Since 2006 the Hungarian Defence Forces has been working to adapt NATO advice on IS-TAR²² capabilities for brigade level such as:

22 EL 0583 — NATO 2006 force proposals for Hungary 2006–2016.

- C2²³, later C4I²⁴ability;
- interoperable data gathering and evaluation panel (ASI²⁵ FUSION Cell);
- Reconnaissance troops;
- SOF²⁶ teams;
- tactical HUMINT troops;
- moving target radars (indicator);
- unattended ground sensors;
- groundbased and airborne EW²⁷ assets;
- Counter RC-IED²⁸;
- SIGINT (COMINT, ELINT)and frontline analysis tools;
- IMINT MALE²⁹ and LAME³⁰ UAV-teams;
- Target Aquisition solutions.

Due to the budgetary situation Hungary is just slowly introducing elements of that proposal. Recently, HUN MoD has aquired LAME UAVs (Skylark) with the IMINT system (day and night optic), which is not satisfactory for operations through a full spectrum. In addition to HUN MoD subordinated firm HM. EI. Zrt's³¹ subsidiary company called Currus Rt. has developed two UAVs Bora and Ikran. Those are based on the experience of former Meteor 3MA and dedicated to only IMINTpurposes. Considering the parameters of those they could mean a national solution (equivalent) to Skylark not meeting MALE and HALE requirements.



Figure 7. HUN HM EI Zrt. developed UAV's (Ikran) landing³²

23 C2 — Command and Control

24 C4I — Command Control Communication Computer and Intelligence

25 ASI — All Source Intelligence

26 SOF — Special Operation Forces

27 EW — Electronic Warfare

28 RC IED — Radio Controlled Improvised Explosive Device

29 MALE — Medium Altitude Long Endurance

30 LAME — Low Altitude Medium Endurance

31 HM EI. Zrt — Honvédelmi Minisztérium Elektronikai, Logisztikai és Vagyonkezelő Zártkörűen Működő Részvénytársaság

32 http://www.hmei.hu/images/rendezvenyek/Robotrepulo/IMG_7832.jpg (downloaded: 22 03 2013) Despite being a small step Bora and Ikran are important outcomes of a joint think thank to create internal solutions for IMINT.

Despite this small achievement we can say there are no adequate ground based nor aerial sensors for IS(TA)R³³ in the HDF. There are advantages to be a part of NATO AGS such as:

- AGS would bridge our technical gaps temporarily until we get full national ISTAR capability;
- spares money to meet Pooling and Sharing and Smart Defence's challenges;
- provides crucial information on AGS targeted areas we had no prior access to;
- gives unique HALE UAV solution for strategic interest and gathering experience.

Knowing these ideas the proposals are follows:

- to spend money to join AGS program (e.g. instead of maintaining HUN contribution to NATO Sealift program);
- to participate in different EUR workshops to develop UAV payloads (e.g. German led Eurohawk SIGINT sensor project);
- to take into consideration to send desk officers to Sigonella;
- to support national solutions to develop MALE UAVs to be able to carry IMINT, SIGINT as well as SAR payloads in order to join AGS in the future;
- to set up a National Intelligence Fusion Center and subordinated elements to be interoperable to NATO C4I-systems.

Nowadays, we (Hungary) have been suffering under from budgetary restrictions. In these days it is extremely important to address military needs towards politicians in order to gain subsidies. I would like to emphasize that UAVs (LAME, MALE, HALE) can serve not only military but civilian purposes as well. For example:

- fight against terrorism;
- maritime surveillance;
- airport security;
- infrastructure resource protection;
- border surveillance (eg. Schengen communities);
- humanitarian relief protection;
- damage assessment (fires, floods, storms, earthquakes etc.);
- law enforcement purposes etc.

These facts may convince decision makers to support our efforts to create national, dual use answers to domestic challenges as well as international requirements such as NATO's.

Recognizing the advantages of being a part of NATO AGS Polish Minister of National Defence Tomasz Siemoniak declared Poland's participation in AGS – NATO Alliance Ground Surveillance system at NATO ministerial in Brussels in October 2012

“From Poland's point of view, joining AGS Program will be very significant for increasing its meaning and strengthening its position in NATO structures. We will be among 14 NATO states building capabilities within that system and at the same time we gain the possibility to strengthen cooperation with countries leading in modern technologies.

33 According to the HDF Standing Branch Workshop's decision (Fegyvernemi Állandó Munkacsoport) the Target Aquisition (TA) refers to Artillery. So TA is not a part of ISTAR in HUNMIL terminology. That is why TA is in brackets.

Moreover, participation in AGS will enable Polish Armed Forces to complement the military capabilities of conducting image reconnaissance and will allow to use it in the future for realisation of national needs or in allied cooperation e.g. during joint exercises.” (Jorge, 2012)

Following the Polish intention I strongly advise HUN MoD officials to revise their non-attendance decision of AGS.

Summary

As one of the most important procurement programs AGS (signed in May 2012 Chicago) is a major step towards NATO Joint ISR. The natural disasters of the last 20 years (e.g. Haiti earthquake, Pakistan flood etc.) as well as armed conflicts (Yugoslavia, Iraq, Kosovo, Afghanistan, Arab spring etc.) have highlighted the fact that it is a necessary and urgent issue to provide a state of the art solution as an Alliance asset for growing information need.

Despite the fact that Hungary is not a part of the 13 (15 by 2017) member nations' initiative later on it would be benefited by the system's future performance. In the very early phase of the program our mother land was involved in the feasibility plan but later we came out because of growing expected expenses.³⁴

Creating our national ISTAR (ISR) capability it is highly important to become interoperable with NATO systems such as NATO JISR, no matter the size of our defence forces and its possibilities.

Lessons learned in Afghanistan made us think that even a piece of tactical information would have strategic impact. That is why we would not be disheartened to see the size differences between our and bigger NATO nations' Armed Forces. Frequently, our contribution would be so vital and crucial that even the bigger needs the smaller one's completion to the whole Common Operational Picture (COP) puzzle.

NATO considers AGS an extremely important project to meet challenges of the 21st century. On 16 October 2012 General Sir Richard Shirreff — NATO Deputy Commander Supreme Allied Command Europe — stated that in a briefing at the Hungarian National University of Public Service. He also noted that in spite of the existing difficulties (e.g. decrease of military budgets) NATO may continue to be the only effective solution and opportunity for giving a successful joint response to the currently transforming security challenges, risks and threats.³⁵

No later than 2017 will NATO Alliance Ground Surveillance System reach Full Operational Capability.

³⁴ According to the former COS of Hungarian Defence Forces General (ret.) Zoltan Szenes' recall the feasibility plan cost 80 000 Euro and further 2–2.5 million Euro need to join AGS

³⁵ Personal participation in the Conference



Figure 8. NATO AGS Global Hawks at Sigonella (Artist Concept)³⁶

The AGS system will provide real-time data, intelligence, and even target identification to NATO users within and beyond line of sight. This solution demonstrates a truly transatlantic approach to NATO's requirements and will provide significant work share directly in the program for national industries of participating nations.

The Alliance Ground Surveillance System definitely will contribute to the collective security of allied nations by providing timely, accurate and reliable pieces of information to handle crisis situations better than ever.

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Tools for Analysing Military Tactics based on Bézier Surface Pattern Recognition

SORMUNEN, Jari¹, ESKELINEN, Harri²

There are many factors which affect a military unit's success in a battle exercise. Some of these factors could be regarded as tactical and others as human factors. Some of them can be measured with numerical values while others are difficult to quantify. Nevertheless, they all affect the success of the battle exercise. This paper describes how to develop and utilize a method based on Bézier surface pattern recognition, which could be used for the overall military tactical analysis of a company's attack. This paper also explains how this method could be applied to an integrated analysis of the most important tactical factors affecting the success and task fulfilment of an attack together with the leader's decision-making and his or her tactical solutions.

Keywords: Military tactics, decision-making, company, attack exercise, Bézier surface.

Background and Introduction

The basic tactical research, “The Success Factors of an Infantry Company's Attack” (SCA–research), which was carried out in the Finnish Defence Forces (FDF) during the years 2004–2007 forms the empirical background of this paper. The SCA–research focused on analyzing different individual effects of selected measured explanatory variables. The variables were selected from the areas of tactics, situational awareness, battle task load, human factors, background factors and response variables. During this research, 59 attack exercises by infantry companies were analyzed. Detailed results are documented in Sormunen's and Eskelinen's paper. (2010)

This paper presents a comprehensive evaluation method for tactical analysis. The development of the method started from constructing the data collection matrix. This 5×4 matrix is constructed in a simple way by displaying the general tactical elements (FDF, 2008) as columns and the known tactical principles (FDF, 2008) as rows. In this paper, the checkers which are formed at the crossings of these rows and columns of the 5×4 matrix are called central tactical variables (CTV), and the aspects they can be divided into are called tactical items. In this paper, we justify and describe this matrix construction and explain the contents of the CTVs and the tactical items. To simplify this presentation, we use the name CMEP–matrix (Command and Control, Manoeuvre, Effect, Performance Maintenance) for this 5×4

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matrix and the method which uses the CMEP–matrix for data collection and tactical analysis is entitled the CMEP–method. The CMEP–matrix is presented in Fig. 1. The set of twenty CTVs here are only an example of the components which were recognized in attack exercises during the background research. (Sormunen, Eskelinen, 2010) The CTVs and the tactical items should be adjusted depending on the battle type and the battle task.

TACTICAL ELEMENTS/ PRINCIPLES	COMMAND AND CONTROL	MANOEUVRE	EFFECT	PERFORMANCE MAINTENANCE
KNOWLEDGE OF ADVERSARY AND OWN Shaping the threat Possibilities of achieving effect Common tactical understanding Position and condition info Avoiding force binding	1 FREEDOM OF ACTION Shaping the threat Possibilities of achieving effect Common tactical understanding Position and condition info Avoiding force binding	2 TERRAIN AND CIRCUMSTANCES Restrictions of adversary Own force strengths Dominant terrains Relative agility	3 USE OF PERFORMANCE Choosing the right object/target Avoiding passive formality Active use of deceptive actions Economic use of force Profitable synchronization	4 CONCEALMENT Variation of action styles Own battle plan secrecy Situation picture of adversary Effect-based decentralization
ACTIVENESS	5 SITUATION EVALUATION AND POSSIBILITIES Seeing the possibility Courage to utilize Will to take initiative Reconnaissance-pull Sensibility of thinking	6 BATTLE READINESS Adaptation to situations Responding to the unexpected Continuity of movement Leadability Positioning	7 COMBAT TECHNIQUES Firing situations (opening fire) Adversary on move when fired Own units positioned when firing Active use of battle composition Proper utilization of strengths	8 FORCE PROTECTION Keeping up preparedness Ensuring early warnings Own performance capacity Terrain adaptation Air protection and -defence
SIMPLICITY	9 CONCENTRATING ON THE ESSENTIAL Main attention on adversary Battle task clear in mind Action competence (training) Utilization of own example Short communication (signals)	10 EXECUTION CAPABILITY Effect and speed (queues) Standardized starts (STP) Weapons quickly to positions Aim to concentrate effect Mobility improvement	11 CLEAR INTENTION Fulfilling the battle task Maximizing casualty production Minimizing own force casualties Satisfactory input-output ratio Battle task tactics	12 FLEXIBILITY Broad method spectrum Fast adaptability Speed of situation variation Security
CONCENTRATION OF EFFECT	13 BREAKING THE BATTLE PLAN OF ADVERSARY Stopping the manoeuvre Forcing adversary to react Aiming at surprise Active choice of time and place	14 BATTLE PULL Advantageous positions Several effect directions Adjusting the movement Profitable battle formations Situational speed	15 BATTLE SUPPORT Producing enough casualties Overall profitable use of all fires Proper centre of gravity Co-effect of supporting branches Breaking adversary's cohesion	16 BATTLE SERVICE Material readiness Support to acting readiness Foreseeing needs Advanced fulfillment of needs Pushing principle in service
RESERVE AND EXERTION OF IT	17 PREPARING FOR VARIATION OF SITUATION Readiness for the unexpected Active use of situation picture Evaluating options Searching culmination Effort to take initiative	18 CONTINUITY Keeping up initiative Aiming at battle culmination Attention to possibilities Focus after battle engagement Keeping up battle engagement	19 UTILIZATION OF SUCCESS Developing initiative Creating culmination Keeping up adversary's pressure Using the possibility windows Perseverance	20 RELEASING NEW RESERVE Utilization of initiative Utilization of culmination Possibilities of continuing Developing battle situations Adversary's pressure growth

Figure 1.

The CMEP-matrix. The set of twenty CTVs is valid for analyzed infantry company's attack exercises.

Qualitative Methods and Analysis

The CMEP-matrix construction is built step by step as illustrated in Fig. 2. The rows and columns are established based on literature research. The central tactical variables and the tactical items are recognized based on the qualitative analysis of reports written by the data collectors during the SCA-research. These reports described the tactical actions of the fighting units in 59 attack exercises.

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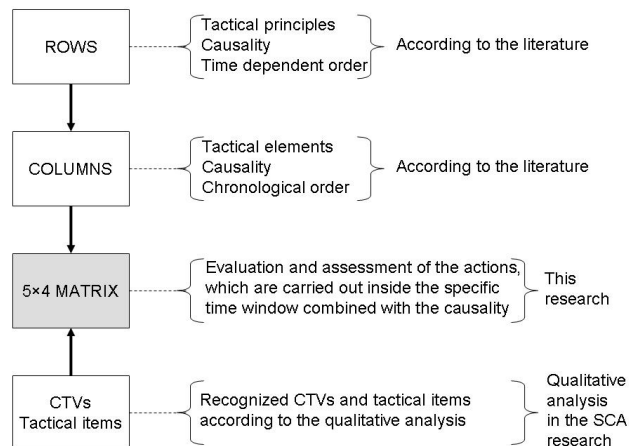


Figure 2.

The development steps and justification of the CMEP-matrix

Tactical principles and tactical elements

First, let us discuss the justification of the rows and columns. The construction and order of the rows and the columns of the CMEP-matrix are based on the observations collected in the SCA-research (Sormunen, Eskelinen, 2010), and supported by literature research.

In the Finnish Defence Forces' Field Manual 2008 (FDF, 2008), the central tactical principles are described with the words, "consciously, actively, simply, concentratedly and continuously". The sequence of the tactical principles, which is the sequence of the rows in the CMEP-matrix, is determined based on the causalities found from the literature and the qualitative analysis of the source data collected from the SCA-research. According to the Field

Manual (FDF, 2008), tactical principles should also always be integrated with the time dependent result. Based on these facts, the sequence of the rows in the CMEP–matrix should be “knowledge of adversary and own, activeness, simplicity, concentration of effect, reserve and exertion of it”. Fig. 3 illustrates the systematic search for causalities from relevant literature between the tactical principles.

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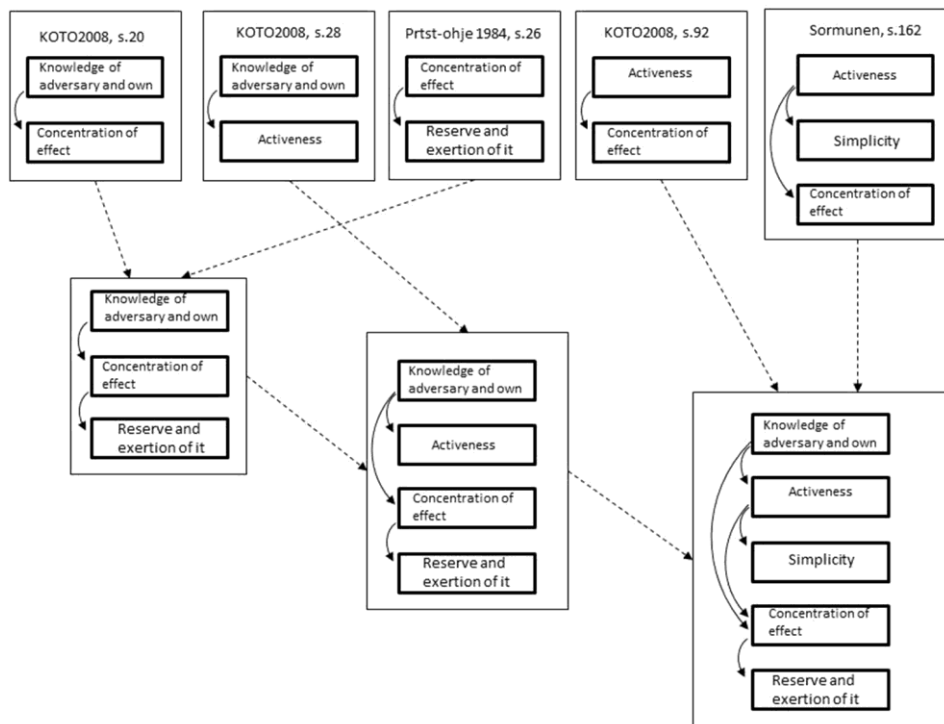


Figure 3. Systematic search for the causalities between the tactical principles. The referenced data sources are: (FDF, 2008), (FDF, 1984) and (Sormunen, Eskelinen, 2010).

It is an interesting detail that the percentages of observations which were collected from the background research (Sormunen, Eskelinen, 2010) by utilizing qualitative analysis place the tactical principles in the same sequence as the previous literature research. The results are illustrated in Fig. 4.

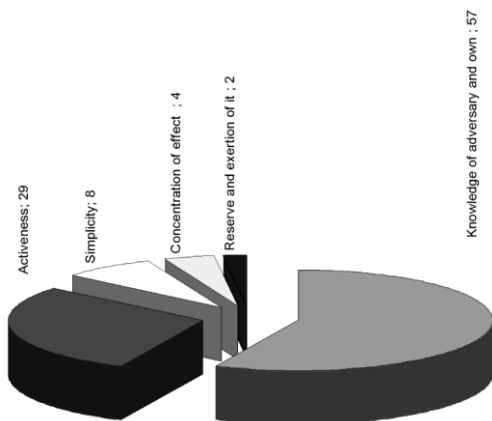


Figure 4. The percentages of observations dealing with tactical principles related to the sequence of rows in the CMEP–matrix. (Sormunen, Eskelinen, 2010)

According to the Field Manual (FDF, 2008), the tactical elements are command and control, manoeuvre, effect and performance maintenance. The tactical principles become apparent in the interaction with the tactical elements of the battle. According to this Field Manual, the purpose of the manoeuvre near the adversary is to move one’s own troops safely to the position from which it is possible to affect the adversary effectively with fire. Further, command and control can be seen as a factor which aims to integrate the other tactical elements of the battlefield. When considering the chronological order of the tactical elements, the sequence is command and control, manoeuvre, effect and

performance maintenance. The tactical elements (columns of the CMEP–matrix) of the CMEP–matrix are the same as the tactical elements in the battlefield according to the Field Manual. (FDF, 2008)

The tactical elements presented in the columns of the CMEP–matrix can be evaluated by utilizing the words presented in the rows of the CMEP–matrix (consciously, actively, simply, concentrated and continuously). For example, command and control could simultaneously be conscious, active, simple, concentrated and/or continuous). This viewpoint has led to the 5×4

CMEP–matrix and enables the qualitative tactical evaluation of an attack.

The analyzed reports written by the data collectors of the SCA–research (Sormunen, Eskelinen, 2010) included 84 perceptions which directly discussed measured absolute time intervals, the registered relative quickness of the effect or the right timing in different tactical actions in the battle space. Based on these observations, it was possible to define the critical time interval, the so–called time window (tw) in which certain actions in the battle space should be carried out. This time window also describes the time limits within which one’s own forces should react to reach higher tactical speed than the adversary. Some examples of different types of perceptions (Sormunen, Eskelinen, 2010) dealing with time are presented in Table 1. This information is derived to establish the size of the critical time window. Also based on the background research (Sormunen, Eskelinen, 2010), some alternative ways to describe the utilization levels of the opened time window are presented in Table 2.

Table 1. Examples of different types of perceptions dealing with time. (Sormunen, Eskelinen, 2010)

Type of perception	Perception (example)
Required or used absolute time for certain actions.	<i>“For example, the best result was five minutes, which was required from the point when the vehicles arrived to the footing area to the point when the platoon started to progress the attack.”</i>
Tactical speed comparison between two fighting sides.	<i>“The unit which was moving more quickly had the edge in capturing the advantageous positions in the terrain of the battlefield.”</i>
Estimation or evaluation of the length of the time interval of an action or between two actions.	<i>“Too much time was spent after the battle to turn the vehicles in the right direction for the next departure.”</i>

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Table 2. Examples of different ways to describe the utilization levels of the time window in the analyzed attacks. (Sormunen, Eskelinen, 2010)

Type of perception	Perception (example)
An open (optional) time window is recognized.	<i>“Often the key factor is the higher speed compared to the adversary. The winner of the battle is often the soldier of the unit which is faster and acts better according to the requirements of the battle situation.”</i>
The open time window is utilized.	<i>“The fighting side which has grasped the initiative has the edge over the adversary at the beginning of the battle. After this, the quick defeat of the adversary is ensured by a quick creation of the center of gravity.”</i>
The open time window is wasted.	<i>“In this case, the prepared attack is, firstly, too slow and vulnerable, and secondly, it may be directed, due to its slowness, not towards the regiment headquarters but in front of the adversary’s second firing level. This turns the role of the attacker to the role of the target at the flank.”</i>
The time window is opened, but it is not utilized.	<i>“Immediate utilization of success and progress would probably have resulted in even further success, but now the stop of the attack gave the option to the blue side to react first and take the appropriate actions.”</i>

From the viewpoint of the CMEP–method, two of the time windows are more interesting than the rest. The first time window covers the time used for deciding and ordering the intended tactical actions. The second time window covers the time used for performing the intended and ordered actions and additional technical delays to the impact moment of the main weapon effect. It is therefore justified to evaluate how the CMEP–method works with different types of time windows.

From the tactical viewpoint, the central aspect which connects the rows and columns of the CMEP–matrix is time. As illustrated in Fig. 5, the time dependent structure of the CMEP–matrix makes it possible to study in the desired time

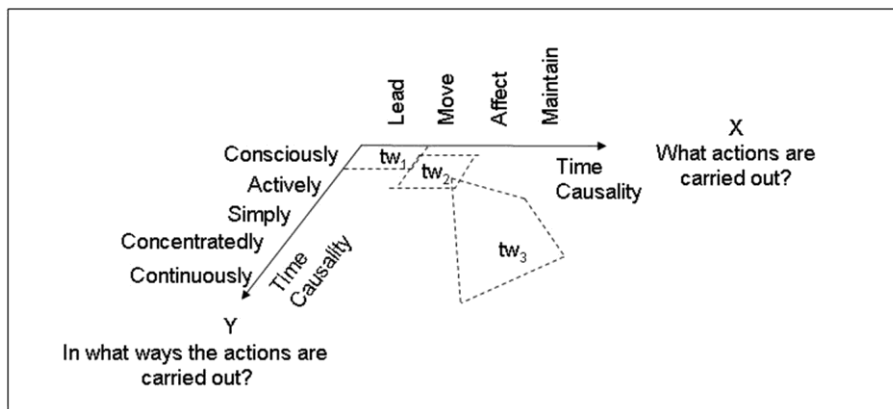
window both what tactical actions have been taken and in what way these actions were carried out.

Within the CMEP-matrix, a part of a tactical phenomenon could be expressed as “conscious command and control” in the time window “tw1” or it could be entitled “active manoeuvre” in the time window “tw2” if it is relevant to limit the size of the time window to illustrate just a small part of the tactical phenomenon. From the viewpoint of the battle result, the study of tactical phenomena could be extended in the time window “tw3”, which covers several checkers of the CMEP-matrix (several tactical actions have taken place and are carried out in different ways). Because both the tactical elements and tactical principles are time dependent and there is causality which establishes their sequence, there is also a time axis passing along the diagonal of the CMEP-matrix.

The CMEP-matrix construction makes it possible to describe the tactical grounds so that e.g. good command and control could be simultaneously based on situational awareness (consciousness) and activeness, or on the other hand, the effect could be simultaneously concentrated and simple. In addition to the description of these types of separate tactical

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reason-consequence-relations, the CMEP-matrix construction makes it possible to study comprehensively different integrated tactical phenomena within the 5x4 field (see Fig. 2).



tw₁ = time window 1
 tw₂ = time window 2
 tw₃ = time window 3

Figure 5. Utilization of the matrix construction for forming the tactical time windows.

Central tactical variables and tactical items

Let us then discuss the establishment of central tactical variables and tactical items. For this qualitative analysis, the source data collected from the background research included 12 000 observations (written comments) by data collectors. This qualitative analysis process reduces and compresses the initial source data so that the total amount of 12,000 observations is reduced to 500-600 observations at each crossing of CMEP-matrix rows and columns. The reclassification stage of the remaining observations compresses the amount to 80-100. Finally, after the abstraction stage of the qualitative analysis roughly 20-25 descriptions were found to describe the crossing of each row and column of the CMEP-matrix. After the generalization of these descriptions to fit in the framework of this research, four to five tactical items were found at each crossing of rows and columns. Finally, these items could be described with one term, which was then assigned as the name of the corresponding central tactical variable. This data reduction and compressing process is described in Fig. 6 according to Miles's and Huberman's book. (Miles, Huberman, 1994)

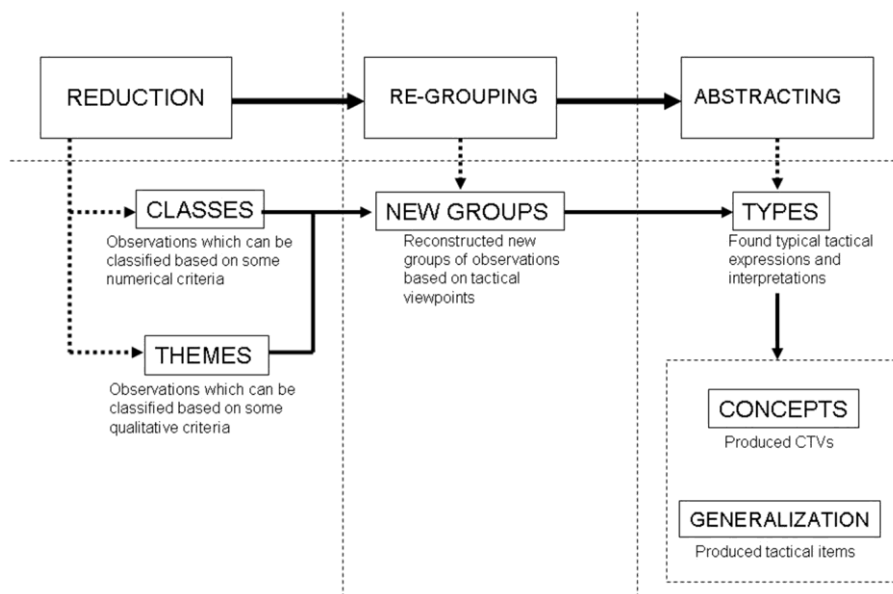


Figure 6. The establishment of the content of central tactical variables and the tactical items based on the principle of qualitative analysis in Miles's and Huberman's book (1994).

The qualitative analysis is carried out at each crossing of the tactical elements and the tactical principles of the CMEP-matrix. In this brief article, it is of course difficult to show all 12,000 observations and their interpretations, but the principle which leads to the definitions of CTVs and tactical items follows the routine presented in Fig. 6. In addition, when referring back to Fig. 1, we notice from the literature that for example Liddell, Hart and Lind have emphasized such comparable contents as "Freedom of action" and "Clear intention" (Liddell, 1954); (Lind, 1985) and Bellamy (1990) has emphasized such comparable contents as "Terrain and circumstances", "Use of performance", "Battle readiness", "Concentrating on the essential", "Execution capability", "Flexibility", "Battle pull", "Battle support" and "Releasing new reserve". (Bellamy, 1990) These findings support the results of the qualitative analysis in this research.

Quantitative Methods and Analysis

The next logical step after the qualitative analysis which resulted in the construction of the CMEP-matrix was the quantifying process of the collected data to be entered into the CMEP-matrix as numerical values of each CTV. When quantifying the qualitative results, the numerical values of each CTV-value were calculated by classifying the number of positive/neutral/negative perceptions. The source data came from the SCA-research. (Sormunen, Eskelinen, 2010) The presentation can be developed in a more illustrative manner by constructing a surface model from these numerical values. This is performed by changing the numerical values of the matrix into the height values of the surface model. As an essential part of this quantitative analysis, formulated Bézier surfaces were used as resulting surfaces,

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which indicate the success of the tactical solutions and performance of an attack. In addition to the formulation of the surface, a specialized surface ratio curve is calculated to be able to evaluate the attacks by using quantified grading.

Based on the qualitative viewpoint, we already know how the columns of the CMEP-matrix describe "what is done" (lead, move, affect, maintain) and how the rows of the CMEP-matrix describe "in what ways these actions are carried out" (consciously, actively, simply, concentrated, continuously) when a company carries out an attack. When we integrate the third dimension with the matrix (z-axis), it is possible to evaluate from the viewpoint of tactics the success of the action and the success of an attack. This principle is illustrated in Fig. 4. ARMS (12) 2 (2013)

If we regard the numerical value of each central tactical variable as its assessment related to the success of the corresponding action described with this variable, the surface model constructed based on the numerical values of each CTV can be regarded as an overall assessment of the analyzed attack. The height values evaluate "how well" knowledge of the adversary and one's own force, activity, simplicity, concentration of effect and reserve and exertion of it have been carried out in relation with command and control, manoeuvre, effect and performance maintenance. The height values of the surface model change depending on time, which makes it possible to study the tactical phenomena at different moments during the progress of an attack or after the end of an attack.

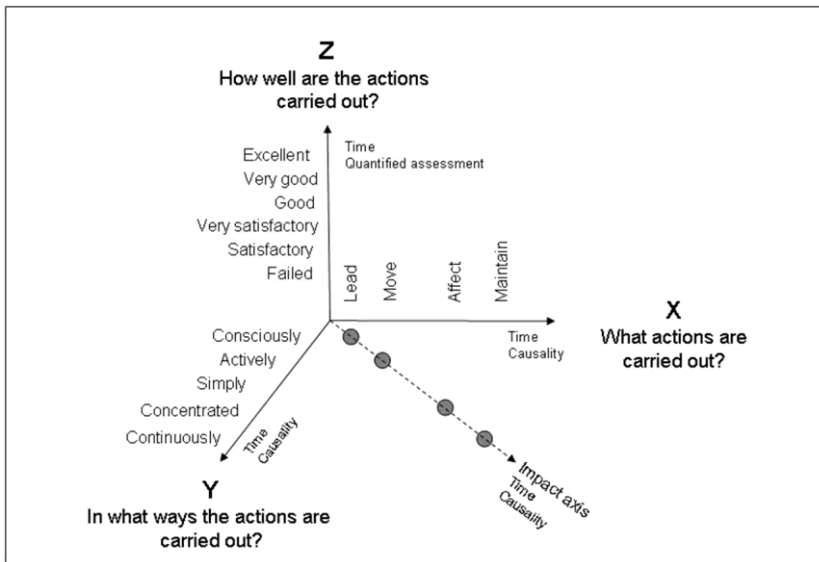


Figure 7. Integrating the z-axis with the CMEP-matrix.

The quantitative evaluations of task fulfilment and casualty data were integrated into the presentation by positioning the surface at the z-axis according to the given numerical values of task fulfilment and casualty data. In the same way, it would be possible e.g. to change the positioning of the surface depending on the difficulty level of the task. This quantifying process is presented in outline in Fig. 8.

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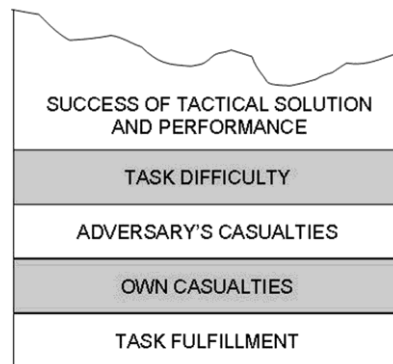


Figure 8. Quantifying process.

As shown in Fig. 8, the basic height values of the surface are calculated by summing up the scaled numerical values describing the task fulfilment and casualties. These values can be regarded as basic assessment criteria of success in the battle and therefore their scaled values are added to each central tactical variable to move the surface to the higher or lower level, which indicates how well the task is fulfilled and what the casualty ratio was after the battle. The additional quantified and scaled values of each central tactical variable are summed with these basic values. The stages of setting the height values on the surface are presented schematically in Fig. 9.

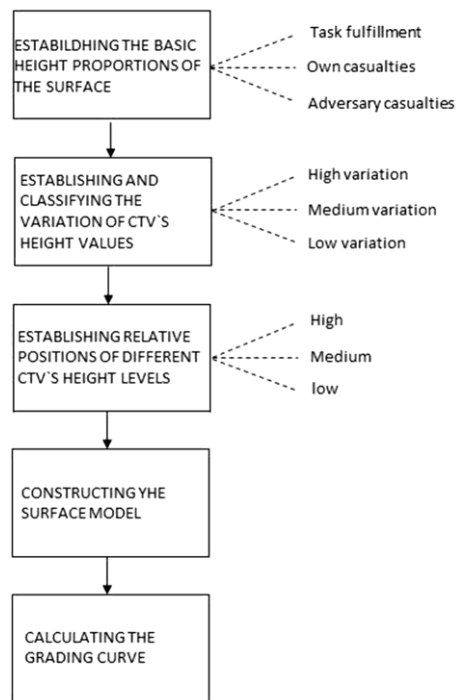


Figure 9.

The stages of setting the height values on the surface

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The basic height values of the surface are calculated by summing up the scaled numerical values describing the task fulfilment (symbol H1) and casualties (own, symbol H2 and adversary, and symbol H3). These values can be regarded as basic assessment criteria of success in the battle and therefore their scaled values are added to each central tactical variable to move the surface to the higher or lower level, which indicates how well the task is fulfilled and what the casualty ratio was after the battle. The additional quantified and scaled values of each central tactical variable are summed up with these basic values. The scaling equations are as follows (comparing with Fig. 8):

- The basic height values $H_{basic} = H1 + H2 + H3$ (scaled between 0...60mm)
- Task fulfilment: $H1 = 0$ (task is failed) or 30 mm (task is fulfilled)
- Own casualties: $H2 = ((100 - \text{own casualties } \%) / 100) \times 15 \text{ mm}$
- Adversary's casualties: $H3 = (\text{adversary's casualties } \% / 100) \times 15 \text{ mm}$.

When setting the hypothesis, the assumed height values of the additional height portion of the surface models for tactical interpretation are established by utilizing mathematical conditions which describe the relative differences of importance between the central tactical variables. In addition to these conditions, the maximum and minimum values (variation) are set for each central tactical variable and the final estimation is made by utilizing the median.

An example of the Bézier surface, which is calculated based on the measured data in the SCA-research (Sormunen, Eskelinen, 2010), for successful attacks is presented in Fig. 10.

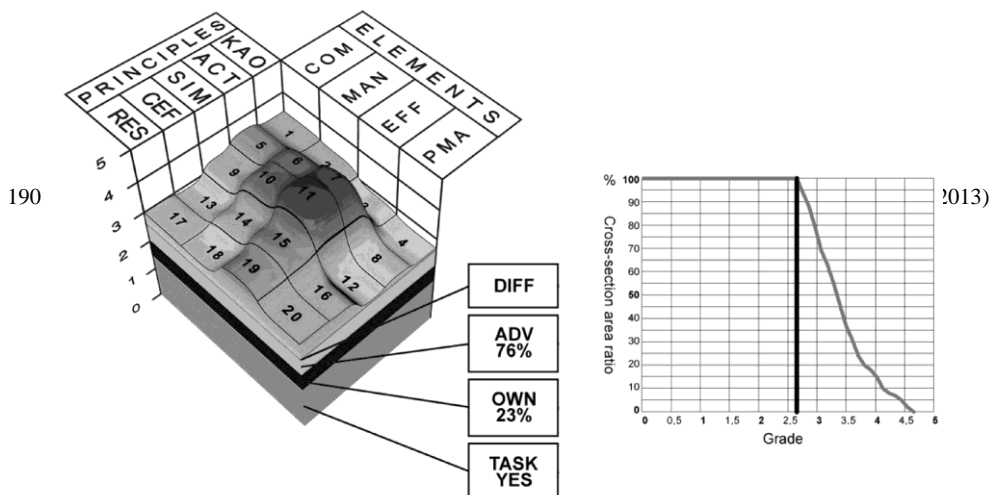


Figure 10. Calculated Bézier surface and the grading curve.

Calculating the Surface Area Ratio Curve

From the produced surface model of the CMEP–method, it is possible to cut different slices along the xy, yz or zx planes to evaluate different tactical aspects or to conduct a time dependent analysis of them. The calculated grading curve (surface area ratio curve) of the

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CMEP–method makes it possible to carry out an exhaustive and overall evaluation of the attack exercise. To be able to evaluate the tactics of the battles by using quantified grading, the surface area ratio curve is calculated. An example is presented in Fig. 11.

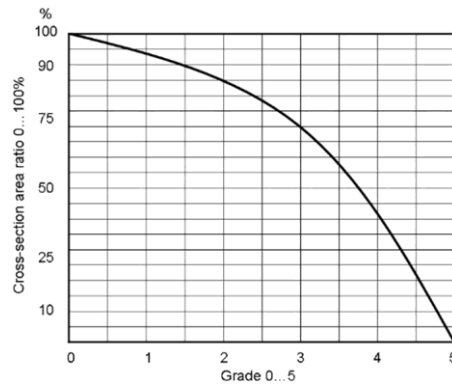


Figure 11. The surface area ratio curve.

From this curve, it is possible to read how large a relative portion of the CTVs have reached the required grading level. On the other hand, it is possible to set a grading value which divides the battles into successful or unsuccessful ones. This curve also shows how wide the basis for success has been or if only a few CTVs affecting success have reached the required level. This grading curve is an application of the Abbott–Firestone curve, which is applied to surface analysis (Schmahling, Hamprecht, 2007: 11–12, 262, 1360–1371).

Bézier Surface Modeling to Support Tactical Analysis

Results of the recent Human Factors Conferences have discussed the importance of visualization in describing the phenomena in the battle space for years. According to these results, exocentric 3D applications proved to be more powerful compared to immersive ones. In analogy to this, the surface presentation of the CMEP–method is constructed to help the user more easily form an overall tactical understanding of the analyzed results.

Bézier surfaces are an extension of the idea of Bézier curves and share many of their properties. In the same way as the Bézier curve uses the more tractable control polygon in place of control points and tangent vectors, the Bézier surface formulation uses a characteristic mesh in place of points and tangent and twist vectors. In an analogical way with Bézier curves, Bézier surfaces pass through the corner points of the characteristic polygon only and they have edge curves that are tangential to the edges of the characteristic polygon at the corner points. These surfaces are variation diminishing and have a convex hull property.

These properties of Bézier curves show that they have a number of limitations of the related curves. They only allow global modification and are somewhat constraining if a smooth transition between adjacent patches is to be achieved.

However, although the limitations of Bézier curves in exact surface modelling are known, it is noticeable that in this

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each CTV and the curves for surface modelling are allowed to follow the path of Bézier curves between the adjacent points. This modelling technique allows for illustration of the researched phenomena with a surface model with a relatively simple and quick data entering interface. Nevertheless, it makes it possible to analyze the properties of the surface with mathematical means if needed: the equation of the points on a Bézier surface is given in (McMahon, Browne, 1998).

The leading thought when designing the use of quantitative tools has been simplicity, especially when presenting the final results of the analysis of tactical solution and performance. However, the usability and feasibility of the developed method can be improved through mathematics. In this research, it means at first that an easy–to–understand data format is used to enter material into CAD–software. Secondly, this computer-aided tool produces, without any practical

modelling work, illustrative figures to present sometimes highly complicated phenomena relevant to tactics.

Bézier surface presentations are utilized both to support decision-making and to integrate the results of several design or reasoning stages, e.g. in optimum shape design. Vucina et al., 2012: 3, 4, 25, 201–207) Also other possibilities to utilize Bézier curves in different types of practical applications have been evaluated (Sohel et al., 2008) to improve the local information gained from the surface model. Different types of enhanced Bézier curve models have been presented in literature (Sohel et al., 2007). Extensive research has also been conducted to find means to describe the shape information of Bézier surfaces for interpreting different modelled phenomena. (Sohel et al., 2007) These aspects are of great interest when there is a need to integrate qualitative and quantitative measurement results to support tactical analysis.

When evaluating the reliability aspects of the surface modelling, two main points were checked: how the selected Bézier surface calculation differed from other possible modelling techniques in relation to pattern recognition and what the difference was in grading.

The point of interest is the higher levels of the surface, which start above the layers describing one's own and the adversary's casualties together with task fulfilment. Four different surface modelling techniques were compared: Bézier, Mozaic, Pyramid and Block surfaces. Basically, the Mozaic-model describes exactly the measured values of each item in all twenty CTVs. Compared to this, the Block model summarizes the values of different items within each of the twenty CTVs and it shows the summarized values of each CTV correctly. The Pyramid model is otherwise the same, but only the peaks are illustrated with the sharp vertex of twenty cones.

The idea of the CMEP-method is to combine the time aspect into both CMEP-matrix axes, which means that the heights of the neighbouring bars should change smoothly according to the tactical phenomena. Unlike the other modelling techniques, the Bézier surface is able to illustrate this feature due to its mathematical properties. The comparison results of different grading curves and the surfaces of each modelling technique are presented in Fig. 12.

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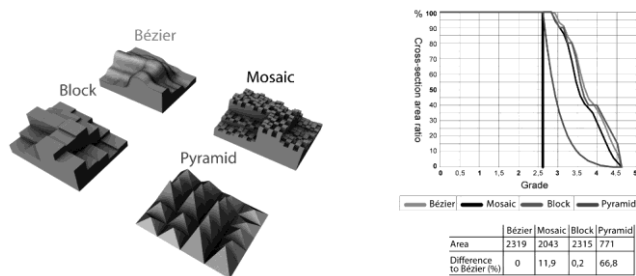


Figure 12. Comparison of different surface modelling techniques.

The comparison of the grading curves shows that on an average, the quality of grading in the Bézier model is 11.9% higher than in the Mozaic-model. On the other hand, the grading curve of the Mozaic model suffers from an unnatural stepwise progress of the curve. It is interesting to notice that the difference between the grading curves of the Bézier and Block models is only 0.2%.

Interpretation of Bézier Surface Patterns to Analyze Tactics

As a part of advances in computing in military operations research (OR), especially in tactical decision-making, the surface interpretation is based on recognizing some geometrical shapes from the surface pattern. This recognition process is supported by a picture series describing the most relevant surface shapes which are assumed to present some tactical phenomena and their success.

The calculated Bézier surface is compared with theoretical surfaces based on which a set of definition maps were produced to support the interpretation process of military tactics. The comparison is divided into the following three parts:

- Geometric similarity of the definition maps and the calculated surface pattern

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- Synthesis of the surface patterns

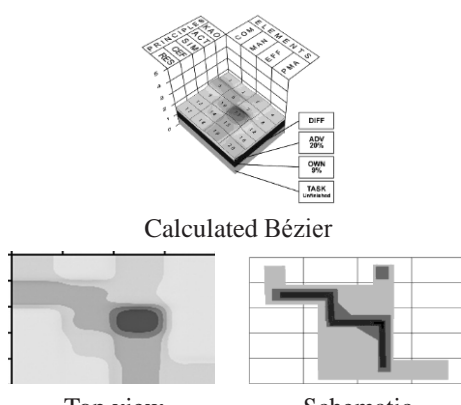
From the top view of the calculated surface, it can be proved that surface patterns at different height levels of the surface indicate and highlight, by different weightings, the aspects which have an effect on the result of the battle. It is as important to recognize these surface patterns at different height levels as it is to recognize the surface pattern at the highest (most visible) surface level. This shows that several aspects simultaneously have an effect on the result of the battle. It also demonstrates that depending on the battle situation, the impact factor of these aspects varies. As documented in Table 3, in this case example, only one chain is named and analyzed. In this case, according to tactical interpretation, in order to enable initiative in battle, the leaders have ensured the freedom of action by maintaining the possibility to affect in creative ways and by avoiding force binding. In addition to this, the leaders have been open to looking for new possibilities and to taking initiative. Initiative in manoeuvres, effects and other actions has shown in proactive actions to vary situations and the unexpected actions of the adversary. The leaders have had a strong

understanding of utilizing the unit's and its subunits' execution capability and they have understood the necessary functions to

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carry out the planned, prepared and trained actions before the adversary has time to force them to do so. Both the leaders and the subunits have had the courage and the justification to find and use the effects of supporting branches in a simple and creative way to fulfil the battle task.

Table 3. Surface pattern recognition and interpretation process.

<p>Constructed surface and its top view and recognized pattern shape</p>		
<p>Recognized shape from the top view of the surface</p>	<p>Recognized (visible) sequential CTVs</p>	<p>Nearest schematic geometry in the set of definition maps</p>
<p>Chain of CTVs in the CMEP-matrix</p>	<p>5 → 6 → 10 → 11 → 15 → 19</p>	<p>1 → 5 → 6 → 10 → 11 → 15</p>

Discussion and Conclusions

The aim of the CMEP-method is to integrate several different variables and affecting factors into one overall tactical analysis according to the leaders' decisions, solutions, and orders and according to the unit's actions and according to the events in the battle space.

By integrating a qualitative and quantitative analysis of an attack within the Bézier surface model, it is possible to extract and identify certain key points of the battle:

- Was the battle task fulfilled and the battle victorious?
- At what cost was the outcome of the battle achieved?
- Is the timing correct, related to the tactical solutions and selected actions during the battle?
- Were the decisions and actions actively justified?
- What were the key variables and culmination points of the attack?

Because the surfaces are produced from measured data into the form of Bézier surfaces, it is possible to add mathematical comparison and pattern recognition to the CMEP-method.

The primary challenge was in finding an appropriate way to handle several qualitative parameters describing tactical aspects. The sensitivity analysis of the CMEP-method consists of interaction between three main analysing stages, which are 1) the accuracy of the measured data, 2) the mathematical sensitivity of the CMEP-method and 3) the sensitivity

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of the CMEP-method's definition maps to support relevant interpretations dealing with the analyzed tactical phenomenon. The sensitivity analysis of the CMEP-method shows that it is possible to affect the resolution of the surface model by tuning the scaling of different layers of the surface model. However, a sufficient amount of source data is more critical to ensure that the height differences of the surface model are clear enough to illustrate different tactical aspects.

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The effect of specific environmental features on the activities of the Hungarian Defence Forces in Afghanistan¹

LIPPAI Péter², PADÁNYI József³

The environment — primarily the weather and the terrain — always has considerable impact on the success of military operations. We have numerous examples in military history when the extreme environment and the hostile weather rendered the implementation of the military leader's plans difficult or even prevented them. These days when the consequences of climate change play an increasing role in our everyday lives we have to pay special attention to the utilization of the experience gained in our missions. The soldiers of the Hungarian Defence Forces are among the first to meet climatic extremities, considerable temperature fluctuations and diseases unknown so far. This attention is made even more important by the fact that our presence extends from Africa to Asia, thus facing extreme circumstances is inevitable. Concurrently we also have to prepare ourselves for the extremely warm or cold weather in our own country. Both the preparation of our soldiers, their clothing and assets, and our operational procedures have to be thought over. This is the only way to enable our soldiers to concentrate solely on their duties thereby increasing their efficiency and safety. We will review below the practical experience gained by our soldiers in the operations in Afghanistan.

Introduction

The participation of Hungarian soldiers in missions abroad – and the collection of relevant experience – started at the end of the 19th century. The six European powers (Great Britain, France, Germany, Russia, Italy and the Austro–Hungarian Monarchy) jointly “sorted out” the situation in Crete (1897), China (1900–1914), Macedonia (1903–1909), and Albania (1913–1914).

The IFOR/SFOR operations predicted the difficulties the character of the terrain represents. The geographic structure of the terrain, roads impassable during winter, inaccessible transmission stations, routing of mountain roads, frequent and considerable water level fluctuations, the impact of high–altitude solar radiation are all factors influencing movement and the execution of tasks. We have lost public roads, military bridges and pedestrian bridges because of the rise of the water level. In order to enable access to radio stations that are important from a military aspect we have detached de–icing and snow removal machinery groups for the winter period. We have prepared detailed and constantly up–to–date route

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plans to enable long trailers to turn around the bends of mountain roads. We have increased repair capacity so that the technical equipment intensely employed in the mountains is always available. We continuously modernized clothing to suit increased stress.

The Hungarian Defence Forces faced the challenges of a natural environment drastically differently from their domestic one during the 2004 mission in Iraq. As a result of considerable temperature fluctuations, desert climate, dust and direct sunlight, effects emerged that had been unknown before. These circumstances put stress both on the soldiers and the technical equipment.

Missions in Africa also represented extremely serious challenges. Our soldiers have kept on participating in (primarily UN) missions on the continent for decades therefore the related challenges, among others the issue of clothing, are not unknown.⁴

We have to face similar challenges also in Afghanistan. Because of the terrain and the extreme weather conditions, substantially different from that of the domestic conditions, particular attention must be paid to these effects. In particular in the light of the fact that in many cases these effects emerge simultaneously, and are mutually reinforcing.

Mission in Afghanistan

The area of Afghanistan is 647 500 km² with a population of approximately 29 million. It has continental borders only and its geography is basically determined by the Hindu Kush mountain range, dominating two–thirds of the country's

territory. From the point of view of terrain the country can be divided into three parts: Central Highlands, Northern Flatland and South-west Basin. The lunar-like, on average 3–5000 m high ridges of the Hindu Kush spreading from west to east seem terrifying for soldiers used to the Hungarian landscape. The average height of the country is 1200 m above sea level, but there are several peaks exceeding 7000 m in the Wakhan Corridor, in the direct vicinity of the Himalayas. The highest peak of Afghanistan is also located here: Nowshak, 7485 m above sea level. Due to the character of the terrain and the accompanying climate the high-lying regions are practically uninhabited. The mountains are passable only through mountain passes, the majority of which are unusable in winter. In winter the Salang Pass (3363 m — on the southern border of the area the Hungarian PRT is responsible for) can be crossed only by applying technical forces. Because of the frequent avalanches. (Hajdú, 2005: 42–45)

Climatic conditions

At the garrison⁵ of the Provincial Reconstruction Team (PRT) of the Hungarian Defence Forces (MH) the climate significantly differs from the Hungarian conditions, most of the year. The city lies north of the Hindu Kush ridge, at the entrance of the north–south valley of the Kunduz River. The valley is relatively narrow up to the city and then turns into a basin with a width of several tens of kilometres. The city is located at 800 m above sea level. The

4 “In Western Sahara it caused trouble that the soldiers were provided with the old 65M boots in spite of the fact that the new desert boots had already been deployed in the defence forces. Several reports and complaints were required until they also received the new, more comfortable boots that adapted better to local weather.” (Besenyő, 2010:144)

5 Pol-e Khomri, in Baghlan provinzi

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predominant so-called subtropical steppe climate is characterised by a hot and dry summer and a winter that is somewhat milder than the winter in Hungary. At the same time the winter is colder than an average winter at that latitude. By virtue of their duties the patrols of the PRT frequently visit high-altitude or desert surroundings that are characterized by more extreme weather conditions. In such environments we always have to pay attention to the acclimatization needs of people used to the European climate. The time required for a given person to reach his original physical and mental capabilities may exceed a week.

The major difference is air humidity which is decisive in one's temperature sensation. The annual and daily temperature fluctuation is also considerable; it may reach or even exceed 20 °C. The maximum daily temperature between May and October is almost continuously above 30 °C while the level of precipitation is negligible. In the summer period the maximum temperature frequently exceeds 40 °C but because of the low humidity it does not feel unbearable. The number of annual sunny hours is extraordinarily high and solar radiation is excessive. Because of the harmful effects of high temperature and strong solar radiation increased attention must be paid to the time spent outdoors, which should be as short as possibly required. (MH ÖHP, 2009: 90)

It is an important safety requirement to have clothing and a personal outfit that suits the weather, provides protection in every respect, is comfortable and provides sufficient “freedom of movement”. If the soldier's sense of comfort is inappropriate, his ability to concentrate inevitably reduces and he cannot focus his attention on his duties.⁶ This could prove fatal under the safety circumstances of Afghanistan.

The soldiers' temperature sensation is fundamentally influenced by clothing with proper thermal insulation.⁷ Thermal comfort has high priority during military service; however, the temperature sensation of the soldiers is not in direct relationship with air temperature. The following can be listed among determining factors: personal (health, psychological and sociological) factors, air temperature, movement of the air, relative humidity (sweating), clothing with thermal insulation and the level of physical activities. The physiology of clothing has special importance for soldiers, as clothing is the most confined environment where they live. The goal of designing clothing is to ensure the well-being of soldiers. Well-being and efficiency depend on the climatic conditions of the environment and the microclimate provided by clothing. The most important physiological function of clothing as a whole is to help keep the temperature of the human body at a relatively constant level so that the daily fluctuation of temperature does not exceed 0.7–1.5 °C. The state of thermal comfort can be defined as a condition (in which) reflects the satisfaction with the temperature of the environment. According to another definition, which can be linked to the flow of energy in the body, the state of comfort means contentment which is possible to achieve when the heat flux to and from the human body is balanced.

The military clothing worn in Afghanistan in winter is thicker while the summer clothing is more airy, made of thinner fabric. This makes adaptation easier and it is also of help if it is available in sufficient volume so it can be changed every day. The fact that the laundry

6 One of the reasons why the units of 2nd Hungarian Army suffered heavy losses during the winter military operations at the Don River during WWII was that the provision of clothing barely functioned. In the extreme cold it resulted in the gradual deterioration of the soldiers' physical condition and thus their effectiveness in war.

7 “Thermal comfort is the condition of mind that expresses satisfaction with the thermal environment.” (ASHRAE Standard, 55, 81)

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system runs smoothly improves comfort and also plays a role in health conditions. At the same time frequent washing due to climatic circumstances attacks the fabric in a few months, mainly along the seams and surfaces subject to increased wear.

There is a certain contradiction between extreme heat and the requirement to protect the entire body as much as possible. Among other reasons rolling up the sleeve of the jacket is not practical because in combat situations (the possibility of which persists continuously) the stony ground may cause serious cuticle damage which — due to the hygienic conditions discussed later — could become infected. Because of the excessive sunlight it is important to wear sunglasses with an appropriate UV grade or protective goggles, especially in snowy surroundings. However, attention must be paid when wearing sunglasses among locals. According to local custom, the lack of clear eye contact during communication may cause trouble. Uncovered skin surfaces — face, ears, neck, lips, etc. — should be smeared with lip care and with super high-factor sun cream. This preventive action is especially important in winter and early spring when going to snow covered but sunny areas. Under these circumstances, the strong UV radiation is not apparent because of the low temperature.

Climatic conditions have an effect on the operation of technical equipment also. Because of the high temperature, overheating occurs more easily during the operation of vehicles, it can be prevented by the proper application of cooling equipment and by increased technical inspections during breaks between marches, and before and after employment. The performance of engines reduces at higher temperatures, while extremely low temperatures may cause lubrication problems. Precision weapons with precise joints may break down easily in very cold weather. Air humidity and temperature has an impact on the adjustment of sharp-shooter weapons.

It is practical to keep vehicles in covered sheds or at least they should be protected from direct sunlight with canvas. Shaded places must be sought (if possible) when stopping if the security conditions permit it. Electronic controls are very sensitive to high temperatures also. Direct solar radiation and high temperatures have an increased effect on rubber parts and seals. Therefore, these must be replaced more frequently than usual, and require more attention during routine maintenance.

Dust wears out not only the human body but also technical equipment. Much higher wear of moving and rotating parts than under domestic conditions must be considered. Electronic devices are especially sensitive to dust contamination which requires the regular and frequent cleaning of the devices at least by mechanical dust removal such as blowing it out with an air compressor or cleaning it with a brush. This also applies to weapons. Turret guns in particular may get soiled while marching therefore special attention is required. During planned breaks, besides continuously maintaining close cover, weapons have to be quickly cleaned at least where they are most prone to get soiled. After executing a mission this represents the main purpose of weapon maintenance (in dry periods) and not the prevention of corrosion. (Air humidity is practically zero.) In case of applying gun oil it must be completely removed because it forms oil mud when mixed with dust.

The environmental conditions in Afghanistan pose specific risks to the operation of aircraft as well. Heat, extreme altitude, bad visibility during landing due to dust and the abnormally poor light conditions require increased attention. Under normal security circumstances night missions are rare because several helicopters and cargo planes have been lost during such missions. However, increased security circumstances require that air transport and air

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support duties be performed under night time conditions also.⁸ Aircraft should be continuously shaded, thereby reducing the direct effect of sunlight and the extremely high temperature. It is general experience that flying is a must even under extreme temperature conditions but the crew must be prepared for it in a versatile manner (clothing, liquid consumption, etc.). (Kohut et al., 2010: 61)

Climatic factors and the time difference between Hungary and Afghanistan (2.5 hours in summer, 3.5 hours in winter) require that the human body be acclimatized before exerting considerable physical effort. Depending on the physical condition this period may last from a few days to one week which must not be left out of consideration, neither during changing deployment, nor when returning from holidays. During a mission, often lasting more than 10 hours, regular rehydration and rest must be ensured by the commanders. This aspect is crucial because of the continuous danger and a traffic culture completely dissimilar from the European.

Under the climatic conditions that put a lot of stress on the body of Europeans it is very important that the staff get a good rest under conditions as comfortable as possible after the day's stress, to enable the body to regenerate. The missions requiring close attention and concentration demand this. The daily regeneration of the body is of utmost importance, for which, preferably, all required conditions must be provided. If regeneration fails to take place it has serious psychic and physical consequences on the body under unfamiliar climatic conditions which again increase security risks.

Daily washing, the possibility of taking a shower, and air-conditioned quarters (heated in the winter) indirectly serve the purpose of maintaining the morale of the forces. These activities considered as routine under domestic conditions are very important also in preventing infections. During lengthy missions, — especially those lasting for several days — it is practical to use wet wipes for cleaning oneself. This does not only serve the purpose of refreshing but it also cleans skin surface sensitive to incidental infections and removes dust. The unprofessional use of air conditioners installed in quarters and vehicles may have harmful effects arising from the big temperature difference

and may even cause pneumonia. Maintenance and disinfecting of air conditioners should be performed more frequently than at home. The use of air-conditioning and the difficult conditions of the terrain can jointly overload the engine, especially with older vehicle types where the air-conditioning was installed subsequently.

For rehydration, it is preferable that water be consumed. It is worth supplementing the required salts, vitamins and trace elements by Normolyt powder added to the water. 6–10 litres of liquid must be consumed during the summer period and at least 3–5 litres in the winter. It is advisable to drink smaller volumes but several times; this goal is perfectly served by the back fluid tanks (Camelback). On the other hand increased attention must be paid to regular disinfection because of the bad public health circumstances. It is very useful to put cooling boxes in the vehicles where the stored liquid stays cold and enjoyable even in the second half of the day. In order to prepare for unexpected situations water reserves lasting for an at least a 48-hour period should always be stored in the vehicles, for the entire crew.

Experience shows, that for bottled water, the half-litre packaging is practical and safe. This is the quantity an average person can consume in “one gulp”. The content of the opened bottles must be consumed within half an hour because after that period harmful biological

8 One of the most efficient methods of eliminating the Afghan resistance had been lifting operations executed by the Special Forces using air transport.

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processes may commence. For similar reasons the bottled water inventory must be stored protected from direct sunlight and preferably in a cool place. We should never forget that the main source of infections in Afghanistan is water.

Alcohol consumption is always a sensitive issue in operational areas. This is the same in Afghanistan, too, where alcohol has an increased physiological effect at high temperatures (blood pressure increase, diuretic effect, nervous depression, dehydration, tiredness, etc.) not to mention the question of security. The excessive consumption of coffee is not recommended either. The natural consequence of considerable rehydration is urination. At the same time circumstances often do not allow the convoys to stop on the way and for the soldiers to relieve themselves. Thus interim measures may occur between planned rests, such as PET bottles used as “bedpans”, closable buckets or diapers for adults (although the latter is not part of the standard equipment of Hungarian soldiers, yet).

Besides the staff and the technical equipment we have to think of the dogs helping our duties. The shading, cooling and regular cleaning of the kennel, as well as the shading of open-air rest areas and the continuous provision of refreshment and drinking water serve the purpose of protecting it from high temperatures and excessive sunlight.

The precipitation, on average less than 400 mm during the year falls in different forms mainly between the end of October and May. The rainiest months are March and April. Plants quickly burn out in May in the absence of precipitation and irrigation. Precipitation in the high-altitude regions could be two to three times more. Severe thunderstorms can produce large amounts of precipitation in a very short time. In high-altitude regions snowfall generally starts as early as in October, and the several meter deep snow layer recedes to the snow line in May only. Snow falls may occur at the Salang Pass, at an altitude of almost 3500 m, even in the summer. In the winter and early spring period snow avalanches must regularly be taken into account, while during the spring thaw destructive floods and mudslides might close key roads. In the area of the Hungarian camp the winter temperature is not extremely cold and daytime temperature rarely falls below the freezing-point; however, in the mountain settlements lying at higher altitudes temperatures below -20 °C are not infrequent. Snow is not common in the neighbourhood of the camp even in winter; snowfall is rare and not in large volumes. (MH ÖHP, 2009: 91)

It must be taken into account when planning missions and selecting clothing that when the weather is mild at the base, extreme weather conditions await the soldiers in the mountains or in the desert a few tens of kilometres away.⁹ In winter this can be snow and snowdrift, frost, avalanche, while in the spring flood, landslide or mudslide. In areas below 2000 m fog is not frequent even in winter because of the low humidity. In the winter period mountains rarely creep out from behind the clouds which could greatly reduce travelling speed and the range of vision. Naturally air support is not possible under such circumstances.

The wind is generally not strong in lower areas. Exceptions are the periods of thunderstorms and the mountain-valley motion of air caused by the cold air suddenly coming down from the mountains along the valleys. The relatively slight motion of air can still pick up fine

9 With inappropriate clothing we risk the success of military operations. A battalion of the U.S. Defence Forces experienced that when they had been deployed in planned operations under good weather conditions in the Korean War. The cold front that arrived during the night brought a chill that 75% of the soldiers, wearing summer clothing, suffered frostbite at the temperature below freezing-point. FM 34-81-1 Battlefield Weather Effects Chapter 1. Source: <http://www.globalsecurity.org/intell/library/policy/army/fm/34-81-1/ch1.htm> (downloaded: 23 02 2013)

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sand and dust, increasing the concentration of the particulate matter, frequently realized in the form of “dust storm”.

The dust in Afghanistan contains a significant amount of dry human and animal faeces residue, especially in inhabited regions, due to a lack of covered sewage systems and sewage treatment plants. When this material gets into the air it increases the possibility of infectious sicknesses. Even when wearing anti-dust goggles inflammation of the eye occurs frequently because of dust getting into the eyes. At the same time the protection of the respiratory tracts is also useful. It is not a coincidence that finely woven cotton scarves are essential parts even of the clothing of men. Although a

net scarf is part of the Hungarian soldiers' equipment it is entirely unfit for filtering out fine dust from the inhaled air when rolled in front of the nose and mouth. This might be the reason why the system handles flexibly the "offence" of all soldiers wearing scarves with a checked pattern, purchased domestically, with the uniform when leaving for a mission.¹⁰ Although officially provided anti-dust masks ensure perfect filtering but wearing and maintaining them — especially in summer — is less practical than that of the cotton scarves.

In dust storm areas one has to be prepared for all communication channels breaking down until the storm is over. In such cases air support as well as fire and combat control becomes more difficult as modern technology is ineffective. This phenomenon may cause disturbances in the operation of aircraft. From a tactical aspect dust storms are favourable to resistance fighters with a better local knowledge which they have exploited several times.

Effects of terrain, plant and hydrography

The terrain of Afghanistan is extremely diverse. In spite of the deserts in the northern and southern parts of the country the already mentioned high-altitude character fundamentally determines the landscape. Overland traffic on the highly structured terrain is focused on roads and mountain passes developed historically in certain valleys. For this reason particular emphasis must be laid on the selection and reconnaissance of routes when planning different missions. Road transport is cumbersome enough under normal conditions already because travelling speed is low due to the obsolete road system.

Because of the extreme terrain conditions and weather conditions that may easily become extreme air transport is also restricted. There aren't that many airfields suitable for fixed wing aircraft. The application of helicopters is considerably hindered by the weather that changes quickly between the high mountains and is therefore difficult to judge, and because of the high altitude above sea level. The difficulties of reserves and supply may restrict the size and efficiency of military units to be supplied.

It is decisive to maintain freedom of movement also during land operations. For this purpose route reconnaissance patrols have to be arranged — independently or in co-operation with the local security forces. The reconnaissance patrolling has to be repeated periodically. The reason for that lies in the experience in Afghanistan. The analysis of present and previous conflicts shows that either because of violent intervention or as a result of natural forces the passability of roads may change radically. The reports of road reconnaissance patrols (road books) represent an irreplaceable source of information but they should not be accept-

¹⁰ The German Bundeswehr equips its soldiers with local looking but domestically produced, uniform design cotton scarves, as part of their equipment.

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ed uncritically. All the more so because the military history of the country includes several occasions when "foreigners" suffered losses when they were leaving their target on the same route on which they approached it.

The insufficiently developed traffic infrastructure and the corridors of movement restricted by the terrain can be watched unnoticed relatively simply and continuously. Therefore the local sympathizers of the resistance fighters can alert their companions in the endangered zone in due time, who then frequently attack, with explosives or by ambush, shooting at convoys heading back home on the same route. If the goal is to block the "inward" convoy the attack may take place on the route leading towards the target area. On a terrain providing good opportunities for concealed and unexpected assaults resistance fighters with appropriate local knowledge select the locations superbly. For this reason efforts should be made that our own troops return from a given target area on a route other than the one they approached by. It is easy to get trapped in the narrow valleys and there is no way out from there.

The mountainous region is not ideal for conducting combined arms operations and the application of motorized formations. The majority of roads are narrow and make only one-way traffic possible, while civilian traffic must continuously be taken into consideration. Steep hairpin bends do not permit the movement of lengthy vehicle combinations even in case of more modern routes. The speed, manoeuvring ability and firepower of motorized forces cannot be best utilized on this highly difficult terrain.

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Soviet troops that used to fight here earlier gained bitter experience about the most suitable methods and systems of ways, from the point of efficiency. It turned out that for fighting against rebels air transport operations are efficient tools because these reduce the response opportunities for guerrillas. (Zicherman, 2005: 173) Allied forces try to make this even more efficient by utilizing their considerable technological advantage in night warfare and they frequently carry out air transport lifting operations during the night. (Zicherman, 2006: 52–56) The geographical circumstances of Afghanistan make the use of communication equipment more difficult. Sometimes even communication within the column on route causes difficulties in the long, narrow, winding and deep valleys. In general it can be stated that communication equipment should be set to a higher performance than usually. Tactical VHF radios can be applied only in a very limited way between troops on mission and the situation rooms controlling them. The application of short-wave devices also requires close attention and serious planning. In case of convoys in motion even the most up-to-date satellite communication devices cannot operate continuously and be completely reliably under these topographical features. It seems satellite data communication systems are relatively the most reliable communication channels. In order to maintain continuous connection 3–4 communication channels of different "bases" should be applied and as an

interim measure one has to prepare to use mobile phones, while observing the rules of undercover communication. However, the high ore content of the mountains can cause unpleasant surprises in spite of the most careful preparations and the use of temporary relay stations. Occasionally there is no solution to overcome permanent and provisional “communication black holes”. It is advisable to prepare a sketch of these communication anomalies on the map and update it continuously.¹¹

11 We had to take this problem into account in Bosnia–Herzegovina, as well. On the structured terrain – especially in the early period of the IFOR/SFOR operations between 1995 and 1999 — the maintenance of continuous communication between the convoys and the camp caused serious difficulties. The situation has changed by today thanks to the restoration of civilian communication systems.

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The steeper and higher mountainsides are naked and rocky, and the majority of the roads are not paved. The stony ground wears down the surface of the tyres quickly, and the tyre also wears faster on the hot asphalt. Brake pads are exposed to higher stress because of the terrain and they have to be replaced more frequently. Appropriate logistical preparations have to be made to fulfil the increased spare part requirement.

The driver crew can prepare for the terrain conditions in Afghanistan only to a limited extent under domestic circumstances. Therefore it is essential that drivers are given the opportunity to get used to the particular terrain conditions after arriving at the operational area. When doing so the staff must learn the rules of activities under undesirable natural phenomena (snow and mud avalanche, earthquake, landslide, sudden floods, etc.). It is very important to use the engine brake when going downhill as much as possible instead of the normal brake. The efficiency of it depends on the model, and in case of heavyweight armoured equipment pauses should be inserted even in the driving style required in the mountains; otherwise brakes might get seriously damaged.¹²

The steep, long rises and the lower oxygen content at high altitudes put excess load on the vehicle engine and their performance decreases. Overheating must be avoided if possible. The proper application of ventilation equipment and the optimal selection of engine performance can help to achieve that. Therefore when covering long distances breaks should be taken at (safe) locations designated in advance for this purpose. Vehicles should not be utilized to their maximum transport capacity and their equipment boosting off–road capabilities should occasionally be tested. At the same time this provides an opportunity to be refreshed on the rules of their use. In addition to installed equipment all vehicles should be furnished with earthwork tools and emergency tools that assist movement. Spare wheels carefully prepared for use and towbars should be standard equipment on vehicles (a towrope is not sufficient because of the mountainous terrain). Technical rescue vehicles and tractors have a lot more duties under these circumstances than at home. Because of sudden technical breakdowns and the increased fuel consumption sufficient volumes of fuel should always be carried by the convoy.

The poor security situation (possibility of attacks), poor road conditions, extreme inclination angles, slopes and rises require that all objects in the vehicle are reliably fastened, because they could cause serious injuries when they break away. The vehicle may roll over therefore all soldiers must undergo rollover training during the preparation period.¹³

The high–altitude environment influences the physical performance of people. The main reason for that is the lower oxygen content of the air. As the majority of our soldiers are not used to it and their loadability reduces considerable. The heavy personal outfit further impairs the staff’s physical performance and reduces the resistance of the body to infections (due to fatigue).

Such factors have greater and bigger impact on military operations than under domestic circumstances because of the underdeveloped infrastructure and extremely diverse terrain. Moreover, the weather forecasts concerning the given area are more inaccurate which makes preliminary planning difficult. In this situation increased cautiousness, the evalu-

12 For this purpose the Soviet troops built “resting bays” in suitable locations along the main supply routes.

13 Based on the narration of the physicians working in the ISAF ROLE–3 hospital in Mazar–e–Sharif a considerable portion of the injuries suffered in Afghanistan are caused by objects breaking away in the vehicles during combat actions.

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ation of fresh, comprehensive reconnaissance information as well as the proper preparation and installation of military equipment can be a solution. The significance of different equipment assisting movement (winch, power take–off, bridge elements etc.) and accessories increases.

Based on their centuries–old experience resistance fighters realized that attacks from “above” are not only more effective (especially in case of anti–tank arms) but – because of the restricted altitude abilities of the weapons of those defending themselves – it reduces the possibility of counterattacks. In order to eliminate this Hungarian troops have installed smaller calibre (7.62 mm PKM) machine guns (able to shoot to a higher altitude) in addition to the 12.7 mm armament in the turrets of armoured vehicles, and the turret shooter also installed his machine rifle in the turret with which he can easily and quickly respond in case of an attack. If necessary he was able to shoot with the PKM machine gun (with manually controlled fire) at a steep angle.

Preliminary reconnaissance and assessment of the terrain was a basic goal when widely applying the SUAV

(Small Unmanned Air Vehicle) by the Hungarian PRT. The highly structured terrain may restrict the “field of vision” of the device on the one hand, and on the other hand the existence of the “optical” contact between the control unit and the flying device must be monitored, because it has an effect on its range. By the proper selection of the location of the control unit — for instance on a predominant height — the range can be fully utilized by selecting the proper flying altitude.

Vegetation also has an effect on military operations. In Afghanistan vegetation starts in the end of March or in April which mostly means the rich grass appearing on mountainsides, as trees start to put out buds only later. As a result of the civil war lasting for decades and the uncontrolled harvesting of wood forests are hardly seen, and only 0.5–1% of the country is covered by forests. In the absence of forestation the existing trees are young and weak, they often look like bushes or shrubs. Undemanding sumac and olive trees have spread mostly. All kinds of fruit tree plantations can be found along the rivers. Sumac forms impenetrable hedges at many places along the roads and channels. Until the shedding of their leaves in November these hedgerows, together with the mud walls typical also for agricultural regions provide favourable conditions for executing an ambush. At higher altitudes sparse hedges can be seen. (MH ÖHP, 2009: 88)

Agricultural production flourishes in the valleys of rivers, although — looking through European eyes — cultivation is performed with medieval methods. The dense channel system ensnaring the valleys and serving agricultural purposes seriously hinders military movements which are emphasized by the fact that bridges are not frequent either. As ditches and channels are not always indicated even on the most accurate maps some safety can be obtained through accurate and farsighted planning and continuous reconnaissance. One of the most important foods in the country is rice and the flooded producing areas represent unpredictable obstacles in the growing period for those less familiar with the given neighbourhood.

Due to the thin vegetation the huge amounts of water flow into the valleys during spring showers and snow melting washes off arable land from the rocks. Soil erosion cuts spectacular wounds in the landscape and the resulting mudslides represent serious danger for those living in the bottom section of valleys and at the feet of mountains. These phenomena may easily catch unawares soldiers performing some activity there. The clayey mud occasionally deposits on the roads in thicknesses of several meters and can bring road traffic to a standstill

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for days. For this reason particular attention should be paid to weather reports before leaving for a mission and alternative routes must be designated.

The water flow of rivers and streams is very extreme. While water-level is low in the dry season, it can be extremely high in rainy periods, especially during the melting of the snow. Floods that are common and sudden in these periods bring about enormous devastation. In case of otherwise shallow mountain streams and rivers the water overflows its banks and overwhelming floods can develop from one hour to the next, filling the entire valley. These make traffic on valley roads impossible. Within a few hours these flood waves may subside from valleys lying at higher altitudes but in wider valleys at lower altitudes lengthy floods may develop. These floods cause great damage and not only on agricultural land but may set back the irrigation network and traffic infrastructure of the valleys for decades. Lacking flood-prevention projects the local population build obstacles using the wrecks of combat vehicles left over from the Soviet era in the most endangered areas to protect the facilities. (MH ÖHP, 2009: 89)

Operations in Afghanistan underline the principle, known for a long time, that the thorough knowledge of the weather, terrain and hydrography is the basis of planning any military operation. These factors have a fundamental influence on the timing, duration and spatial course of the operations. Under the terrain and soil conditions prevailing in Afghanistan increased fuel consumption and limited travelling speed should be considered. The hindering factors of the terrain and the weather are important from the aspect of applying manoeuvres, communication and support (CAS [Close Air Support], UAV, etc.) opportunities. The width, routing and condition of the roads may restrict the capabilities of the available technical equipment. In case of driving through settlements it should be taken into account that steep slopes and rises, occasionally combined with narrow streets, strongly restrict the opportunity of manoeuvring and turning. This prevails even more for longer vehicles with a big turning radius.

Public health conditions

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The quality of natural river water is unfit for human consumption because of the sewage flowing in the region of inhabited settlements and the lack of treatment facilities. In spite of that, locals, lacking anything better, obtain their drinking water from the rivers. It is not a coincidence that the public health situation is very serious in Afghanistan which is illustrated by the high level of infant mortality (16%) and the life expectancy which is quite low compared to European conditions (45–46 years). (MH ÖHP, 2009: 66)

Due to the environmental conditions of the country analyzed malaria, typhoid, different intestinal infections, rabies, A and B variants of infectious hepatitis, leprosy, bacterial and mycotic infections as well as tuberculosis are real hazards in the country. A significant part of the losses of the Soviet troops once fighting in Afghanistan was caused by such diseases of which infectious hepatitis; typhoid and dysentery were the most outstanding. Different forms of gastric infections can be caught from bacteria in the air. Specific vaccination of the effective forces before missions and the strict adherence to hygienic measures are vital. The strong immune system required under these circumstances demands a

healthy diet and nutrition as well as an opportunity for the body to regenerate. (Hajdú, 2005: 50–53)

In the operation area food and water may only be consumed from controlled sources. Knowing the local customs this is difficult to realize during continuous liaising with the LIPPAI Péter, PADÁNYI József: The effect of specific environmental features on the activities...

population because it is bad manners to refuse hospitality. On such occasions one must pay attention and drink preferably hot tea only, and eat only freshly cooked or fried food, and in moderation. For other foods it is recommended to observe the eating habits of the locals and follow them. Such is for instance the peeling of fruit.

Under the climatic conditions of Afghanistan the storage and transportation of foodstuffs is very important. Hygienic conditions are provided at military bases. Problems may arise when there is a power shortage for a longer period because of a technical breakdown and re- frigerators thaw. If that happens large quantities of foodstuff might be thrown out. Sandwich- es hermetically wrapped and stored in cooling boxes are permitted en route, while executing a mission, primarily in winter, but not in the summer. During the execution of lengthier missions ready-to-eat foods including canned food that can be warmed up is the solution.¹⁴

Generally it can be stated that the majority of infections transmitted by food can be avoided by heat treatment. Regular consumption of warm food is also important from the aspect of maintaining power to resist illness.

Parasitic infections are basically transmitted through physical means (food and beverage- es, physical contact, etc.) therefore the chances of occurrence can be reduced by observing appropriate hygienic stipulations. Regularly washing oneself and one's clothing is the most important remedy for becoming infected with lice.

Malaria presents a serious hazard mainly between March and October.¹⁵ Protection against this disease includes the following: periodic but regular pest extermination around military camps, impregnation of the clothing of soldiers with appropriate substances, tightly woven mosquito netting, and the application of insecticides, spraying the accommodations with repellent chemicals and paying greater attention to prevention. It is generally accepted practice that soldiers (when accommodated in containers) “seal” all gaps in the containers that lead to open air with thick adhesive tape when moving in. This provides mechanical protection against the unpleasant visitors mentioned above and also against dust.

The tightly woven mosquito net protects against sandfly (smaller than mosquito) that spreads leishmaniasis in the region of puddles and refuse dumps, at dawn and dusk.¹⁶ The latency period of the disease is 6 months. Sandflies normally fly at low altitudes, below 1 meter. If possible bed height should be arranged accordingly. It is important, because of in- fections, rodents and sandfly problems that the staff preferably does not eat in the sleeping quarters and that the waste collecting vessels are regularly emptied. The high volumes of waste produced in the camps and the content of the sewers should be treated and removed in a proper way. The living and working environment should be regularly cleaned. In order to avoid infections personal relief should be performed in an “organised” manner even under field circumstances, and it is a lot more important to properly wash afterwards.

14 MRE — Meal Ready to Eat.

15 It is not our intention to give ideas which pharmaceuticals could provide protection against malaria. All the more so because side effects could represent serious hazards in operations like in Afghanistan. Medicine may only be taken under medical supervision, without exception.

16 1–1.5 million people get sick annually in the form affecting the skin and mucous membranes and half a million in the form causing visceral lesions. The estimated number of people infected is 12 million. The disorder occurs in approximately 90 countries and the entire Mediterranean region is considered infected. In certain countries — in Afghanistan also — the infected person himself can be a source of further infections. Source: <http://www.webbeteg.hu/cikkek/eloskodok/8598/leishmaniasis> (downloaded: 25 02 2012)

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The insect, called by the Hungarian soldiers “Nenets” (official name: Paederus — small beetles that can fly, normally active in the night, with a brown–black colour) was able during summer months to cause very ugly and unpleasant, although limited, skin irritation by crush- ing against the skin and getting a liquid, (as a matter of fact its “blood”) similar to vesicant chemical weapons, on it. Such injuries started to heal only after several weeks. The physicians of ISAF found the “clue” to the phenomenon after several years of observation. The covering of the skin surface as much as possible helps prevent this. (Löchner, 2012: 73–78)

It is advisable to put a concrete bed over the cautiously selected camp site or fill it up to a depth of at least 20 cm with filler consisting of coarse gravel and stones. This prevents the formation of puddles and creeping/crawling insects/reptiles do not like it either. The fact is that due to the geographical and climatic conditions snakes should also be taken into consid- eration, of which several are venomous. Cats are one of the natural enemies of snakes and keeping them in a controlled and moderate manner can be definitely helpful. At the same time contact with animals should be avoided in general, because they are potential carriers of infections. One can expect that spiders and scorpions show up as well as insects having a painful (although not necessarily fatal) bite, and causing problems in the operation of the human body.

Because of the high temperature extraordinarily intensive sweating facilitates the devel- opment of fungal skin infections. This phenomenon may occur even when using advanced water repellent and “breathing” fabrics because the different protective equipment and tacti- cal gear press clothing to the skin to such an extent that it cannot breathe

adequately. In case of staff continuously exposed to this kind of stress, increased attention must be paid to the skin's opportunity to regenerate. Besides using skin care creams it is recommended to lighten the clothing inside the camp, under safe conditions. In this regard the provisions for clothing rules must be interpreted in a realistic manner.

Thorough hand sanitizing before eating should be performed as a routine, both in transit and under the conditions of a military camp. Besides normal hand washing the use of hand sanitizing agents is mandatory. It is practical to use the latter after all occasions when contact is made with the objects of the local surroundings, after relieving oneself, or coming into contact with animals even to the slightest extent. This is true also if normally all soldiers wear gloves in order to avoid injuries. In addition to the smaller hand sanitizing packages in the personal equipment there are disinfectants on the vehicles, in bigger packaging.

Feet and skin care using antifungal preparations should be continuous. Soldiers must be provided with at least two pairs of boots with sole and uppers suitable for the climatic and high-altitude conditions so that they could change them every day. Thus the footwear not in use has enough time to be properly aired and dried. For drying the inner sole of the boots must be removed every time. It is advisable to check the interior of all footwear before putting them on to see if there are any "unauthorized tenants" in them (insects, creeping/ crawling insects/reptiles). This is especially applicable in case of accommodation in tents or if footwear is put outside the closed container for ventilation.

Due to the bacterial content of the air in Afghanistan special attention must be paid to properly dress different kinds of open injuries, as tetanus infection is a real hazard. A warning signal is that even smaller scratches and wounds heal much slower than back home while redness typical for inflammation shows up around the wound. In case of bad injuries efforts must be made to get the injured person into absolutely sterile circumstances as soon as pos-

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sible. If this is not done any injury may get infected to such an extent that it results in loss of life or loss of the injured body part.

The increased risk of infection does not only require strict personal hygiene but also the special cleaning and tidying of the occupied living space. Over and above the living environment this includes the vehicles which are the everyday "workplaces" for many soldiers. These vehicles regularly travel to locations hazardous in terms of infection. In inhabited settlements — in the absence of sewers — sewage water practically flows on the streets and vehicles wade in it. The contamination picked up by the boots of the soldiers and the tyres should be systematically removed from the exterior and interior of the vehicles. The application of field car washes may seem luxurious at first sight but in the context of the above they operate at certain "relief locations".

In spite of the very strict hygienic provisions and given information almost everyone in the Hungarian contingent — and with some soldiers more than once — that he has to cope with disorders of the digestive system. In most cases the real cause cannot be determined but it is a fact that the missions have to be accomplished under circumstances that are quite peculiar to Europeans. The soldiers' immune system cannot be prepared for these circumstances as it is "socialized" under a different virus environment.

However, we can say, that as a whole public health cases did not significantly influence the operations of the Provincial Reconstruction Team. Thanks to the rigorous preventive actions and continuous attention the development of epidemics has been prevented. At the same time we have to state clearly that the importance of medical support cannot be stressed enough.

Summary

Afghanistan, with its particular natural conditions represents a big challenge to all armed forces. Military operations performed in the country require complex and comprehensive preparations and planning. It is essential to thoroughly and cautiously analyze the environmental conditions of the missions and to respond to the negative phenomena quickly, cautiously and in a carefully assessed manner. For this purpose it is very important to write up military history experiences and the experiences of the soldiers collected on the spot, and to incorporate them into the preparation of soldiers and technical equipment.

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Convergence study of 1–D CFD¹ cell size for shockwave parameters using Autodyn hydrocode

ROMÁN Zsolt²

The use of CFD codes has become widespread to solve the shockwave propagation problem, as they are able to successfully model explosions. Using the structured grid spherically and cylindrical charges cannot be modelled in 3D, thus remapping techniques have been developed to map spherical shockwaves from 1D to 2D and then to 3D. This method highlights the importance of the accuracy of the 1D model, which is mainly dependent on the mesh size. This study aims at finding the required division ratio for the calculation domain.

Introduction

Apart from the empirical formulas for shockwave parameters mentioned in TM5–1300 (Department of the Army, Navy and the Air Force, 1990), there is a growing use of more advanced techniques in blast effects engineering. Since CFD codes provide the possibility of calculation in 3D only on structured grids, one has to implement mapping techniques to get fine results. Remapping is a procedure where we calculate the explosion of a spherical charge only in 1D, and when it hits the ground, or any obstacle — and the problem turns into a 2D or 3D problem — we switch to the spatial solver, and copy the available 1D domain into the 3D model with all specific transport parameters. This way the spherical or cylindrical propagation of a shockwave can easily be handled in the 3D structured grid.

This procedure though requires caution, because care has to be taken about the accuracy of the 1D calculation. The accuracy of the 1D model will determine the accuracy of the whole — time consuming — calculation. Accuracy mainly depends on the mesh size, so the aim of this study is to carry out a convergence study for this problem, in order to determine the necessary mesh size for accurate results. At first, the model setup is discussed, then the results are presented, and then, the convergence study is carried out based on the analysis results, and finally a conclusion is made and the required cell size is described.

Model setup and analysis settings

The most widespread, up-to-date method to investigate effects of shockwaves is using the Jones–Wilkins–Lee equation of state of explosives linked with a numerical Euler flow solver code. (Nagy, 2012) The equation of the Jones–Wilkins–Lee equation of state for TNT is based on Lee, Finger, Collins (1973).³ Air is modelled as ideal gas. Initial condition of air is

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3 <http://www.osti.gov/scitech/servlets/purl/4479737> (downloaded: 19 02 2013)

101.33 kPa ambient pressure and 15 °C temperature. An Euler–Multimaterial solver is used to run the calculation. (Century Dynamics, 2006)

The convergence study has been carried out on a domain, which is 6 m long with a spherical TNT charge, having a radius of 60 mm which corresponds to a charge weight of 1.47 kg. The one dimensional domain is visualized in Autodyn by a wedge, the angle of which is determined by the software. The spherical charge is located in the center with a given radius, the rest of the domain is air. Gauge points are set up every 100 mm measured from the center. Figure 1. shows the layout of the model, while Figure 2. shows a shaded pressure-distance diagram and a pressure-time function for one of the gauge points.

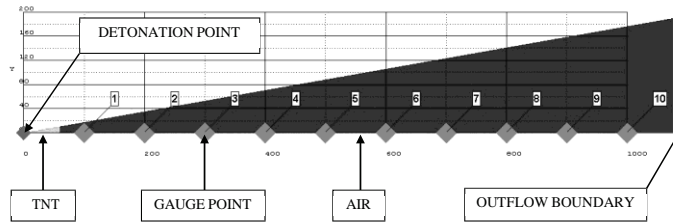


Figure 1. Partial view of the model (zoomed on center 1 m)

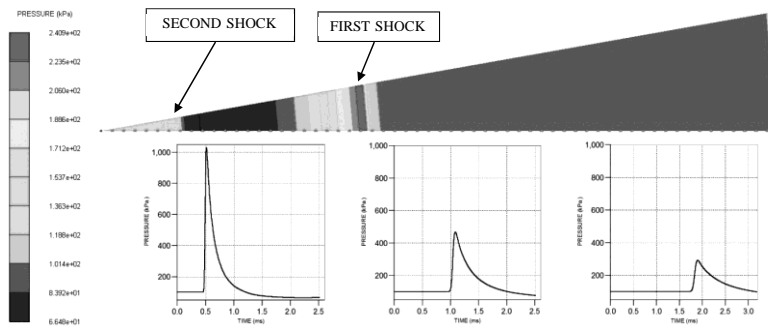


Figure 2. Pressure-distance and pressure-time diagrams of the calculation

Results of the analysis

Table 1–2. show all the details — input and output — of the analysis. In the tables N shows how many cells were formed in the domain, cell size is the exact size of one cell in this study, and charge domain division shows how many parts are the charge divided into due to N. Each gauge point distance corresponds to a Hopkinson scaled distance [Z] (Hopkinson, 1915):

$$Z = \frac{R}{W^{1/3}}$$

Covered Z values range from 0.439 m/kg^{1/3} to 3.953 m/kg^{1/3}, and it has to be pointed out that these values describe blast scenarios in a general way, so the convergence results to be determined and deductions to be made are independent of the actual charge size.

N	cell size	Charge domain division	Z [m/kg ^{1/3}]									
			0.439	0.879	1.318	1.757	2.196	2.636	3.075	3.514	3.953	
			R									
			0.5 m	1.0 m	1.5 m	2.0 m	2.5 m	3.0 m	3.5 m	4.0 m	4.5 m	
100	60.0 mm	1	1549.2	706.8	368.7	238.8	192.9	168.2	151.6	142.0	135.1	
200	30.0 mm	2	2183.1	915.2	421.1	271.0	210.0	179.8	160.6	148.1	140.0	
300	20.0 mm	3	2697.5	1000.3	451.8	286.5	219.4	184.6	164.2	151.0	141.9	
400	15.0 mm	4	3049.3	1030.2	468.6	292.5	223.1	187.3	165.6	152.2	142.9	
500	12.0 mm	5	3324.7	1047.0	480.2	299.1	225.7	189.0	167.0	153.0	143.6	
1000	6.0 mm	10	3780.6	1127.8	509.8	311.5	232.3	192.5	169.3	154.8	144.9	
2000	3.0 mm	20	4086.1	1192.6	533.0	321.1	236.5	194.9	171.0	156.0	145.8	
3000	2.0 mm	30	4217.8	1224.4	542.6	324.8	238.3	195.8	171.7	156.5	146.2	
4000	1.5 mm	40	4272.5	1239.1	547.8	326.3	239.0	196.3	171.9	156.7	146.3	
5000	1.2 mm	50	4333.9	1249.7	550.4	327.7	239.6	196.5	172.2	156.8	146.4	

Table 1. Input and output pressure [kPa] data of the analysis

N	cell size	Charge domain division	Z [m/kg ^{1/3}]								
			0.439	0.879	1.318	1.757	2.196	2.636	3.075	3.514	3.953
			R								
			0.5 m	1.0 m	1.5 m	2.0 m	2.5 m	3.0 m	3.5 m	4.0 m	4.5 m
100	60.0 mm	1	152.58	148.69	107.36	89.88	76.86	66.83	58.00	51.76	46.67
200	30.0 mm	2	159.79	150.35	109.53	89.64	76.00	66.20	57.97	51.39	46.36
300	20.0 mm	3	157.70	155.03	110.93	89.85	76.46	66.23	58.14	51.65	46.39
400	15.0 mm	4	158.16	159.72	111.46	89.58	76.41	66.30	58.05	51.64	46.43
500	12.0 mm	5	155.59	161.63	111.63	89.76	76.35	66.31	58.15	51.61	46.43
1000	6.0 mm	10	153.43	165.50	111.02	89.35	76.17	66.03	57.90	51.48	46.23
2000	3.0 mm	20	153.30	167.11	111.02	89.60	76.34	66.19	58.07	51.58	46.33
3000	2.0 mm	30	153.58	167.81	111.06	89.73	76.46	66.25	58.16	51.74	46.41
4000	1.5 mm	40	154.07	167.76	111.11	89.76	76.51	66.29	58.18	51.66	46.43
5000	1.2 mm	50	154.18	167.80	111.11	89.86	76.56	66.38	58.22	51.68	46.59

Table 2. Input and output impulse [kPams] data of the analysis

Pressure values show an increasing trend as they converge, while impulse values are quite the same, they show far less dependency on the division of the domain. To show the different characteristics of the pressure and impulse, values of gauge point at 2 m are plotted on Figure

3. It can be seen that impulse values show a little scattering about the converged value, there is no significant difference between results obtained by different mesh sizes. These findings are also valid for the other gauge points. So we can state without further investigation, that impulse values can be trusted no matter which domain division was used to calculate it, while pressure values require further investigation.

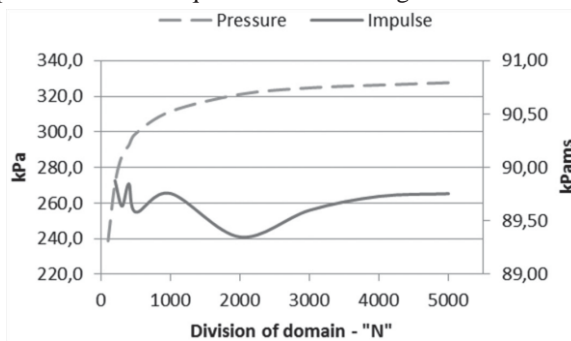


Figure 3. Pressure and impulse values at 2 m as a function of N domain division ratio

Convergence study

The idea of a convergence study is to declare a specific value for the examined variable, which is considered accurate. This specific value should be an analytical solution, but in this problem, no analytical value — either for overpressure or for impulse — is possible to determine. Some authors carried out a convergence study for CFD mesh cell size using Kingery–Bulmash blast parameters as a comparison. (Yanchao et al., 2008) The validity of this method is questionable, since it is known, that Kingery–Bulmash curves contain inaccuracies as well, and field-test data is dependent on more variables showing scattering when measured. Ambient pressure, temperature, wind, point of detonation, shape of charge, homogeneity of charge are all variables with scattering, while all these are handled as fix parameters in CFD–calculation, and empirical constants only play role in the EOS of explosive material. Because of this difference in the number of variables which they are depending on, comparing results of the Kingery–Bulmash curves with CFD–calculation results is not a reliable method to measure the accuracy of mesh size. The value which we consider accurate is determined based on a relative error limit. We use the domain division ratio number “N” to describe the number of cells. As “N” increases, the number of cells increases, and results are getting more accurate, they converge to a specific — yet unknown — value. Introducing the relative error ε for the n –th division step,

$$\varepsilon_n = \frac{P_n - P_{n-1}}{P_{n-1}}$$

we can declare a P pressure value to be accurate if its relative error compared to the previous N division step is below a convergence criteria, which we take here as 2%. This theory requires

- equal increments in N ,
- which is chosen in a way so that calculation time remains within reasonable limits.

As discussed previously, the first step was to determine the relative error of overpressure values for each $n > 1$ division increment step. Calculated ε values can be found in Table 3. It can be stated that the $N=5000$ division meets the convergence criteria at all distances. Based on this statement, results obtained with $N=5000$ are declared accurate. Absolute error of a certain step is calculated using the formula:

$$P_n \varepsilon_{n,abs} = \frac{P - P_n}{P_n}$$

The absolute error, relative error and pressure values for gauge at 2 m can be seen on Figure 4. It can be clearly seen how the absolute error decreases as N increases, and how pressure values converge. However, relative error is non-monotonic (shows more increasing and decreasing regions), which is because of the unequal increments in N , and it can be seen here, in addition to why the relative error with unequal N increments can not be used for declaring the accurate value.

N	cell size	Charge domain division	Z [m/kg ^{1/3}]								
			0.439	0.879	1.318	1.757	2.196	2.636	3.075	3.514	3.953
			R								
			0.5 m	1.0 m	1.5 m	2.0 m	2.5 m	3.0 m	3.5 m	4.0 m	4.5 m
100	60.0 mm	1	-	-	-	-	-	-	-	-	-
200	30.0 mm	2	40.92%	29.50%	14.21%	13.49%	8.84%	6.90%	5.90%	4.35%	3.62%
300	20.0 mm	3	23.56%	9.29%	7.30%	5.73%	4.46%	2.67%	2.24%	1.91%	1.34%
400	15.0 mm	4	13.04%	2.99%	3.71%	2.08%	1.73%	1.42%	0.89%	0.80%	0.73%
500	12.0 mm	5	9.03%	1.63%	2.48%	2.27%	1.13%	0.92%	0.83%	0.53%	0.47%
1000	6.0 mm	10	13.71%	7.72%	6.16%	4.14%	2.94%	1.86%	1.38%	1.20%	0.93%
2000	3.0 mm	20	8.08%	5.75%	4.55%	3.08%	1.81%	1.25%	1.00%	0.78%	0.61%
3000	2.0 mm	30	3.22%	2.67%	1.79%	1.14%	0.76%	0.48%	0.39%	0.29%	0.25%
4000	1.5 mm	40	1.30%	1.20%	0.97%	0.47%	0.29%	0.23%	0.15%	0.14%	0.11%
5000	1.2 mm	50	1.44%	0.86%	0.47%	0.42%	0.23%	0.09%	0.14%	0.09%	0.08%

Table 3. Relative error of pressure values for each N increment

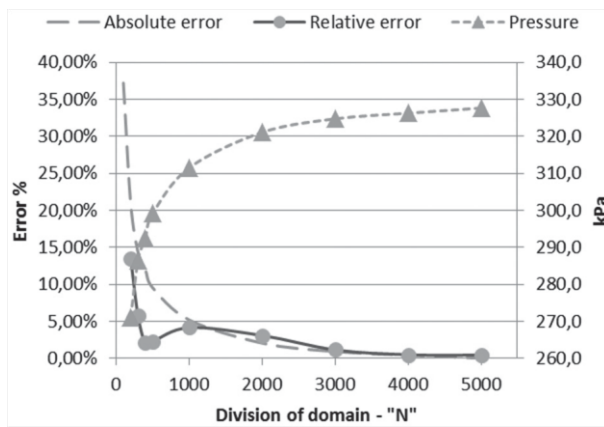


Figure 4. Absolute error, relative error and pressure values plotted against N at the gauge point at 2 m

Table 4. shows absolute error for all gauge points. At the bottom of the table, the N value corresponding to exactly 5% error was interpolated. For a given domain, these N values decrease as gauge points move away from the center, dashed cells in Table 4. show that the farther the gauge point is from the center, the smaller the N number is required for an absolute error smaller than 5%. However if we only calculate the required N for the given R value, where the gauge is located, we get a non-monotonic function, which is plotted on Figure 5.

N	cell size	Charge domain division	Z [m/kg ^{1/3}]									
			0,439	0,879	1,318	1,757	2,196	2,636	3,075	3,514	3,953	
			R									
			0,5 m	1,0 m	1,5 m	2,0 m	2,5 m	3,0 m	3,5 m	4,0 m	4,5 m	
100	60,0 mm	1	179,8%	76,82%	49,29%	37,23%	24,16%	16,79%	13,56%	10,46%	8,39%	
200	30,0 mm	2	98,52%	36,54%	30,71%	20,91%	14,08%	9,25%	7,23%	5,86%	4,60%	
300	20,0 mm	3	60,66%	24,93%	21,82%	14,36%	9,21%	6,41%	4,88%	3,88%	3,21%	
400	15,0 mm	4	42,13%	21,31%	17,47%	12,03%	7,35%	4,92%	3,95%	3,05%	2,46%	
500	12,0 mm	5	30,35%	19,36%	14,62%	9,55%	6,15%	3,96%	3,10%	2,51%	1,98%	
1000	6,0 mm	10	14,64%	10,81%	7,96%	5,19%	3,12%	2,06%	1,70%	1,30%	1,05%	
2000	3,0 mm	20	6,06%	4,79%	3,26%	2,05%	1,29%	0,80%	0,68%	0,52%	0,44%	
3000	2,0 mm	30	2,75%	2,07%	1,45%	0,90%	0,52%	0,32%	0,29%	0,23%	0,19%	
4000	1,5 mm	40	1,44%	0,86%	0,47%	0,42%	0,23%	0,09%	0,14%	0,09%	0,08%	
5000	1,2 mm	50	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	
N corresponding to 5% error for whole domain			2321	1965	1631	1062	690	395	295	243	189	
N corresponding to 5% error for given R value			193	327	408	354	287	197	172	162	142	

Table 4. Absolute error of pressure values and N numbers corresponding to 5% error limit

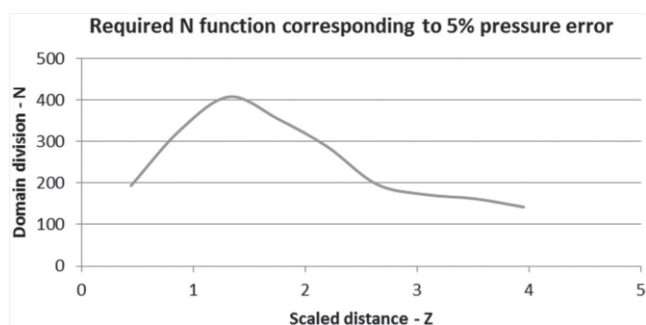


Figure 5. Required N function corresponding to 5% pressure error

Using Figure 5, one can determine the required division of domain based on Z and R input variables. It is worth pointing out that function shown in Figure 5, has a peak at about $Z=1$, and it is a non-monotonic function. As a conservative approach it can be stated that dividing the scaled distance into 400 cells is enough to get accurate results for all scaled distances.

Conclusion

A convergence study has been carried out for blast parameters using 1-D Autodyn hydrocode. The investigation pointed out that impulse shows no dependency on the mesh size, while pressure values change considerably with mesh size. With the help of a parametric approach it has been shown that it's possible to create a "required N" function for domain division corresponding to a desired error limit. In the study, the 5% absolute error criteria was chosen and the required N function was presented in terms of scaled distance, so this function can be used for other blast scenarios to estimate the required cell size for domain division. Further investigation should include the effect and influence of charge division, and possibilities of the use of cell size zoning.

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Application of Analytic Hierarchy Process in fuzzy logic–based meteorological support system of unmanned aerial vehicles¹

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This article aims to present the potential connection point of the analytic hierarchy process (AHP) and the fuzzy logic–based analog forecasting method. When we try to find the most similar situations with an analog forecasting system, we can be confronted with the problem of the different importance of different meteorological parameters. We can solve this problem by weighting the individual variables. We applied AHP to determine the correct weights. The preliminary results of a case study show the effectiveness of this application in analog forecasting support systems for unmanned aerial vehicles (UAVs).

Introduction

The operational use of UAVs has had a significant growth in the past decades around the world. (Gertler, 2012) The number of registered unmanned systems has increased from 544 to 1424 between 2005 and 2011. (Skrzypietz, 2012) Nowadays the military applications are more common, namely the UAVs are able to complete a military mission without risk of loss of life and with low costs. With the help of modern remote sensing devices they are exceedingly applicable for completing surveillance, reconnaissance and intelligence missions, too. Nowadays the scope of civilian applications is significantly widening. The most important non–military fields are disaster management, protection of critical infrastructure and scientific research, etc. (Skrzypietz, 2012) In most cases the weather has greater impact on UAVs, than on aircraft replaced during implementation. It primarily depends on the different characteristics of UAVs (e.g. size, weight, etc.) and the devices applied. (Joint Air Power Com-

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petence Center, 2010) (Bottyán, 2012: 418–422) It draws attention to the importance of the accuracy of ultra-short term weather forecasts, which are used in the final stage of planning and during the mission execution. Statistics based analog methods can give assistance to make more accurate these types of forecasts. (Riordan, Hansen, 2002: 139–146) At present in Hungary there is no operational weather support for UAVs at all. That is the reason why our goal is to develop a fuzzy logic-based analog forecasting subsystem as a part of a complex meteorological support system for UAVs. This article aims to show an application of the analytic hierarchy process, which can activate and refine our system under development. First of all we present the fuzzy logic-based forecasting system, after that we show the analytic hierarchy process and their possible connection point in the field of analog forecasting. At the end we demonstrate the application of AHP through a case study.

Fuzzy Logic-Based Analog Forecasting System

The basic principle of analog forecasting is to find similar weather situations in past and present actual conditions and rank them according to the degree of their similarity in the interest of giving relevant information for weather forecasts. For a theoretical basis of an operational fuzzy logic-based analog forecasting system, the reader can refer to Hansen et al (2007: 1319–1330). We based our statistical approaches on their results. First of all we set up a database for Hungarian military airports, which is based on routine aviation weather reports (METARs). (Bottyán et al., 2012: 11–18) The applied fuzzy logic-based algorithm measures the similarity of the elements of this database. The fuzzy sets — which are composed for describing the degree of similarity between two variables — used in this process are determined by operational meteorologists, which is a common method in the development of fuzzy systems. (Meyer et al., 2002: 105–123) Fig. 1 shows an example of the fuzzy sets.

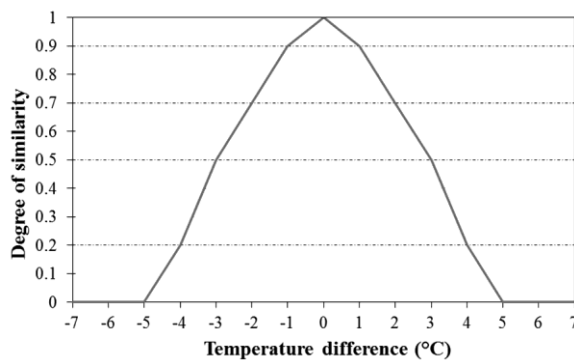


Figure 1. Example of a fuzzy set: degree of similarity in the function of temperature difference

When the temperature difference equals zero the similarity value is the highest (1). If the mentioned difference reaches 5°C, then similarity will be zero. The intermediate values (0.9, 0.7, 0.5, and 0.2) connected to the expressions of similarity (very similar, between very and quite similar, quite similar, slightly similar) respectively. The individual parameter values of

a situation are examined one by one and the overall similarity of a situation is arrived at from averaging or the minimum of the similarity of the elements. The two approaches of determining the overall similarity work parallel in this process until we can choose the better one using the forecast verification results. After finding the most similar situations we can compose a prediction from the consecutive observations of the chosen situations with an appropriate method which is under construction. Obviously, the initial values of a given meteorological parameter from the most similar cases have a determinative role in the forecast process. The higher the difference between initial values, the higher the risk of an inaccurate forecast. As it mentioned earlier, the main goal is to improve the meteorological support of UAV-flight missions. As in every aviation task, the accurate cloud ceiling and the horizontal visibility forecast have an important role in the success of mission execution. In addition, the accurate prediction of these meteorological elements is one of the greatest forecasting challenges for aviation forecasters.

The lines above lead to our assumption: we can improve the accuracy of the forecast of individual elements by using appropriate weights highlighting the importance of them during the fuzzy logic based forecasting process. The application of suitable weights gives more similar initial values for the parameters selected as more important. There is another way to take better account of ceiling and visibility: the appropriate designation of fuzzy sets. But this method is very complicated, because the expert judgments are hardly applicable in an indirect way. Normally the experts determine for example how the different horizontal visibility values are similar to each other to get the fuzzy set. But in this case they have to define the potential modification of the fuzzy set in order to increase or decrease the importance of a meteorological parameter because of its perfect prediction.

In our opinion weighting of the variables is significantly simpler and at the same time a better solution for emphasizing importance of meteorological elements in this question. That is why we chose the first method which will be described in details later.

Analytic Hierarchy Process

The Analytic Hierarchy Process was introduced by Saaty (1977: 234–281) and motivated by the psychology of decisions. The AHP is basically a technique for ranking regarding various criteria when initially we have subjective comparisons. This method is widely used in decision making, especially to solve complex problems such as the selection of the appropriate candidate for a job, allocation of strategic resources etc. One of the strengths of the AHP is that it assigns numbers to each possible choice, making the further calculations easier. It turned out that it can be applied in our situation for weighting the importance of the meteorological parameters based on forecasting experts' opinion.

Let us formulate the original problem. We are given n objects (in our case the different meteorological parameters) and our aim is to find weights w_i for $i = 1, \dots, n$ such that the weight w_i refers to the importance of the i^{th} object. Initially we only have an estimation on the ratio of the importance of the i^{th} and the j^{th} object for each pair i, j . Let us denote these estimates by a_{ij} for $i, j = 1, \dots, n$. Then of course we require $a_{ij} = \frac{1}{a_{ji}}$.

Note that these might be inconsistent, i. e. $a_{ij}a_{jk} = a_{ik}$ not necessarily holds. For example we can start with the assumption that the 1st object is 2 times more important than the 2nd one,

the 2nd is also 2 times more important than the 3rd, but the 1st is only 3 times more important than the 3rd. In such a situation we cannot expect that the weights will perfectly reflect the ratios. Thus, our goal is to find w_i 's such that the difference between a_{ij} and $\frac{w_i}{w_j}$ is as small as possible.

Let us denote by A the $n \times n$ matrix of the ratios. It is easy to see that if the given ratios are consistent then the desired vector of weights $w = (w_1, \dots, w_n)$ is an eigenvector of the matrix A with eigenvalue n , or in other words $Aw = nw$ and in such a case n is the maximal eigenvalue. Surprisingly the converse also holds, Saaty proved that for any matrix of the type described above the matrix is consistent if and only if $\lambda_{\max} = n$ where λ_{\max} denotes the maximal eigenvalue of A . Moreover, he proved that even in the case of inconsistency the best choice for the weight vector is the eigenvector belonging to λ_{\max} in the sense, that it minimizes a certain function of the differences between a_{ij} and $\frac{w_i}{w_j}$ (for the detailed proof see Saaty (1977: 234–281)).

To determine the eigenvector we used the standard power iteration method. Saaty advised measuring the consistency of the given matrix with λ_{\max}^{-n} which λ_{\max}^{-n} turned out to be a reasonable estimate.

Using the above statements the AHP process goes as follows:

- assignation of the estimated ratios a_{ij} for $i, j = 1, \dots, n$ yielding the matrix A ;
- calculate the eigenvector w_{\max} of A belonging to the maximal eigenvalue λ_{\max} by iteration;
- norming w_{\max} gives the desired vector $w = (w_1, \dots, w_n)$ such that w_i is the weight of the i^{th} object.

Weighting of Meteorological Parameters

As we have shown in the previous chapter the analytic hierarchy process is a method of multi-criteria decision making. To make a connection between AHP and the original problem to be solved it is necessary to model the problem as a hierarchy. In our case the goal of analog forecasting means decision making: to find the most similar situation in the database. So the alternatives are the single weather reports. Each of these routine observations contains the actual values of the different meteorological variables. In AHP there are criteria for evaluating alternatives. For criteria and sub-criteria we used please refer to Fig 2. The number of the criteria and sub-criteria gives the difficulty of finding the best alternatives. Even in case of two criteria and two alternatives, the decision making can be very difficult if the different criteria prefer different alternatives. The meteorological problem to be solved has seven different criteria and sub-criteria, and more than 100 000 different alternatives. Because of the large number of alternatives we do not apply the whole analytic hierarchy process for finding the most similar situations, but for this step we have the fuzzy logic-based algorithm which is described above.

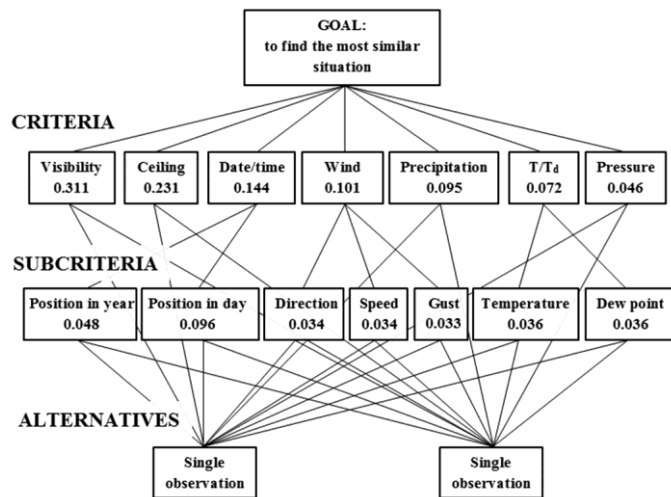


Figure 2. AHP hierarchy of the problem and the weights obtained

We used AHP only for weighting criteria which are meteorological and time parameters. Originally we have had eleven variables, which are now classified into seven criteria. Four of them are divided into sub-criteria because of the dependence and unimportance of variables. In the first step we collected the expert judgments of pairwise comparison of criteria based on a general definition (Table 1.). Some of the final results of pairwise comparison are shown in Table 2. These ratios give the elements of the matrix defined in the previous chapter. Then we determined the desired weights using the method described earlier. The received weights will be shown at the case study. Inconsistency is 2.5% which is less than the tolerable 10%, so the results are significantly reliable.

Table 1. Domination, definition and mathematical background of pairwise comparison

Domination	Definition	Math
No	Equal	1:1
Weak	Between equal/ slightly more	1:2
Moderate	Slightly more	1:3
Moderate plus	Between slightly more/more	1:4
Strong	More	1:5
Strong plus	Between more/much more	1:6
Very strong	Much more	1:7
Very strong plus	Between much more/ definitely much more	1:8
Absolute	Definitely much more	1:9

Table 2. Some example of results of pairwise comparison

Parameter to be compared	Applied ratio	Parameter to be compared
Precipitation	1:1	Wind
Date/Time	2:1	Wind
Visibility	5:1	Pressure
Visibility	2:1	Ceiling
Date/Time	1:2	Ceiling
...

Case Study

First of all we determined the appropriate initial values used at the case study. Our earlier conditional climatological analysis were able to help us to look for a situation in which we could find any height of ceiling at a given visibility value. The chosen ceiling category (amber line on Fig 3.) has a relative frequency maximum at 2000 m visibility. Additionally its value is similar to the relative frequencies of completely different ceiling categories. The appropriate selection of the rest of the examined parameters can maximize the number of similar situations differ significantly only in ceiling. We can represent the initial conditions with a fictional meteorological report: METAR LHSN 150745Z 23006KT 2000 BR BKN005

M00/M01 Q1017=. The meaning of this report is: the METAR was made on the 15th day of the month (in this case the month was January) at 07:45 UTC in Szolnok, Hungary. The wind is from 230° and the wind speed is 6 knots. The horizontal visibility is 2000 m because of the mist and the cloud ceiling height is 500 feet. The temperature is 0°C; the dew point temperature is -1°C. The sea level pressure is 1017 hPa.

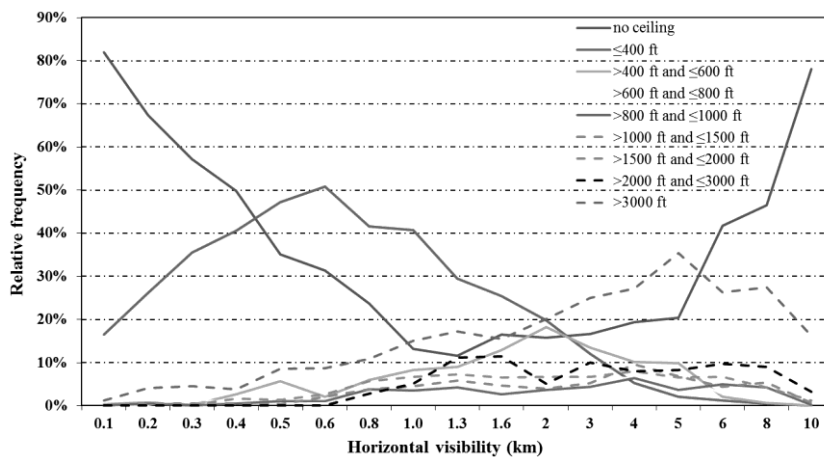


Figure 3. Changes of relative frequency of ceiling with horizontal visibility

We ran the similarity model two times: we used equal weights in case #1 and the results of AHP pairwise comparison as optimized weights in case #2 (Table 3.).

Table 3. Applied weights in similarity model runs

Criteria/Subcriteria	Applied weights in case #1	Applied weights in case #2
Horizontal visibility	1.0	0.311
Cloud ceiling	1.0	0.231
Date/time		
position in year	1.0	0.048
position in day	1.0	0.096
Wind		
direction	1.0	0.034
speed	1.0	0.034
gust	1.0	0.033
Precipitation	1.0	0.095
Temperature/Dew point		
temperature	1.0	0.036
dew point	1.0	0.036
Pressure	1.0	0.046

The similarity model runs gave significantly different results. As we mentioned earlier the applied weights have a key role, when we bring into focus some chosen meteorological parameters. That is the reason why we present and highlight the most similar situations in the view of the most important variables (Table 4.). In case #2 all of the first ten individual visibility values and the mean ceiling are equal to initial values (2000 m visibility and 500 ft ceiling) and the deviation is less than the smallest applied difference in meteorological reports.

Table 4. Results of the similarity model runs based on different weights

Rank of the most similar situations	Case #1		Case #2	
	visibility	ceiling	visibility	ceiling
1	2000 m	5000 ft	2000 m	500 ft
2	3000 m	5000 ft	2000 m	500 ft
3	3000 m	400 ft	2000 m	400 ft
4	2000 m	5000 ft	2000 m	400 ft
5	2500 m	600 ft	2000 m	600 ft
6	1500 m	400 ft	2000 m	400 ft
7	2500 m	600 ft	2000 m	500 ft
8	2000 m	700 ft	2000 m	500 ft
9	2500 m	600 ft	2000 m	600 ft
10	3000 m	500 ft	2000 m	600 ft
Mean	2400 m	1880 ft	2000 m	500 ft
deviation	489.9 m	2044.4 ft	0.0 m	77.5 ft

In case #1 the results are unconvincing. The deviation is extremely high and three of the first four situations present a totally different synoptic situation in cloud conditions. This case study indicates the effectiveness of the optimized weights and foreshadows its usefulness in fuzzy logic-based analog forecasting systems.

Conclusion

The potential application of analytic hierarchy process in a fuzzy logic-based forecasting system has been described. The applied weighting method proved its efficiency in many different fields of life. The convincing preliminary results of the case study show the applicability of the procedure in the field of meteorology.

A probable continuation of this study is the extension of the case study as detailed verification of the analog forecasting method based on initial values of a similarity model.

A possible extension of this research appears promising. Applied weights adjusted to actual weather situations could improve the effectiveness of meteorological support of UAVs by the increasing accuracy of forecasts.

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“The eye is the lamp of the body. If your eyes are healthy, your whole body will be full of light.” (Matthew, 6: 22)¹

Human iris polymorphisms: computer–based and genetic assessments of human irises and possible applications in human identification

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During personal identification we can analyse the phenotypic or genotypic complexions of a human. The ancient histories of scientific activities in this field were related to the descriptive or measurable features, called phenotype analyses. In the last decades of the 20th century, during the era of human genetics, numerous polymorphic genetic markers were discovered investigating the human nuclear or mitochondrial DNA (deoxyribonucleic acid). The results of the Human Genome Project revolutionized the applications and opened an era of the investigations for externally visible characteristics (EVCs), the so called DNA based phenotyping (age, hair–, and eye–colour investigations) using informative molecular markers. The polymorphic characteristics of the human eye are well known. This partly originates from the vessel network and the layer order of the retina or the unique construction of the initial section of the optic nerve at the eye-ground. The iris’ individuality resides in its complex textural construction. The iris’ colour and partly its patterns (variations of the Fuchs’ crypts, nevi dots, Wolfflin nodules and contraction furrows) are genetically determined. All of these previously mentioned iris polymorphisms led to the development of a number of automatic phenotypic or genotypic biometric personal identification practical applications.

The aim of this study is to briefly summarize the background of this topic condensing those results which are available in this field, and to present our efforts related to a novel approach in the field of iris colour prediction.

1 <http://bible.cc/matthew/6-22.htm> /New International Version ©1984/ (downloaded: 30 07 2012)

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Introduction

The wonderful complexity of the human eye, originating from its visible or hidden structure, has affected the thinking of theologians, artists, scientific minds, scholars and believers in the metaphysical world, throughout the centuries. The classic idea that “...the eye is the mirror of the soul...” was already described in a translation of the New Testament. (Clement I. 19:3,

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1768: 29)^{6,7} At the beginning of the nineteenth century, William Paley (1743–1805), a theologian, in his fundamental work (Paley, 1802), called the eye an inexplicably complex “device” of human vision, which in itself is a proof of a “Creator”; in his view the proof of the existence of the creator God. Even in the world–famous work of Charles Darwin, which is known to be a scientific historical milestone, certain elements of self–criticism were found concerning the reliability of the theory of evolution, in which, because of the complexity of the human eye, he had doubts in its possible evolution by natural selection. (Darwin, 1859: 167)

In the 19th and 20th century, medical scientists described the anatomy of the eye and outlined the essence of its operation by performing functional tests.

The vessel network and the layer order of the retina (the light–sensitive membrane covering the back wall of the eyeball that is continuous with the optic nerve) or the unique construction of the initial section of the optic nerve at the eye-ground (fundus) are the bases of unique retinal or fundus based automated person identification techniques which use optical coherence tomography. (Fercher et al., 1993: 113–114), (Naseri et al., 2012: 29–33) Moreover, the

uniqueness of the iris' single components (the iris is the coloured part of the eyeball that controls the amount of light that enters into the eye cavity), and its' textural variations opened opportunities onto development of independent biometric techniques (exp. IrisCode). (Flom, Safir, 1987), (Daugman, 1994)

After completion of the Human Genome Project (HGP)⁸ scientists selected those candidate genes which may play a key role in the inheritance of human eye colour? These efforts made it possible to predict eye colour from any biological sample of a person. (Kayser et al., 2011) The aim of this study is to briefly summarize the background of this topic condensing those results which are available in this field, and present our efforts concerning a novel approach in the field of iris colour prediction.

The structure of the human iris: colours and patterns

The development of the human iris, partly from the neuroectodermal optic cup and partly from mesodermal elements, begins around the third month of gestation. After birth, the pigmentation in the double cuboid cell layer (named iris pigment epithel: IPE) continues till the end of the first year. The iris (and the lens) play a role in dividing the human eye ball into two closed chambers: (1) anterior: between the cornea and iris and (2) posterior: between the lens and iris (Fig. 1.).

6 "Let us fix our thoughts upon him, and behold, with the eyes of our soul, his long-suffering purpose."

7 <http://bible.cc/matthew/6-22.htm> /New International Version ©1984/ (downloaded: 30 07 2012)

8 HGP — an international scientific research project (1990–2003) with the leadership of the USA, with the primary goal of determining the order (sequence) of the purine and pyrimidine base pairs that make up the

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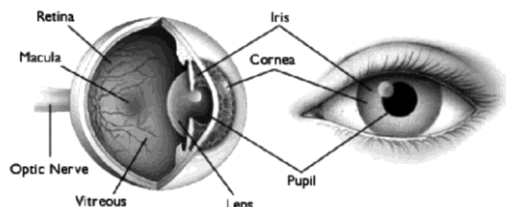


Figure 1. The main structure of the human eye⁹

The iris itself regulates the strength of illumination toward the retina. The high pigment content of the IPE and the pupil's own function, narrowing or dilating the pupil diameter using its dilator or sphincter muscles, block light from directly passing through the iris to the retina. The base structure of the iris is very complex. The frontal and saggittal sections of the human iris are highlighted in Figure 2. In case of the frontal section, the iris can be divided into two concentric major regions, the pupillary zone (1): located between the pupillary frill (a black, anterior termination margin, the only visible part, of the posterior pigmented layer) and the collarette (the thickest area of the iris), the border toward the ciliary zone (2). The ciliary zone ends at the ciliary body. The wider inner part of this zone consists of a large number of radial and concentric contraction furrows (overlapping the dilator and sphincter muscles) and Fuchs' crypts¹⁰, in the narrower outer, marginal part several peripheral crypts are located.

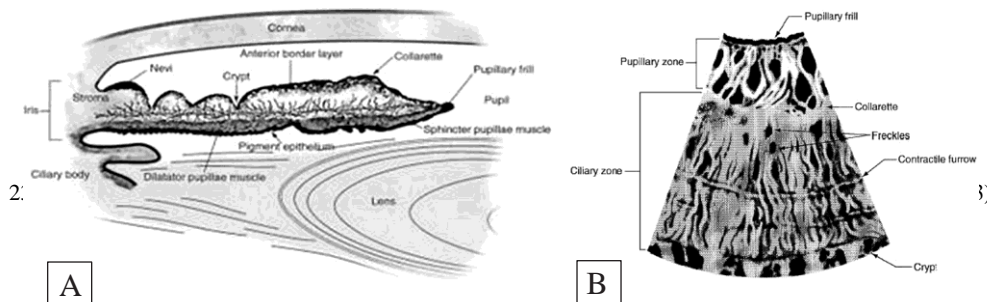


Figure 2. The structural base elements of a human iris. (A) sagittal section, (B) frontal section¹¹

9 The picture is available at <http://web.princeton.edu/sites/ehs/laserguide/index.htm> (downloaded: 16 06 2012.)

10 Fuchs' crypts: Pit-like depressions or openings found near the collarette and near the periphery of the iris.

They allow the passage of aqueous humour from the anterior chamber into the stroma of the iris as the volume of the iris changes with dilatation and contraction. (Millodot, 2009)

11 <http://math.ipm.ac.ir/scc/vision/iris/Iris-Recognition.htm#db> (downloaded: 16 06 2012)

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In humans, the different iris colours are determined partly by the concentration of melanin in the IPE¹³, and by the melanin content within the iris stroma, and finally by the stromal cellular density. The pigment content of the melanocytes is genetically determined. The final growth of iris colour is also influenced by the Rayleigh or Mie scattering¹⁴ of light in the stroma. The visible anterior layer and some known natural patterns of iris are demonstrated in Figure 3.

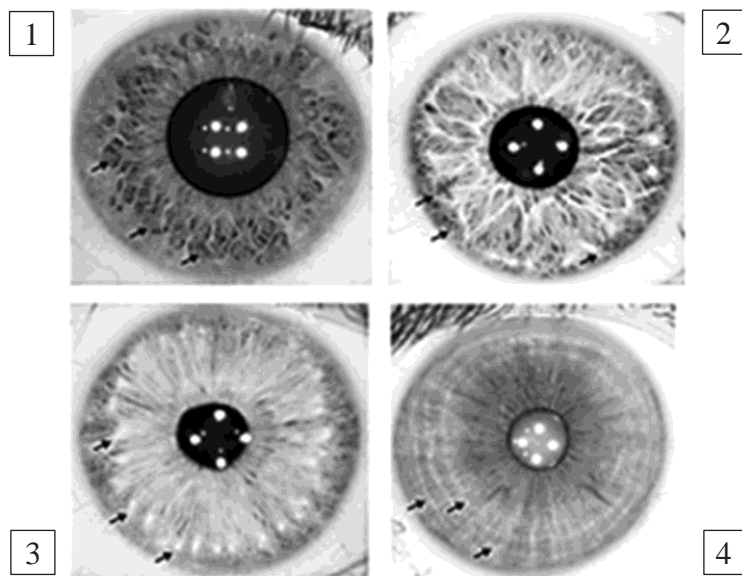


Figure 3. Changes in iris' frontal anterior texture (indicated by arrows):
1. Fuchs' crypts; 2. Nevi dots: collection of melanin pigment;
3. Wolfflin nodules: Patches of accumulated collagen fibrils;
4. Contraction furrows: overlapping the dilator and sphincter muscles¹⁵

Role of the human iris in phenotypic biometric identification

Recently, based on the uniqueness of the iris, a „science-like” and a truly scientific way to develop a mode of human identification has opened up. The former is called iridology¹⁶ which is rooted on the presumption that nearly all human inner organs have a designated topographical location within the coloured human iris and any sort of change in a given position may indicate that an organ is healthy or diseased (Figure 4.). The world medical scientific community is divided about this kind of adaptation of iris polymorphisms, but it is a fact that

12 <http://en.wikipedia.org/wiki/Melanin> (downloaded: 16 06 2012)

13 http://en.wikipedia.org/wiki/Iris_pigment_epithelium (downloaded: 16 06 2012)

14 http://en.wikipedia.org/wiki/Rayleigh_scattering (downloaded: 16 06 2012)

15 *ARMS* (2010) originally published as parts of the Figure 2. (Sturm, Larsson, 2009)

16 Iridology was re-discovered in the 1800's by Ignác Péczeley (1826–1922), a Hungarian physician. He developed one of the first Iridology charts, published in his book (Péczeley, 1873), it is the basis for most Iridology charts today.

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old age, or a few human eye diseases especially several ophthalmological medical treatments cause changes in an iris' original colour. (Teus et al., 2002: 1085–1088), (Imesch et al., 1997: 117–123). Despite these exemptions medical science regards iridology as a pseudo-science, because the methods and results do not satisfy the criteria of so-called evidence based medicine. (Simon et al., 1979: 1385–1387), (Ernts, 2000: 120)

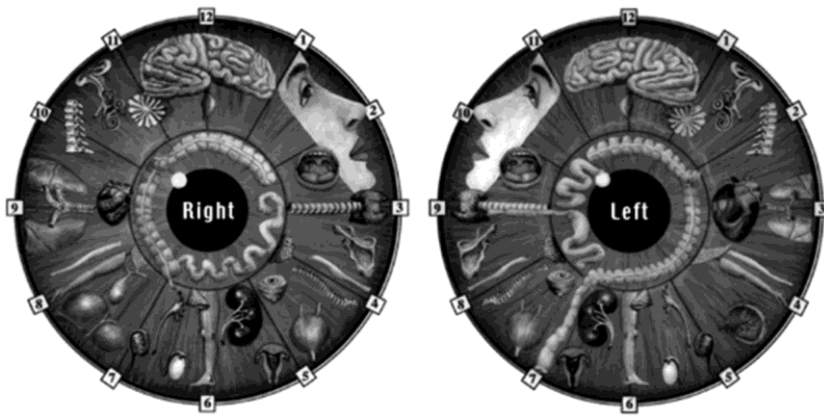


Figure 4. The projections of the organs on the human iris¹⁷.

The other mode has been determined by the continuous scientific–industrial revolution of the 20–21st centuries, especially due to the developments of information technology (IT) and genetics. The research work in these fields has led to new technical adaptations rooted in the identification of the fingerprint–like polymorphisms of the iris texture, the fundus and the retina of the human eye. The best–known application of this effort is iris rapid photo– graphing and personal identification, that has become a significant part of up–to–date safe– ty and security technology systems (for computers, lap–tops, military facilities, border and airport access control systems, ATMs). The principle of such technology is the Daugman’s¹⁸ conversion of the polymorphic surface texture of the iris into a biometric bar–code

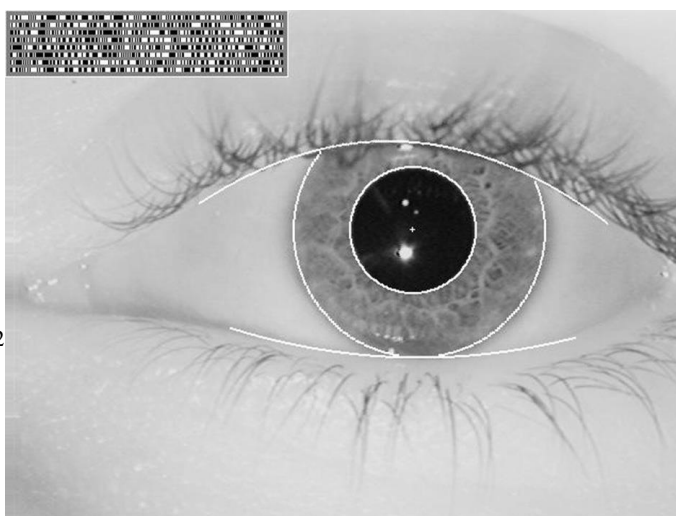
(Figure 5.), using the image processing technique based on the Gabor’s¹⁹ wavelets, and the Gabor’s transformation. (Daugman, 1994), (Gábor, 1946: 429–457) The first official application of this patented procedure was implemented in the United Arab Emirates. In this country, since 2001, during entry at the airport’s, a continental or a harbour’s border, a compulsory rapid IrisCode based control should be carried out on a person. (Daugman, 2004) Since then, many countries busiest airports [(Canada /all of the eight international airports(Aps)/, United King- dom /Heathrow Ap/, Germany /Frankfurt Ap/, Netherlands /Amsterdam Ap/, Japan /Narita Ap/)] have started to use the same technology, but Malaysia and Singapore are among those countries where the travellers crossings through the border are facilitated by this technology.

17 <http://natural-people.com/wp-content/uploads/2011/04/iridology.jpg> (downloaded: 21 06 2012)

18 John Daughman is a physicist, Professor of Department of Computer Vision and Pattern Recognition, Cambridge University. Developer of the iris–based identification principle.

19 Dennis Gabor, born Gábor Dénes (Budapest, 05 06 1900 – London, 09 02 1979): Hungarian–born physicist. In 1971, for the development of the holography method he won the Nobel Prize in Physics.

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Figure 5. The biometric bar–code of the human iris.

The identification is based on the extraction of the so called “IrisCode” using standardized conditions for photo shooting and Daugman’s image processing. (The pixel stream in the upper left corner is a unique biometric identifier derived from the demodulation of 2–D [two dimensional] Gabor’s wavelets, which is comparable to patterns stored in reference databases²⁰)

Commercial and military applications are also gaining ground: in laptops or cell phones instead of access codes

(password), or in stadiums, buildings, airports and in closed military security zones to allow entries, iris-based recognition technologies and applications have been developed. (Daugman, 2009: 819–825)

Based on the examination of the iris of the human eyes, photograph and document recognition technologies and the developmental processes of the digital imagery techniques have led to a considerable number of discoveries which are patent protected nowadays.²¹

Today's facial recognition programs use the unique iris texture in part to recognize the individual facial components, cutting out digitally any parts if necessary, or even determining the different eye positions precisely, following the continuous traceability of the moving face images. (Liu et al., 2002: 693–698)

Finally, one of the most recent US patents involves the genetic prediction of human iris colour from unknown biological samples based on genetic analyses. (Kayser et al., 2011)

20 <http://www.cl.cam.ac.uk/~jgd1000/csvt.pdf>, (downloaded: 11 07 2012)

21 In the USA, since 1976, among the available patent protections and patent claims handed in onto a patent procedure, 46385 pieces are related to the human iris. <http://www.patentstorm.us/search.html?q=iris&s.x=0&s.y=0>, browsed using the key word "iris" (downloaded: 15 06 2012)

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The milestones in the colour assessments of human iris

In the first decades of the 20th century, in possession of human genome mapping, the basic and applied biotechnological research have focused on the possible genetic inheritance of human physical traits and properties under the laws of genetics. These efforts have opened up new areas of genetic analysis based human identification, called DNA based phenotyping. In the first wave of such analyses, the investigations of those genetic characteristics which possibly take part in the inheritance of the human eye colour have also been involved. (Walsh et al., 2010) During these projects researchers intended to build up referential databases followed by the creation of predictive models which allow the reliable assignments of a human feature (eye colour, hair colour, skin colour etc.) related to results of analyses of candidate gene loci from biological samples of unknown origin. For such research and for any prediction, a standardized way of coding eye colours is essential.

Lots of historical antecedents of such coding procedures are well known. Initially, manual analyses and systematization of photographs was carried out. (Seddon et al., 1990: 1592–1598) Such analyses were time-consuming; the results depended on the professionals' skills, knowledge, actual physical states, special abilities (exp. colour-discrimination sensitivity). Currently, such methods are not acceptable because of the required criteria of evidence-based-results, the repeatability and the (post) verifiability of the scientific statements. The results derived from such investigations are also unsuitable for the construction of computer databases. In 1998, the first automated iris colour-scale (RGB²² based) systematisation was published (German et al., 1998: 103–110), then the automated iris shade recogniser system was announced in 2001 (Takamoto et al., 2001: 412–419), with which the changes in nuance of the iris could be examined. The quantitative measurement protocol of the pigmentation of the human iris was developed in 2000, using the so-called CIELAB²³ colour models. (Melgosa et al., 2000: 252–260) In 2003, the University of Wisconsin (US) reviewed the previously published scientific techniques in this field, and the application of an automated, so called equidistant colour space (CIE 1976 UCS or CIE $u'v'$ colour space) was suggested for iris identification in their technical report, which is essentially independent of the circumstances of the shooting. (Hunt, 1992), (Fan et al., 2003) Today, other constant colour scales namely the HSI, HLS and HSV²⁴ colour models are frequently applied in digital imaging processes for real-time and continuous identification of moving objects. (Okuma et al., 2004: 28–39)

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22 RGB: This colour model is an additive colour model in which red, green, and blue light are added together in various ways to reproduce a broad array of colours. The name of the model comes from the initials of the three additive primary colours, red, green, and blue. (<http://en.wikipedia.org/wiki/RGB>)

23 CIE: The International Commission on Illumination (usually abbreviated CIE for its French name, Commission Internationale de l'éclairage) is the international authority on light, illumination, colour, and colour spaces. It was established in 1913 as a successor to the Commission Internationale de Photométrie and is today based in Vienna, Austria. CIE $L^*a^*b^*$ (CIELAB) is the most complete colour space specified by the International Commission on Illumination. It describes all the colours visible to the human eye and was created to serve as a device independent model to be used as a reference. http://en.wikipedia.org/wiki/International_Commission_on_Illumination (downloaded: 22 07 2012)

24 HSI, HSV and HSL: These are cylindrical-coordinate representations of points in an RGB colour model. The three representations rearrange the geometry of RGB in an attempt to be more intuitive and perceptually relevant than the cartesian (cube) representation. Developed basically for computer graphics applications. http://en.wikipedia.org/wiki/HSL_and_HSV (downloaded: 22 07 2012)

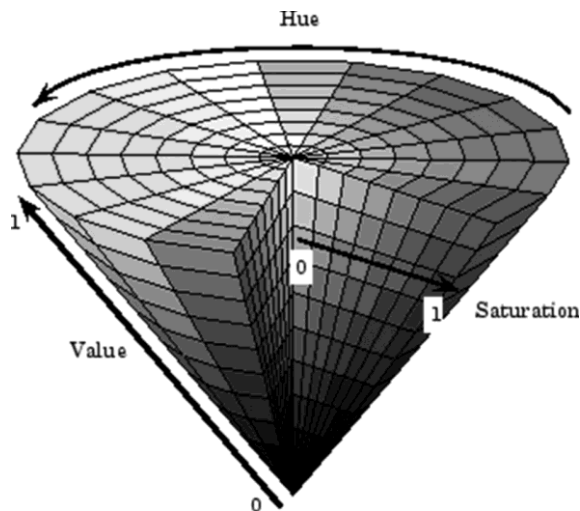


Figure 6. Illustration of the HSV colour space cone²⁵

The HSI colour space based iris analysis, as the part of facial recognition software was published in 2002. (Liu et al., 2002: 693–698) We could not find data that the HSV colour model has been used to identify iris colour, so far.

One of our research aims was to point out that the Hue part value of the HSV colour space model is a useful and powerful tool for iris digital image processing in the work of preparing a prediction model for eye colour.

Materials and methods

The total workflow of our project, which was organized by the DNA Lab of the Institute of Forensic Medicine, NFSI, Budapest was summarized as follows (Figure 7.):

1. We collected informed written consent from 94 unrelated Hungarian individuals. We fixed the eye colours on the worksheets (both the donor and laboratory workers' opinion)
2. Buccal swab samples were collected using Whatman's Sterile Omni Swab[®] (Catalog #WB10-0004), according to the manufacturer's instructions.

25 http://www.mathworks.com/help/images/_f8-20792.html (downloaded: 12 08 2012) The Hue values represent a 360° colour wheel at the outer top circle of the HSV cylinder. The brown colour occupies the area from 0 to 40°, the green 60–180° and the blue–gray 180–240° of the colour circle.

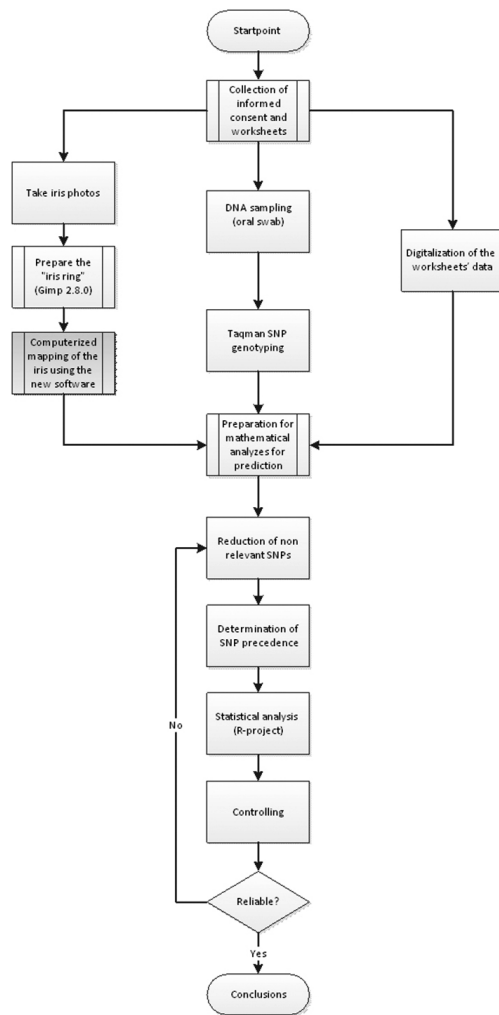


Figure 7. The workflow of the entire scientific project.

- We performed a computerized mapping of the iris ring. Firstly, we took photos with a high resolution Nikon digital camera (Nikon D60 + Nikon SWM VR ED IF Macro 1:1), using standard adjustments followed by computer analyses. We took at least 2 pictures from each individual from both eyes.
- To create the predicting model based on the Taqman® SNP²⁶, genotyping assay was carried out for those candidate gene loci which, in scientific literature, are known to play a role in the inheritance of the iris colour (Table 1.). Using the TaqMan® Assay 20 different SNPs²⁷ were tested for each human buccal swab sample according to the Applied Biosystems' protocol²⁷. The six most informative loci were selected for the statistical analyses.

26 SNP: Single nucleotide polymorphism

27 http://tools.invitrogen.com/content/sfs/manuals/cms_057275.pdf (downloaded: 10 08 2012)

28 National Center for Biotechnology Information <http://www.ncbi.nlm.nih.gov> (downloaded: 11 08 2012)

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SNP loci AARMS (12) 2 (29)	Gene symbol	Cytogenetic Band	28	Based on European	
				Genotype frequencies N(NCBI)	Allele frequencies ³⁷
rs12913832	HERC2	15q13.1a	113	0,07510	0,02642
rs16891982	SLC45A2	5p13.2d	58	0,11225	0,02793
rs1800407	OCA2	15q13.1a	112	0,39192	0,23762
rs12896399	–	14q32.12a	113	0,00008	0,00003
rs1393350	TYR	11q14.3a	113	0,45856	0,80025
rs12203592	IRF4	6p25.3b	113	0,02288	0,01297

Table 1. For building up the prediction model 6 SNPs were tested separately for each individual.

- For statistical analyses and model building the MATLAB® and R-Project²⁹ programs and formulas were used. We

used a multinomial logistic regression model for the prediction analysis, as reported in a previous study of hair colour. (Branicki et al., 2011:

443–454) Consider eye colour, y , to be four categories blue, green, brown and inhomogeneous, which are determined by the genotype, x , of k SNPs, where x represents the number of minor alleles per k SNP. Let π_1 , π_2 , π_3 , and π_4 denote the probability of blue, brown, green, and inhomogeneous, respectively. The multinomial logistic regression can be written as

$$\begin{aligned} \text{logit}(\text{Pr}(y = \text{blue}|x_1 \dots x_k)) &= \ln(\pi_1/\pi_4) = \alpha_1 + \sum \beta(\pi_1)_{k x_k} \\ &= \ln(\pi_2/\pi_4) = \alpha_2 + \sum \beta(\pi_2)_{k x_k} \\ \text{logit}(\text{Pr}(y = \text{green}|x_1 \dots x_k)) &= \ln(\pi_3/\pi_4) = \alpha_3 + \sum \beta(\pi_3)_{k x_k} \end{aligned}$$

where α and β can be derived in the training set. Eye colour of each individual in the testing set can be probabilistically predicted based on his or her genotypes and the derived α and β ,

$$\begin{aligned} \pi_1 &= \frac{\exp(\alpha_1 + \sum \beta(\pi_1)_{k x_k})}{1 + \exp(\alpha_1 + \sum \beta(\pi_1)_{k x_k}) + \exp(\alpha_2 + \sum \beta(\pi_2)_{k x_k}) + \exp(\alpha_3 + \sum \beta(\pi_3)_{k x_k})} \\ \pi_2 &= \frac{\exp(\alpha_2 + \sum \beta(\pi_2)_{k x_k})}{1 + \exp(\alpha_1 + \sum \beta(\pi_1)_{k x_k}) + \exp(\alpha_2 + \sum \beta(\pi_2)_{k x_k}) + \exp(\alpha_3 + \sum \beta(\pi_3)_{k x_k})} \\ \pi_3 &= \frac{\exp(\alpha_3 + \sum \beta(\pi_3)_{k x_k})}{1 + \exp(\alpha_1 + \sum \beta(\pi_1)_{k x_k}) + \exp(\alpha_2 + \sum \beta(\pi_2)_{k x_k}) + \exp(\alpha_3 + \sum \beta(\pi_3)_{k x_k})} \\ \pi_4 &= 1 - \pi_1 - \pi_2 - \pi_3. \end{aligned}$$

Categorically, the colour category with the $\max(\pi_1, \pi_2, \pi_3, \pi_4)$ was considered a predicted colour.

29 MATLAB: (matrix laboratory) this is the major product of the MathWorks (Apple Hill Drive, Natick, Massachusetts, USA). "It is a numerical computing environment and fourth-generation programming language... MATLAB allows matrix manipulations, plotting of functions and data, implementation of algorithms, creation of user interfaces, and interfacing with programs written in other languages, including C, C++, Java, and Fortran." (<http://en.wikipedia.org/wiki/MATLAB>) R-project APP: R is a language and environment for statistical computing and graphics. R provides a free, wide variety of statistical (linear and nonlinear modelling, classical statistical tests, time-series analysis, classification, clustering, ...) and graphical techniques <http://www.r-project.org> (downloaded: 07 08 2012)

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6. We rechecked our predictive model with the samples which were included in the file building, and compared the software prediction (SP) ability to the participants' own opinions and to the Martin-Schultz scale (an eye colour scale, commonly used in physical anthropology since the beginning of the 20th century).

In the present paper we demonstrate basically the computer based eye colour analysis in the above mentioned step 3.

Results

1. For the computerized mapping, we developed a new automated program for the iris colour analysis. Its flowchart is represented in Figure 8.
2. Using a standard computer graphic program (Gimp 2.8.0) we cut out the adequate parts of the iris rings' photos and stored the digitalized data without compression in PNG file format (Figure 9.).
3. Using the α -channels in the PNG format we were able to create irregular contours from the iris rings storing an average 100 000 pixels, respectively. The shadows of eyelids and eyelashes and/or other glittering areas or other artificial elements of the original pictures were cut out digitally.
4. The pixels were analysed individually using a newly developed software program to create a complex statistical dataset about the colour components of the iris based on the HSV colour model. In the printing industry, where the applications of high-precision colour processing systems are required, those colour spaces are preferred which use the so called basic colour components (additive: RGB or the subtractive: CYMK colour models). In these complex colour scales millions of unique colour shades can be produced with the combinations of the red, green or blue colours in the RGB, or the cyan, magenta, yellow and black colours in the CYMK model. In contrast, the HSV/HSL/HSI colour models have disadvantages compared to the RGB or CYMK, providing less information about the basic components of a distinct colour. In the case of an eye colour examination, however these kind of disadvantages provide benefits, because it is necessary to assign the colour results originating from the samples into only a few groups of the eye colour (greenish, bluish, brownish, or inhomogeneous), so there is no need to utilize the whole resolution ability of RGB or CYMK models (Table 2.). In other words it is not important to determine the compounds of the colours, but what colours are seen visually.

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R	G	B	Colour shades	H	S	V		R	G	B	Colour shades	H	S	V
101	70	45		27	55	40		23	131	231		209	90	91
101	58	23		27	77	40		72	162	247		209	71	97
98	50	11		27	89	38		112	167	219		209	49	86
142	73	18		27	87	56		118	160	199		209	40	78
150	92	45		27	70	59		110	159	206		209	47	81

Table 2. The table represents the very fine resolution ability of the RGB and the standard Hue (H) values in the HSV colour space in case of several colour shades of the colour brown and blue, respectively. A given main colour can be created by the mixture of very different values of R, G, B colour components. In contrast the H value is standard in cases of different shades of a base colour.

5. In the first version of the analysis we determined those eye colour groups that are characteristic to the human eye, and that external observers are able to distinguish and determined the Hue value limits of those distinct colour groups, and the standard deviations as well (Table 3.). It was clearly visible in the basic eye colours (brown, blue, green), but the grouping of some human irises are not so clear. Those coloured irises were named inhomogeneous. We realized that these complex colours are mixtures of the basic human eye colours mentioned before (greenish-blue, greenish-brown, etc.).

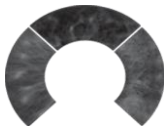
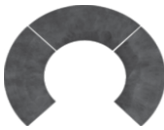

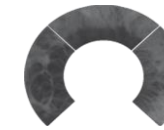
Eye colour's code	0	1	2	3
Eye colour	Blue-gray	green	brown	inhomogeneous
Hue	180-240	60-180	0-40	SD>55
Saturation	<10	>10	>10	-
Pictures of iris ring derived from our own database				

Table 3. The eyes' colour code system in our project with Hue representations. Four, very distinct iris colour groups could be represented. (See also the Notes 45, 47). All results of the eye colour, where finally the pixel analyses demonstrate at least 55 SD value, were defined as inhomogeneous.

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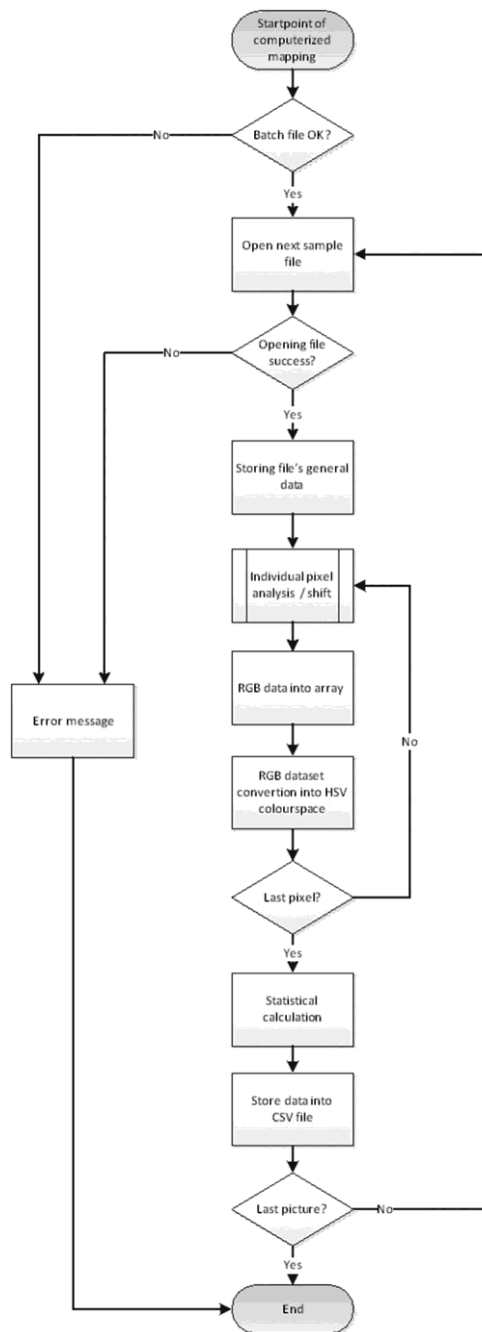


Figure 8. The flow chart of the computerized mapping of iris ring with the new software.

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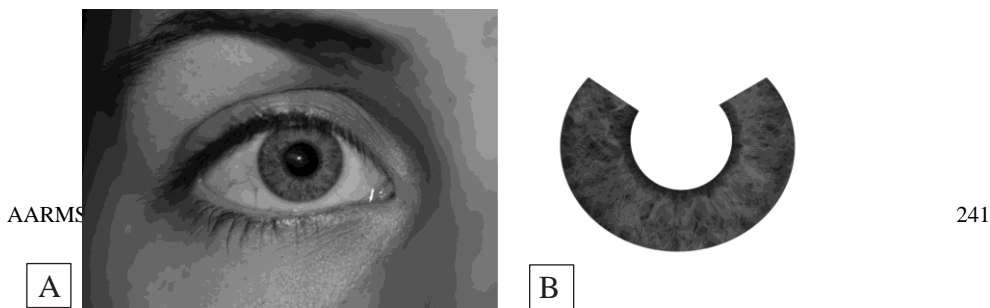


Figure 9. This figure represents an original iris picture (A), and the derived, digitalized colour iris ring cut out by Gimp 2.8.0 (B) for the forthcoming computer analyses. (The shadows of eyelids and eyelashes and/or other glittering territories or other artificial elements of the original pictures were cut out digitally.)

Discussion

The fundamental assumptions of our project were the followings:

1. Photographing the iris of the human eye can be standardized, i.e. the taking of photos and processing of the statistical results are not dependent on changing external conditions.
2. The statistical definition of the brown, blue and green colours is possible using the stable Hue value colour wheel of the HSV colour cone. In the patent submission of the prediction model of the eye colour (Kayser et al., 2011), only two unique eye colour predictions — the blue one and the brown one — have been found, moreover the intermediate, and the non-identifiable subgroups' designations have been used by the authors, although in Europe the independent appearance of the green eye colour is relevant (independently the appearance is 3–5 %, while the green colour also plays considerable role as an additive colour component in the compound eye colours). In relation to the intermediate and the unidentifiable coloured irises, more precise statistical grouping models can be specified (we named this new group inhomogeneous).
3. A software program could be prepared for the automatic iris colour analysis, which could yield a suitable data set for any further statistical work on the way to build up a more accurate predictive model.

In the preparatory section of our research work, when the colour spaces were chosen, we took several photographs of the iris of a selected person. The captured pictures demonstrated considerable differences between the values of RGB of the investigated areas. This phenomenon is the consequence of that fact that the typical human eye colours: brownish, greenish and bluish colours could be stirred in many ways from the three basic components of RGB, so that the colour shades represent only minimal differences.

In the same phase we also standardized the shooting conditions. We examined one iris of an individual using four different exterior illuminations; moreover using two different flashes we analysed the light relations and the effects of the flashes for the prepared pictures. Beside the exterior effects we compared the RGB and HSV colour space values. Our conclusions are summarized in the following points:

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1. During the taking of photos of the iris of the same person, under the different external conditions (low light, scattered light, fluorescent or sunlight) the colour elements are very slightly affected. Using macro lens and flash (Nikon Speedlight SB800) in the close-ups (30 cm[>]) we could minimize the influence of external factors. There was no need to use an external flash.
2. Using application of the HSV colour scale the standard deviation could be decreased significantly deviation in each sample of the same individuals. Thus, for our goal, instead of the use of the three variable basic components of RGB colour space (with a higher standard deviation), the use of Hue value in the HSV colour space (with a smaller standard deviation) is more adequate.
3. The flash does not neutralize the reflections on the exterior surface of the eye. So it is necessary to pay attention during the making of the samples that the pictures are taken in a position, where the bright surfaces inducing the reflections (window, lighting bodies) cannot be seen. We observed that the following typical objects could also cover a part of the iris: a) outer reflective surfaces, b) eyelashes, c) eyelids, d) nose shade.)

We examined the freely available graphic programs as well, as to what kind of manner could present a statistical data set about the colour components of a given coloured picture. Finally we decided to manage our statistical work with the help of a self-developed program, because of the limited abilities of the other investigated programs. Before the implementation we targeted for the software the next basic propositions:

1. the ability to handle both the JPG and PNG formats,
2. in case of PNG files, the transparency of the preset PNG α -channels could be handled by the software,
3. the ability of processing of bounded samples,
4. the ability to save the derived results in CSV or XLS formats,
5. The ability to store detailed information about the analysed samples as follows:

- The file name as a unique identifier,
- The number of processed pixels
- The minimum-, maximum-, average-, median and the standard deviation values of the components in the RGB colour scale. AARMS (12) 2 (2013)
- The minimum, maximum, average, median and standard deviation values of the components in the HSV colour scale.

The program applied the Java programming language³⁰, using the Java™ SE Development Kit 7 from Oracle industry.

The database prepared by the software and the results of the investigated SNPs of a given person (we reported the genetic results elsewhere previously [(Völgyi et al., 2011) (Kozma, 2011), (Kozma et al., 2012)] served as the basis of our mathematical model — using ordinal and multinomial logistic regression — for the eye colour prediction.

The algorithms based on these inputs (statistical and SNPs results) proved to be reliable when we rechecked the model using biological samples of the individuals included in the file building. Four iris colours (blue, green, brown and inhomogeneous) were predicted in

30 Java is a programming language and computing platform first released by Sun Microsystems in 1995. It is the underlying technology that powers state-of-the-art programs including utilities, games, and business applications. Java runs on more than 850 million personal computers worldwide, and on billions of devices worldwide, including mobile and TV devices.

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high statistical reliability. After retesting all of the 94 samples included in the model, the SP rate reached the 63 % value. In a study, published previously, this ratio reached only 61 % without the ability of discriminating the green colour. (Walsh et al., 2010) We also analysed the reliability of the program comparing the SPs to the participants' opinions about their own iris colours. We found that the SP rate reached the 90 % value in this connection. We also compared our SPs to the results of the iris categorization according to the Martin-Schultz scale (an eye colour scale, commonly used in physical anthropology since the beginning of the 20th century). We found an 81 % prediction accuracy in this connexion.

Conclusions

Based on the analyses performed, it can be stated that besides the Daughman's identification (IrisCode) of known persons, the prediction of human iris colour as an externally visible human characteristic could be a useful application in those cases where the biological samples were collected from unknown individuals. This kind of human trait belongs to those three visible human characteristics (such as hair colour and human age) that can be reliably predicted from DNA data sets. (Kayser et al., 2011), (Branicki et al., 2011 : 443–454), (Zubakov et al., 2010 : R970–R971)

This may open several civil and military applications in the future such as (a) missing person identifications; (b) analysis of biological samples from unknown individuals; (c) confirm and control eye witnesses; (d) disaster victim identification; (e) completion of data derived from other computer-assisted face-recognition programs and (f) forensic enquiries, or the work of military or civil intelligence.

One of the ultimate goals of our work is (in the IT input side) to achieve eye detection on images and documents. We are planning to perform the whole statistical analysis of a sample automatically, after the final preparation of images (iris rings).

At the output side, we wish to prepare the prediction model to an automatic iris drawing ability, too. For this aim we have to develop the method of deriving the statistical dataset because of the relatively frequent appearance of the inhomogeneous iris colour (34% according to the software analysis). One kind of solution to this problem can be the separation of the basic colour components using the so called frequency distribution, and at the same time define the primary and secondary colour elements of such a compound iris colour.

In the future, using the same principles the investigations could be extended to the prediction of hair colour. With the development of science there is a high probability also, that other polygenically inherited human traits or predispositions can be predicted from biological samples.

These approaches clearly reflect the impulse of the DNA based phenotyping in the human identification process, which will open up a new area in the field of bioethical science as well. Without a wide scientific discussion, the interpretability of the results, and the acceptance of the method by broader society may be difficult.

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(Footnotes)

- 1 National Center for Biotechnology Information <http://www.ncbi.nlm.nih.gov>
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War at the Background of Europe: The Crisis of Mali

BESENYŐ János¹

In 2012 the seemingly stable country of Mali experienced a sudden collapse, this along with the declaration of independence of the brand new Tuareg state, the massive spread of extreme Islamism shocked the international community. Initial disbelief gave way to the UN Security Council's resolution to restore Mali's territorial integrity. Fueled by the fear of a greater and bloodier conflict and its over-spill, limited military operations began. Along with the Economic Community of West African State-led operation, the country's former colonial master, France, began its own controversial military operation. Many people think that by doing so, France is trying to prove itself a great power and able to intervene on the world political stage according to its own diplomatic interest and being a force to contend with. Others however think that France is facing another Indochina-like fiasco in Mali. Who is right, will be determined by the failure or the success of the current operations and by the results of the restoration afterward. In this paper I would like to clarify the reasons for the events taking place in the country, their dynamics and possible consequences.

keywords: Mali, AQIM, Boko Haram, Tuareg, Azawad, rebellion, France, USA, European Union, peacekeeping, Operation Serval,

Mali

The country is located in the West African territory; bordered from the North by Algeria (1376 km), from the South by Guinea (858 km), Ivory Coast (532 km), and Burkina Faso (1000 km), from the East by Niger (821 km), from the West by Mauritania (2237 km) and Senegal (419 km). The land area of the country is 1,241,190 square kilometers, which is considered the world's 24th largest state, but only 4% (2360 square kilometers) of that is cultivated, despite the fact that an additional 1,000,000 hectares are arable, according to some estimates. (IMF, 2011) It does not have a coast line, but the country is crossed by the river Niger. The climate varies from subtropical to desert. The summer is a dry season from February to June, the rainy season begins from June to November and from November to February a dry, and cool period starts. (CIA, 2013) The average annual temperature is 27.5°C, and the hottest month of the year is April, when 39°C counts as typical. The coldest months are December and January, when temperature averages 16°C. (ACAPS, 2012)

The country is mostly made up of flat areas, in the north-west, semi deserts stretch into the Sahara, the south is more savannah type — limited agriculture is found here — and the north-east is covered by mountains.

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Mali is one of world's 25 poorest countries, its main sources of revenue are mostly gold mining (Bertelsmann Stiftung, 2012: 21) and exporting agricultural products (cotton, live-stock). The country has major exploited mineral resources such as gold, phosphates, kaolin, salt, uranium, gypsum, granite, and also significant are the non-exploited stocks of bauxite, iron ore, manganese, tin and copper. Along the Niger River there is farming (cotton, millet, rice, corn, citrus fruits, vegetables, groundnuts, gum arabic, shea nuts, cattle, sheep and goats), fishing and foresting, and they gain significant energy from the hydroelectric power plants (Félou, Taoussa) operating here. Mali has been greatly affected by the drought in the recent years, which caused desertification and livestock farmers migration. The country heavily depends on the aid provided by international organizations. (Bertelsmann Stiftung, 2012: 25) With IMF support from 1996 to 2010, the country — with government's structural reform and increase of efficiency — was able to produce an average 5% economic growth but this was not sustainable due to the increased security concerns. (IMF, 2011) In 2011, the country realized only a 2.6% growth, in 2012; it had a 5.9% decline forecast. The IMF approved immediate emergency aid at the end of 2012 to somewhat reduce the damage caused by the drought, the military putsch and by the outbreak of fighting in the north. (IMF, 2012) For these reasons, the commercial and tourism sector suffered substantial losses. The communication sector strengthened considerably in recent years, however the access to LAN line phone or internet service is still limited, although the majority of the population possesses mobile phones. The country's major economic partners are: China, France, Senegal, South Korea, Indonesia and Ivory Cost.

The transportation service is underdeveloped. The country has a narrow-gauge railway line (593 km), but only a small portion of the roads are paved (less than 3597 km out of 18912 km), and also the Niger River is only navigable during the rainy seasons. The sea can only be accessed through Senegal which has proved to be problematic for the

country numerous times. (Diallo, 2008: 46)

The people living here, originate from different tribes so the composition of the population is very heterogeneous. The main groups of the population are Mande — Bambara, Soninke, Malinka — 50%, the Fulani (Pelu) 17%, Voltaic 12%, the Song Hai 6%, the Tuaregs, Arabs 10%, and several other small tribes (Bozo, Dogon, Tukolor, etc.). (Imperato, 1996:

16–17) The French living here represent 5%. The majority of the population speaks French and Bambara, but many other African languages are also spoken. According to 2012's estimates, the country's population is 15,494,466 people, of which 47.8% are under the age of

14, 49.2% are between the age of 14–64 and less than 35% are over 65. 1,628,000 people live in the capital. 36% of the population lives in cities, the rest make a living out of agriculture and nomadic livestock (10% of the population). (CIA, 2013) The growth rate of the population is 3.2%, which yields a major problem to the already weak social care network system. The illiteracy rate is high, since only 24% of the total population are able to write and read.²

Therefore, state-run or private television and radio's role and influence are very high. (Bertelsmann Stiftung, 2012: 10)

Education, especially in the northern territory — inhabited by Tuaregs and belonging to the underdeveloped part of country — is very low. (IMF, 2011) A substantial part of the population is Muslim (90%), mainly Sunnites belonging to the Maliki faction, which was significantly affected by Sufism and other earlier tribal religions. In recent years, the number of radicalized Muslims has increased, and they do not hesitate

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to use violence in the interest of protecting and propagating their faith and beliefs. Although Mali is a secular state, the Muslim religious leaders have significant influence, which was shown in 2009 when they vetoed the Family Code which was amended by the government. Christianity and Animism (together 10%) are practiced by a minority.³

Health care is underdeveloped, which is shown by the ratio of the person per hospital bed ratio which is 2000 to 1. Officially 1% of the population is HIV positive, but the prevalence rate is somewhat higher than that. Diseases such as malaria, viral encephalitis, yellow fever, cholera, and various infections caused by untreated food and water are considered common.

The country's military force consists of three main units: the army, the air force and the National Guard. In the army, units of conscripts and volunteer (professional) soldiers serve. Compulsory military service begins at the age of 18 and the service time for enlisted soldiers is uniformly 2 years. Although 1.9% of the GDP is spent on military expenditure, the staff is underpaid, poorly trained and unmotivated. A significant part of the officer corps are uneducated and corrupt, which was demonstrated during the Northern military operations. During the 1991 changes, the army itself led the democratic change, which resulted in significant positions for them in the state leadership, but did not bring any positive changes to the army itself. Today, the number of military service personnel has declined to 7700 due to military losses and desertions. (Diarra, 2012: 15–16) After the last period, it would be essential to rebuild the shattered military command and control system. It would be necessary to reeducate, remap and rearm them to be able to effectively operate against the Islamist extremist occupiers in the Northern provinces. (ACAPS, 2012)

Illegal migration and the smuggling of arms and drugs, other commercial products — vehicles, fuel, food, cigarettes, alcohol, livestock etc. — cause a major problem for the government. A great number of these smugglers are Tuaregs who understand the desert very well, and have been known for centuries for escorting, and robbing caravans and desert trafficking. (Lohman, 2011: 6) (Diarra, 2012: 2) Destabilizing terrorism filled with Islamist ideology, kidnapping, organized crime networks covering the whole country and the high degree of corruption also cause problems in the region. (Bertelsmann Stiftung, 2012:19)

The Tuaregs

In order to better understand the recently escalated conflict, we must understand the ethnic group, the Tuaregs, which caused its outbreak. They are an ethnic group with Berber origins, whose members are composed mainly of Mali, Niger, Burkina Faso, Chad, Libya, Algeria, Mauritania, Mauritius, and Egypt. They mainly live in the Sahel region of Mali, Niger, Mauritania, Mauritius, and Egypt. (Imperato, 1996: 41, 234) Some estimates suggest that they are a group of 1.5 to 2 million people, most of whom settled in Mali and Niger. (Bondersholt, Gyldenholm, 2012: 3) In Mali according to some estimates, 600,000 people make up its population, but this has not been confirmed by a census. (Keita, 1998: 6)

The armed activities are a century-old tradition for this group, and the warriors (imushar) are the most well respected members of their society. Although they spend most of their life on the road, they practice farming in their settlements.

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The name Tuareg derives from the Lybian desert city called Targa — in Arabic it means “Comes from Targa” — but some people just call them the ‘blue men of the desert’, for the colors they wear, or they may call them ‘masked men’ for their characteristic protective masks worn on their faces. They call themselves the “free people” —

Amazigh. It is an appropriate name since this group of people is well known for their desire of freedom, and also because they do not recognize any authority above themselves. The Tuaregs live in a tribal system and they have created 7 major alliances and name them by their geographical position. The allied tribes can be divided up into tribes, fractions and families. (Diallo,

2008: 43–44, 50–53) The sort of feudal type of tribe can be divided into 4 classes. The nobles own the land, the animals and they control the tribe. The second group of the tribe includes the vassals, people who take care of the noble's land and animals.⁴ (ACAPS, 2012) A third group includes religious leaders, teachers and in the fourth group are blacksmiths and craftsmen – tent, carpet, weapon, jewelry makers. The tribe is directed by its leader (Amenokal), who belongs to the nobles and exercises political rights and judges case laws, and also acts as an intermediary between the nobles and the vassals. In the decision making process, however he must consult with the council of the tribe (Arollan), which consists of nobles, and prior to making decisions. The tribal leader can only be a man, but it is calculated based on matrilineal descent as to who is considered a Tuareg. This indicates their respect and honor toward women, who in the Tuareg traditions are 'guardians' (Schraeder,

2011: 185) with a high degree of autonomy and, as opposed to other Arab tribes, they have their own possessions, which can be retained after divorce according to the marriage contract. Women have the right to decide to whom they wish to be married, they do not have to hide their faces and they can work even without the permission of their husbands. Since polygamy does not exist among Tuaregs, they can only have one wife. The Tuaregs are famous warriors and artists, men are still proud of their fighting skills, their hand–forged sword is their most precious belonging. Some blades are passed from generation to generation.⁵ Most of them still wear the famous blue clothing (Tagelmust), but more and more people, especially youngsters are wearing western clothes. Furthermore, they are leaving the desert cities or moving abroad.

The majority of Tuaregs became Muslim in the XVI. Century, but they retained their pre–Islamic habits and beliefs.⁶ (Scelto, 2002: 1) They believe in various spirits such as the spirit of nature (Kel Asuf), and they have various rituals for almost every occasion (birth, naming, wedding, Muslim holidays, death, etc.). They have their own language (Tamazight, Tamashek) which is one of the oldest languages, it is at least 3500 years old, a fact proven by their writing (Tifinaagh). Developed in ancient times, that writes from right to left. (Ilahiane,

2006: 84–85) The different allied tribes speak different dialects of their language. From their

4 This group (according to estimates 800,000 capita) includes the former slaved–status blacks (Bell), whom after the abolition of slavery remained with the tribe, under the rule of their former owner. Still they do not get paid for their work, but they provide them with catering and accommodation.

5 When I was serving as a peacekeeper in Western Sahara, I met with a Tuareg man, whose blade had a running wolf on it, a symbol which was the emboss of Passau sword making masters in the Middle Ages. It is possible that the blade was a part of a commercial deal or got to the Sahara as booty. In the time of the Turkish– Hungarian wars. In the late medieval period many Berber Tuaregs served in the Turkish auxiliary units, they did not get paid, but kept the loot. Their habit was to collect not only the undamaged arms but also the half– broken blades from the battlefields which were converted into one–handed swords. To this day, many such blades turn up in the markets, to the delight of European art dealers.

6 Some researcher believes that before the arrival of Islam the Tuaregs were Christian.

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trade and smuggling activities most of them are fluent in French and several other African languages (Hausa, Songhai, Arabic) as well.

For centuries, the members of the ethnic group have been active participants in trading in the Sahara area and roam the five main trade routes, as traders, as caravan escorts and as robbers. The traders originally traded with artisans of gold, silver, jewelry, blue cloth, and salt traders, but in recent years, they switched to more profitable trading goods such as weapons, drugs, cigarettes, vehicles, fuel, and other contraband, and also they started guiding illegal human trafficking toward the European Union. In a changing world as an increasing number of people settled down they began farming animals, cultivating the land, or producing craft iron, wood, and jewelry products. Also they take work in the neighboring countries as guest workers.

Their population in Mali represents only a small portion of the total population, less than 10% but this value is only an approximation as exact figures are not available. This is explained partly because of their nomadic, roaming life, and partly because their distancing and separating themselves from the central government.

Before the pre–colonial period, not a single state was able to permanently subjugate them. The French who conquered their territory by the end of the 1800s, were only able to “pacify” them by 1917. (Bondersholt, Gyldenholm,

2012: 29–31); (Humphreys, Mohamed, 2003: 17) From then on, they have been marginalized as an ethnic group that is unable to comply with European laws. On their the territory a military administration operated, which tried to regulate and keep under control every aspect of Tuareg life; it taxed their caravans, confiscated their camels for military purposes, took their pastures, which they had been using for centuries, then took part of the men to work as forced labor or to military service. They tried to permanently resettle them, but that did not work out. Later, the French planned to create an independent Tuareg entity to completely separate them, but this was never fully implemented. Since the French obstructed them from trading, they converted to nomadic shepherding so they lost their previous role and their influence significantly reduced in Sahel. (Diallo, 2008: 3) After this, it is no surprise that they did not gain roles in the country's governances, even after the declaration of independence, new political positions were taken by the ones living in the Southern territories. In the 1990s, and also between 2006 and 2009, with Algerian intercession, they reached an agreement with the government to provide them regional autonomy and for the armed forces to integrate them into the military

(army, national guard, police). The government also agreed to provide them greater financial support for the underdeveloped northern territories. However these agreements have not been complied with so they became more and more dissatisfied and took up arms again.

The Tuareg Rebellions

Since Mali's independence, the Tuaregs have rebelled several times against the government, something which has led to cruel bloody battles and considerable sacrifices on both sides. (Boukhars, 2012: 4–5) The first uprising immediately broke out after obtaining independence in 1963, because the Northerners — including the Tuaregs — were not, or in only very limited numbers, able to occupy the new state's government positions and also they did not fit into the modernization strategy based on social ideology forced by the country's first president

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Modibo Keita.⁷ The new leadership did not support the nomadic lifestyle, since it considered it useless. Therefore, similar to the French, they tried to resettle the ones that continued roaming. (Bondersholt, Gyldenholm, 2012: 4–5); (Schraeder, 2011: 180–181) Their land was taken into state property and they wanted to force the Tuaregs into cultivation by prohibiting roaming, grazing livestock and forcing them to free their slaves who served their tribes. The Tuaregs felt that the country's independence did not bring them any good; they felt that their former colonizers were replaced by new ones from South Mali. Uprisings unleashed by part of the marginalized Tuaregs (Iforas tribe) were brutally defeated by the government after almost two years.⁸ (Keita, 1998: 10); (Imperato, 1996: 235) They not only bombed them but poisoned their artesian wells and government soldiers held public executions. (Schraeder, 2011: 181–182) The government believed that it could handle the situation by military means, therefore, negotiations between the opposite parties were out of the question. In those clashes more than 1000 Tuaregs lost their lives and thousands more fled to Algeria as well as neighboring countries. (Keita, 1998: 9–11); (Humphreys, Mohamed, 2003: 18) This event, at that time, did not catch the attention of the international community because it was occupied with ones in the Congo and Cyprus. After repressing the rebellion in 1968, a military putsch replaced the previous government and the new president, Moussa Traoré, introduced military governance in the Northern Territory, where outsiders were not allowed to enter until 1987 and where any means were allowed to suppress the aspiration of independence.

Many young people emigrated to Niger, Burkina Faso, Mauritania and Libya out of necessity, fleeing the destruction of their sheep during the drought period between 1970 and 1987, during which they lived in refugee camps for years. (Ilahiane, 2006: 40–41, 104–105) They created the Azawadi and Adrar Tuareg Liberation Movement (Mouvement Touareg de Libération de l'Adrar et de l'Azawad), which aims at the creation of Tuareg Azawad. The Tuaregs did not receive any aid arriving into Mali; it was distributed in the more developed southern areas between the government loyalists or were stolen by particular ministers. (Imperato, 1996: 42–43) This is when the second Tuareg rebellion broke out provoked by some Tuaregs imprisonment. The Azawadi People's Liberation Movement's (Mouvement Populaire de Libération de l'Azawad – MPLA) leader Iyad Ag Ghali, who is currently the commander of the Ansar Dine, played a leading role in the uprising.⁹ (Keita, 1998: 38–39) The MPLA's militants on June 28th 1990 attacked Mali's north-east Tideremen military base, then Ménaka city. In September, next to Tuxemene, they destroyed a 200 person military unit which resulted in many more young people joining Tuareg's forces, whose headcount soon reached 3000 people. This uprising was much better organized than the previous one and the rebels received almost unlimited support and modern Soviet light weapons from Libya. Mali's armed forces counted 6900 persons, the gendarmerie, 1800 persons, and the police, 1000 persons but they were not properly equipped and motivated. (Keita, 1998: 39) The gov-

7 The Northern provinces: Kidal, Gao and Timbuktu gives the country 2/3 of its area, but only 10% of the total population lives there.

8 According to Lieutenant Colonel Kalifa Keita who was involved in the suppression of the second Tuareg rebellion, only 1,500 participated in the 1962 to 1964 armed conflicts because the Tuareg community was not able to consistently act against the government.

9 In the uprising several other minor organizations were involved, such as the Popular Front for the Liberation of Azawad (Le Front Populaire de Libération de l'Azawad – FPLA) the National Liberation Front for Azawad (Le Front National de Libération de l'Azawad – FNLA), Basic Autonomic Unified Front for the Liberation

of Azawad (La Base Autonome du Front de Libération de l'Uni Azawad – Fula), and Azawai Arabic Islamic Front (Le Front Islamique Arabe de l'Azawad – FIAA).²⁵¹

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ernment responded brutally to the Tuaregs initial success. A state of emergency was declared and they launched an immediate attack against the Tuareg community. (Imperato, 1996:

235–236) Hundreds of civilians were whipped, and more than a few were publicly executed. They slaughtered part of the Tuaregs' and other tribes' sheep, which enraged northern Arabs against them and led to the escalation of the conflict. During the conflict, 6–8000 people lost their lives. (Humphreys, Mohamed, 2003: 3–4, 19–21) Finally the government realized that they cannot eliminate the uprising by themselves, with their own armed forces, therefore, with the help of neighboring Algerian intermediation, the opposition parties sat down at the negotiation table and, on 1991 January 6th, they concluded their first peace treaty — Accord de Tamanrasset, it resulted in the immediate cessation of hostilities.

(Bondersholt, Gylden- holm, 2012: 40); (Ilahiane, 2006: 119) The main points of the agreement were as follows:

- Immediate ceasefire and exchange of prisoners of war;
- Tuareg rebels retreat to the tribal areas;
- To reduce the number of the government's armed forces in the northern territories especially in Kidal;
- The immediate termination of military governance, the introduction of civil adminis- tration;
- The immediate termination of particular military garrisons which pose a threat to Tu- aregs;
- Integration of Tuareg rebels into Mali's army, with proper conditions – rank, duty station, etc.;
- The decentralization of administration, providing more autonomy in local affairs;
- Increased financial resources and infrastructure development for the northern region.

Later however, they did not respect the agreement completely; only in part. (Lohman, 2011: 6–7); (Diallo, 2008: 49) A military putsch, led by Amound Toumani Touré, overthrew the former dictatorial regime on the 11th of April 1991 and the Tuaregs concluded their sec- ond treaty — Pact National — with the new government led by Alpha Oumar Konaré which officially ended the rebellion. Those Tuaregs who accepted positions were integrated into the government's army or were allowed into public service. (Schraeder, 2011: 191–193) In April of 1993, 610 former rebels joined the army, in 1996 1200 people — part of them joined the National Guard and the police as well — and 300 people also joined the paramilitary forces and 120 people the civil administration. (Keita, 1998: 33–34) With this agreement, however the government managed to disunite the Tuaregs who were unable to consistently act against the government, so enforcing the peace treaty was not without problems.¹⁰ (Humphreys, Mo- hamed, 2003: 22–29); (Keita, 1998: 8–9, 20) The atmosphere of mutual distrust remained

10 Signing of the accord did not automatically bring peace between former enemies, who considered each other to be suspicious, and occasionally provoked bloody clashes with each other. This was the case in May 20th 1991 when one unit of the army was chasing Tuareg rebels and captured 48 Tuareg and Arab traders, and the village leaders in Lere town and immediately executed them as anti-government rebels. The government tacitly supported – or just did not take notice of them – the tribal militias that initiated revenge on the Tuaregs who were terrorizing them before (who took “tax” from the farmers, and launched slave-hunting expeditions against them, etc.). The Songhai group established the Ganda Koi (the land owners) militia, who started exterminating farmer and shepherd Tuaregs who were not involved in armed clashes. There was a clash among the Africans where a well-known religious leader and 60 of his followers were killed at the same time! Arab groups fought on the side of the Tuaregs, while on the side of the Songhais the Africa (Fulani / Peul) groups fought, supported by the government with soldiers and arms. Years of armed conflict have had an impact on the current conflict.

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and due to various misunderstandings the Tuaregs and the military repeatedly clashed with each other. For example, in 1994, part of the Tuaregs integrated into the Tonka and Kharous army garrison mutinied, which resulted in many losses of soldiers' lives. (Keita, 1998: 21) Therefore, some Tuareg groups established the Azawad People's Movement (Mouvement Populaire de l'Azawad – MPA), the Popular Front Azawad Liberation (Front Populaire pour la Libération de l'Azawad – FPLA), followed by the Revolutionary Army the Liberation of Azawad (Armée Révolutionnaire pour le Libération de l'Azawad — ARLA) organizations, which continued the battle against the government and other tribal groups. (Schraeder, 2011:

190) This period lasted until 1996, when the third treaty – Flamme de la Paix — was con- cluded on March 27th, after which, the opposing parties actually ceased hostilities. After the signing ceremony in the presence of the country's president Alpha Oumar Konaré, and the President of Ghana, the former rebels burned 3000 arms as a sign of confidence. (Bonder- sholt, Gyldenholm, 2012: 48); (Keita, 1998: 18) By this time the UN Refugee Agency had resettled those Tuaregs back into Mali who had fled from the fights and droughts to refugee camps in Mauritania. The government started investing into the infrastructure in the North

– construction of schools, health care facilities, and drilling wells – and began to provide greater autonomy for the Tuaregs, who now were able to join the political life of the country.

This period came to an end soon since the military putsch led by Amound Toumani Touré removed Konaré from his office in 2002. He was the one looking for peace at any price with the Tuaregs. For the new government the observation of the previous agreement with the Tu- aregs became less important, so again they were marginalized. In the fight against terrorism, which followed 9/11, Mali, as a U.S. ally, announced a fight against terrorist organizations operating in the region and in 2002 against smugglers trading with weapons and drugs in the abandoned Saharan areas. (Besenyő, 2011: 38–41) The Tuaregs who are familiar with the deserts played a significant role in these activities; therefore, the government forces launched several military operations against them which caused part of them to join Al-Qaeda. (Lecocq, Schrijver, 2007: 158–160); (Diarra, 2012: 7–8); (Besenyő, 2010: 148–154) The pro- liberation of light weaponry caused frequent armed clashes between the Tuaregs and their neighbors, which have gotten bloodier over time. Despite this, the government did not pay sufficient attention to the region. Therefore, the fights escalated in 2006, when more Tuareg leaders belonging to the Kel Adagh tribe deserted from the army and attacked Kidal and Meneka on May 23rd. (Lecocq, Schrijver, 2007: 155–156) That day, the rebels established the Democratic Alliance for Change (Alliance Démocratique pour le Changement du 23 to- day's–ADC) organization which demanded the developments of the northern areas and the implementation of the treaty signed in 1992. The Tuaregs moved themselves into the hardly accessible Tigharghar Mountains where the government powers were unable to liquidate their armed groups. Mali again requested the mediation of neighboring Algeria, hence July 4th 2006 they brought the 4th peace treaty – Accord d'Algers – under the roof, which was nothing else than the

renewed version of the previous one. (Boukhars, 2012: 11) Similarly, they pledged the development of the northern regions, the integration of Tuareg soldiers into the national army, and the withdrawal of the government forces to their southern positions. However, part of the rebels did not believe the government and, with the leadership of Agh- ali Alambo and Ibrahim Ag Bahanga, they established the Tuareg Alliance for Change of Northern Mali – ATNMC organization, which continued the fight. Since the government did not have sufficient military force to crush the rebellion, they initiated peace talks again. They

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concluded the 5th peace treaty in Kidal in April of 2009, which contained the implementation of the promises from the previous four agreements. (Bondersholt, Gyldenholm, 2012: 56)

It seemed that the government finally kept its promise. By December 2010 the army significantly reduced its station in the north and also set up a special Tuareg force unit. To demonstrate their peaceful intentions, they permitted the return of the Tuareg leader Ibrahim Ag Bahanga who was exiled in Libya for more than 2 years. In August 2011, the government approved a USD 65 million program for development of the northern regions.¹¹ The amount that was necessary for the program was provided by the European Union, the World Bank, the United Nations Development Program and other donor organizations. However, no significant changes occurred in the North, smaller armed clashes continued to take place between the government and the Tuaregs when the government ordered new military units into the northern regions. (Bertelsmann Stiftung, 2012: 6, 21, 35) These conflicts had not yet reached the stimulus threshold to call the attention of the international community to deal with it. It should be recognized that not one agreement has been able to eliminate the marginalization and segregation of the Tuaregs and have been unable to integrate them into their society. Time was just preparation for the next revolt to break out.

The Eruption of the 2012 Uprising

This low intensity conflict escalated on January 17th 2012, when the National Movement for the Liberation of Azawad / MNLA¹² occupied the Aguelhok (Menaka) settlement and launched a comprehensive attack on the government forces stationed in the north. The military putsch, one month prior to the election, helped the attack and facilitated the disintegration of the poorly equipped, unpaid military units fighting against the Tuaregs. It also helped in the disintegration of the functioning government. (Besenyő, 2012: 10–12) It started from the Kati barracks, led by Captain Amadou Haya Sanogo, and the putschists established the National Committee for Reconstruction, Democracy and Restoration of Statehood (Comite National pour le Redressement, la Democratie, et la Restauration de l'Etat — CNRDR) organization. The putschists led by Sanogos, rebelled primarily because of the military leadership's inertia, and because of the captured and massacred soldiers (Diarra, 2012: 4) in the north garrison in Aguelhok, and against the corruption that runs across the leadership of the

11 Programme Spéciale pour la Paix, la Sécurité et le Développement au Nord-Mali

12 The organization was formed in late 2011, mainly from the Movement of National Azawad-MNA which gave it its base, it was previously created in 2010 and was created based on a number of smaller and larger Tuareg groups. The MNA acted as a defender of the interests of the Tuaregs, but their main activities were limited to taking possession of international aid, and its lucrative smuggling with AQIM groups. Once the previously chased off people returned to Mali from Libya, the MNA merged into the MNLA organization. The new formation is extremely fragmented, with several types of ideology, conflict of interest and tension between each other, which were only temporarily set aside, because of the common enemy. They mainly owed the quick military victory to Mali's army units which were stationed in the north, because they did not have the proper weapons, training, and management and they had not been paid for months. The officers were involved in politics rather than in training or management. A large part of their activities involved corruption and smuggling activities. The MNLA were aware of their weakness and formed alliances with radical Islamist groups, which only used them for their own purposes. Currently they are at war with their former Islamist allies. The best known commanders are Muhamad Ag Najim and Algabassn Ag Intallah. According to their own claim they have 10,000 armed men, but many of these switched to the fundamentalist groups, or operate independently.

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country infecting the political elite and also evidenced through their nepotism.¹³ (Boukhars, 2012: 5) Though the committee suspended the constitution, the rebels were not able to consolidate their power due to disorganization and other opposition, such as the lack of support from the majority of the population and from part of the army.¹⁴ The social dialogue they started dismally failed and the army has been forced to give up even more territory. The military takeover was not recognized by the international community, it not only protested against it but, also threatened the putschists with possible sanctions and military intervention. The African Union suspended Mali's membership and the representatives of the Economic Community of West African States placed further pressure on the leaders of the putsch to hand over the power to a civil governmental administration to govern the country until a new parliamentary election was held. By coercion they were forced to accept this. All participants in the putsch were given amnesty and Amadou Toumani Touré and Sanogo resigned from power and withdrew from public life. The former spokesman of the parliament, Diounounda Traoré, was elected as the new president. However, the new government that stepped into office in August 2012, did not win the total support of the society and also between the military and civil administration the atmosphere remained tense. (Boukhars, 2012: 7)

In early April, various groups, MNLA, the Islamist Ansar Dine (Defenders of the Faith) group¹⁵ as well as other

Arab militias, launched an armed attack against the government. They occupied the three northern regions of Kidal, Gao and Timbuktu. On April 5th 2012 the Tuaregs occupied Douentza city. The next day, they announced that they had reached their objectives and declared the Azawad Republic. They formed their government, which has not been recognized by the international community.¹⁶

Gunmen involved in the fighting have been fighting previously in, the since fallen Libyan President's, Gaddafi's mercenary army. In late 2011 they fled to Mali along with their armed

13 http://www.jamestown.org/uploads/media/TM_010_Issue13.pdf (downloaded: 14 01 2013)

14 Many units of the military did not support the putschists, for example the armed groups loyal to the former president tried to recapture the capital from the rebel soldiers, but their attempt failed.

15 The organization's first leader the Tuareg Iyad ag Ghali from the Ifoghas tribe, is considered one of the noblest among them. He is known for his conservative view of Salafism (a follower of the Tablighi school) and is one of the emblematic figures of the 1990 revolt. He participated in the funding of the MNLA in late 2011, but the position he intended to get – because of his “suspicious” connections to Al-Qaeda, Algeria and Mali's political elite – he did not attain. According to his critics he did not want an independent state in the area of North, rather a state ruled by the law of sharia, which was opposed by most of the Tuareg who wanted to form a secular government and legal systems. Therefore, when the Tuaregs launched an attack against the central government, they set up their own group, Ansar Dine, which received logistical and military support from the Katiba Abdelkrim al-Ansar (winners battalion) militia led by Targum. Their estimated number could be around 500–2000 people, among them foreign (Yemeni, Qatari, Algerian, and Nigerian) armed men could be found. The group's first success was the occupation of the city of Kidal, and then the expelling of the MNLA from Timbuktu. Since the uprising in April 2012 was led by him, it made him seem the most successful military leader, in addition he has the best trained and equipped armed men. However, the majority of Tuaregs still do not accept him as the leader. <http://www.bbc.co.uk/news/world-africa-18814291> (downloaded: 03 01 2013)

16 The original declaration could be found: <http://www.mnlamov.net/component/content/article/169-declaration-dindependance-de-lazawad.html> (downloaded: 16 01 2013)

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inventory and battle experience¹⁷ (Besenyő, Marsai, 2012: 92–93); (Diarra, 2012: 12–13) where they almost immediately launched an attack against the secular government.¹⁸ (International Crisis Group, 2012: 3); (Humphreys, Mohamed, 2003: 18–19); (Keita 1998: 13–14) These groups temporarily allied against the government forces and even collaborated with the local branch of Al-Qaeda — AQIM / Al-Qaeda in the Maghreb – as well.¹⁹ (Diarra, 2012: 13–15) However, this alliance was vulnerable since the Tuaregs desired their own “secular” state; on the other hand, the Islamists imagined a country based on religion, applying Sharia laws, as their future.²⁰ They started introducing this in those territories where they gained power; where they destroyed hotels and restaurants — because they sold alcohol previously

— and they also mutilated more people because of various “offenses”. The Tuaregs did not agree with these extremist kinds of outbursts, but the Islamist organizations such as Ansar Dine, the Movement for Unity and for the Jihad for Western Africa (MUJAO — Le Mouvement pour l'unicité et le jihad en Afrique de l'Ouest)²¹ and the Nigerian Boko Haram, who are present here, had more armed men and power than the Tuaregs.²² Therefore, at first they tried to put aside their differences and tried to gain control with joined forces of those territories which have fallen under their rule. For example, the Islamist groups appointed Emir Yahya Abou al-Hammam as the leader of the occupied Timbuktu, someone who belongs to

17 Unfortunately Libya's NATO operation contributed to this, in which the air strikes eliminated the Gaddafi forces, but could not prevent the dictator's army, Mali's Tuaregs (their estimated number 2000–4000), equipped with huge amounts of light and heavy weaponry from returning to their home countries, where they might use this against French and other European soldiers. Thousands of SA-7 anti-aircraft missiles are believed to be in their hands, which have not been used yet. Of course, the government of Mali also made a mistake, when they let the Tuaregs return to the country without first taking care of their weaponry disarmament and demobilization.

18 Part of the weapons after the 1963 uprising, while others during the great drought started in 1984 migrated from Libya, where they entered the Pan-African forces which were founded by Gaddafi in 1972. The squad gained considerable combat experience in Afghanistan, Lebanon, Israel (Palestinian intifada), Syria and Chad. AARMS, (17) 2 (2013)

19 The Salafist Group for Preaching and Combat (GSPC) is considered the predecessor group, which in 2007 became an African ally with Al-Qaeda. The organization has been embedded into the society of the northern areas by 2003, where they gained considerable political and social support and therefore they were able to reinforce the organization shattered by the Algerian security forces. Their best known leader is Abdelmalek Droukdel. In recent years it has become one of the most structured and supported terror groups in Africa. Their incomes are from smuggling cigarettes, alcohol, drugs, weapons, and other goods, as well as from taking hostages. The AQIM takes advantage of their Arabic roots and enjoys more support from the Arab community. One of their central powers is Timbuktu where they cooperate closely with the local Arab militias which were sponsored and supported by former president – Toure. The inter-ethnic conflicts between Arab–Tuareg and Fulani Song Hai (Peuhl) makes the organization's activities substantially easier. In addition, the income earned by AQIM were used to bribe and purchase the tribal leaders – with Sport Utility Vehicles, weapons, etc. – they then provided free access throughout their lands, occasionally information and logistical support for the organization's soldiers. The AQIM units have a significant number of well-trained experienced foreign armed men from Iraq, Afghanistan, Yemen, Algeria, etc, who unlike the Tuaregs and Arabs living in Mali, have nothing to lose, therefore reaching an agreement with them is almost impossible.

20 <http://www.al-monitor.com/pulse/security/01/08/torture-and-violence-against-opp.html>

(downloaded: 17 01 2013)

- 21 The MUJAO spun off from AQIM and first entered the scene in the occupation of Gao city, although according to some information at the end of 2011, their men kidnapped three aid workers from the Algerian Tindouf refugee camp. The organization's members are not Tuaregs, but are assembled from Lamhar and Songhai tribes who, although deeply religious, still obtain cover for their expenses from crimes committed. They maintain good relations especially with the Arab community, most of their leaders are from Algeria and Mauritania. They are able to finance their activities better than the MNLA. They have about several hundred armed men and their most important leader is Bilal Hicham.
- 22 <http://www.fas.org/sgp/crs/row/R42664.pdf> (downloaded: 17 01 2013)

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Al-Qaeda. But not much later, the news went around that the city was divided between the Islamists and the Tuaregs, and occasionally armed conflicts took place. Similar cases had been happening in other places which soon caused the momentary allies to jump at each other's throats. On June 27th in the city of Gao MUJAO, militants launched an attack against MNLA and occupied its headquarters. Soon after, they were chased out of the city. The intensity of the battle was typified in that clash where the Tuareg leader, Bilal Ag Acherif, was wounded and lost nearly 20 of his armed men.²³ By the end of July, the MNLA lost almost all of their influence in the northern territories where Islamist groups gained power.

It seems there is no unity among the Tuaregs, which was proven on May 19th, 2012 when, the forces wishing to preserve the country's unity, established the so called Republic Movement for Reconstruction of the Azawad (Mouvement républicain pour la reconstruction de l'Azaouad – MRRA) organization, whose army not only launched an attack against the Islamic groups but also against the MNLA. Not so much later, the former members of the Arab community, the National Front of Liberation of Azawad was established; their members want peace in Mali and are ready to confront any armed groups initiating the disruption of the country. (Besenyő, 2012: 10) Similarly, the group, Front for the Liberation of the Azawad (FPA), split from the MNLA and no longer have independence but a crackdown on Islamist extremism as its most important priority.²⁴ Other ethnic groups living in the north – and in some places, the settlements themselves – similarly created their own militias with elaborate names like Patriotic Resistance Movement for the Liberation of Timbuktu (patriotique the Mouvement pour la Libération de résistance de Tombouctou — MPRLT), but their effectiveness is questionable. Using government subsidies, they established 15 militias of which the best known are the Patriotic Resistance Forces, (Forces patriotiques de résistance — FPR) including 6 armed groups and 6000 members and the North Mali Liberation Front, (Front de Libération du Nord-Mali — FLNM) which includes two Hai Song groups and a couple hundred militants controlled by a Tuareg colonel from the army. (ACAPS, 2012) It seems in the north, everyone is fighting each other — even occasionally militant Islamist forces — but no one is strong enough to be able to impose their will on other groups.

The Humanitarian Situation

After the rebellion broke out in January of 2012, within 3 weeks, more than 30,000 people fled from their residences, soon followed by tens of thousands of others. A majority stayed in government controlled areas — mainly in Bamako and surrounding areas — and the minority moved to the neighboring countries of Mauritania, Burkina Faso, Niger, Guinea, Togo and Algeria, where they quickly set up refugee camps. Several thousand people remained in the North hiding in abandoned places, too afraid to leave their small assets behind. These people were not only exposed to nature, but to armed Islamists as well, bent on robbing, beating and raping them. Many were murdered trying to protect themselves and their families.²⁵

More charges were drawn up by the Human Rights Watch organization's fact revealing team, reporting from the scene on the various groups occupying the northern territories, they

23 <http://www.bbc.co.uk/news/world-africa-18610618> (downloaded: 14 01 2013)

24 <http://bigstory.ap.org/article/ap-interview-malis-secular-rebels-splinter> (download: 14 01 2013)

25 http://www.jamestown.org/uploads/media/TM_010_Issue13.pdf (downloaded: 14 01 2013) and <http://www.unhcr.org/refworld/pdfid/505c16fe2.pdf> (downloaded: 14 01 2013)

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called attention to the terrorizing of civil society, raping of women and young girls, robbing, looting, brutalizing captured government soldiers, and the use of child soldiers (in the pursuance of war, Ansar Dine recruited children by force into their units).²⁶ There is evidence that Tuareg and Islamist groups destroyed Christian churches, bible schools, hospitals, and attacked Christian minority groups living in the country. As such, a mass exodus began. Most of the Christians living in the north fled to government controlled territories or to one of the neighboring countries. The Islamists however did not spare the Muslim shrines either; such as the one located in Timbuktu — one of the World Heritage Sites — a grave considered holy by Muslim religious teachers was partly destroyed along with the 600 year old entrance of the Sidi Jahya mosque.²⁷ The introduction of Islamist rule not only destabilized public law and order, but the accompanying executions, stonings, limb mutilations, tortures and public flogging also caused more refugees.

Of course, we can not call the government forces fighters for the truth either, as they executed Tuareg policemen and soldiers because they were afraid that they would betray them to the MNLA. (Besenyő, 2012: 11) In light of this, it is understandable that the majority of the survivors turned their backs on the government and joined the MNLA forces.

Some members of the government forces also took part in the abuses, robberies and even murders of Tuaregs and other groups.²⁸

Since the outbreak of the conflict, more than 420 000 people were forcibly displaced from their residences, their care remains unresolved.²⁹ A part of the refugees remained in Mali, but even more people have been fleeing into neighboring countries, where they feel more secure. Out of the 3.3 million people living in the North, the supply of at least 1.76 million is not ensured, as access to food is increasingly more difficult with prices escalating astronomically since the outbreak of the conflict. (ACAPS, 2012)

However, the Islamists banned any international aid organizations from conducting any humanitarian activities on territories controlled by them. Some of these organizations were even afraid to enter these territories for fear of kidnapping and other violent acts in which members of the Red Cross were harmed, causing the evacuation of the majority of their colleagues from Mali. The hostile behavior against foreigners has been significantly amplified by the ongoing operation of the French, therefore the aid workers are in actual danger in Mali and in neighboring countries. Since most public institutions (hospitals, clinics, schools) are not operational, and the majority of wells ruined, therefore health care has almost completely disappeared in the north. As a cholera epidemic broke out in Gao, the results worsened and the death toll rose higher.

International Reactions

Seeing the military success of Islamist expansion the African Union called upon the UN Secretary General to contribute with an UN Security Council resolution to establish a “West– African Afghanistan” before the immediate deployment of African troops.³⁰ Representatives

26 <http://www.hrw.org/node/106800> (downloaded: 04 01 2013)

27 http://hkk.uni-nke.hu/downloads/kozpontok/svkk/Elemzesek/2013/SVKK_Elemzesek_2013_1.pdf (downloaded: 24 01 2013)

28 <http://reliefweb.int/sites/reliefweb.int/files/resources/afr370012012en.pdf> (downloaded: 20 01 2013)

29 <http://www.fas.org/sgp/crs/row/R42664.pdf> (downloaded: 17 01 2013)

30 <http://www.cbc.ca/news/world/story/2012/11/14/un-african-union-mali.html> (downloaded: 14 01.2013)

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of the Economic Community of West African States held extraordinary meetings, where they agreed, if necessary, they would deploy organized forces – similarly as it was done in Libya – to restore the legal order, prevent the country’s collapse and provide humanitarian aid to Mali and the surrounding states.³¹ The leader of the regional organization, the Ivorian leader Alassane Ouattara, called the events that happened in Mali a serious security threat, not only for Mali but, for the entire region. The community leaders threatened the MNLA leaders during the Ouagadougou City meeting, that if they don’t give up their secessionist aspirations, then they will send significant military units to support the government forces to recapture the northern territories. The threat was effective to some extent as the Tuaregs’ fight with Salafist groups wore away at their demands for independence; weakening it significantly and culminating in their agreement to begin negotiations with the government. The Tuaregs even offered to help in operations against Ansar Dine and other Salafist groups. Nowadays it seems that they would even give up their aspirations for independence.³² Meanwhile, the Economic Community of the West African States made agreements with leaders of neighboring countries outside of the negotiations and imposed economic sanctions and embargos against Mali. So previously imported products became no longer available for purchase. The organization and the African Union asked for the intervention of the UN and sought to obtain authorization to launch armed interventions against the Islamists. The UN passed a positive judgment on this request and the Security Council on October 12th of 2012 passed a resolution (2071) against the occupying Islamist forces in Mali.³³ Representatives of the Economic Community of West African States agreed on November 11th 2012 in Nigeria to send troops with the support of the UN to recapture the northern territories occupied by Islamists. (ACAPS, 2012) This has not been easily realized, since the organization’s first plan to launch a 3300 person military operation was rejected by the UN — they only approved planning, troop organization, preparation and equipment gathering. Because of the escalation of the conflict, the UN Security Council finally approved part of the resolution 2085 on December

20th, 2012 to launch an African–led International Support Mission in Mali (AFISMA). An intervention mandate was for one year. (UN Security Council, 2012) Of course it is questionable what this mission can achieve, since the Economic Community of West African States already operates a military mission in the territory of Bissau–Guinea, where in April 2012 a military putsch happened. The Community has sent peacekeepers to the country to restore the civilian government, but the missions mandate was not clarified, and no results have been demonstrated. Therefore, it is questionable for many if the Community can play an effective role in Mali.

There was no consensus between the leaders of the neighboring countries. One of Algeria’s (Diarra, 2012: 17–18) — the region’s political and military great power — ministers stated that the conflict can only be handled by negotiation, and Mali can not be divided since they reasonably feared that if the Tuaregs establish an independent state then Tuaregs living

31 http://www.jamestown.org/uploads/media/TM_010_Issue13.pdf (downloaded: 14 01 2013)

32 If they took the offer seriously from the leaders of MNLA, the international community should accept it since the Tuaregs could be effectively used in the “enemy of my enemy is my friend” principle against their former allies, who would want revenge. The question is what do they want in return and also what is Mali willing to give since the independence of Azawad is out of the question, maybe a limited autonomy could be realized. <http://www.bbc.co.uk/news/world-africa-21009958> (downloaded: 14 01 2013)

33 <http://www.un.org/News/Press/docs/2012/sc10789.doc.htm> (downloaded: 14 01 2013)

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in Algeria will step forward with similar claims.³⁴ In the recent past Algeria closed its border with Mali, so as to prevent the flow of militants and various arms, and thereafter in Operation Serval closed its airspace against French aircraft. Many considered that these steps were necessary, but insufficient, and they urged for an increased role of the region’s leading countries in the conflict. (Boukhars, 2012: 13–17) Burkina Faso was also supportive of the negotiated settlement, also in the region the president Blaise Compaoré is known as the “peacemaker” for his mediation role between the Community of West African States and the various power groups in Mali.³⁵ However Niger clearly supported swift and decisive military action. The country’s foreign minister demanded the immediate abolition of northern Mali’s “terrorist groups” at a conference in Nouakchott organized by the neighboring states and later President Mahamadou Issoufou himself claimed that armed Islamists are being trained by Afghan and Palestinian jihadists. Ivory Coast not only strengthened their borders but also allowed French military units to pass through to move against the extremists. These units launched “Operation Licorne” in September of 2012 from Ivory Coast to help the UN mission.³⁶ Senegal and Ghana, however, strongly rejected any participation in military operations in Mali. (Boukhars, 2012: 18) Finally, after several debates and discussions, the surrounding countries consistently agreed to support the World Organization’s military intervention which aims to restore the integrity of Mali.

Since 2002, the United States has been co-operating with the government on the “Pan Sahel Initiative” and its successor, the Trans Sahara Counter-Terrorism Partnership (TSCTP) anti-terrorism program (Lecocq, Schrijver, 2007: 143–145); (Diarra, 2012: 20) as its most important partner in the region the US hopes to make Mali into an example of African democratization, despite initially expressing concerns regarding the conflict. At this time they did not want to admit that their policies in the Sahel countries have failed, because in all three countries they supported (Mali, Mauritania and Niger), military putsches occurred in recent years. Initially designed military intervention never took place because of the high risk involved.³⁷ Sometime later they joined the Economic Community of West African States-led negotiations, provided substantial humanitarian aid for the refugees, but still argued against military intervention.³⁸ At the same time they provided substantially increased military and training support subsidies for the anti-terrorism fight. Finally, the AQIM and other militant Islamist groups gained strength causing the USA to consider Islamist military groups as global threats instead of regional ones and to take a limited role in the operations against them. In this framework they provided logistics, military reconnaissance and military intelligence data for the surrounding countries, and initiated operations although they have not been willing to send troops.³⁹

After the proclamation of the breakaway Tuareg state the European Union indicated that it does not support any action which leads to a disintegration of Mali, and approved a plan in which they provide training and logistic support within a framework of a limited military

34 According to some information the MNLA has good connections with the opposition Berber party in Algeria which worries many.

35 http://www.jamestown.org/uploads/media/TM_010_Issue13.pdf (downloaded: 14 01 2013)

36 <http://www.guardian.co.uk/world/2013/jan/15/french-troops-triple-mali> (downloaded: 20 01 2013)

37 <http://www.guardian.co.uk/commentisfree/2013/jan/14/france-lonely-intervention-mali> (downloaded: 01 20 2013)

38 <http://www.fas.org/sgp/crs/row/R42664.pdf> (downloaded: 17 01 2013)

39 <http://www.guardian.co.uk/world/2013/jan/15/mali-who-is-doing-what> (downloaded: 01 20 2013)

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operation for the government forces by European soldiers. According to some opinion this mission could begin in February.

As far as the country’s former colonial keeper, France, was concerned, Mali was still in their sphere of interest despite initial hesitation to intervene in the conflict due to the lack of a development of a single solid point of view in the French government.⁴⁰ They were only able to agree that they clearly reject the Tuaregs independence effort and support the unity of Mali. Then, after several months of debate the “hawks” prevailed and persuaded the French president Francois Hollande to launch a limited military operation “Operation Serval” against the Islamist forces. Ban Ki Mun, UN Secretary General, supported this operation from the beginning, and on December 20th 2012 the UN Security Council voted without dissent in the resolution 2085, so it opened the way for the intervention of the French.⁴¹

The French Military Operations⁴²

The Islamists grew bored with the 2012 year-end stalemate and, in January of this year, they launched an armed intervention against the south-west part of Mali. Three militant groups with a total of 1200 armed men occupied Konna and Mopti cities, and posed a threat to the strategically important city of Sévaré.⁴³ The country’s demoralized army was unable to stop their push forward and, as a result, the alarmed government in Bamako called on the former colonial

keeper, France for military intervention, and also declared a state of emergency on January 13th of 2013.⁴⁴

Subsequently, France launched the military operation known as “Operation Serval” on January 11th 2013 to stop the attack, ensure the protection of the capital Bamako city, and to help to restore the country’s unity. The operation, according to the commander Admiral Edouard Guillaud and to French official statements, will only last till the arriving AFISMA

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- 40 They could not agree in regards to the intervention because 8 French hostages are still in the hands of the terrorists, and they were threatened with execution if the military operations were launched. The operation was partly compelled by the fact that 6000 French citizens live in Mali, and in the surrounding Muslim states another 30000 reside. These are the main target for the Islamic extremists. The French government mainly worries about their protection.
- 41 Romano Prodi was appointed by the Secretary as the Special Rapporteur on the Sahara crisis, which indicates that the United Nations would take a major role in consolidating Mali’s region after the military operations. However, there are those who believe that Prodi is not the right choice, as he does not know the Sahel countries, nor does he speak French. This will significantly reduce the efficiency of his work.
<http://www.guardian.co.uk/world/2013/jan/15/mali-france-military-intervention> (downloaded: 20 01 2013)
- 42 The operation day by day can be reached in this page: http://news.silobreaker.com/operation-serval-11_533259771 and also at http://www.armyrecognition.com/serval_opertaion_mali_french_army/index.php link (downloaded: from 12 01 2013 continuously)
- 43 This is the only city beside Bamako which is able to land heavy cargo aircraft, which are required for the effective management of the humanitarian situation in the North, or it could even provide a support operation to compel peace.
- 44 <http://www.sldinfo.com/the-french-serval-operation-the-double-edged-sword-of-the-mali-operation/> (downloaded: 17 01 2013)

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troops will be able to take effective action against the extremists.⁴⁵ The question is what if the Africans fail in Mali, similarly to Burundi and Darfur. Will the French remain in Mali or will they entrust the fate of Mali to the African’s good luck. They will likely remain as it was probably already decided in early January to intervene. The fact made it easier that although they did not have any units in Mali, but in the surrounding states nearly 3,500 soldiers were stationed accordingly to various inter-state agreements. (Besenyő, Hetényi, 2011: 199–208) The first attack against the extremists was launched by the 4th helicopter regiment and was carried out by “SA340 Gazelle” type attack helicopters in Sevan region where an armed military convoy was stopped. In this action the French suffered their first combat loss when Lieutenant Boiteux Damien helicopter pilot lost his life. The next day, several hundred French soldiers took part along with a Malian army unit in the attack against the Islamists who had occupied Konna city a couple of days prior and where they liquidated one of Ansar Dine’s command posts. The news coverage reported falsely that time that the city had been recaptured since the disorganized, poorly equipped and trained Malian army was unable to take advantage of the French air strike’s benefits. The government finally gained control over the city on January 18th. On the same day, French fighter jets bombed Douentza, Lere, Gao and Kidal cities, where they destroyed fighting positions and logistic storage areas (fuel and weapons). In this operation the French used the double-action (laser / GPS) GBU-49 precision bombs for the first time. The helicopters and fighter jets involved in the operation came from the French military base in Chad or Burkina Faso. In the first two days of “Operation Serval” at least 100 people lost their life from the radical group while only a couple of people from the French-Malian units.⁴⁶ The radical groups launched a counterattack toward Bamako and occupied Diabaly city, but due to the increased French air strike they began their retreat not only from the central areas, but they also withdrew from Gao, Kidal and Timbuktu cities. Nevertheless, the French have become more cautious, as they were surprised by the trained Islamists groups, using modern arms, organization and determination.

This caution did not hurt since the different armed groups liked to hide among the civilian population, whom they use as shields during the attacks making it very difficult to differentiate fighters from civilians leading to more civilian deaths during the fights.⁴⁷ Nevertheless, the French advance continued without hindrance, and on January 16th they attacked

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- 45 From the French military force the following units engaged in operations: French Foreign Legion 1st regiment (1er Regiment de Cavalerie étranger), 2nd Marine Regiment (2e Regiment d’Infanterie de Marine), 21st Marine Regiment (21e Regiment d’Infanterie de Marine), 3rd Parachute Regiment (3e Regiment d’Infanterie de Marine de Parachutistes), 92nd mechanized infantry regiment of the French Special Forces (Brigade des Forces spéciales Terre, BFST), and the 4th Special Force Helicopter regiment (4e Regiment d’Helicopteres des Forces spéciales). The planned maximum number of troops will be 2,500. This number, however, on 21st of January increased to 3150, from which 1600 stayed in Mali. In the air strike two Mirage F1 CR and six Mirage 2000 D 4 (Chad), the 1/7^{es} Provence fighter century Rafale fighter aircraft (France), two C135 transport aircraft and several reconnaissance aircraft and combat helicopters century (Tiger EC 665 attack helicopter with) were involved. Read more about the air force: <http://theaviationist.com/2013/01/24/mali-air-war-update/> (downloaded: 24 01 2013) The ongoing operations were led by Brigadier General Bernard Barrera in Mali. The allies estimate approx. 3000 extremists in oppositions, since some of them have already fled to neighboring countries, and also approx. 3000 MNLA militants are not fighting against the French.
- 46 <http://www.bbc.co.uk/news/world-europe-21002918> and <http://www.guardian.co.uk/world/2013/jan/15/mali-france-military-intervention> (downloaded: 20 01 2013)
- 47 <http://www.guardian.co.uk/world/2013/jan/16/french-ground-operations-mali-underway>

and recaptured Markala first and on January 21st Diabaly and Douentza cities.⁴⁸ At the same time the French reached Niono and Sevan towns and continued the air strikes, in which the fleeing Islamist from their position in Kidal lost several of their vehicles. On January 25th the air strikes continued in the area of Asongo and Hombori, and not long after the French– Malian units attacked Gao city. On January 26th, the French special units occupied Gao’s strategically important positions (airport, Wabary bridge) and the entire city was recaptured a few hours later. Meanwhile from Diabaly toward Lere and Timbuktu the French launched a 600 person unit, which the Islamists tried to stop with smaller ambushes. Almost immediately after replacing Gao’s occupying unit with the 21st Marine regiment as their counter- part, they advanced toward Timbuktu, whose extremist occupiers had retreated by January 28th. On the same day, the MNLA militants occupied Kidal, Tessalit and Khalil settlements which had been left to their fate previously by the Ansar Dine militants. The French troops reached their last base Kidal city on the night of January 29th which was occupied without a fight.⁴⁹ After that, the extremists who stayed alive tried to flee into their hiding positions in the desert or tried to flee to the surrounding countries. In the next period if the French and their Allies want to completely liquidate the extremist groups and prevent them from seeping back to Mali after the departure of the French, then possible desert operations need to be prepared where their air and technical advancement prevails less. This is clearly not a very appealing prospect as the French political and military leaders intend to minimize the loss of manpower. Taking the radicals’ fighting experience and equipment into account, this will not be an easy task.

The U.S. took part in the French operation with logistic and intelligence support, with C–17 military transport aircraft operating an air bridge between France and Bamako, and also providing information gathered by satellites and drones. Further military contributions were the U.K. contributing, 2pcs C–17 Globemaster III transport aircraft, trainers and consultants, a special unit and reconnaissance aircrafts, while Canada provided C–17ER Globe- master III military transport aircraft), Germany 2pcs. Transall C–160 transport aircraft, Italy 2 C–130 Hercules and Boeing KC–767, the United Arab Emirates 2pcs C–17 Globemaster III transport aircraft, Spain C–130 Hercules transport aircraft, Belgium C–130 transport aircraft and an Agusta 109 paramedic–rescue helicopter, Sweden C–17 Globemaster III transport aircraft and Denmark C–130J–30 Super Hercules transport aircraft providing logistical support. The French have had multiple negotiations with several other European countries for operational support which they have ultimately not realized.⁵⁰ Interestingly those states – Italy, Spain –, which are major final destinations for drugs and illegal immigrations through Mali, did not participate in the military operations, and respectively, their participation in

48 http://www.expatica.com/fr/news/french-news/two-weeks-of-french-intervention-in-mali_256661.html
(downloaded: 24 01 2013)

49 <http://www.bbc.co.uk/news/world-africa-21256781> (downloaded: 30 01 2013)

50 Unconfirmed information indicates that Hungary offered a maximum 10 person medical team to serve in the operation. The French took notice of it but have not officially requested the units deployment.

support was not substantial.⁵¹

Most of the international community considered it necessary and accepted the military intervention, but a good few of them opposed it, talking about French re–colonization of the country. This is contradicted by the fact that the majority of the population of Mali gladly welcomed the French soldiers, whom they had been waiting for, to help the removal of ~~ARMED~~ ~~extremists~~.⁵² The Muslim world’s reaction was mixed, there are countries that have welcomed the intervention, and have supported it, such as the United Arab Emirates, but many protested against the “crusaders”, and demanded their immediate withdrawal from Mali. On January 16th a group of AQIM occupied the Amenas gas field in Algeria, and took

41 foreign hostages of whom 37 died during this Algerian hostage situation. Although the AQIM leader Mokhtar Belmokhtar stated that the action was a response to the French intervention in Mali, many signs indicated that it was planned before that. Nevertheless, all States involved in the military operations should prepare for possible terrorist attacks. At the Arab Economic Summit in Saudi Arabia on January 21st the Egyptian President Morszi in a strongly worded statement condemned the French intervention, which, according to him, poses threats to the neighboring states. So far these opinions were not able to seriously effect the Server Operation in which the French have been demonstrating considerable professionalism with minimal loss. However the peacemaking process has been traduced by war crimes committed by Malian soldiers who have been executing Islamic extremist without evidence or trial.⁵³

The Operation Launched by the United Nations

In this operation, the African States offered 3,500 soldiers, and financial, logistical and intelligence support is expected from the West (European) states. According to the World Organization's plan, the troops will arrive in September of this year but the international community is applying increased pressure on the African states to start the operations as soon as possible.⁵⁴ The operational leader Nigeria however indicated that even if the African teams arrive prior to Mali, their training and installment would take considerable time, so they would not

51 In my opinion more incorrect beliefs appeared in connection with the operation. One interesting example was Anne Applebaum's recent writing (The world's new super power, <http://fullcomment.nationalpost.com/2013/01/28/anne-applebaum-on-europe-the-worlds-new-superpower/> (downloaded: 29 01 2013)). She writes about Operation Serval as the European superpower's successful military action. However, if we take into account the EU's military and peacekeeping operations up to date, then we can clearly see that a significant part of the European countries have limited ability to participate in any operation. Some places the military capability is there, but the policy makers do not support "expensive foreign adventures," but even more of them are countries who can not afford a long-term foreign military action, not even as part of an alliance. We must clearly state that the operation in Mali is a purely French military operation (the Mali army units are demoralized and their force value is highly questionable, the African soldiers have not been previously involved in live deployment), even with the limited support provided by the U.S. and some European countries. This evidenced is supported by the fact that the French did not ask for NATO support

in any action when it was initiated nor during its progress. The training operation which is to be launched in February by Europeans (EUTM MALI), even if it achieved important goals, will not contribute to the success of the current operations and their results will be visible at a later time.

52 http://hhk.uni-nke.hu/downloads/kozpontok/svkk/Elemzesek/2013/SVKK_Elemzesek_2013_1.pdf and also <http://www.aljazeera.com/indepth/interactive/2013/01/201312113451635182.html> (downloaded: 24 01 2013)

53 http://edition.cnn.com/2013/01/24/world/africa/mali-military-offensive/index.html?hpt=hp_t3 (downloaded: 25 01 2013)

54 <http://www.guardian.co.uk/world/2013/jan/16/mali-guide-to-the-conflict> (downloaded: 20 01 2013)

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be ready for immediate deployment. Some have also questioned the African soldiers' effectiveness in the desert environment, as most come from the entirely different environment of rainforest and savannah, and are less familiar with desert tactics.⁵⁵ We have not yet mentioned that the Islamists are equipped with better weapons than the African units, whose mandate is only for one year. The most highly skilled Nigerians have to realize that not everyone at home supports their role in Mali where the activities of Boko Haram are gaining strength. Because of internal security problems Nigeria may even order its soldiers back, but this could also happen in the case of other African countries. Perhaps this is also the reason why they tried to negotiate with the opposition partners, but at the end they could not avoid the military intervention. On January 18–19th the first 260 African soldiers (Nigeria, Togo and Benin) arrived at Bamako, but they did not participate in the operations. According to the preliminary agreements Chad 2000,⁵⁶ Nigeria 1200,⁵⁷ Togo 540, Niger 1200, Senegal and Burkina Faso 500 each, Benin 300, Guinea 150, Ghana 120 soldiers, were offered to the AFISMA unit established by the Economic Community of West African States. They appointed Major General Shehu Abdulkadir from Nigeria as the mission commander, Brigadier Garbo Yaya from Niger as the deputy and chief Jean Paul Ntab from Senegal as the colonel.

Inspired by the French success on January 19th in Ivory Coast city a meeting was held by the leaders of the West African States,⁵⁸ as well as Chad's President Idriss Deby, the French Foreign Minister Laurent Fabius, the representative of the U.S., the EU, Great Britain, Germany, Spain, Belgium, Burundi, Canada, Egypt, Italy, Libya, Mauritania, Morocco, South Africa, and Tunisia. The participants Côte d'Ivoire, Ghana, Liberia, Senegal and also Sierra Leone agreed to start assembling their troops in Mali.⁵⁹

On January 21st the Economic Community of West African State's spokesman Abdel Fatau Musah announced that the African troops will arrive by January 29th and they will immediately begin to fight against the extremist groups.⁶⁰ In the light of the former African operations, this statement seems a bit hopeful, especially if we consider the deficiency in the qualifications and equipment of the African troops. (Besenyő, 2008: 5–15) This was evidenced by the African Union executive meeting held on January 25th, in which the member states were repeatedly asked to send more troops as soon as possible to AFISMA units. Also the member states requested immediate financial and logistical support from the World Organization for the operation. However, the UN Secretary-General only supported this request if the mission's logistic supply is not provided by the organization rather, in a framework of bilateral agreements with other countries, the U.N. would only take over this activity in the stabilization period after all the military operations concluded. In fact, according to the secre-

55 <http://www.guardian.co.uk/world/2013/jan/16/mali-french-ground-war> (downloaded: 20 01 2013) és http://www.issafrica.org/iss_today.php?ID=1558%2634 (downloaded: 20 01 2013)

With these viewpoints I agree as well, I served as a military advisor in Darfur AMIS (African Union Mission in Sudan) in the peacekeeping mission in 2005 appointed by the European Union, where for the same reasons many soldiers lost their lives to the African troops in local armed groups' clashes.

56 Chad sent a 1200 soldier mechanized artillery regiment and two 400 capita logistics battalions into Mali, but not under African, but French command.

57 <http://www.bbc.co.uk/news/world-africa-21121262> (downloaded: 20 01 2013)

58 Benin, Burkina Faso, Côte d'Ivoire, Ghana, Guinea-Bissau, Liberia, Mali, Nigeria, Niger, Senegal and Sierra Leone

59 <http://www.afriquejet.com/20130120227/Mali-intervention-force-ECOWAS-mobilises-more-troops-logistic-support.html> (downloaded: 20 01

tary-general of the World Organization the organization would be unable to perform its task if their employees became the target of AQIM and other terrorist organizations.⁶¹

In the meantime, the possibility was raised that the Chad and Niger units gathering in Niger could open another front in the back of the extremist group, but this failed when they destroyed the key bridge for the possible operation next to Tassiga which would have given easy access to Gao city for the Africans. The Chad and Niger units only arrived after the capture of the city, and they took over its supervision. On January 29th the Chads occupied Menaka, while the Nigers Ansongo cities which are used as bases for further operations. The leaders of the Economic Community on 28 of January approved the increase of the number of per capita to 5700 to which Chad provided an additional 2,000 troops. The western states on January 29th in a donor conference held in Adis Abbaba offered \$455 million to support the operation of AFISMA.⁶² Of this amount they intended to finance the rebuilding, training, and installment of the Malian army.

According to the African Union, this amount will not be sufficient to operate AFISMA, with an estimated cost of about USD 950 million.⁶³ Will the international community pay for this, will the Africans be able to take this mission to completion and stabilize the region? We will only be able to see this after the withdrawal of French troops.

Organized by the European Union Training Mission⁶⁴

In the EU meeting in 2012 mid-October, the representatives of the 27 member states voted to support Mali's territorial integrity and the restoration of the democratic governance and rule of law. Therefore, the initiation of a training mission has been approved. On January 17th

2013, the meeting held by foreign ministers of the European countries endorsed the mission launch in Mali, and promised support for the African-led operation. With a budget of 12.3 million Euros planned for 15 months, the mission commander will be the French Brigadier General Francois Lecointre, who conducted a field pre-assessment on January 20th and 23rd in Mali to learn about the necessary conditions to initiate the mission. According to the plan 250 trainers, 200 soldiers responsible for logistics, guarding and protection get a role in the EU's new mission.⁶⁵ The mission's command will be in Bamako, but the training activities will be conducted in other areas of the country. The EU will pay only the costs of the operation, while the nations will provide the equipment, salaries and the travelling expenses of the troops sent there. Hungary has declared at a forum that although Africa does not belong to its closer sphere of interest, it will send 10 military trainees into the operation (6 snipers, 3 medics and a staff officer).⁶⁶

61 <http://www.trust.org/alertnet/news/un-chief-warns-against-un-logistical-support-for-mali-war/> (downloaded: 24 01 2013)

62 <http://summits.au.int/en/20thsummit/events/donors-conference-mali> (downloaded: 30 01 2013)

63 <http://www.bbc.co.uk/news/world-africa-21256781> (downloaded: 30 01 2013)

64 The operation by day can be reached in this page: http://news.silobreaker.com/eutm-11_98654715

65 http://eeas.europa.eu/csdp/missions_operations/eutm-mali/final_factsheet_eutm_mali_en.pdf (downloaded: 26 01 2013)

66 <http://www.sldinfo.com/the-french-serval-operation-the-double-edged-sword-of-the-mali-operation/> (downloaded: 20 01 2013)

Conclusion

The question is not whether the military operation will be successful but how the winners will want to consolidate and rebuild the Northern areas of Mali. In fact, the country leadership must understand that the previous violent, discriminative methods can not "modernize" the Tuareg society, because it always leads to a conflicted situation. The historical experience of the Tuaregs understandably rejects the government authorities, and distrusts their activities. This is why the government needs to find a new approach to the northern region—and the Tuaregs in it—and its remedy for their problems, and also a constructive dialogue with them. This may include granting them limited autonomy, or the transformation of government structure to a functional federal state in which the ethnic groups would have greater autonomy and political representation. This would require a reliable, stable functioning government in Bamako that supports all segments of the society. If this will not be realized then in that case Mali should prepare in advance for the next and subsequent Tuareg uprisings.

After the reconstruction of the country, regional cooperation also needs to be improved between countries, in which the international community needs to take an active part. They need to eradicate the weapon and drug smuggling in the area and create programs for nomads which will replace their income from these activities. They need to establish and effectively implement a country-wide disarmament, demobilization and reintegration program in which they disarm the

various armed groups with special attention paid to the question of child soldiers recruited by the Islamic extremist. At the same time they need to pursue the training and equipping of the Sahel countries' forces, so they will be able to effectively take action against the smugglers and the Islamic extremists. The armed forces should be kept away from politics and used only for military use, border patrol and other professional activities.

Also, it raises the question, what will happen with the Islamists who have fled; where else will they "exploit" their military experience gained in Mali? In how much time will they be able to reorganize their groups to cause problems in other West African countries, where the West has significant political and economic interests? When will they be able to carry out terrorist acts, in either France or in other European countries that are involved in the operations, as they previously have threatened?⁶⁷ Considering the previous years events, unfortunately the western world must be prepared for these events.

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International collaborative military mapping programs' implementation and development opportunities in Hungary

NYERGES János¹, KULCSÁR Gábor²

The two most important military mapping projects in Hungary are the Multinational Geospatial Co-production Program (MGCP) and the SAAB JAS 39 Gripen aircraft support, with digital mapping system.

29 countries joined the largest mapping program, called the MGCP to create up-to-date, 50k scale, high density 1°x1° cells for a geospatial database to cover the majority of the global landmass. Hungary has been a participant since December

2005, and contracted 28+1 data cells for completion by 2013.

Under the terms of the Gripen lease-purchase agreement, Hungary has to provide basic data for the aircraft on-board system which requires continuous database maintenance for both surface and obstacle databases. Another task is to maintain the Digital Map Generating System (DMGS).

Keywords: Multinational Geospatial Co-production Program (MGCP), SAAB JAS 39 Gripen (Gripen), Digital Map Generating System (DMGS);

Since 2001, the Ministry of Defense (MoD) Zrínyi Mapping and Communication Servicing Non-profit Limited Company (MoD Mapping Company) perform the geoinformatics tasks (supply and produce) of the MoD. The tasks are monitored and controlled by the Geoinformation Service (GEOS) of the Hungarian Defense Forces (HDF).

Tasks for a year are mainly the responsibility of the GEOS HDF. State-finance is a crucial aspect, which fundamentally determines the amount of tasks that can be performed.

The company has 2 main mapping projects:

1. Multinational Geospatial Co-production Program (MGCP)
2. SAAB JAS 39 Gripen aircraft support with Digital Map Generating System (DMGS)

Multinational Geospatial Co-production Program

History

Hungary and Hungarian cartography (together with other nations) have the possibility of participating in the world's largest mapping project, and of contributing to practical applications. The geospatial database is based on international standards.

The basic concept of the MGCP program was built in the late 80's, when the U. S. Defense Mapping Service, now known as U.S. National Geospatial Intelligence Agency (NGA), proposed to create a high-resolution digital database covering all of the continents.

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In April 2003, in Vancouver, at the conference of national mapping services, the NGA initiated the launch of the Multinational Geospatial Co-production Program (MGCP)

There are 29 nations participating in the program. The program is managed by the NGA, cooperating with the Leading Nations (nations contracted for more than 200 cells). They are responsible for the implementation and coordination of regional cooperation and assistance to participating nations. The leading nations are: Australia, Canada, Denmark, France, Germany, Italy, Norway, Spain, Sweden, United Kingdom, and the USA.

The geospatial database consists of 1°x1° degree cells. The cells must be produced from remote sensing source data (not older than 3 years); all costs must be covered by the producing nation.

The aim of the program

The program aims to create a modern, up-to-date digital geospatial database which can cope with 21st century challenges. The program will set up global 1:50 000 and 1:100 000 scales (equal data density with the topographic maps) geospatial databases with modern data content in 1°x1° degree cells.

As a result, every participating country has the rights to access a geospatial warehouse, called the International Geospatial Warehouse (IGW), where all the nations' cells are stored. All the cells are homogeneous in data and based on

international standards.

Implementation Process

For the 1st phase there was a 1+5 year time frame (between 2006 and 2011) for data producing (the first year for the test cell, and five more years for the additional cells), but based on the nation's common decision they extended this timeframe by two more years. By the end of the decade, the first military needs database will be ready.

The criteria for access data in IGW is to have (at least) five finished, Quality Controlled (QC) and uploaded 1°x1° cells.

Hungary's participation

Hungary joined the program in December, 2005 by undertaking 28+1 cells.

The following procedure is used for preparation and uploading:

- GEOS HDF is responsible for realization of the program;
- MoD Mapping Company, Digital Cartography Dept. is responsible for the technical implementation.

After finishing and uploading the 28+1 cells, Hungary has the rights to download 113 cells from IGW. This would be enough to download e.g. all Afghanistan's cells.

In 2012 the chairman of MGCP TG called upon Hungary to be the custodian of one of the technical documents. This document is part of the QC process.

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The status of implementation

The professional resources are available at the MoD Mapping Company.

Since January 2013 Hungary has finished 23+1 cells of the 28+1.

Location	Contracted	Accepted	Waiting for acceptance	In production	Waiting for data capture	Reserved for Phase 2	Planned for Phase 2
Test cell	1	1					
Europe	9	9					
Africa	19	13	1	1	4	5	18
Total	29	23	1	1	4	5	18

Chart 1. MGCP status in Hungary 2013

Unfortunately, in autumn 2008 the economic crisis was still reflected in the financing of mapping tasks. In 2009 the lack of raised funds caused the failure of the original plan (one cell was not finished). In 2010 the program was entirely removed from the budget of MoD. After that, the programs were restarted in Hungary.

In this financial crisis the MoD Mapping Company tried to minimize the costs of the Program. By reorganizing the internal resources they put the QC in-house at the last two African cells.

In 2011 MoD Mapping Company started an In-house production. After substantial preparation 6 operators have been trained. Now only two, but experienced, operators are working on data capture.

Based on the last 2 years, the funding of the programs is balanced now. The Ministry sees the project's crucial role, so every year warrants the necessary financing.

Since only two companies are involved in the program (GEOS HDF and MoD Mapping Company) the workflow has sped up. The two operators are able to finish four cells per year, and the active participation on the technical meetings results in a smooth international acceptance process and high data quality.

SAAB JAS 39 Gripen aircraft support with digital mapping system

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Under the terms of the Gripen lease-purchase agreement, Hungary has to provide basic data for the aircraft on-board system which requires continuous database maintenance for both surface and obstacle databases. Another task is to maintain the Digital Map Generating System (DMGS).

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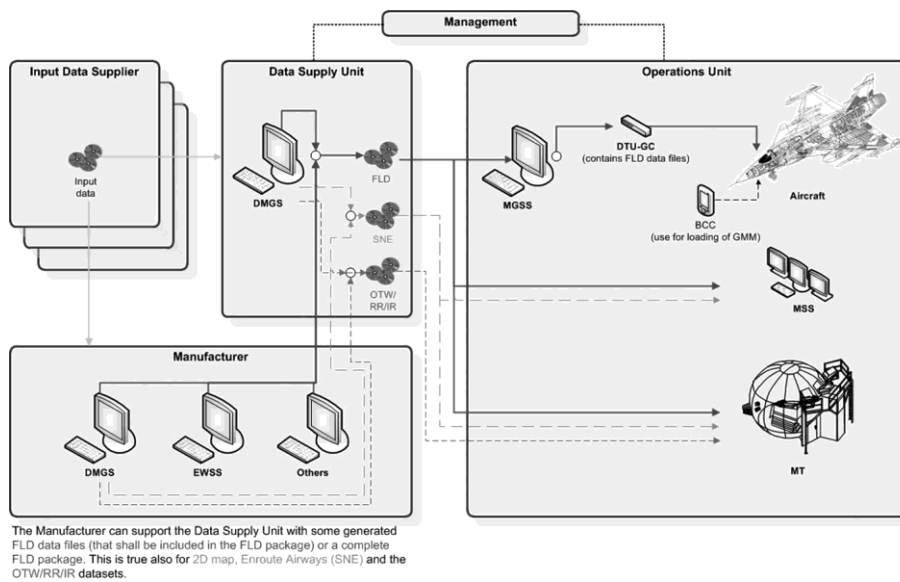


Figure 1. A functional overview of the geographical and aeronautical data supply process for the Gripen materiel system, including organizations, tools, materiel system components and data deliveries (yellow lines = input data files, blue lines = FLD files or FLD package, green lines = SNE datasets (e.g. 2D map and Enroute Airways), red lines = OTW/RR/IR datasets)³

Beginnings

In 2001 the Swedish and Hungarian governments entered into a lease–purchase agreement, with a further modification in 2003 that included 14 Gripen C/D (12 single–seater and 2 two–seater aircraft). All aircraft were delivered in 2006 and 2007, and all 14 aircraft were in operation with the Hungarian Air Force by the end of 2008.

As the first step of the Hungarian Defence Forces Network–based warfare capability, at the time of Gripen aircraft acquisition, the relationship elements between the aircraft and the air command & control system had to be established. It has to develop the mapping and GIS systems as well as the similar elements for the air command & control system. The Swedish partner provided the necessary courses for the GIS professionals. The first courses were held in Sweden between 2004 and 2005.

During 2005 and 2006, the first ten Hungarian pilots also concluded their training. To date a total of 22 pilots have completed their training. The training of technicians and ground crews was completed in March 2007.

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Applied databases

As the starting databases DTA50 (1:50.000 data density), DTA 200 (1:200 000) DTA 1000 (1:1 000 000) digital topographic databases were provided. Besides the topographical data- bases ortho imagery (over special areas of interest), Landsat satellite images (over the whole country) have been used as background information.

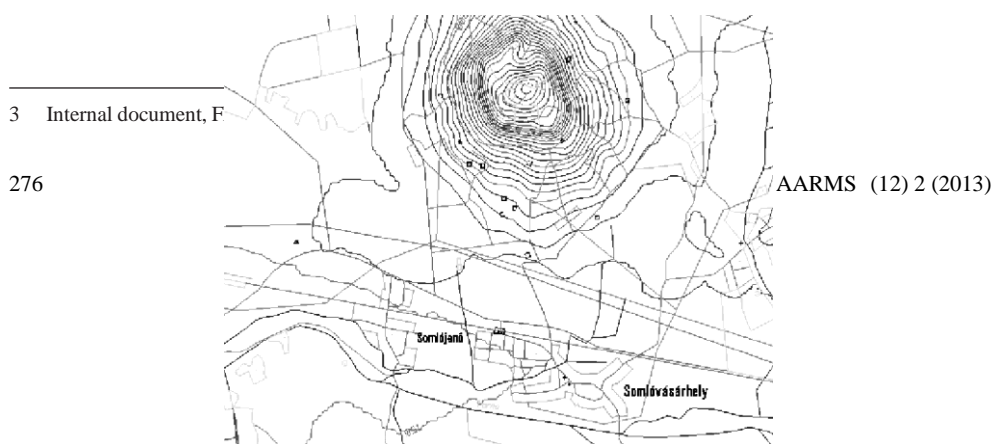


Figure 2. DTA 50⁴

The Digital Obstruction Database from a 60 m height (which based on geodetic survey) has been used and was last updated in 2008, and as a special safety requirement, a 25 m obstacle database has been surveyed for the airfields.

Digital Map Generating System

The Digital Map Generating System (DMGS) provides the aircraft, as well as the support systems and training simulators, with correlated geographical data. The DMGS imports various geographical source data formats into a single common database, from which data is selected and refined to enable export of the desired output format. (Saab AB, 2013)

The first DMGS system (version 2.3) was installed in 2006. Then 2.6.1's followed, then 3.2, and then the still used 3.4 version, which runs on a Windows server environment.

The databases are updated annually, with the exception of the airspace structure database, which immediately follows the changes.

The Software Development Plan (SDP) defines development and management of the Field Loadable Data (FLD) for the Gripen materiel system. The SDP is provided by the Swedish Defence Materiel Administration and it is intended for use in the Hungarian Air Force. At this time there is no responsible organisation for it, the FLD is produced and verified according to the instructions in the SDP. Without a verified process, the FLD cannot be used.

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Future of the Gripen aircraft support with digital mapping system

Hende Csaba, Minister of Defence, announced on 2012 November 13th that Hungarian Gripens will perform air policing over Slovenia and the Baltic States under the terms of a NATO agreement.

The Minister said that Hungary's Gripens are to guard Slovenia's airspace soon, while they are expected to participate in Baltic Air Policing between 2015 and 2018.

Slovenia, like Estonia, Lithuania and Latvia, does not have its own air policing capabilities, so other NATO-member states take turns in providing air policing. This is the first time that Hungary and its Gripens will protect and monitor the skies over Slovenia and the Baltic States.

The current contract with the Swedish government was due to expire in 2016, but the countries have now decided to extend the partnership by another ten years.

The most important task for the Gripen support would be to define the responsibility levels between the concerned organizations.

Summary of a possible future of the Multinational Geospatial Co-production Program

In order to achieve common goals, the MGCP program is an excellent example of cooperation between nations with the consolidation of resources which results in an outcome for all participants with multiple returns.

Hungary and Hungarian cartography (with other nations) have the possibility to participate in the world's largest mapping project, and contribute to practical applications.

The first phase will be finished by the end of 2013. From 2014 we will be able to start the second phase. The aim is to upload 51 cells and to be able to access more than 300 cells from the warehouse.

The most important benefit is the program's aim itself: the ability to give geospatial support to the military missions with the most up-to-date databases. In case of any foreign missions for soldiers e.g.: in Mali or Afghanistan, they will be able to download geospatial database or even up-to-date paper maps over the area. This is why the Program was established. On the other hand the Hungarian military's Geographic Information System (GIS) experts acquire experience in how to create/upload/maintain a worldwide geospatial database. This information can be useful for any national database. The participants establish international relationships in leadership and technical experience as well. Moreover, its technical assistance already exists among the nations.

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MGCP software technology can be used in other projects. For example the special data checking software, called Geospatial Analysis Integrity Tool (GAIT), is a free software (for military purposes) and has a wide variety of checks which are able to shorten the Quality Control process time.

Conclusion

As soon as the SDP is well defined, they will be able to produce verified databases not only for the Hungarian Air Force but for the Thai and Czech Air Force as well, since they have not got the DMGS.

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In our opinion, it would be worthwhile to expand the MGCP work in-house, increasing the number of operators, and thus be able to produce at least 12 cells in a year. The more cells produced means the more the contributor can access from the international warehouse. The first planned 28+1 cells are easily obtainable, and for 51 cells it only needs to continue for a few more years. The knowledge is there, just waiting for the necessary decision.

Appendix A: Definitions, Terms and Acronyms

BAR	Bar Code Computer.
DMGS	Digital Map Generating System
DTA	Digital Topographic Database
DTU–GC	Used for transferring FLD files to the aircraft. ESRI Environmental Systems Research Institute EWSS Electronic Warfare Support System
FLD	Field Loadable Data
GAIT	Geospatial Analysis and Integrity Tool
GEOS HDF	Geoinformation Service of the Hungarian Defense Forces
GIS	Geographical Information System
GMM	Gripen Moving Map
HDF	Hungarian Defense Forces
IGW	International Geospatial Warehouse
IR	Infrared Image
MGCP	Multinational Geospatial Co–production Program
MGCP TG	Multinational Geospatial Co–production Program Technical Group
MGSS	Maintenance Ground Support System
MOD	Ministry of Defense MSS Mission Support
System MT	Mission Trainer
NATO	North Atlantic Treaty Organization
NGA	National Geospatial Intelligence Agency
OTW	Out the Window database, simulation environment in the mission trainer system
RR	Radar image dataset
SDP	Software Development Plan
SNE	Synthetic Natural Environment dataset
QC	Quality Control

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Historical aspects of the Catholic Church's role in the police forces in Hungary¹

SZABÓ Csaba²

This study presents the police forces in Hungary during the Austro–Hungarian Empire, complete with an analysis of the period between the two world wars. The presentation of organization and structure aims to introduce and analyze the system of relations mainly between the Catholic Church and the police forces. As to the author's research on local history, when comparing the gendarmerie (in Hungarian "Csendőrség") and the town police, the study primarily focuses on the police forces of the Royal Town of Sopron and the Royal County of Sopron.

The goal is to prove that pastoral care, established through the cooperation between the institutions of pastoral care and the armed forces, was operating within an effective framework during the period encompassing the two world wars.

Systems of relationships in the police of the town of Sopron

Police administration has a social purpose of maintaining security and public order. The state is expected to set out criteria based on democratic factors laid down in the laws and implementation instructions. Implementing these criteria in a due manner ensures the protection of the collective values of the society and the lives, possessions and dignity of individuals against illegal practices. (Finszter, 2011: 5)

A properly designed policing strategy is capable of achieving the implementation of policing objectives by which it becomes possible to strengthen public security. The effectiveness of policing establishments can be measured with adequate efficiency in two different ways. In the one case, the crime, public order preservation and traffic safety statistics show the effectiveness of policing. In this way we get a picture of the number of offenses detected in criminally infected areas, as well of the development of road traffic accidents. In the other case, the people's subjective sense of security can be picked as a subject of analysis. Local security is a priority issue that greatly affects people's subjective sense of security. (Katona,

2008: 27) Assessing the effectiveness of police work in most cases is determined by the quality and quantity of contacts between individuals and police officers taking action.

People working in the enlisted staff of police forces and national security agencies, when taking action, as well as when building their social and individual relations, in most cases are confronted with emotional and moral problems affecting the individual behavior to a greater or lesser extent. A sufficient degree of processing these problems of emotional and moral origin in the organisational unit's structure is not provided for. The experience of the past

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few years has shown that not only soldiers, (Ujházi, 2012: 295–313) but also police officers and the staff of national security agencies and other organizations implementing policing activities, live and work in particular circumstances which need the emerging problems of an emotional origin to be addressed accordingly.

The Compromise took place in the spring of 1867 and organised the Habsburg Empire on the basis of dualism. The empire consisted of two countries with parliamentary systems: Austria and Hungary. In addition to a single monarch, the two states were linked by foreign affairs, defense, treasury and a customs union. (Unger, Szabolcs, 1973: 211) After the Compromise, the management and execution system of Hungarian law enforcement wanted to be fully rid of the organizational structure it had been forced to have by the Austrian Empire. The main objective was to restore the situation as it was in 1848. After the rearrangement of policing, which followed the Compromise, the Hungarian Royal law enforcement agencies consisted of Hungarian (town) police establishments, the Royal Hungarian Gendarmerie, the Royal Hungarian Excise and the customs agencies, the bodyguard units, the Hungarian Royal Crown Guard and the House of Representatives Guard, as well the correctional facilities. (Parádi, 1995: 52)

The Hungarian police establishments were split into state and municipal (town) police establishments. Assurance of public order was practiced by the state and local governments.

The Sopron Town Police Captaincy began its operation on April 3, 1861, but until 1866, despite repeated protests from the town, the "Polizeidirection", as a state law enforcement authority, was also operating within the municipality.³

The Town Police Captaincy ceased operation in 1872, its functions, powers and jurisdiction to maintain order in the area was taken over by the municipality police. Its tasks can be defined as follows: residence qualifications, industry affairs, labour books, apprentice contracts, recruitment, maintaining order, issuing fugitive warrants.⁴ The panel was headed by a captain, who had been appointed by the local government through tenders. The captain directed the subordinated bodies through the police administration office.⁵ The town government exercised full control over the police, so, through vacancy announcements and financing, numerous tasks from subsidizing, purchase and replacement of uniforms and weaponry, disbursing loans up to retirement were concentrated in one management body. The town leadership paid great attention to education and raising the cultural level of the enlisted police personnel. Clear references to the development and maintenance of the relations between the leadership and enlisted personnel of the Town Captaincy and the Catholic Church can be found in the mayor's 1907 year report. (Töpler, 1908: 32)

The town leadership made efforts to establish a small scale library for the enlisted police staff. In the absence of library funds, the library was completed from donations and offerings. (Töpler, 1908: 33) One of these donators was Páder Rezső, the provost of the chapter named after St. George the martyr. He had donated a large number of religious and literary themed books for the enlisted police staff.⁶

3 Sopron can be found near the western border of Hungary, at the foot of the Alps, 60 km from Vienna and 220 km from Budapest. http://portal.sopron.hu/Sopron/portal/front_show?contentId=1558 (downloaded: 16 03 2013)

4 Sopron Town Council documents, IV. B 1403 Index Books: 1861, 1920, 1921.

5 Such corporate bodies were administrative, criminal, guard and law enforcement bodies, and, as auxiliary facilities, detention facilities, audit offices, utility offices, servant personnel, and, for some towns, agriculture and night guards, somewhere even the firemen associations.

6 In the period between 1902 and 1916, Páder Rezső, a Roman Catholic Provost was a vicar of the chapter in the St. George parish in Sopron.

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The mayor's records and report clearly show that the Catholic Church was providing support to the town police not in an organisational form but based upon individual initiative.

Presenting religious duties of the policing establishments in Sopron County

From 1881 until 1946, the Royal Hungarian Gendarmerie operated in the area of the Kingdom of Hungary, Transylvania and Croatia. The Gendarmerie, unlike the town police, mainly carried out the public security duties of law enforcement in rural Hungary. In personnel, advancement and disciplinary matters, the Gendarmerie reported to the Ministry of Defence while in respect to administrative and police service it was under the control of the Ministry of the Interior. (Csizmadia, 1976: 192–193)

In 1925, one Gendarmerie Division Command operated in the area of Sopron County having its headquarters in Sopron, under which there were two wing headquarters, five squadron headquarters and twenty post headquarters.

The evaluation of the public security situation in 1925 and the efficient operation of the gendarmerie are presented in the following quote.

“As concerns the restoration of public security, the fullest appreciation is deserved by the Gendarmerie's operation, which already completely relies on peace and is a model-like institution in respect to both discipline and reliability.” (Gévay–Wolf, 1926: 38–39)

In addition to their public security service, the main task of the Gendarmerie operating in the county was to prevent smuggling and to control the border. In the years after World War I, after the normalization of the public security situation, it was the first time a shortage of gendarme was experienced. This shortage was mainly due to the outbreak of the World War II and the First Vienna Award (1938), as many gendarmes were deployed to Upper Hungary (Felvidék) and Subcarpathia (Kárpátalja) in order to restore public security. (Czillinger, 1941: 44)

The ministries that directed the Gendarmerie, in the period between the two World Wars sought to manage the emotional, mental and physical burdens of the gendarmes, implementing this through prescribing education, sport activity and spiritual exercise.

When studying the available documents, it becomes apparent that the Gendarmerie's service regulations and thus their moral mentality was permeated by Christian and religious affection. ~~an~~ ~~arms~~ ~~of~~ ~~the~~ ~~police~~ ~~through~~ ~~worship~~, Church, care for spiritual salvation, conscience and prayer.

To provide an orderly and disciplined gendarme service, knowledge of, and adherence to, moral and religious values was essential. Communication with people, professional execution of instructions, providing legality of actions and showing an example of respect for private life – are activities where religious values are always kept in mind.

The books and records available also show how important it was for the implementation of gendarme services that religious duties be exercised. In addition to professional and vocational problems, gendarmes were provided support in solving moral and emotional problems as well. All this is sufficiently proved in the pocketbook “A csendőr vallási kötelességeiről szóló” (“About religious duties of a gendarme”) officially distributed by the Ministry of Defence. (Endrődy, 1902)

The section on religiosity determines the Gendarmerie to be a strong bulwark of the state and the Church. In the given period, the Church's influence on the gendarme was not only in

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terms of human conduct, in displaying moral and religious values, but as a law enforcement agency, which also functioned to support the Church. This was how the relationship between the Church and the law enforcement was solidified. Religion appears as a solid base for the gendarme, protecting him from mental and bodily influences.

“This sure foundation can be no other than the faith and religiosity.” (Endrődy, 1902: 76)

Without religiosity there is no trust and reverence. Religion is the basis and support for, and developer of, the state and social life, virtue and morality.

“If anyone should be religious, most of all a gendarme should be this”. (Endrődy, 1902: 78) A gendarme, similarly to a modern policeman, had a number of problems to contend with. He had to comply precisely with orders and instructions and meet his duties as set out in legislation, also he needed to choose the right social circle and friends, as well as continue

a moral and sober lifestyle, setting an example to follow for law-abiding citizens.

“Religion encourages a gendarme to faithfully fulfill his duties even when in greatest danger; religion binds the heart of a gendarme to remain true to his oath and the cause he serves; religion blesses all noble actions of the gendarme and sanctifies his grave.” (Endrődy, 1902: 79) The above lines describe all the essential qualities of policemen that help in

executing their tasks and show them the way in situations that sometime seem hopeless. In the performance of duties the lawfulness and the humane attitude shall be strived for.

The second part of the section on religiosity is about the importance of faith and prayer.

“The unbeliever does not listen to the voice of conscience; has no virtue, no morality, which would exhort and ennoble his apathetic mood; piling sin on sin he finally becomes a burden to himself – and commits suicide.” (Endrődy, 1902: 81)

Unfortunately, people in despair intentionally take their own lives. They cannot or do not want to face the tasks and problems waiting for them. A suicide can be avoided through co-ordinating desires and needs, thereby creating an emotional balance. (Buda, 2001: 15) There are certain jobs and occupations (e.g., policeman, fireman, doctor, paramedic, soldier, nurse, clergy) where the performance of work tasks is associated with increased mental and physical strain. In most cases, they help people in trouble. Whereas, emotional problems emerging during help-rendering activities can cause internal stress or emotional trauma, to try to manage these alone and cope with hopelessness alone, may lead the individual to try to escape through suicide.⁷ At the same time, solutions offer themselves even for the most hopeless problems. In this case, faith and pastoral care can contribute to alleviating the tension of the soul, thereby saving lives.

“Avoid the company of non-believers because bad company ruins good morals.” (Endrődy, 1902: 84)

Already more than a hundred years ago, the gendarmes' attention was called to the danger of developing improper social relationships. Virtue and morality — these two concepts defined the Gendarmerie's motto, by making the gendarmes, during their service, recognize criminal lifestyles, and, in all circumstances, seek to bring these people to justice. Nowadays, instead of morality and virtue, we focus on the concepts of blamelessness, honesty, integrity and being corruption-free.⁸

7 Such problems of emotional origin include: partner relationship conflicts (divorce, child custody), issues of financial origin, loss of a job, brushes with the law, problems at workplace (conflict with colleagues and/or a boss), death of a close relative, serious illness, mental disorders, depression, alcohol and/or drug use.

8 Presentation of the National Defense Service. <https://intra.police.hu/nvsz> (downloaded: 13 01 2013)

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Under the Fundamental Law of Hungary every person shall be entitled to the free exercise of their religion. (Magyar Közlöny, 2011: 10661) During the period of off-duty time, the police members have the opportunity to attend worship services. However, this was not always the case.

“[...] All holidays and Sundays, whenever service allows it, with a humble and eager heart hurry to participate in worship. Not only on the days when the routine order allows, but whenever only you can.” (Endrődy, 1902: 87)

The manifestation of a Christian attitude and outlook on life have become apparent even to civilians as they could see gendarmes, dressed in uniform, participate in a church service. AARMS (12) 2 (2013)

The following lines can be read in the memoirs of Bajcsi Károly, retired gendarme captain. *“In Táta, every Sunday we went together; that is, in a troop, to the Church located on the Calvary hill for a church service, that is, to listen to the Mass where the gendarmes assisted the priest.”* (Bajcsi, s.l.)

The participation in worship appeared in the Gendarmerie's life as an opportunity, recommendation and expectation.

The section on religiosity describes the power of prayer and its role in the Gendarmerie's life.

“If someone needs prayer, certainly it is a gendarme; it gives him courage in danger and, drop by drop, adds patience to his heart in the various vicissitudes of life, it gives him strength to discharge his duty.” (Endrődy, 1902: 90)

True religious life can be found not in the postulates of faith and not in church institutions, neither in ordinances, but in your prayers. *“All the devoutness of a gracious soul manifests in the words of prayer.”* (Borbély, 1977: 17) Through prayer, peace and devotion fill the hearts and the entire being of man. As a result of prayer, the mind is purified and, in unity with the happiness of the soul, wins strength and encouragement from God to overcome emerging problems.

The positive expression of Christian moral conduct by Hungarian gendarmes is sufficiently reflected by the action by which members of the Royal Hungarian Gendarmerie, with the assistance of Raoul Wallenberg, Embassy counselor and under the protection of the Swedish Embassy, saved lives of thousands of Jewish refugees through defeating attacks of members of the Arrow Cross Party and, in this way, preventing their intended deportation. (Szalay, 2002: 151)

Conclusions

Using and analysing historical examples, and the documents from the end of the 19th century and the beginning of the 20th century, subscribed by the municipality of the Royal Town of Sopron, we have highlighted the system of connections between the contemporary town police and religion and the Church. Reviewing the documents revealed that the town leadership sought to provide professional training and teaching of religious and moral standards to the enlisted police staff by creating a library. We cannot find clear references in the municipal reports and registry books as to what kind of relationships the enlisted police staff was fostering with churches, but it could be clearly seen that the local government was seeking to build church relations.

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Faith, religion, pastoral care and participation in worship were fully integrated into the life of the Gendarmerie. Routine orders, teaching aids and statutory references discuss the aspiration for Christian, religious and moral behavior for the enlisted staff of the Gendarmerie.

Finale

The present study sought to answer in what form religion, faith and pastoral care had been present in law enforcement agencies and policing establishments in the last centuries, with specially focus on the territorial units in the Royal County of Sopron. The research was divided into two parts. First of all, documentary materials on the police of the Royal Town of Sopron, and the mayor's reports found in the Archives of Sopron were the subject of the investigation. Secondly, the documents and sub-prefect's reports concerning the Gendarmerie unit located in the Royal County of Sopron were studied.

It appears from the documents found that the leadership of the Royal Town of Sopron sought to provide professional and cultural development for the police personnel, but the religious and pastoral care was not implemented in an organized manner. As concerns the Gendarmerie serving in the Royal County of Sopron, we found significantly more complex systems of religious and ecclesiastic relationships. The Ministry of Defense, as one of the central governing bodies of the Gendarmerie, purposefully sought to create religion and faith links to Churches. This effort was primarily directed at issuing publications aimed at moral education and ensuring organised participation in worship.

Through amending domestic and international bilateral agreements a possibility can be created to establish the police pastoral service, which would provide efficient support for manageability of spiritual and moral problems policemen are being faced with.

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The AD–AHP planner: Incremental path planning for robots incorporating decision theory

KOMLÓSI István¹

Path planning for mobile robots in dynamic environments with many objectives to regard at once is challenging and often impossible. However recent outdoor robotic applications encounter many situations when such an approach is needed. This paper presents a path planning method for mobile robots that incorporates decision theory to guide the search. The method is able to handle an arbitrary number of objectives at the same time and also enables the incorporation of human logic into the planning process. All parts of the algorithm suit real-time implementation.

Introduction

Recent developments in field robotics and autonomous vehicles have raised the demand for advanced and intelligent navigation systems capable of planning safe and dynamically feasible trajectories while minimizing objectives like path length, energy cost and trip time. In a dynamic environment the relevance of the objectives and their relation to each other can also change rapidly, i.e. if the robot has limited time to reach its goal destination minimizing the total trip time has higher priority over energy consumption until changes in the environment like a sudden blockade on its previously planned path forces the robot to choose a more energy efficient yet more time consuming path.

In the case of unmanned ground vehicles, when passing through rugged terrain the robot can be exposed to risk. Consider a planetary rover with limited battery charge and limited time to reach its destination. The robot has to navigate through a canyon where the solar cells cannot recharge the robot's battery efficiently. At the same time the robot is exposed to the risk of turning over on the rocky surface or getting trapped due to falling rocks. The robot's navigation system has to be capable of planning an energy efficient but safe path avoiding dangerous areas while incorporating the risk of getting trapped within the canyon. In the case of the Mars rovers such an operation could result in losing the robot.

Robots applied in military operations can also be exposed to significant risk. Consider a military robot that has a rescue mission. It has limited time to reach its destination and also a limited battery charge that it must not consume before it reaches the goal state. Between the robot's current state and the goal destination lies a mine field. The robot's navigation system has to be capable of planning a safe path while continuously evaluating the risk of damage when passing through the mine field.

Robots often have to navigate in dynamic and cluttered environments with imperfect information on the terrain. Efficient replanning of the path is needed since a previously planned

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path can be invalidated by obstacles like falling rocks, or due to imperfect map information when new sensory information received show previously low risk areas to be high risk areas.

Optimizing many objectives at once is challenging. The robot’s path planning problem results in minimizing a dynamically changing multi–cost function. Minimizing such a cost function can be time consuming and computationally cumbersome. Also the robot has to perform this operation frequently when replanning is needed. Instead of finding the minimum of such a cost, function decision theory has to be incorporated into the path planning process.

We propose a modified version of the widely used D* algorithm, where determining the focus of the search is performed using the Analytic Hierarchy Process (AHP) method.

This paper is organized as follows. In the next section the AHP method is discussed followed by a short overview on incremental planners for robots. After that we introduce the AD–AHP method that incorporates decision making into the incremental planner. After the simulation results the conclusion ends the study.

The Analytic Hierarchy Process

The Analytic Hierarchy Process introduced in the relevant documents (Saaty, 1980), (Saaty, 1988) is an efficient method for multi–criteria decision making. Given a set of alternatives and a set of criteria AHP selects the best alternative. The AHP method has been used in machine learning for artificial intelligence applications (Kong, Liu, 2005), also it proved to be useful in military engineering for selecting optimal military equipment (Gyarmati, Kende, Felházi, 2009), (Gyarmati, 2006), (Kavas, 2009). The study (Fallahi, Leung, Chandana, 2009) introduces a method where the Fuzzy–AHP was used along with the Ant Colony Optimization path planner for selecting an appropriate UAV for a mission. Another application has shown AHP to be useful in disaster management (Mali, Rao, Mantha, 2013) where finding the best route in an emergency case was carried out by Dijkstra’s algorithm on a graph where the arc costs were determined by AHP. The study (Vaidyaa, Kumarb, 2006) gives a general overview on recent AHP applications.

As given in the decision matrix below, the decision system has M alternatives and N criteria. The entries of the decision matrix are the performance values of the alternatives within each criterion. To determine the best alternative these entries are weighed by the weighing coefficients that express the importance of a criterion.

	<i>Criterion</i>				
	C_1	C_2	C_3	...	C_N
<i>Alt.</i>	W_1	W_2	W_3	...	W_N
A_1	a_{11}	a_{12}	a_{13}	...	a_{1N}
A_2	a_{21}	a_{22}	a_{23}	...	a_{2N}
A_3	a_{31}	a_{32}	a_{33}	...	a_{3N}
				...	
...
A_M	a_{M1}	a_{M2}	a_{M3}	...	a_{MN}

Analytic Hierarchy Process performs pairwise comparison within each criterion. A judgement matrix has to be established for each criterion (not to be confused with the formally mentioned decision matrix)

$$\begin{array}{cccc}
 C_i & A_1 & A_2 & A_3 \\
 A_1 & 1 & a_{12} & a_{13} \\
 A_2 & 1/a_{12} & 1 & a_{23} \\
 A_3 & 1/a_{13} & 1/a_{23} & 1
 \end{array}$$

where $a_{ij}=1/a_{ji}$ are values from the relative scale of importance according to Saaty's book (1980). When $a_{ik}a_{kj}=a_{ij}$ is satisfied for all entries in the matrix then the judgement matrix is consistent. Judgement matrices are often inconsistent since human decisions cannot always assure consistent rankings. The W_i weighing coefficients can be derived from calculating the priority vector according to the judgement matrix for the criteria.

AHP works as follows. One has to determine the priority vector that is the right principal eigenvector of the judgement matrix for each C criterion. It has been shown in article (Saaty, 2003) along with other thoughts on the priority vector that it must be the right principal eigenvector of the judgement matrix that satisfies

$$A\omega = \lambda_{\max} \omega$$

where λ_{\max} is the maximal eigenvalue and ω is the eigenvector. This is especially important in the case of inconsistent matrices. One way to obtain the priority vector is to approximate it by taking the geometric means of each row and then normalizing them by their sum so that the entires of the priority vector can be approximated by

$$p_i = \frac{\sqrt[n]{\prod_{j=1}^n a_{ij}}}{\sum_i \sqrt[n]{\prod_{j=1}^n a_{ij}}}$$

Next the consistency index CI has to be estimated so that it can be derived from the formula

$$CI = \frac{\lambda_{\max} - n}{n - 1}$$

The consistency ratio CR is to be calculated by dividing the consistency index by the Random Consistency Index that is often given in tables (Saaty, 1980) as a function of n . The consistency ratio refers to the consistency property of the judgement matrix. It has been shown in (Saaty, 1980) that if the consistency ratio is greater than 0.1 it is preferable to rees- tablish the judgement matrix.

The entries of the decision matrix are the entries of the priority vectors for each criterion. The final priorities can be calculated by taking the scalar product of each row according to the alternatives and the weight vector that is

$$A_{AHP}^i = \sum_{j=1}^n a_{ij} w_j \quad \text{for } i = 1, 2, 3 \dots M$$

where A_{AHP}^i the final priority of the i th alternative.

Incremental planning

Robot path planning in dynamic environments has been in the focus of robotics research for a long time (Latombe, 1991). Many methods have proven to be efficient and useful. The study (LaValle, 2006) gives a general overview on planning algorithms. The popular potential field's method (Hwang, Ahuja, 1992) has proven to be efficient for simple path planning tasks. Since it suffers from the problem of getting trapped in local minima, different versions of this method were developed to overcome this difficulty (Fox, Burgard, Thrun, 1997), also the Probabilistic Road Map method has been widely introduced (Kavraki, Svestka, Latombe, Overmars, 1996). The likewise popular Rapidly Exploring Random Tree (RRT) method introduced in (LaValle, 2006) also has many variants (Ferguson, Kalra, Stentz, 2006), (Ferguson, Stentz, 2006a), some of them are capable of planning in high dimensional search spaces (Ferguson, Stentz, 2007). Soft computing methods like genetic algorithms can be incorporated in path planning, also neural networks and fuzzy-systems have been widely used for this task (Li, Yang, Seto, 2009). The (Yanduo, Kun, 2009) study presents a path planning method, using Liquid State Machines, that is a member of the family of recurrent neural networks, and shows promising results (Maass, Natschlaeger, Markram, 2002).

When detailed information on the terrain is available in the form of a map for the robot's navigation system, map based path planners prove to be useful. Among map based planners grid based path planning methods were frequently addressed since incremental planners like A* (Hart, Nilsson, Raphael, 1968) are capable of solving the planning problem. The main idea of grid based path planning is dividing the map into cells where each cell has an associated traversal cost. When a cell is occupied by an obstacle the cell's traversal cost is set to a high value (or to infinity). A graph is built where the graph nodes correspond to the corner or the center of the grid cells while the edge costs correspond to the traversal cost of the cells. The objective of minimizing the overall path cost, which is the sum of the traversal costs of the cells the robot passes through, can be performed by finding the shortest path in the corresponding graph.

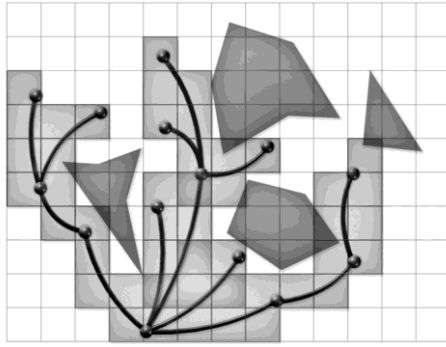


Figure 1. The concept of grid based planning²

Incremental planners keep a record of the path cost of every visited node. At the same time a heuristic cost is estimated from the dedicated node to the goal or to the start state depending on the search direction. Each visited node is inserted into a priority queue called an open list with a key value that is the sum of the path cost and the heuristic cost estimate. When the heuristic does not overestimate the real path cost to the goal the resulting path will be optimal. The open list thus contains the potential nodes that the search can be continued from and the search is focused towards the node with minimal key value on the open list. The heuristic cost estimate focuses the direction of the search and vastly influences the optimality of the solution. Finding efficient heuristics in a multi-cost environment is challenging and is often impossible in high dimensional search spaces.

Every time a node is expanded, i.e. its neighbours are visited, it is taken off the open list. Incremental planners also maintain a list for backpointers. When a previously visited node is revisited by expanding a node from the open list and the node's cost value decreases due to the expansion the state is updated, that is, the cost value is set to the decreased value and the node's backpointer is set to the expanded node. This way the algorithm can keep a record of the best path obtained so far.

The D* algorithm (Stentz, 1994) is the dynamic version of A*. It has been proven to be at least two orders of magnitude more efficient than planning from scratch with A* when changes in the arc costs occur. The main idea was to regard only those affected states that could potentially improve or invalidate the previously planned path. A one step lookahead of the path cost is used for this reason to identify inconsistent states where arc costs have changed. When the grid resolution of the map was insufficient but the process had to operate with fixed memory capacity, the Multi-Resolution Field D* (Ferguson, Stentz, 2006b) algorithm was developed, which is now currently used as the primary path planner along with TEMPEST onboard the Mars rovers Spirit and Opportunity (Carsten, Rankin, Ferguson, Stentz, 2007).

² <http://www.robodesign.ro/marius/my-projects/illustrations/motion-planning> (downloaded: ca. 2013)

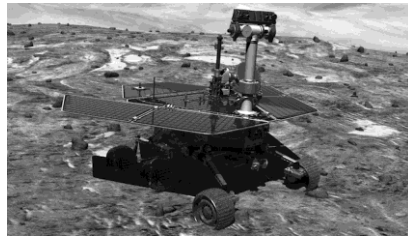


Figure 2. Mars rover³

In a large state space, as mentioned above, efficient heuristics are needed to focus the search. Another way to deal with the large number of states is to define dominance relations. The DD* algorithm (Korsah, Stentz, Dias, 2007) efficiently prunes the search space by using dominance relations, i.e. when a node is dominated by another by the mean of dominance, the search will be aborted from the dominated node. In a rapidly changing environment non-dominated states can turn dominated and vice-versa.

The most recently introduced member of the D* family is the Anytime Dynamic A* (AD*) planner (Likhachev, Ferguson, Gordon, Stentz, Thrun, 2005), which is capable of planning in rapidly changing environments by continuously improving previous solutions through refining its heuristic cost estimate. Since it is an anytime algorithm it runs until elaboration time allows and within the given time frame it produces a path with a suboptimality bound.

We will take the AD* planner as a basis of the AD–AHP algorithm that is introduced in the next section.

The AD–AHP path planner

The AHP improved AD* algorithm works as follows. Instead of determining a single cumulative cost function that sums up all costs, i.e. path length, time, energy, risk, etc. with given weights and instead of defining dominance relations a priority queue is maintained for each cost function where nodes are inserted with their corresponding key values when visited. The key values similarly to the basic operation are the sum of the given cost (i.e. energy cost, time cost) and the heuristic cost estimate. The cost of risk can be expressed as a probability value so the key value of a node on the “risk open list” must be calculated using an appropriate method in probability theory. It is assumed that the ranking of the objectives is done by another process that monitors the robot’s vicinity constantly and decides the best ranking of the objectives in any situation. Some neural network approaches like the Learning Vector Quantization (LVQ) method (Kohonen, 1995) could be used for this reason.

First the start state is inserted into each open list and the neighbouring nodes of the start state are visited. For each visited node a cost value, a one step lookahead and a heuristic cost estimate is calculated according to all cost functions. The visited nodes are then inserted into the corresponding priority queues.

The next step is to determine which node to select for expansion. Given the actual ranking of the criteria, i.e. the ranking of the different costs and given a finite set of alternatives, i.e. graph nodes with minimum key values in each priority queue by using AHP, the best node to

³ <http://www.universetoday.com/50930/mars-rover-pictures/> (downloaded: ca. 2013)

continue the search from can be determined. The AHP procedure has to be performed every time before taking a node off the open lists. It is wise not to take only the nodes with the best key values but to take nodes from a finite horizon, say the four or five best nodes in order to gain a greater set of alternatives. Of course, this could result in extra computational expense.

A quintessential question of the method is when to update a node’s cost value if it is re-visited, since an improvement in energy cost could result in an increase in the time cost and vice-versa. The main idea is to update states according to the weight vector of the criteria. Let

us denote the actual path length of the current node with d_o , its energy cost with E_o , time-cost with t_o , and the cost or probability of risk with r_o . Assume that after updating the state one gets d_p, E_p, t_p, r_p , for the same values. The change of the values can be expressed in proportions of each other in a vector. This vector is then multiplied by the weight vector of the criteria that is assumed to be normalized to unity. Given the weighing coefficients w_d, w_E, w_t, w_r , when

$$\begin{pmatrix} w_d & w_E & w_t & w_r \end{pmatrix} \begin{pmatrix} d_1 \parallel d_0 \\ E_1 \parallel E_0 \\ t_1 \parallel t_0 \\ r_1 \parallel r_0 \end{pmatrix} < \begin{pmatrix} w_d & w_E & w_t & w_r \end{pmatrix} \begin{pmatrix} d_0 \parallel d_1 \\ E_0 \parallel E_1 \\ t_0 \parallel t_1 \\ r_0 \parallel r_1 \end{pmatrix} \tag{1}$$

is satisfied, the state can be updated, i.e. the cost values are set and the node’s backpointer is set to the currently expanded node. It is assumed that all values are nonnegative, and zero entries in the above equation should be discarded and left out of the comparison.

The algorithm operates on as AD*, after reaching the goal state the heuristics are improved and the search restarts. It has to be mentioned that if a dramatic change in the environment or a dramatic reordering of the objectives occurs, it is wise to replan from scratch instead of trying to improve already existing solutions.

The main advantage of this approach is that human logic can be incorporated into the path planning process and thus an arbitrary number and arbitrary kinds of objectives can be handled at once. The robot can often find itself in situations when ranking the objectives by importance requires human expertises. If the robot’s navigation system is capable of learning, with human aid, it is possible for the robot to build up and continuously update a database of the rankings and apply the previously mentioned LVQ or some other method to determine the proper ranking when it finds itself in unfamiliar situations.

The formal description of the AD–AHP can be found in the Appendix. The main steps are of AD* (Likhachev, Ferguson, Gordon, Stentz, Thrun, 2005), the relevant modifications are where the AHP was incorporated into the algorithm.

Simulation Results

Simulations were carried out with four objectives, for cell traversal costs the cost values according to the different objectives were set randomly. Given was a start state, a goal state and three obstacles. The robot was regarded a point robot. Fig. 3. – Fig. 6. show the result of the path planning when each objective was regarded independently. On each picture the cells with a darker shade have higher cost value. On Fig. 7. and Fig. 8. the results can be seen when the planner had to regard all objectives at once first with weight vector w_1 and then with weight vector w_2 .

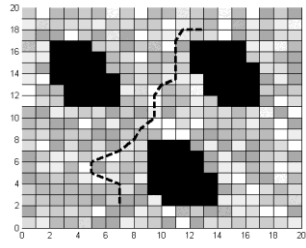
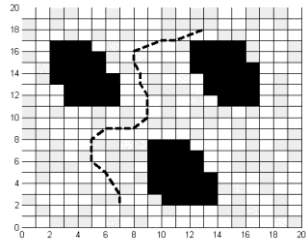
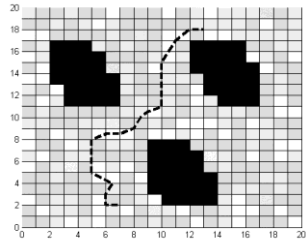


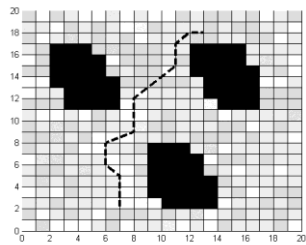
Figure 3. Planning results with the first objective Figure 4. Planning results with



the second objective Figure 5. Planning results with the third objective Figure 6.



Planning results with the fourth objective



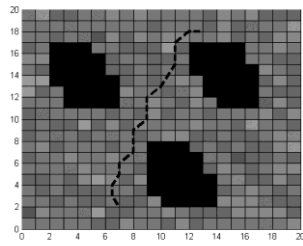


Figure 7. Planning results with all objectives with the first weight vector

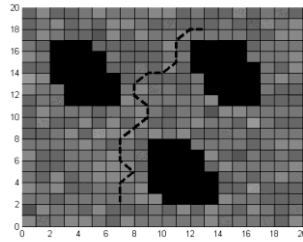


Figure 8. Planning results with all objectives with the second weight vector

Conclusions

We have introduced a novel incremental planner that is capable of planning collision free trajectories for robots in a dynamic multi–cost environment while incorporating decision theory. Instead of using a single cost function and state dominance, Analytic Hierarchy Process was used along with AD* to determine the focus of the search. The advantage of the algorithm is that very different objectives can be handled at the same time with the incorporation of human logic. All parts of the algorithm suit real–time implementation.

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Appendix

Notation

s	state
$g(s)$	cost vector of state S
$rsh(s)$	one step lookahead cost vector of state S
s'	neighbour state of S
$h(s, s_{start})$	heuristic cost estimate vector from state s to the starting state
$Pred(s)$	predecessor states of S $Succ(s)$ successor states of
$S_{bptr}(s)$	backpointer of S
$OPEN$	priority queue for states to expand $CLOSED$ queue for states
removed from $OPEN$	$INCONS$ queue for inconsistent states
ϵ	suboptimality bound
$/$	element by element division

Main ()

01. $g(s_{start}) = rsh(s_{start}) = \infty; g(s_{goal}) = \infty;$
02. $rsh(s_{start}) = 0; \epsilon = \epsilon_0;$
03. $CLOSED = INCONS = \emptyset$
04. for each criterion $OPEN_i = \emptyset$
05. $OPEN = \bigcup_i^N OPEN_i$
06. calculate weights for all criteria and store them in W
07. insert s_{goal} into every $OPEN$ with $key_i(s_{goal})$
08. ComputeorImprovePath();
09. publish current ϵ suboptimal solution
10. forever
11. if changes in the weights are detected
12. update weight vector W
13. if changes in edge costs are detected
14. for all directed edges (u, v) with changed edge cost
15. update edge costs according to each criteria
16. UpdateState(u);
17. if significant edge cost changes were observed
18. increase ϵ or replan from scratch
19. else if $\epsilon > 1$
20. decrease ϵ
21. if significant changes in the weights were observed
22. replan from scratch
23. Move states from $INCONS$ to all $OPEN$;
24. $CLOSED = \emptyset$

25. `ComputeorImprovePath()`;
26. publish current ε – suboptimal solution;
27. if $\varepsilon = 1$
28. wait for changes in edge cost and in weights

ComputeorImprovePath ()

01. while ($\text{key}(s = \text{SelectMinState}(\text{OPEN}, W)) < \text{key}(s_{start})$ OR $g(s_{start}) \neq \text{rsh}(s_{start})$)
02. remove s from *OPEN*
03. if $W^T(g(s)/\text{rsh}(s)) > W^T(\text{rsh}(s)/g(s))$
04. $g(s) = \text{rsh}(s)$;
05. $\text{CLOSED} = \text{CLOSED} \cup \{s\}$
06. for all $s' \in \text{Pred}(s)$ `UpdateState(s')`;
07. else
08. $g(s) = \infty$;
09. for all $s' \in \text{Pred}(s) \cup \{s\}$ `UpdateState(s')`;

UpdateState (s)

01. if s was not visited before
02. $g(s) = \infty$;
03. if ($s \neq s_{goal}$)
04. $s' = \text{SelectMinState}(\text{Succ}(s), W)$;
05. $\text{rsh}(s) = g(s') + c(s, s')$;
06. $\text{bptr}(s') = s$;
07. if ($s \in \text{OPEN}$) remove s from *OPEN*
08. if ($g(s) \neq \text{rsh}(s)$)
09. if $s \notin \text{CLOSED}$
10. insert s into *OPEN* with $\text{key}(s)$;
11. else
12. insert s into *INCONS* ;

key (s)

01. if $W^T(g(s)/\text{rsh}(s)) > W^T(\text{rsh}(s)/g(s))$
02. return $[\text{rsh}(s) + \varepsilon \cdot h(s_{start}, s); \text{rsh}(s)]$;
03. else
04. return $[g(s) + h(s_{start}, s); g(s)]$;

SelectMinState (OPEN, W)

01. for all $\text{OPEN}_i \in \text{OPEN}$
02. select s_i with minimum key on *OPEN* for all criteria
03. establish judgement matrices with s_i as alternatives with according cost
04. calculate priority vectors
05. establish decision matrix
06. select best alternative according to W
07. return best alternative

SelectMinState ($Succ(s), W$)

01. for all criteria
02. establish judgement matrices with $s' \in Succ(s)$ as alternatives
03. calculate priority vectors
04. establish decision matrix
05. select best alternative according to W
06. return best alternative

The Representation of Human Rights and Economic Positions in Cuba

SZABÓ Máté Csaba¹

This article describes the more than a decade-long process, during which Cuba, having lost its economic stability, has been economically moving closer to EU countries that are investing more and more in tourism and other industries. Although in many areas a shift towards a market economy can be observed in Cuba, these measures have not been accompanied by political reforms and guarantees of basic human rights that are considered fundamental values in the European Union. The article introduces the efforts of the Cuban opposition and organizations over the last twenty years, and describes the steps, with which the European Union has supported and recognized those who are fighting for freedom and rights in Cuba. Through these actions the European Union makes it clear that besides improving economic relations, the EU emphasizes and monitors the political systems of its trading partners, expecting them to guarantee certain basic rights.

The decision of the European Parliament, regarding who the Sakharov Prize would be awarded to, was preceded by great expectations.² In 2010, Guillermo Fariñas received the high-ranking prize, which is awarded to exceptional personalities, groups, or organizations fighting against oppression and fighting for freedom of thought.³ The result surprised many, as this has been the third occasion since 2002 for a Cuban person or organization to win the award. The two other nominees were Birtukan Mideska, an Ethiopian female politician, and an Israeli group, called Breaking the Silence.

It is worth considering and observing the background of the decision and why a Central– American country can be so exceptionally important for the European Union, as it might seem that the Caribbean area does not belong to the primary political and economic sphere of interest; furthermore, unfortunately, there are plenty of political systems in the world where freedom of speech and freedom of opinion are significantly restricted. In order to understand the prevailing state of affairs concerning human rights, it is worth looking back on the efforts of the last two decades.

Although, the changes in the political systems, taking place in 1989 and 1990, and the collapse of the Soviet Union left the insular country without ideological, and even worse, without economic support, the aging Caribbean dictator, Fidel Castro, adhered to his orthodox communist views, so any kind of opening or détente was out of the question. After losing the most important donor to the economy, the economic blockade dictated by the United

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² <http://www.europarl.europa.eu/aboutparliament/en/00f3dd2249/Sakharov-Prize-for-Freedom-of-Thought.html> (downloaded: 05 08 2013)

³ <http://www.europarl.europa.eu/sides/getDoc.do?pubRef=-//EP//TEXT+IM-PRESS+20101001FCS84570+0+DOC+XML+V0/EN&language=EN> (downloaded: 05 08 2013)

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States and the additional Toricelli and Helms–Burton Laws almost asphyxiated Cuba; in the 90s, the Cuban economy lived through years of crisis, and it cannot be said that the country has managed to recover from the trauma yet. Supply disruptions came to stay, the infrastructure declined, production ceased in many former sections; moreover, sugar production, the greatest pride of the country, reached the worst level experienced. Mechanical power was replaced by animal power and power supply declined to 4–6 six hours per day in cities. The inhabitants suffered from illnesses caused by malnutrition due to food shortage, food–rationing, and problems connected to distribution. The state of public health also started to decline significantly, and it is easy to understand the bleak vision of the future in this society if we regard the great number of abortions. (Anderle, 2004)

The system found the only breakout point, which ensured its survival, in tourism. In this area, Cuba has exceptionally favorable conditions, and the significant traditions of the industry go back to before the revolution. Fidel Castro's brother, Raul Castro, who is ruling the country now, played a key role in the construction of the economic program, which made sedentation possible for foreign joint–venture companies in some separated areas. (Latell, 2008) After the initial distrust, a significant capital–inflow began, and by the end of the 90s, Canadian, partially Mexican, but mainly a large number of European (Dutch, Spanish, and Portuguese) investments turned up on the island. During the 2000s, strategic industries, such as telecommunication, transportation, and sugar production, also obtained large–scale investments.

It is important to emphasize that from the War of Independence to Fidel Castro's takeover, Cuba was counted as part of the American economic sphere, and from the inevitable fall of Communism, the economic groups that belonged to the United States wanted to ascribe Cuba to their own sphere of interest again. However, because of the embargo, they

excluded themselves from the economic opportunities offered by the island, a factor not taken into consideration up to the 90s, because the embargo-policy did not account for the opportunity that the communist political system and market-economy would be reconcilable. However, as a result of the foreign investments laws in 1995, 360 joint-venture companies were registered, but there were some national societies and companies completely owned by foreign countries. Although, some American investment groups wanted to expand on the island, it was banned by their own political systems. (Leonard, 2004)

The American political and economic elite was forced to realize that the embargo policy instead of leading to the fall of the Cuban regime, excluding the American capital groups, made the occurrence of other foreign investors possible, who, using it as an “economic bridgehead,” can break into the Central-American market, which had almost completely been led by American capital and American articles beforehand.

Observing it from this aspect, the birth of the 1996 law linked to Senators Helms and Burton is not a coincidence; the law, in title, is about freedom and solidarity, but it primarily aims to make the position of joint-venture companies untenable. The law let the United States cancel its contract with any American company that maintains commercial relations with Cuba; moreover, if the company carried out trade with a Cuban company which had been an American company before the Cuban nationalization, (like most of the companies), then the American losers of nationalization can bring an action for damages against the company. A national wave of protest started against the law which, to the Cuban political elite’s delight, was regarded as the manifestation of American’s new imperialism.

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The loudest protesters emerged from the European Union; moreover the European Council declared in its 2271/96 regulation on November 22, 1996, a ban on the enforcement of the American law, which would allow for legal steps against American companies. (The Council of the European Union, 1996) The national scandal and the commercial war, which was thought to follow, did not happen: President Clinton and all his successors since then suspend the enforcement of the law in force every six months.

So, the Helms-Burton law did not achieve its purpose, but it is worth observing from which countries the highest number of investors have arrived in Cuba to date: besides China and Canada, there is Spain, Italy, the Netherlands, France, Great Britain, and Mexico, so it is obvious that some countries of the union managed to acquire significant economic positions in the area. The European Union became the most important commercial partner of Cuba; more than half of the foreign capital investments in Cuba arrive from the European Union.⁴

In the years leading to 2000, as a result of the huge investments, a high number of holiday resorts were built for Western tourists. The suffocating absence of currency seemed to get better, thanks to the tourists’ dollars and Euros. (Buzás, 2002) So, Cuba was relieved for a while, but the Castro-clan had to stick to its ideological views in this situation and it would not yield ground for any kind of relief, so it took steps against opposition organizations as it had done before for decades. The most well-known human right organizations condemned Cuba many times, because it suppresses almost every thought of opposition, strictly regulating and supervising every form of expression of opinion. In spite of all these circumstances, political dissidents have appeared in Cuba, of whom Oswaldo Payá was the most important and most significant.

Oswaldo José Payá Sardiñas was born to a deeply religious family, where he experienced the oppressiveness of Communist Cuba. It was a significant experience of his youth when he refused to carry out the command to transport prisoners of war to prison. He spent three years in labor camp for his disobedience, and his readiness to act based on his deep Catholicism became crystal clear then.

In 1988, he established the Christian Liberation Movement (Movimiento Cristiano Liberación) in Havana, which fights for political change and freedom with peaceful means. In

1992 and in 1997, he announced that he wanted to take the advantage of his rights ensured by the constitution of the communist state: he ran for election to the National Assembly of Popular Power. The political authorities managed to thwart him twice with administrative devices, as the election committees did not accept his nomination, although he had thousands of signatories who explicitly supported him.

As Anderle *Ádám* states, the emergence of the Catholic Church in political life was a new phenomenon in the 1990s. (Anderle, 2004) Its new journals, like *Credo*, *Palabra Nueva*, became the new forums of the Democratic opposition. The numbers of the people going to masses increased, church-based (or organized by the church) became the stages of the actions of the opposition. The Catholic Church became a political alternative, especially after the pastoral (letter) issued by the bishop in September 1993, which was addressed to the nation and to the Miami immigrants pleading of peace, unity and the search for a way out of economic and moral crisis. The Communist power reacted furiously and harshly.

⁴ <http://lanic.utexas.edu/project/asce/pdfs/volume14/spadoni.pdf> (downloaded: 05 08 2013)

Following the failure of 1997, one year later, Paya established the Valera Project named after Felix Valera, — a Cuban clergyman, who fought for the abolition of slavery and for the freedom of the colonies in the 19th century —

with the Christian Liberation Movement. (Sweig, 2009) The Valera Project took advantage of article (88/9) of the Communist Constitution which says that 10,000 eligible civilians, who can be identified, can propose a bill to the national assembly. (The Constitution of the Republic of Cuba, 2002)

In fact, the bill was a political reform; according to it, the freedom of speech, the freedom of assembly, the freedom of religion, and the freedom of press have to be ensured in Cuba, and it also stood up for the release of prisoners and for the right to launch a business venture.

The Communist nomination committees did not accept the bill; moreover, they accepted a constitutional amendment which secures the immutability of the socialist nature of the state. As the Valera Project was received with extensive sympathy in the United States, the Cuban government wanted to give the impression that it had been a pre-planned action financed by the USA, and not a civil initiative. During the next few years, many of the signatories of the plan suffered abuses from the state, which forced many people to give false evidence. Paya continued his peaceful action and fought for freedom, and for social and economic reforms, his work was recognized by the European Parliament as Paya was awarded a Sakharov Prize in 2002. In the same year, an unprecedented collaboration took place between the Cuban opposition: in the Declaration of Todos Unidos (Everyone Together) in 2002, with more than 25,000 signatures, they proposed the plan to the National Committee.

This was too much for the state led by Castro, where verbal resistance against the government was regarded as a subversive action, and one could be sentenced to prison for 25 years because of it. During the “Black Spring” of 2003, 75 activists of the opposition were detained and were sentenced to prison for 6 to 28 years due to their actions against national independence and territorial unity. Although Paya himself was not among those detained, two thirds of the journalists, librarians, political and civil-right activists, declared agents of the United States, suffered under the campaign, which aimed to destroy the Valera Project. Although the authorities hoped that they would manage to suppress the opposition and to eliminate the participants, they were mistaken, because the wives, mothers, and children of the prisoners brought their plight to the attention of national public opinion. The families carried on the spirit of the opposition.

The “Ladies in White” (Damas de Blanco) became a spontaneous movement in 2004. It does not act as a political party, and it does not belong to any political organization. Women wearing white clothes as a symbol of innocence and charity acted like “the Mothers of Mayo Street” in Argentina, who became famous in the 1970s, because they wanted to be informed about their children who disappeared during the military dictatorship.⁵

“Ladies in White” assembled in Saint Rita’s Church every Sunday, and after the ceremony, they march down the 5th Avenue of Havana peacefully and they spoke up for the release of their loved ones and for the imprisoned people in this insular country, all the while holding flowers. At first, they wrote letters to the Cuban authorities, but the authorities did not answer for decades. This was the first occasion that women marched in the streets of Cuba to protest against unjust imprisonments. One of the most serious actions against the “Ladies in White” was on March 20 in 2004, when the members of the Organization of Cuban Women attacked

⁵ <http://www.humanrightsfirst.org/our-work/human-rights-defenders/cuba/the-ladies-in-white/>
(downloaded: 05 08 2013)

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and assaulted them. The members of the dissident group protested peacefully and asked for the immediate release of prisoners of the state. In spite of the threats and insults, “Ladies in White” still fights for the rights of Cuban prisoners and for the pride of the Cuban people.

Their peaceful protest, by which they ask for the immediate and unconditional release of prisoners of conscience and for justice, was awarded a shared Sakharov Prize by the European Parliament in 2005. The EU, in answer to the imprisonment and the violation of human rights, reacted with the application of sanctions. Until 2003, the European Union contributed to the basic food and water supply in Cuba, which was hit by hurricanes, and with aid of almost 145 million Euros and to achieve other humanitarian goals. In regard to the state of human rights, it suspended the remittance of further support until the solution of other problems, putting the government into a difficult situation.⁶

In spite of the imprisonments, Paya reckoned that the suppression of the government did not hold the opposition work back, as it was his firm belief that Cuban people need change without violence. He started the National Dialogue in 2003, in which more than 12,000 Cuban people living on and outside of the island shared their opinions and views about the future of Cuba. The experiences and proposals he acquired here were built into the initiative called “Program of All Cubans” which was announced by Paya and aims to contribute to peaceful and democratic change. The government reacted to every initiative angrily and dismissively, but they did not dare to arrest Paya, due to his international recognition, although he is still subject to persecution and his exit requests are also refused.

The leader of the opposition, who is also nominated for the Nobel Prize, has been accused of being the agent of American interests and he was also said to be a paid agent of the Europeans, but what is even more surprising is that some immigrant Cubans tried to label him a Communist. Critics never forget to remark that the Sakharov Prize, in addition to the moral acknowledgement, also means 50,000 Euros for the awarded person. It goes without saying that none of the Cubans awarded got an exit visa to have the opportunity to go to the award ceremony.

Although many people hoped that the decisions made against the political prisoners would be revised, nothing happened for years, though the state has been led by Raul Castro, who is said to be a reformer, since 2006. For the

release of the prisoners to be put on the agenda by the communist power, a tragic event had to happen.

Orlando Zapata Tamayo was also convicted in 2003, but not as the member of the 75s. For he had been arrested before for “acts against the revolution,” he had been organizing a protest from the beginning of his imprisonment, and he did not cooperate with his custodians, he was sentenced to prison for 6 years. In the 6th year of his imprisonment, as a form of protest against the circumstances in prisons and because he was kept in prison among common criminals, he started his hunger strike in December, 2008. As a move against the government he also demanded that the Cuban prisoners of conscience should be kept in prison under circumstances that Fidel Castro enjoyed from 1953 when he was sentenced for the siege of Moncada barracks — this issue was distorted by the authorities, stating that the prisoner wanted to have a television during his hunger strike. The warders of the prison Kilo 7 in Camagüey did not ascribe great significance to the case. Orlando Zapata’s condition worsened rapidly, especially after the inspectors tried to persuade him to stop his hunger strike

6 http://eeas.europa.eu/cuba/index_en.htm (downloaded: 05 08 2013)

with the withdrawal of water. The prisoner’s weak body (after 23 days of starving) could not carry on the fight any more— although recognizing the problem, they tried to feed him artificially, on February 23 in 2010, and he died. (BBC, 2010)

Although Orlando Zapata Tamayo did not belong to the best known members of the opposition, he is now considered to be the greatest martyr of Cuba; however, the Cuban press did not write a word about his death for a long time, and when it became unavoidable, they tried to make him appear a common criminal. He successfully turned the attention of national public opinion towards the situation concerning human rights in the insular country of Cuba. Under the barrage of national critiques, the Cuban government started to formulate its intention to arrange the situation of prisoners whom had been forgotten for decades.

The flame of revolt was taken over by the journalist Guillermo Fariñas, who was a psychologist, he also announced a hunger strike. Fariñas declared that he would hold on until the release of the 52 members of the group of 75s. As he was not a prisoner himself, the slow worsening of his condition could be seen at his home in Santa Clara — in the insular country and outside its borders. The Cuban government reacted furiously and with harsh critiques of the situation that got great publicity, but as a consequence of huge national pressure, the negotiations started with the Church as a mediator. The communist leadership refused to admit that it would yield to the pressure; yet, on July 8 in 2010, Jamie Ortega, the bishop of Havana, declared that the prisoners of conscience would be released by the end of the year, so Fariñas stopped his hunger strike, which had been going on for 134 days. On hearing of the releases, many expressed their joy, prompting Cuba to further steps. (European Union, 2011)

It soon turned out, that there is no general amnesty, nor democratic progress. The prisoners were released in smaller groups continuously, and most of them were transported to the airport to depart to Spain with their families. Because of the intervention of the Spanish minister of foreign affairs, Miguel Maratino, the dissidents got protected citizenship and work permits, and they were promised that Madrid would support them in the future. The physical and psychological state of people arriving to the capital of Spain was evidence of the cruel life in prison. Because of the wet cells, many had to live with serious and permanent health problems. Among the prisoners, there were people who had lost forty kilograms during the years. The ex-prisoners, in addition to their circumstances, also reported of cruel torture from the jailers; physical/ corporal punishments commonly happen in Cuban prisons, but they also apply psychological pressure very often; they reported a fellow prisoner who was not allowed to talk to anybody for months, his only comrades were rats and cockroaches. Some could not see the sun from their cells for months, while others were not allowed to turn off the lights.

Though the Cuban authorities expected that everybody would want to leave the country, and they would manage to send all the dissidents into exile, twelve people decided to stay in their mother country. The system has shown its true colors to those who decided to remain: it did not rescind the remaining part of their jail sentence, so, in theory, they could be called back to prison at any time; furthermore, they are subject to strict and permanent control. Supposedly, the protraction of the process of release until the spring of 2011 aimed to strengthen the feeling of uncertainty in the dissidents.

At the same time, the Cuban government achieved an undesirable goal, that from the declaration until the release of the last prisoner, they were able to avoid the question of the Cuban state’s concern for human rights. However in the fall of 2010, when the Sakharov Prize was

awarded, and when it became obvious that Fariñas would not get an exit visa, so — similarly to Oswaldo Paya and the group “Ladies in White”— he could not receive the award, more and more people started to question the willingness of the Communist state to change.

The European Union, following the serious damages caused by hurricanes, restarted the humanitarian cooperation and the dialog with the insular country on a ministerial level, and the primary aim of Cuba is to suspend the Common Position against Cuba, which has been applied since 1996 by the European Union after the releases. The aim of the Common Position, which is examined every six months, is to advance the fulfillment of democracy in the insular

country and the respect of human rights. In Spain, many argued that the European Union, as an answer to the release of the dissidents, should abolish the Common Position, while taking over the lead and tightening the relationships with Cuba; all these triggered the resistance of the Cuban immigrants, dividing the member states as well.

Finally, the ministers of foreign affairs of the member states still maintained the Common Position; however, they asked Catherine Ashton, the High Representative for Foreign Affairs and Security Policy of the European Union, to carry on negotiations about commercial and political cooperation, raising the relationship between Cuba and the European Union to a bilateral level. Besides, the package deal of twenty million Euros for aid, a developmental contribution has been finalized, and cannot be withdrawn, from 2011 to 2013.⁷ This will definitely be necessary, as the economy of Cuba needs huge reforms: after a fourteen-year intermission, the 6th Congress of the Communist Party was organized in April 2011 with the new economic model in the center.

At the same time, more people, primarily from the countries of the ex-communist block, expressed that they do not agree with the tightening of the relation between Cuba and the European Union until the radical improvement of the situation of human rights. (Wałęsa, 2010) They point to those events that happened on the first anniversary of Orlando Zapata's death. In February 2011, the Cuban dissidents intended to organize a peaceful procession in Havana and all over the country; however, the state authority, which was afraid that the revolutions in the Arabian world would serve as a model for their country and the flame of dissatisfaction would break out, nipped the commemoration in the bud. Days before the planned demonstrations, those people who were thought to participate in the demonstrations were arrested one after the other; many of them were injured in prison. The regular procession of the group "Ladies in White" was disrupted by the throwing of eggs and stones, committed by hundreds of demonstrators in favour of the present political system. Groups from the governing party injured many journalists and human right activists. After the anniversary, more than two hundred dissidents were discharged.

Finally, Guillermo Farinas had to wait three years, until he could receive his exit visa to collect his prize, on the 3rd of July 2013, in Brussels from Gianni Pittella, European Parliament Vice-President who presided at the award ceremony. (EP News, 2013)

7 http://eeas.europa.eu/cuba/index_en.htm (downloaded: 05 08 2013)

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Summary

Although Cuba is considered a country that belongs to the sphere of interest of the United States, due to the political tensions between the two countries, the member states of the European Union have built up a significant economic position in the island.

Besides the deepening economic positions the European Union wishes to stand for the fundamental rights and values of the members states. To assist the democratic transition, to widen human rights, and to restore the rule of law, Brussels pays special attention to the opposition movements in the communist island.

To this end, the Parliament of the European Union awarded a Cuban dissident the Sakharov Prize for Freedom of Thought, and remarked that Cuba still has a long way to go until the normalization of human rights.

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Military theoretical basics of the concept of culture of warfare

FORGÁCS Balázs¹

The study demonstrates the evaluation of the concept of culture of warfare and highlights its relations with Clausewitz's perspective on military affairs. The model of cultures of warfare in Hungary was created in the 1990's by Kovács Jenő, a Hungarian general and military theorist who used the original British concept of military culture as a base. He thought that different cultures of warfare evolved throughout history due to the varied historical and cultural patterns of the societies causing differences in concepts of leadership, manoeuvre and engagement. The theoretical bases of varied ways of warfare can be found in Clausewitz's "On War". The Prussian military theorist defined the dual nature of war, which means different use of the instruments of force and violence: aspiration to annihilation or attrition. Thinking about war in the framework of a general theory of the use of force and violence does bring us closer to discover and understand the basic aims of warfare.

Introduction

When examining the topic of cultures of warfare, first of all, we need to make it clear that the concept itself and also the typology of the means of fighting wars is well established from the point of view of military sciences. Following the usual methodology of general military theory I have based my study on the fundamental work of Carl von Clausewitz's "On War". Even though the book was written almost two centuries ago, it has been an adequate source for defining the basics of any study on the art of war ever since.

The origins of the concept

It would be a vain effort to look for the concept of the culture of warfare in any Anglo–Saxon, Russian or Hungarian encyclopedia of military sciences. Because of the novel and unsettled nature of the concept, it has not yet become one of those notions which describe the characteristics and nature of war, the armed forces, the ways of war is fought, the periods previous to fighting and following war, or those that describe the environment in which actual fighting takes place. The concept was not included in the Hungarian Encyclopedia of Military Sciences (Szabó, 1995), even though the Hungarian person who elaborated on this concept, Jenő Kovács, as an expert of military sciences and the art of war, was an active participant in producing this Encyclopedia.

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The concept of military culture exists in Anglo–Saxon literature. It is important to note that Soviet–Russian military science lacked this concept or anything similar, as Jenő Kovács put it: “former Soviet military science examined the set of problems closely related to culture of warfare as part of the study of means and forms of strategy.” (Kovács, 1995: 18) Even though Jenő Kovács examined the “forms of strategy” while studying the characteristics of meeting engagement during the second half of the 1960s, he only reflected on the Soviet–Russian point of view and results. As he put it: warfare is “... the sum of all (forms), methods applied and actions taken in order to carry out all tasks at any level of fighting a war.” (Kovács, 1995: 12) The extensive study of culture of warfare and its introduction to Hungarian military sciences could only take place after he had examined the Anglo–Saxon views as well. (Kovács, 1995: 18) (Kovács, 1967a: 7–19) (Kovács, 1967b: 3–12) R. A. D. Applegate and J. R. Moore in their study “Warfare – an Option of Difficulties. An Examination of Forms of War and the Impact of Military Culture”, (1990: 13–20) stated that all military organizations are influenced by certain conditions (terrain, weapon systems, time, resources, training and morale) and various circumstances (geographic factors, strategic aims, climate, presence of allies, number of population, level of their education), which set up the basic framework within which a military organization operates and one in which military culture is formed.

The latter was defined as: “A military culture is the collection of ideas, beliefs, prejudices and perceptions which constitute and determine the relationship between the constituent parts. As a result, military culture determines internal conditions such as selection and promotion criteria, training, education, the allocation of resources and the vocabulary of military debates; these in turn combine to give a distinct character to a military organism and determine the nature of operations they can execute and hence the form of war they adopt. Thus the internal conditions

of an army (ie its culture) can have a greater influence on the form of war adopted than the external conditions and circumstances – this can be the path to defeat.” (Applegate, Moore, 1990: 13) This study and the mentioned definition provides the basis for Kovács’s terminus technicus introduced in the Hungarian military literature.

At the beginning of the 1990’s Kovács Jenő made an attempt to draft the theoretical basics of an independent Hungarian military strategy. Within this framework he also studied cultures of warfare comparing the sometimes contradictory views of Western and Eastern scholars. The concept was first outlined in one of his social theoretical essays, in a chapter titled “*Military Strategy and Cultures of Warfare*”. (Kovács, 1995: 12–48) The military theorist — following Western methodology — founded his thesis on the empirical fact that peoples, societies and their military leaders try to employ available military forces in different ways. Thus he recognized that belligerent forces mostly belonged to different cultural complexes, and carried different cultural values. Thus, military leaders commanded their forces in different ways, and applied different combat tactics. He realized that – just like many other processes – war was dependent, and is still dependent on the culture of the given societies: this is why he differentiated among cultures of warfare. Based on this, Kovács Jenő defined culture of warfare as: “*the sum of all military, intellectual and material values that determines the basic aims of disorganizing enemy forces and the preserving of one’s own forces. Culture of warfare can be described as a development of military sciences or as the character of the armed forces, but in other ways as well.*” (Kovács, 1995: 17–18) It is obvious that Kovács’s transformed version of the original concept has become shorter and much simpler. In my opinion the reason for this was that the Hungarian military theorist used a

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different system of typology than his Anglo–Saxon contemporaries. Kovács Jenő had certain knowledge of Western military sciences and he could interpret basic Western terminology within the very rigid Soviet–Russian system of typology.

In his interpretation, culture of warfare is “*a set of social, military theoretical and material conditions and circumstances, upon which other elements, dependent on the characteristics of the given war, the level of military technology, and the theatre of war and on morale, rest. Tactical manuals articulate mainly the principles and rules resulting from this dependency. Culture of warfare at the same time carries a broader meaning than operative manuals do, as it penetrates all aspects of societal life (science, art, education, economy, etc.)*.” (Kovács, 1995: 18–19) To put it shortly, culture of warfare in his interpretation shows how society relates to the military affairs of the country, and as a continuation of this, we also get a picture of how members of the military and the phenomenon of war relate to each other.

Kovács Jenő differentiated among the following three cultures of warfare: *manoeuvre–centric* and *material–centric* cultures of warfare, and that of *guerilla warfare*. It is important to note that in the original study of Applegate and Moore, which provided the basis for his work, the authors differentiated among four types of warfare: positional war, manoeuvre war, long–range penetration and guerilla war. In case of the latter, the combined use of these concepts (the mixed use of operational–tactical, strategic and grand strategic concepts) clearly shows that the typology of the Anglo–Saxon military specialists was still novel at the turn of the 1980s–1990s. Based on these I think that the use of Kovács Jenő’s categories is more justifiable when setting up a typology for wars in general. According to the logic of the use of force, we can group cultures of warfare based on his typology as follows: manoeuvre–centric culture of warfare is aimed at annihilation, while material–centric and guerilla cultures of warfare are primarily aimed at attrition. To put it in another way: the first reflects the characteristics of direct warfare, while the other two indirect warfare. (Forgács, 2008a) (Kessel, 1987) (Nagy, 2004a) According to which the cultures of warfare have been — mostly unintentionally — articulated and followed by nation states these were the strategic aims which built their armed forces, defined their use and fought their wars based on these purposes.

The theoretical foundations

It might seem surprising when reading Kovács’s study that he only briefly dealt with the military theoretical basics and other theoreticians of the concept. He based his studies primarily on secondary sources while he only used a small number of primary sources. In my opinion the explanation lies within the ARMS (1996) itself produced by Kovács Jenő throughout his life: his work focused mainly on the practical approach and on satisfying practical needs, so studying the theoretical fundamentals was only a secondary aim for him. Cultures of warfare constituted only a part of his work dealing with a new Hungarian military strategy, so the above mentioned circumstances and his early death give an explanation for the lack of further in–depth research. My studies so far, and the complex review of primary and secondary sources indicate that we can apply Clausewitz’s thesis to the use of military power when taking a closer look at the cultures of warfare.

The basis of the above mentioned hypothesis was developed by Clausewitz in his thesis on war and its dualism, manifesting in the parity of attrition and annihilation. (Clausewitz, 2004) (Clausewitz, 2004: 639–690) (Kessel, 1987: 157–174) (Perjés, 1983) (Nagy, 2004a:

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146–175) Without repeating his thoughts here, I would like to note that the Prussian military theoretician studied the dual nature of war and the aims of annihilation and attrition in his book, *On War*, in different depth but baring the same importance, thus, marking the beginning of a new era. While the former was given a complete in–depth analysis, one finds only frag- mented sketches exist on the latter. But this does not mean that Clausewitz devoted less atten- tion to indirect warfare — as it is underpinned by the “Notice” at the beginning of his book. The Notice also indicates that the author planned a fundamental revision and restructuring of the book, but his early death prevented him from doing so. As Nagy Miklós Mihály put it: “*The main point is, that Clausewitz already recognized the dualism of war. By stating that oc- cupying a given territory will bring results during the peace negotiations already established the idea that the purpose of armed forces is not simply waging war.*” (Nagy, 2004a: 155)

Based on my previous experience and the relevant literature, I think that certain phenom- ena of recent military affairs, like terrorism, can be explained through the study of culture of warfare and the concepts of attrition and annihilation. (Hahlweg, 1976) (Nagy, 2004b:

16–20) (Kiras, 2005) (Forgács, 2008b: 88–100) In practice, the conceptual categories defined by Kovács Jenő are the equivalents of attrition and annihilation from the point of view of military theory, as explained above. At the same time it would create a theoretical trap if we tried to prove by practical and historical examples that these cultures of warfare are clearly separate and have a clear borderline among them.

In the second half of the 19th century it became clear during the so called “strategy debate” (Delbrück, 1920) (Perjés, 1983: 438–448) well–known from Hans Delbrück that neither at- trition, nor annihilation can be clearly determined as unique strategic aims. The historical experience of wars show, although to a different extent, that both of them are present in the superior acts of war. This leads us to the conclusion that even though in theory we can clearly differentiate among the three above mentioned cultures of warfare, in present practice, how- ever, their characteristics are mixed, thus, nowadays we experience the gradual disappear- ance of the clear borderlines among them.

Clausewitz’s perspective on military affairs

When studying the concept of cultures of warfare we need to start from the definition of war itself. It was defined by Clausewitz as: “*War therefore is an act of violence to compel our op- ponent to fulfill our will.*” (Clausewitz, 2004: 1) The First Book of “*On War*”, “*On the Nature of War*”, then examines the functioning of military power: he states that military power leads to the utmost use of force and this process is intensified by three interactions. The first is that the belligerent parties mutually generate and increase their use of force in order to achieve victory.² The second is that the parties are insecure concerning their own survival right until they are able to make their opponent defenseless. Until that point both parties are endangered by the fact that the other party might do so, thus generating a spiral of the use of utmost force.³ The third interaction supposes that the parties may know the defense capabilities of their counterparts thus, both will increase their own effort in order to subdue the other, or

2 “*As one side dictates the law to the other, there arises a sort of reciprocal action, which logically must lead to an extreme.*” (Clausewitz, 2004: 3)

3 “*As long as the enemy is not defeated, he may defeat me; then I shall be no longer my own master; he will dictate the law to me as I did to him.*” (Clausewitz, 2004: 4)

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until he reaches the limits of his options.⁴ The utmost use of force constitutes the category of absolute war which is only a theoretical concept.

After defining these interactions Clausewitz immediately asks the question: *What are the modifications in reality?* (Clausewitz, 2004: 4) He makes it clear when this process could work in real life: “*It will if, (1) war becomes a completely isolated act, which arises sud- denly, and is in no way connected with the previous history of the combatant States; (2) If it is limited to a single solution, or to several simultaneous solutions. (3) If it contains within itself the solution perfect and complete, free from any reaction upon it, through a calculation beforehand of the political situation which will follow from it.*” (Clausewitz, 2004: 4) Sum- ming it up, in a real war there are both generating and moderating factors of violence, and to the extent generating factors are present, moderating factors will also be at play. Based on all these I agree with Nagy’s thought, that as he puts it: “*the logical system of arms (1929–2017) developed by Clausewitz is a unified set of interactions which prevents the utmost use of force through its own internal mechanisms.*” (Nagy, 2004a: 152)

The most important among the moderating factors is the political aim of the war,⁵ as “*war is only a part of political intercourse, therefore by no means an independent thing in itself.*” (Clausewitz, 2004 Book 8 Chapter 6 part A and B: 672–674; Vol. II.: 672–681) According to Clausewitz “*War is only called forth through the political intercourse of Governments and Nations.*” (Clausewitz, 2004: 674) Based on this he states that “*We maintain, on the contrary, that War is nothing but a continuation of political intercourse, with a mixture of other means.*” (Clausewitz, 2004: 674) Thus politics have a direct effect on the way war is fought, as: “*The perfectly unbridled element of hostility, for all the circumstances on which rests, and which determine its leading features, viz., our own power, Allies on both sides, the characteristics of the people and their Governments respectively etc., – as enumerated in the first chapter of the first book – are they not of a political nature, and are they not so inti- mately connected with the whole political intercourse that it is impossible to separate them.*” (Clausewitz, 2004: 675) “*In one word, the Art of War in its highest point of view*

is policy, but, no doubt, a policy which fights battles instead of writing notes.” (Clausewitz, 2004: 677) Kessel also supports these theses in his basic study, as ‘the nature of war depends, or could depend on the nature of political aims and vice versa, just as the political aim is influenced by the same political conditions, from which war itself is derived.’ (Kessel, 1987: 159)

According to these it is easy to see that the aims of war reflect the political will. Kessel suggests that “the whole issue can be divided into two main concepts: on the one hand there is the political aim at the beginning of the outbreak of war; on the other hand there is the political influence upon war during fighting, which may vary according to the state of affairs.” (Kessel, 1987: 159) This political aim is present in the Notice of On War by Clausewitz, where he states: “The two kinds of War are, first, those, in which the objects is the overthrow

4 “Granted we have obtained in this way an approximation to the strength of the power to be contended with, we can then take a review of our own means, and either increase them so as to obtain a preponderance, or, in case we have not the resources to effect this, then do our best by increasing our means as far as possible. But the adversary does the same; therefore, there is a new mutual enhancement, which, in pure conception, must create a fresh effort towards an extreme.” (Clausewitz, 2004: 4)

5 About the political aims moderating war Clausewitz wrote the following: “Thus policy makes out of the all-powering element of War a mere instrument, changes the tremendous battle-sword, which should be lifted with both hands and the whole power of the body to strive once for all, into a light handy weapon, which is even sometimes nothing more than a rapier to exchange thrusts and feints and parris.” (Clausewitz, 2004: 675)

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of the enemy, whether it be that we aim at his annihilation, politically, or merely at disarming him and forcing him to conclude peace on our terms, either for the purpose of retaining them permanently, or of turning them to account as matter of exchange in the settlement of a peace.” (Clausewitz, 2004: 37)⁶ Based on the dual nature of war — attrition or annihilation

— we can conclude that the will of fighting the war is present in completely different forms, which manifest in the different use of the military and the different intensity of fighting. (Kessel, 1987: 157) Clausewitz also mentions the transition between these different characteristics: the common element in both cases is violence, which, according to Kessel, connects the two types, “this is why these two types of war may change from one into the other.” (Kessel, 1987: 169)

Conclusion

In my opinion the characteristics described above are also reflected in the differences of the types of cultures of warfare, namely in the differences in use of force indicated by the war aims that are determined by political aims. When studying the cultures of warfare it is best to differentiate among them by examining their characteristics, as differences are present in several areas: violence, political aims, intensity of violence, and the parity of annihilation and attrition.⁷

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6 Notice, emphasis by Clausewitz: On the dual nature of war and the political will determining wars see: Kessel, 1987: 157–174)

7 The differences of cultures of warfare can be determined by examining the following factors: the means of violence, the political aims; the intensity of violence and the parity of annihilation and attrition. These are the most important, ever returning questions of any military theory.

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International efforts to create a weapons of mass destruction free zone in the Middle East

NAGY Milada¹

The efforts to create a nuclear weapons — later weapons of mass destruction² — free zone in the Middle East face many difficulties: the Arab–Israeli conflict, the deterioration of the Israeli–Palestinian peace process, the growing number of actors in the peace process, the nuclear program of Iran, the security policy of Israel etc. The aim of this paper is to give an overview of the international (United Nations [UN], European Union [EU]) efforts from the 1960s to the indefinite postponement of the Middle East weapons of mass destruction free zone (MEWMDFZ) conference planned for December 2012.

Keywords: Middle East, weapons of mass destruction free zone, United Nations, NPT 1995 resolution, European Union

The beginnings

Efforts to create nuclear–weapons–free zones (NWFZ) are not new, their origin dates back to the 1960s. One of the cornerstones of the nonproliferation regime of the nuclear weapons is the Nuclear Non–proliferation Treaty (NPT), with which (1968) the international community established a significant norm in the nuclear field. The other important cornerstone is the legal and political possibility to create geographical areas free from nuclear weapons. The first territory to become a nuclear–weapons–free zone by the Tlateloco Treaty (1967) was Latin America and the Caribbean. It was followed by the Treaty of Raratonga in 1985 (the area of the South Pacific), the Treaty of Bangkok in 1995 (the area of South Asia), the Pelindaba Treaty in 1996 (Africa), and, finally, the Treaty of Semipalatinsk in 2008 (Central Asia). Uninhabited areas such as the Antarctica (1959), outer space (1967) and the ocean floor (1971) were announced nuclear–weapons–free zones by the international community.

The initiative related to the Middle East also dates back to the 1960s. According to Mohamed Kadry Said³ Egypt suggested nine conditions for establishing a nuclear–weapon–free zone (NWFZ) in the Middle East in 1963, (Said, 2004: 126) on the basis of which in December 1974 the creation of NWFZ in the Middle East appeared on the agenda of the United Nations for the first time.⁴ The antecedent of the proposal was the Arab League Summit on September 1–4, 1974 which took place after the end of the 1973–1974 Arab–Israeli war. The initiative was introduced at this summit, and was forwarded by Mohamed Reza Pahlavi,

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⁴ UN Assembly, Resolution 3263, 7 January 1975. Accepted with 128 yes, 0 no, 2 abstain (Israel, Myanmar)

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the Shah of Iran, to the UN General Assembly on September 16, 1974, with the active support of Egypt. It was included in the proposal that “Middle Eastern states should be prohibited to manufacture or otherwise to acquire nuclear weapons,” and countries possessing nuclear weapons should be prohibited to use weapons of mass destruction against the states of this area. The proposal urged the immediate establishment of safety measures related to nuclear and non–nuclear weapons, and Egypt established its right to take steps to preserve its own security in case Israel possessed nuclear weapons. (Egypt State Information Service, s.l.)

Resolution 3263 of the UN General Assembly (1974) calls upon all parties concerned in the establishment of a nuclear–weapon–free zone in the region of the Middle East to refrain, on a reciprocal basis, from producing, testing, obtaining, acquiring or in any other way possessing nuclear weapons and to accede to the Nuclear Non–Proliferation Treaty. The resolution expresses hope that all states, including the nuclear–weapon states, will lend their full cooperation to the effective realisation of the aims of the resolution. According to the resolution the UN General Assembly annually discusses the issue and modifies it according to the current security policy situation. (UN, 1974:27)

In March 1975 the Secretary–General of the UN sent Resolution 3263 to the countries concerned for discussion. (UN, 1975) A nuclear–weapon–free zone in the Middle East would have been established by the accession of Bahrain, the United Arab Emirates, Egypt, Iran, Iraq, Israel, Yemen, Jordan, Qatar, Kuwait, Lebanon, Oman, Syria and Saudi Arabia (out of the listed countries Egypt is party to the Pelindaba Treaty, the Treaty of the African Nuclear–Weapon–Free Zone since 1996). The countries in their official answers referred to the diplomatic difficulties. The question of Israel

caused the strongest disagreement. Egypt and Iran were the countries which especially emphasized their distrust towards the Jewish state, this way obstructing the exposure of “mutual acceptance” which is related to the content of the resolution. The point upon which every Middle Eastern country – except for the country concerned – agreed was that one of the most important conditions of establishing a nuclear-weapon-free zone was the accession of Israel to the Nuclear Non-Proliferation Treaty. (UN, 1975) Resolution 3263 of the UN General Assembly — pursuant to the content of the resolution — was modified every year according to the political and security situation. The states concerned continued to express their opinion and the UN Secretary General annually announced them in his report.⁵ Bahrain, Egypt, Jordan, Kuwait, Lebanon and Oman supported the second paragraph of the resolution, which states that the parties refrain from producing, testing, obtaining, acquiring or in any other way possessing nuclear weapons. Egypt, Jordan, Iran, Iraq and Syria found it essential that all members of the area be members of the Nuclear Non-Proliferation Treaty (paragraph 3). Kuwait would ratify the Nuclear Non-Proliferation Treaty in case Israel did the same. According to Jordan, until Israel is not member of the NPT, the NWFZ cannot be realized. Israel stated that “it would take further steps in order to insure durable peace in the area”, and was inclined to participate in the conferences dealing with the issue. (UN, 1975)

⁵ Resolutions of the UN General Assembly on the weapons of mass destruction free zones in the Middle East (1974–2012): 3263, 3474, 3171, 32/82, 33/64, 34/77, 35/147, 36/87, 37/75, 38/64, 39/54, 40/82, 41/48, 42/28, 43/665, 44/108, 45/52, 46/75, 47/48, 48/71, 49/71, 50/66, 51/41, 52/34, 53/74, 54/51, 55/30, 56/21, 57/55, 58/34, 59/63, 60/52, 61/56, 62/18, 63/38, 64/26, 65/42, 66/25, 67/28.

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The impact of the war between Iraq and Iran

In the years after 1975 no serious changes took place. In 1980 the NWFZ resolutions were adopted without a vote because Israel gave up its abstention policy and participated in the sessions. In 1981 Israel bombed the Osiraq nuclear reactor in Iraq, claiming that this step had been a preventive attack concerning the security of the states of the region and its own security. The military action was condemned by the UN General Assembly in its Resolution 36/87, with particular regard to the forming of a nuclear-weapon-free zone in the Middle East. (UN, 1981:57) One year later, in 1982 the UN proposed in its Resolution 37/75 to take measures in order to prohibit the military attacks against nuclear installations. (UN, 1982:56), (UN, 1983:57)

Meanwhile, during the war between Iraq and Iran (1980—1988) chemical weapons were used which caused the death of thousands of people, furthermore, it was revealed that some Middle Eastern countries were pursuing chemical and biological weapons programs (e.g. Syria). In reaction, in April 1990 the President of Egypt, Hosni Mubarak urged the creation of not just a nuclear-weapon-free zone, but that of a mass destruction weapons free zone in the Middle East (MEWMDFZ). He sent his proposal to the UN Secretary-General, the effect of which was that the UN General Assembly that year (1991) accepted Resolution 46/30 which “welcomes all initiatives leading to the general and complete disarmament, including in the region of the Middle East”. (UN, 1991:61–62) Therefore, the significance of the creation of a weapons of mass destruction free zone in the Middle East was demonstrated at the level of both the UN Security Council and the General Assembly.

In 1991 UN Secretary-General, Javier Pérez de Cuéllar, (de Cuéllar 1991) presented a report on the same issue, the preparation of which was authorized by a 1981 Resolution of the UN General Assembly. (UN, 1991:61–62) The UN Secretary General defined the Middle East as a region spreading from Lebanon to Iraq, and from Syria to Yemen. He emphasized that Israel, according to its promise, “would not be the first to deploy nuclear weapons in the Middle East”,⁶ adding that from this statement it is not clear whether the testing of nuclear weapons is included or not. The accession of the Middle Eastern states to the Nuclear Non-Proliferation Treaty — particularly that of Israel — as well as bringing Israel’s nuclear research institute in Dimona⁷ under the control of the International Atomic Energy Agency (IAEA) would be an important step towards the realization of the goal. The study states that confidence-building measures similar to those taken in Europe after the end of the Cold War would be necessary in the region. (de Cuéllar 1991: 40–42)

The 1990s

After the first Gulf War (1991) the international community revealed the mass destruction weapons programs of Iraq, and the Security Council condemned the country’s efforts of this kind in their Resolution 687 (April 13, 1991): “Iraq has attempted to acquire materials for

⁶ Levi Eshkol’s (the Prime Minister of Israel between 1963–1969) 1965 March Declaration. <http://www.nti.org/country-profiles/israel/nuclear/> (downloaded: 19 04 2013)

a nuclear–weapons programme contrary to its obligations under the Nuclear Non–Proliferation Treaty of 1 July 1968”, and urged the creation of the nuclear–weapon–free zone in the Middle East. The Resolution obliged Iraq to destruct or remove all chemical and biological weapons and manufacturing facilities, to destruct all ballistic missiles with a range greater than 150 kilometres, this way creating a new proposal. The initial proposal, that is, the idea of nuclear–weapon–free zone was complemented, thus, the main goal of the new proposal was to create a weapons of mass destruction free zone in the Middle East. (UN Security Council [SC], 1991a)

At the beginning of the 1990s steps towards the disarmament of the Middle East took place not only in the UN. It was the Arms Control and Regional Security Working Group — one of the five multilateral working groups formed within the framework of the Madrid Peace Process — where negotiations took place on the issue of creating a weapons of mass destruction free zone in the Middle East (May 1992—December 1994). Egypt and Israel held bilateral talks which ended with no practical results, due mainly to, on the one hand, the disagreement between the two parties concerning the question of arms reduction (Egypt wanted to expand the NPT to Israel), on the other hand, due to the end of the Arab–Israeli Peace Process. Although the series of negotiations brought no tangible results, the fact that Israel decided to discuss the question of arms reduction with its neighbours and other countries of the region was a positive result. Confidence–building became a significant concept and accompanied the Middle East peace negotiations in the 1990s.

The Barcelona Process

After the interruption of the Arab–Israeli Peace Process, the European Union also tried to interfere in the Middle East Peace Process. On November 27 and 28, 1995 at the Euro–Mediterranean Conference in Barcelona the Barcelona Declaration was accepted, which stated that “the signatory parties⁸ shall pursue a mutually and effectively verifiable Middle East Zone free of weapons of mass destruction, [...] and their delivery systems”, they should promote regional security through non–proliferation regimes, that is, through arms control and disarmament agreements.⁹ Furthermore — according to the Declaration — the parties will consider practical steps to prevent the proliferation of weapons of mass destruction as well as the excessive accumulation of conventional arms. In the last paragraph of the chapter on political and security partnership it was stated that the parties consider any confidence and security–building measures that [...] contribute to the creation of an “area of peace and stability in the Mediterranean”. (EU, 2005) The Euro–Mediterranean Partnership and the Barcelona Process supposed a dialogue and cooperation, but it was the key actors of the region (Israel, the Palestinian Authority, Egypt, Syria, Lebanon and Jordan) which did not agree with the cited points of the chapter on political and security partnership, therefore, the initial enthusiasm started to decrease.

As a result of the revitalized initiative, on July 13, 2008 the Union for Mediterranean was established in Paris (UfM). The closing declaration of the summit, similarly to the Barcelona

⁸ EU15 states, Egypt, Israel, Malta, the Palestinian Authority, Turkey, Tunisia, Syria, Jordan, Morocco, Lebanon, Algeria, Cyprus

⁹ Nuclear Non–Proliferation Treaty (NPT) 1968; Chemical Weapons Convention (CWC) 1993; Biological Weapons Convention (BWC) 1972; Comprehensive Test Ban Treaty (CTBT) 1996.

declaration, included a reference to the issue of the weapons of mass destruction free zone in the Middle East, but non–proliferation as a concept was not included in it. (UN, 2008) The UfM was launched by Ex–President of France, Nicolas Sarkozy, though today it operates only at a formal level, and, regarding WMDFZ, it has brought no progress.

An attempt to create the weapons of mass–destruction–free–zone of the Gulf States

In 1999 the UN Disarmament Commission established the necessary recommendations¹¹ for the creation of nuclear–weapons–free zones. The basic criteria were that all the states of the zone had to accept the status, to insure efficient control and to urge the peaceful use of nuclear energy. (Goldblat, 2005)

In December 2004 the initiative to create the NWFZ of the Gulf States,¹⁰ was put forward by the Gulf Research Center. However, it raised the question why the Arab Gulf States would want to have their own WMDFZ? The answer was obvious: it had been more than 40 years that the Middle East NWFZ was proposed and it had not been realized. Should a WMDFZ or a NWFZ be established in a territory much smaller than the originally foreseen scope, namely the Arab Gulf, it could expand into a NWFZ which covered the whole Middle East. Nevertheless, this aspiration has remained mostly academic thinking, consequently has not been realised yet. (Alani, 2005)

The 1995 NPT Resolution

The first reference to the creation of a NWFZ in the Middle East in the closure declarations of the NPT Review Conferences was mentioned in 1985, in points 11—13 of the VII paragraph: “The Conference welcomes the consensus [Resolution 39/54 — M. N.] reached by the United Nations General Assembly concerning the establishment of a nuclear-weapon-free zone in the region of the Middle East.” (Center for Nonproliferation Studies, 1985) Thereafter a further ten years passed before the question of WMDFZ in the Middle East appeared on the agenda. It was discussed at the NPT Review Conference held between April 17 and May 12, 1995. The fact that the issue could appear on the agenda was due to the diplomatic efforts and the Arab–Israeli Peace Process, preceding the conference. Israel had been integrated into the NPT process, at bilateral levels, since 1994. Egypt had already expressed its opinion before, according to which if Israel signed the NPT, the Arab states would accede to the treaty on the prohibition of chemical weapons. The Arab League — under the leadership of Egypt — passed a resolution in their September 1994 session, proposing that all the states of the region should join the NPT, including Israel, but the Jewish state refused to join the treaty. By January 1995, the rhetoric of Egypt became harder. Amr Moussa, the Minister of Foreign Affairs accused Israel, saying that the secret weapon of mass destruction program of Israel was the reason why the Middle East Peace could not be realised. (Feldman, 1997)

In April—May 1995 Israel did not take part in the conference. Egypt decided that it would not support the “extension of the NPT without clarification” until Israel was not a party to the treaty. In addition, Egypt stated that if the majority of the NPT members voted for the

10 Bahrain, Oman, Kuwait, Saudi Arabia, Qatar, United Arab Emirates, Iraq, Iran and Yemen

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extension of the treaty without naming Israel, it might make Egypt leave the NPT, and even undertake a potential confrontation with the USA. (Feldman, 1997) The Egyptian campaign did not manage to make Israel sign and ratify the NPT. As a result of the American pressure, the originally all–Arab position gradually disappeared and Egypt remained alone with its proposal. Eventually, the Resolution on the Middle East of the 1995 NPT Review Conference contained no concrete reference either to the nuclear weapons of Israel, or to the arms reduction talks in the Peace Process. In the second point it “notes with satisfaction” that, in its report, the Main Committee of the Conference recommended to “call on those remaining States not parties to the Treaty to accede to it, and to accept International Atomic Energy Agency safeguards on all their nuclear activities”. (UN, 1995) The last point (point 6) deals with safeguards. Its text is rather general, calling upon all states party to the Treaty on the Non–Proliferation of Nuclear Weapons, and in particular the nuclear-weapon states, to extend their cooperation and to exert their efforts with a view to ensure the early establishment by regional parties of a Middle East zone free of all weapons of mass destruction. At the same time, it is important to mention that the integration of the MEWMDFZ into the NPT review process could not be successful until the parties have no confidence towards each other.

At the 2000 and 2005 NPT Review Conferences the 1995 resolution was confirmed, but the discussion of the issue took place only in May 2010, at the following review conference. The greatest result of the conference was that the participants accepted an action plan, consisting of 65 points, in order to realize the 1995 resolution, the NPT and the disarmament. Furthermore, another resolution was created about the organisation of a conference to be held in 2012, counting on the participation of all the countries of the Middle East. After the conference, 28 May 2010 James L. Jones, National Security Advisor issued a declaration on behalf of the USA in which he confirmed his desire to be the co–sponsor of the 2012 conference (further sponsors are the United Kingdom, Russia and the Secretary General of the UN). Before the declaration Israel had strongly condemned the USA for voting for the resolution of the conference. The USA expressed the importance of the national security of Israel, and did not accept the isolation of Israel or the imposing of “impossible expectations”. The USA states that its position concerning the Peace in the Middle East has not changed, including its “unwavering” commitment to the security of Israel. At the same time, they find it regrettable that Israel does not take part in that part of the NPT document which deals with the Middle East, and the fact that Iran regularly infringes the resolutions of the NPT and the UN SC. (Jones, 2010)

Finland was appointed to be the host of the conference, and Jaakko Laajava, the Finnish Under–Secretary of State became, later, its high representative. (UN SG [Secretary–General], 2012) The USA, Great Britain and Russia supported the initiative, but except for them — and the efforts of the Egyptian diplomacy — the European Union did not play a very active part. The EU similarly to the UN, supported the creation of the WMDFZ in the Middle East. In September 2008 the EU organised a seminar in Paris, as a result of which the European Council accepted the decision “in support of a process of confidence–building leading to the establishment of a weapons of mass destruction free zone and their means of delivery in the Middle East in support of the implementation of the EU Strategy against Proliferation of Weapons of Mass Destruction”, and decided to organize another seminar. (EU, 2010) It took place on July 6–7, 2011, and was organized by the EU Non–Proliferation Consortium and was supported by the European External Action Service. The main points of the agenda,

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similarly to those of the previous seminar, dealt with the possibilities of the creation of the confidence–building strategies and the MEWMDFZ. (EU, 2011a), (EU, 2011b)

During the organisation process of the 2012 conference it became a widespread view that the conference was doomed to fail, and this would have a negative impact on the following five-year period (2010—2015) of the NPT Review Conferences. That time nobody supposed that the conference would not take place. As it came through the three main supporters (the USA, Great Britain and Russia) issued rather different declarations. On November 23, 2012 the US Department of State issued a declaration on the postponement of the conference, referring to the seriousness of the situation,¹¹ but did not give any alternative date. One day later in the declaration of Russia the date of the conference was set for April 2013, emphasizing that the preparations had reached the appropriate level, but some countries were not present, this was the reason why the conference did not take place.¹² Great Britain, in its own declaration expressed its hope for the continuation of the dialogue and the organisation of the conference in 2013. (Davenport, 2012), (Landau, Stein, 2012) Until the inner conflicts of the region are not solved (Egypt as the main representative of the Arab world and Israel are not able to bring their ideological points of view in line with one another; Israel, for safety reasons, would not discuss giving up its available weapons; Iran continues its nuclear program — though the international community has serious doubts as to its being for peaceful purposes; — in Syria due to the civil war the situation of the chemical and biological weapons cannot be arranged¹³ etc.), no conference will be able to realise a WMDFFZ in the Middle East.

Conclusion

The Iran–Iraq war, the first Gulf War and the situation of nuclear non-proliferation in the region all had and still have a great impact on the development of the WMDFFZ initiative. Several other factors could interrupt the process (for instance, a deterioration in the settlement of the Israeli–Palestinian relations) which is closely connected with the development of the security and diplomatic situation of the region.

The postponement of the 2012 conference seems to mark a deadlock in the process, since the participants firmly insist on their viewpoints. The obstinacy can also be explained by the multilateral diplomacy, as it excludes the possibility of real dialogue between the parties. As it was written in the declaration of the US: “Outside states cannot impose a process on the region [...]. The mandate for a MEWMDFFZ must come from the region itself. A comprehensive and durable peace in the region and full compliance by all regional states with their arms control and nonproliferation obligations are essential precursors for the establishment of such a zone”. (Nuland, 2012)

11 The Operation Pillar of Defense was an Israel Defence Forces operation against the Gaza Strip which started November 14, 2012 and ended November 21, 2012.

12 Israel indicated that its country would not participate in the conference. Iran had stated earlier that it is unwilling to have any kind of talk with Israel, and refused to go to Helsinki, but after hearing that Israel would not take part in it, accepted the invitation. According to analysts Iran did it only when it became obvious that the conference would be cancelled.

13 On September 14, 2013 an agreement was reached between US Secretary of State John Kerry and Russian Foreign Minister Sergey Lavrov on Syria’s chemical weapons. The purpose is the total destruction of Syria’s chemical capability. Until now (September 21, 2013) there is no concrete scenario about its implementation.

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Small Countries and Cyber Defence

SHERIFI, Shkendije, G.¹, NAGY Károly²

Cyber security problems pose a particularly important challenge for Small Countries. Their achievements can easily be destroyed by a cyber attack. Therefore, Small Countries cannot rely on the great powers or alliance systems the same way they would in the case of a military threat. A new interpretation of the concept of cyber space creates a new approach to cyber security problems. This new approach and the cooperation with the cyber defence system of NATO facilitate the development of an individual cyber security policy and the support of social development.

Key words: cyberspace, virtual worlds, cyber security, cyber defence, comprehensive approach

Introduction

Cyber security problems are now in the focus of the security efforts of the great powers and international institutions. It is particularly difficult for the so called Small Countries to find a solution to these problems. The expression Small Countries is used for countries which are unable to ensure the realization of one or more basic state functions. Such basic functions are the guarantee of the sovereignty and territorial integrity of the country; providing public education, public services such as law and order etc. The above would imply that small countries are aid economies; but this is not the case. It is true that all aid economies can be regarded as small countries, but countries which need the help of the great powers or an alliance system to ensure their sovereignty or territorial integrity are not necessarily aid economies. There have been other reasons for the introduction of the rather fuzzy definition of small countries as well. We do not want to use the expression aid economy due to our critical view of current international aid delivery processes.³

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3 We have introduced our criticism and discussed the opportunities to be exploited in our study. (Nagy, Karasszon, 2008) Unexploited opportunities result from the fact that aid economies do not have deep rooted institutions; therefore, an institutional system and virtual economic zones based on the latest Information and Communication technology (ICT) developments could easily be established to meet the challenges of globalization. Unfortunately, this is not happening. Donor countries often use aid economies as a dump for their obsolete technology. Opportunities inherent in aid economies to facilitate the development of globalization remain unexploited.

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According to the above definition Afghanistan⁴ or the considerably smaller Kosovo⁵ can both be regarded as SCs. It should be noted that the present study does not discuss the possible SCs. Some specific examples with regard to Kosovo and Afghanistan are only provided to facilitate the better understanding of our argument.

This condition raises special issues with regard to the organization of the defence and security of SCs. We are convinced that there is more at stake than the seemingly negligible local problems of SCs. Due to the global connection of info-communication systems, cyber criminals and cyber terrorists can penetrate these countries, even if only virtually, similarly to al-Qaeda in Afghanistan. If that happens, these centres pose a global threat.³²⁹

The deterrent force of the great powers, the International Community, or an alliance system is able to provide effective defence against armed interventions directed at SCs. Deterrence is based on possible retaliation and/or on rapid reaction, which renders the attack futile from the very beginning. But is it the same in the case of a cyber attack? Apparently not, or not exactly. Assistance may be provided, but what kind of retaliation could be used for deterrence when often it is not even clear who the attacker is, let alone providing evidence for state level intervention?⁶ Cyber attacks are often carried out under a foreign banner through the use of unconventional forces, such as multiple hacker communities⁷. In spite of the disproportionately greater capacities of external defence forces, how could collaboration be possible on an equal footing? Such questions can be answered on the basis of an effective cyber security policy. The objective of our research is to provide a general theoretical and methodological model for the cyber security policy of SCs.

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- 4 According to the NATO Secretary General, by 2014 Afghanistan will be able to guarantee its own security: *“Our current combat mission will be completed by the end of 2014, when our Afghan partners have assumed full responsibility for the security of their country”*. (NATO, 2012a) Accordingly, Afghanistan – if it does not need long term external aid in any other respect- will cease to be a Small Country by our “working definition”
 - 5 There is another situation with Kosovo. The security umbrella of Kosovo is becoming stronger. On one hand, *“the Secretary General made it clear that NATO and KFOR will continue to guarantee security in Kosovo and remain ready to deal with any attempts to undermine the progress that has been made”*. (NATO, 2013a) On the other hand, Camp Bondsteel is carrying out IT developments which might have cyber security aspects as well: *“General Dynamics will provide information technology (IT) support to USAREUR headquarters and its associated staff elements and organizations as part of the USAREUR Theatre Warfighter Command, Control, Communications, Computers and Intelligence (C4I) program. The majority of work will be performed at the USAREUR headquarters in Heidelberg, Germany, at other sites within Germany and at Camp Bondsteel, Kosovo”*. (NATO, 2013a)
 - 6 NATO holds the following view: *“Furthermore, there is virtually no effective deterrence in cyber warfare since even identifying the attacker is extremely difficult and, adhering to international law, probably nearly impossible. Under these circumstances, any form of military retaliation would be highly problematic, in both legal and political terms”*. (NATO, 2011) Some experts believe that such cyber weapons as the Stuxnet fire- and-forget weapon could be used as a deterrent, for they can cause physical damage through a simple data (code) flow. (Lee, 2012) In our opinion, such deterrence is a double edged sword, for *“conceptually location can be grasped as a meeting point, an inter-crossing point of activity fields, connections and vital relations, influences and movements”*. (Castells, 1996: 356)
 - 7 According to J. Davis, *“What is worrying in this regard is the potential nexus between state-sponsored attacks against NATO and non-state armed groups that might be tasked to carry out such an attack... In the cyber arena, there is also the possibility of non-state actor attacks, sponsored by a nation-state, as seems to be the case with recent probes into US and NATO security networks.”* (Davis, 2011)

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Cyber Security Climate Change

Several factors indicate that a different approach is required to reduce the cyber security problems of Small Countries to a manageable level. The priorities of Small Countries should also be determined correctly for them to be able to join international collaboration processes.

Signs of threat

In 2009—2010, a serial was published on the possible consequences of a large scale attack against the United States, referring to an *“Information Digital Pearl Harbour”*⁸. Such warnings are endless. However, relevant NATO statements indicate that they should be taken seriously. (NATO, 2011)

With regard to the most important conditions of defence, a Hungarian study has also been published. (Kovács, Krasznay, 2010) The authors, Kovács and Krasznay, illustrate the threats to the national economy and political system in case of a cyber attack. The magnitude of damage is compared to the biggest tragedy in Hungarian history: the lost battle against the Ottoman Empire at Mohács on 29 August 1526.

In the Introduction by the Rt Hon Francis Maude MP, Minister for the Cabinet Office of the UK Cyber Security Strategy (Cabinet Office, 2011) he wrote: *“the 2010 National Security Strategy rated cyber attacks as a ‘Tier 1’ threat and why, despite a tight fiscal situation, we set £650 million aside over four years to develop our response.”* If cyber attacks are the

‘Tier 1’ threat’ for the UK, it must be the same for SCs, too. However, SCs do not even have a chance to finance their cyber security activities at a level reaching a critical mass.

Cyber security problems have become more serious since the above warnings. For example, Kaspersky holds that *“the world needs to come to an agreement over cyber weapons just like it has with nuclear and biological weapons”* (Parrish, 2012) In July this year, at the G8 summit a US Russian agreement was made about the establishment of a cyber hotline to prevent accidental cyber war. (Gallagher, 2013)

According to our research results, there is a solution for SCs to take effective measures to guarantee their own security and sovereignty and exploit the opportunities which are described in the UK Cyber Security Strategy as follows: *“Our vision is for the UK in 2015 to derive huge economic and social value from a vibrant, resilient and secure cyberspace, where our actions, guided by our core values of liberty, fairness, transparency and the rule of law, enhance prosperity, national security and a strong society”* (Cabinet Office, 2011)

For the efforts of SCs to be successful, positive changes are required in the world. Since SCs cannot do too much to influence the above, it can be regarded as a kind of climate change. Individual countries must adjust to these changes, the development of which can be influenced through global cooperation.

Cyberspace

The theatre of cyber war, envisioned by many, is cyberspace. Despite this approach, we agree with the view held by Libiczki: “*Understanding cyberspace as a warfighting domain is not helpful when it comes to understanding what can and should be done to defend and attack networked systems. To the extent that such a characterization leads strategists and operators to presumptions or conclusions that are not derived from observation and experience, this characterization may well mislead.*” (2012: 322)

For example, the UK Cyber Security Strategy uses the following definition: “*Cyberspace is an interactive domain made up of digital networks that is used to store, modify and communicate information. It includes the internet, but also the other information systems, that support our businesses, infrastructure and services.*” (Cabinet Office, 2011: 11) As we can recognize here cyber space is no longer referred to as a “warfighting domain”.

We start out from our earlier defined concept, which is the following: “*The “medium” carrying the structures of the information society is cyberspace. Cyberspace is the rapidly widening universe of the virtual worlds. We can join cyberspace via local virtual worlds. Cyberspace technology connects the functions of the computer with the abilities of the human.... The age of the information society will arrive when the virtual worlds created by human imagination will be reified on the basis of the achievements of electronic technology, and the participation of people in these virtual worlds becomes wide-spread, general and routine.*” (Nagy, 2001: 107)

According to this approach, the development of society points towards the creation of a global information society. Consequently, in the long run cyber security becomes a central issue for participants joining the virtual worlds. “*A person joining a virtual world is exposed to a considerable number of dangers ranging from a violation of basic human rights to immediate physical or neurological damage. Therefore the operation of virtual worlds involving wide masses requires social conditions in which human and personal rights enjoy a higher protection than they ever did before.*” (Nagy, 1996:151) That is the reason why not much is said about the information society these days. Following 9/11, the development of the information society came to a halt. (Nagy, 2007a: 49)

While approaching the concept of cyberspace from the aspect of virtual worlds might seem utopian, a new challenge to our imagination and problem solving capacities has already emerged. Founded by Russian entrepreneur Dmitry Itskov in February 2011, the project “*The 2045 Initiative*” aims to create technologies enabling the transfer of an individual’s personality to a more advanced non-biological carrier, and extending life to the point of immortality. (Itskov, 2012) The project *The 2045 Initiative* also forecasts the emergence of new dimensions of future, or so called virtual needs in the field of cyber security. It is not yet certain whether this initiative will ever be implemented, but from the point of view of strategic thought development it would be useful to analyse it in depth, through a scientific approach, as to what new challenges we might have to face to ensure the undisrupted survival of the human mind on a technological basis without any mutations. The importance of the above — as discussed by Szabó in detail (1985: 329) — is that if we can satisfy certain future or virtual needs in the present, then some unsatisfied present or effective needs will automatically disappear. Consequently, this kind of strategic view facilitates the effective solution of both present day and future problems.

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A new approach is required

If we consider that the health and lives of people participating in virtual worlds is threatened by cyber security problems, then the interpretation of Kovács and Krasznay seems to lose its validity: “*By attacking information technology systems no losses or only indirect losses are caused in human lives, but the economic and political damages are insurmountable.*” (Kovács, Krasznay, 2010: 45)

In the future the health and lives of people will be directly threatened by cyber security problems, which will eventuate a new view of these problems. The most serious result could be the classification of cyber weapons as weapons of mass destruction. In the virtual worlds they can disrupt the functioning of technological systems and cause health problems. Accordingly, Kaspersky’s recommendation might be reconsidered in the field of the non-proliferation of weapons of mass destruction.

In the field of information and information-communication technology (I/ICT) security, often the most fundamental things are optional. If a car does not meet the relevant technical requirements and specifications in force, it cannot be used in traffic. On the other hand if someone wants to install a fire-wall on their computer, they can do so, but they are not obliged to do so. At the same time, if a computer without sufficient protection is used on the internet, it poses a potential threat to other users as well. In summary the security in ICT systems cannot be optional. Every ICT system must meet internationally set security requirements at production and installation⁹.

1. Changes are required in the following five areas to reduce the complexity of the cyber security problems of Small Countries to a manageable level:
2. Similarly to the prevention of the proliferation of weapons of mass destruction, an international surveillance and

- control system should be established to prevent the development, production and use of cyber weapons;
3. Security in ICT systems cannot be optional. Every ICT system must meet internationally set security requirements at production and installation;
 4. The use of backdoors should be banned by international agreements, and the authorization of exceptional cases should be strictly regulated;¹⁰
 5. The responsibilities of telecommunication, cloud and other service providers concerning the data they receive should be established by international agreements. There should be clear regulations with regard to the provision of data to a third party without the authorization of the client, and the responsibilities for the resulting damages;
 6. In the field of privacy protection, efforts directed at the widespread application of digital signature and of secure digital codenames should be renewed and supported.¹¹

9 One of the objectives of NATO is to develop such a requirement system. (NATO, 2013b) This could be adopted by Small Countries as well, even if they are not NATO members.

10 One of the authors of the present study points out the dangers related to the use of back doors in his former work. (Nojeim, 2012) Nojeim calls efforts directed at the use of back doors and similar applications “backfire policy”. (Chaum, 1992: 426)

11 There were cryptographic applications in the 1990s that provided strong protection in the field of privacy. For example, cryptographic invention known as a “blind signature” was published in 1992. (Kovács, 2009) The importance of the application of cryptographic protocols was pointed out by us in the following publication (Nagy, 1996) (Nojeim, 2012)

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In order to achieve success in c, d, and e, the great powers should deal with “problematic cyber security policies”, or “backfire policies” in their own countries.

Problematic Cybersecurity Policy Ideas

According to Nojeim “*Washington is awash with cyber security policy ideas for Congress to choose among. Some policies are “low hanging fruit” that should have been adopted long ago. But others, including those outlined in this article, could do more harm than good by undermining civil liberties and necessary information sharing, slowing down decision making and moving decision-making authority from the best decision makers, and creating perverse incentives and unexpected economic and systematic impacts, all of which would undermine cyber security.*” (Chaum, 1992: 432)

The paper of Nojeim identifies some of the most problematic cyber security policy ideas, explains how they could backfire, and offers in each case an alternative approach that could accomplish the goals of the policy proposal called into question. It explores proposals to:

- empower the government to block or limit Internet communications on private networks;
- give the Department of Defense the lead cyber security role for civilian government and privately owned critical infrastructure information systems;
- have the government monitor private networks and communications for cyber security reasons; and
- increase the scope of what is lawful electronic surveillance by re-architecting new communications technologies and services to make them more wiretap ready.

Each of these proposals would unjustifiably increase the federal government’s ability to take unilateral action in networks otherwise (and more appropriately) subject to highly distributed governance. According to Nojeim, SCs might be affected by the “Internet Kill Switch” proposal (Chaum, 1992: 409), the “On-Going Information Sharing as a Back-Door to Governmental Monitoring” (Chaum, 1992: 426) and the “Impose Design Mandates on New Communications Technologies to Facilitate Electronic Surveillance” (Chaum, 1992:

429) initiative. Due to the global economic role of the US, the internet Kill Switch might have tragic consequences for SCs because the internet economy would become dysfunctional. The other two, as Nojeim points out, “*could backfire by discouraging the growth of technologies, such as cloud computing, that rely on the privacy of communications*” (Chaum,

1992: 427) and “*can also undermine security because such a database could, itself, become a target for hackers.*”

(ARMS, (1992, 2013)

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Cyber Defence

Let us assume that due to a positive cyber security climate change there is a chance for SCs to improve their security situation. To make these efforts more effective, they should take part within the framework of international cooperation. Such a framework is offered by NATO. Following the introduction of that framework, our suggestions with regard to priorities are made accordingly.

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NATO Cyber Defence

In the present study, as opposed to the concept of cyber security, the concept of cyber defence is not used in general. Instead, we want to refer to the relationship between SCs and NATO Cyber Defence. NATO Cyber Defence is not a reincarnation of information warfare within the framework of NATO¹². These two concepts significantly differ from each other, especially since information warfare is not only defensive in nature.

NATO Cyber Defence is a complex system of collaboration, doctrines, theories and various processes required for the implementation of NATO's Cyber Defence policy. The expression NATO Cyber Defence refers to the totality of the activities of NATO carried out in the interest of cyber security. NATO Cyber Defence is not a model for SCs. SCs should not create a small cyber defence. Instead, they should participate in the cyber security activities of the Alliance. Small Countries should develop and implement their own cyber security policy.

According to NATO Cyber Defence Policy, "NATO's top priority on cyber defence is protecting the communication systems owned and operated by the Alliance. The protection of rational critical infrastructures remains a national responsibility, which requires nations to invest resources in developing their own capabilities. NATO is helping Allies in their efforts to build up cyber defences by sharing information and best practices and conducting cyber defence exercises." (NATO, 2013b) An important source for SCs to create their own critical infrastructure cybersecurity protection plan is the "Executive Order — Improving Critical Infrastructure Cybersecurity". (The White House, 2013)

At the same time it is apparent that NATO integrates the problem of cyber security into a unified system in the name of a comprehensive approach with other areas of defence and security¹³. NATO has developed a wide ranging global collaboration¹⁴ where the organization of collective work has an important role in dealing with cyber security problems. NATO has also established close cooperation with the private sector and the world of academia. The integration of SCs into the Cyber Defence Policy system of NATO will have the following advantages:

- Use of best practice;
- Education and training;

12 In his study "Electronic Warfare and the Asymmetric Challenge" Kovács points out that "information warfare as a term was removed from doctrines in the US and from NATO's documents as well in early 2000." (Kovács, 2009: 137) The term information warfare also included electronic warfare. At the same time, as a result of developments and conceptual changes, Libiczki says the following: "Things did change. The term information warfare, in the process of morphing into "information operations," created "influence operations," which covers psychological operations and concomitants, such as strategic communications. The cyber part of this formulation, computer network operations, married the "cyber" prefix and separated itself completely from matters psychological. Electronic warfare returned to its own aerie. So, at least the term, information warfare, has been rectified." (2012: 336)

13 "However, in today's world, territorial defense must embrace critical infrastructure protection, consequence management, planning to thwart an Electro-Magnetic Pulse (EMP) attack, aspects of energy security and cyber operations". (Davis, 2011)

14 The latest news, that NATO and Colombia signed an Agreement on the Security of Information, is an accord that will allow NATO and Colombia to explore future cooperation and consultation in areas of common interest. The Security of Information Agreement does not formally recognise Colombia as a NATO partner but constitutes a first step for future cooperation in the security field. It will facilitate the participation of Colombia in a number of NATO activities. (NATO, 2013c) The first step in NATO—SCs collaboration should be the conclusion of such an agreement.

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- Comprehensive approach;
- Security requirements based on wide ranging collaboration;¹⁵
- Large scale international collaboration.

The "cyber defence approach" has an additional advantage: even if only implicitly (as we mentioned in the footnote 9), due to its military aspects, it opens a door to electronic warfare, without the knowledge with which any successful cyber security activities are possible. We use the word implicit because the place of electronic warfare has shifted significantly in recent years, and although it seems steadier nowadays, it is not yet been recognized in public NATO documents.

In other words, the Cyber Defence System of NATO is based on consensus, it is clear and offers a global framework for Small Countries within which they can implement their own cyber security policy effectively.

Smart ICT Developments

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Advances in ICT (Information and Communication Technology) such as Cloud Computing and Big Data Applications offer further opportunities to reduce the complexity of cyber security problems.

Cloud is a resilient, distributed parameter system. It hides the target from the eyes of the attacker. The defence of Global Cloud will be established through a global effort. Instead of defenceless and divided users, cyber criminals will have to face gigantic multinational service providers with vast resources. In the cyber security activities of countries emphasis from the control of their own citizens should be shifted to the control of these big service providers.

Cloud Computing and Big Data applications make it possible for SCs to spread their cyber security risks, create new conditions to ensure the authenticity of information, and eliminate unreasonable objections to processes facilitating social development.

In the development of the ICT infrastructure of Small Countries cloud applications have one more important advantage: Small Countries do not get involved in futile and anachronistic hardware and software developments (it is like trying to develop and manufacture a car on your own); instead, they can use their resources to develop user creativity.¹⁶

Cyber Security Knowledge Centre

The study “The Role of Knowledge Centres in Information Warfare” illustrated that the most effective defence in information warfare waged with the assistance of state institutions can, paradoxically, be provided by the network of institutions under civil control; that is, by knowledge centres. (Nagy, 2007b) Nagy, K. (2007) The concept of knowledge centres

15 “NATO will identify its critical dependencies on the Allies’ national information systems and networks and will work with Allies to develop common minimum security requirements.” (NATO, 2013b)

16 Kosovo could be a nice example for the potential of this creativity: “Kosovo Digital Diplomacy Strategy reviewed as one of the best in Europe”. (Kosovo’s New Diplomat, 2013)

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has various definitions, and implementations¹⁷. We can define the concept of cyber security knowledge centres through the following basic functions. These functions illustrate that the Cyber Security Knowledge Centre is different from NATO Cooperative Cyber Defence Centre of Excellence (Nagy, 2009b) and it is different from Computer Emergency Response Teams (CERTs), too.

Developing a new security culture is an essential pre-condition for exploiting the opportunities offered by a network of knowledge centres. (NATO CCD COE)

The functions of the Cyber Security Knowledge Centre (CSKC) are as follows:

1. Fast and efficient output of new knowledge and information required for competent cyber security related policy-making, developments, etc.;
2. Acceleration of the acquisition of practical knowledge required for competent cyber security related policy-making, implementation of policy guidelines and for the identification of specific problems arising in connection with cyber security;
3. Creation, maintenance and continuous improvement of a platform designed for the efficient transfer of knowledge; establishment of foundations with completely new characteristics, to be used in addressing cyber security issues in order to provide best practice methodology.

New Security Culture

In order to gain public support and strengthen the development of social capital, security culture programs should be established. An example for that is the “New Security Culture Programme” launched in Hungary in 2007. (Nagy, 2007c)

The first step for Hungary in the establishment of the New Security Culture Programme was a lecture called “Security of virtual worlds.” (Nagy, 1996)¹⁸ The context of this lecture provided the opportunity to present some aspects of the cornerstones of cyberspace security philosophy. The definition below has become the basic principle for cooperation, also included in the motto of the New Culture of Security Programme (Culture of Cooperation – Cooperation of Cultures): “*The relationship between the “participants” in the cyberspace and the institutions should be one where unilateral control and confrontation is replaced by cooperation based on mutual trust. In order for this precondition to become implementable reality, instead of hopeless and ineffective attempts aimed to control cyberspace communication, institutional resources should be shifted towards cooperation with participating communities and the exploration, localisation and elimination of “black holes” (coalitions with a non-public distribution technique used for the manifestation of partial interests)*”. (Nagy, 1996: 154)

This basic principle was later confirmed by a pertinent OECD initiative with the “force of harmony” (OECD, 2002), a UNO decision based on this (UN General Assembly, 2004) and the “Act on Cyber Crime” (Cornell University Law School, 2002), an act which was passed in the USA in 2002. It should be noted that the OECD initiative advocates the creation of a new culture of security mainly in order to address cyber security problems.

17. Since then, the concept of knowledge centres of similar functionality has been developed for energy security centres. (Nagy, 2009a) The theoretical and methodological background required for the creation of virtual knowledge centres has been published in a renowned scientific journal (Nagy, Körmendi, 2012), and the technological conditions have been developed. (Nagy, 2009b) As a result, they can be established any time.

18 This initiative had another significant scientific background in the work of the co-authors Várhegyi and Makkay too. (2000: 199–206)

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The procreation and the operation of a security culture program require an extensive international cooperation. Its essential part is the cooperation on scientific and technological fields. The above mentioned “NATO framework”

provides excellent conditions for the SCs to develop their own security culture programs.

Privacy

The most difficult task presented is fighting resistance to finding solutions for the protection of privacy. Providing privacy is a social task and it is a basic requirement for the creation of social capital. The protection of privacy is a key issue in democratic legislation and it is the focal point of security culture. Providing privacy requires time and sufficient financial resources. It is important to look at the problem of privacy in a historical context. (Peterman, 1993)

We have arrived at the conclusion that due to the complexity and global impacts of the question, there is only one viable solution for SCs: They should adopt practices used in developed democracies, such as the United States.¹⁹ Privacy and human rights may be restricted for security reasons just like in the US²⁰, but only if SCs can offer the same guarantees as the US. If these guarantees do not exist, privacy should enjoy a priority.

The situation with the privacy in Kosovo is an example, that despite the difficulties these problems could be solved at the highest level: “Over the five past years, Kosovo has made remarkable progress, institutions have been established and consolidated, a very advanced legislation framework has been put in place and there has been a constructive approach to regional co-operation. The government of Kosovo has worked with its full competence and commitment to building strong, accountable and transparent democratic institutions, a professional internationally trained police force, and above all, to promote international human rights standards and community rights that are granted by the Constitution of Kosovo.” (Maddock, 2013)

Conclusions and Recommendations

The only way for Small Countries to deal with cyber security problems successfully is to reduce unmanageable complexities to a manageable level through the implementation of various developments and smart policies. That can be achieved through the application of strategic thinking, a comprehensive approach, an appropriate system concept and brave decisions. Our current analysis were based on our earlier published research results and on information related to the latest challenges and developments. As a result, we have reached the following conclusions:

1. International or global tendencies aiming to strengthen cyber security and the elimination of backfire security solutions should be researched and supported. The opportunities inherent in these processes should be exploited. This will significantly reduce the scope of problems to be solved with the use of own resources;

19 This proposal was first made in 1999, when we thought that certain countries were unable to fight against the insatiable appetite of their security institutions for information. (Nagy, 1999: 182)

20 Today, at the time of the Snowden scandal (Lee, 2013), little is said about the efforts made in the US to resolve the conflict between privacy rights and the collection of information to counter terrorist activities. It is enough to mention the National Strategy for Trusted Identities in Cyberspace (The White House, 2001), or the NIST Grants (PBA, 2012), which well illustrates these efforts.

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2. Efforts directed at the use of backfire policies by internal or external interest groups should be resisted. In order to recognize such policies and counter the various types of pressure applied, scientific means available for the acquisition of information, analytical methods and wide ranging international collaboration should be applied. That will protect the governments of Small Countries from unnecessary losses, dangerous solutions and serious security risks. One should be able to say “no”, which is not always easy for small and therefore exposed countries;
3. ICT and cyber security developments should be integrated into a unified system. The purchase of services and the exploitation of the opportunities offered by cloud computing should be preferred to investments. The availability of service based ICT infrastructure should be supported by appropriate regulation, standardization, control, and good contracts. This will both reduce ICT and security costs and place the burden of the security problems of Small Countries on the shoulders of large multinational service providers with a much wider range of resources;
4. The solution of cyber security problems should be supported through the establishment of specialized knowledge centres and security culture programs;
- 338 5. Regardless of internal political conditions, international collaboration in the field of cyber security should be integrated into the collaboration system of NATO Cyber Defence. ARMIS (12) 2 (2013)

In order to successfully deal with their cyber security problems, Small Countries should apply the following schemes:

- Minimize the scope of problems to be solved with own resources through appropriate ICT developments, outsourcing, purchase of services, and the development and use of secure systems;
- Spread the remaining problems among authentic domestic and international security collaboration systems;
- Avoid wrong directions, fake solutions, anachronistic developments and backfire solutions and recognize risks that cannot be covered through sensible expenditure, aiming at appropriate contingency planning.

The realization of the above depends mainly on professional competence and the persuasion of supporting foreign powers and domestic political forces instead of the use of financial resources. In this work, the most important supporter of Small Countries is the public. The support of the public can be gained through the use of privacy policies, which are

in accordance with the Universal Declaration of Human Rights. If Small Countries enter the mire of secrecy for security reasons, they can only loose.

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Changes in terms of metabolic syndrome, its occurrence in the civilian population, and in Hungarian and foreign military organizations

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Obesity again has become the center of attention due to its growing incidence experienced in the last decade and its strong coherence to cardiovascular diseases. Especially abdominal obesity together with dyslipidemia featuring hypertonia, hyperglycemia, high level of triglycerides, and low level of HDL³ cholesterol accounts for cardiovascular risks. The independent and comprehensive term metabolic syndrome is used for their frequent collective occurrence and combination. In the past years, the term cardiometabolic risk was created by considering other cardiovascular factors besides the components of the syndrome.

Increase in the number of the obese was observed in military organizations worldwide, too. Parallel to obesity, there is a growing number of both professional and contracted servicemen in the Hungarian Defence Force exposed to the increased danger of cardiometabolic disease according to the metabolic syndrome criteria's. The efficient reduction of cardiometabolic risk is possible with appropriate prevention strategies. The population's primary and secondary prevention starts in primary care with the involvement of family doctors, but it is also a fundamental responsibility in the military healthcare system in order to preserve a force fit to fight. Keywords: obesity, metabolic syndrome, cardiovascular and cardiometabolic risk

Obesity, especially abdominal obesity is a risk factor relating to cardiovascular diseases and diabetes mellitus type II. It often collocates with high blood pressure, hyperglycemia, and dyslipidemia characterized by an increased level of triglyceride and low level of HDL cholesterol. Their collocation or combination is called metabolic syndrome. (Alberti et al.,

2009) According to the data, including all European countries and recently published by the World Health Organization⁴, death caused by cardiovascular diseases account for more than half of all death, even more than tumors and chronic respiratory illnesses. (WHO, 2009) Hungarian mortality figures indicate the same, although death caused by chronic liver diseases occurred more than death by chronic respiratory illnesses in 2009 (Table 1.).

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3 high-density lipoprotein

4 WHO

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	2009	2011
Total Death caused by the most frequent diseases	130 414	128 795
Malignant tumor	32 536	32 670
Severe necrosis of the heart muscle	7 709	7 085
Other cardiovascular diseases	25 477	26 145
Cerebrovascular disease	14 145	13 369
Chronic respiratory illness	4 734	4 843
Chronic liver disease	5 080	4 146

Table 1. Age-standardized mortality rate by main causes of death in 2009 and 2011, based on data of KSH⁵

IDEA⁶ was a large, international, cross-sectional research, including 63 countries, to analyze the data of 168,000 patients of primary care. Based on the results, waist measurements and geographical distribution obesity was evaluated.

The conclusion was as follows: waist measurement besides BMI figures is a valuable marker for cardiovascular diseases and diabetes mellitus type II. In the Eastern European region, cardiovascular diseases occurred with outstandingly high frequency both among men (27%) and women (24%), unlike in other regions, where these figures were between 8% (Canadian women) and 16% (Northern European men). Diabetes mellitus has shown more regional differences than cardiovascular diseases. Other than the East Asian (cardiovascular diseases) and the South Asian (diabetes) region, both diabetes and cardiovascular diseases are experienced more among men than women. The age-standardized occurrence of diabetes mellitus was the highest in the Middle East (men: 22%, women: 19%), in Northern Africa (men: 19%, women: 16%), and South Asia (men: 17%, women: 18%) (Balkau et al., 2007)

- 5 Central Department of Statistics, http://www.ksh.hu/docs/hun/xstadat/xstadat_aves/i_wnh001.html (downloaded: 20 05 2013)
- 6 Internal Day for the Evaluation of Abdominal Obesity

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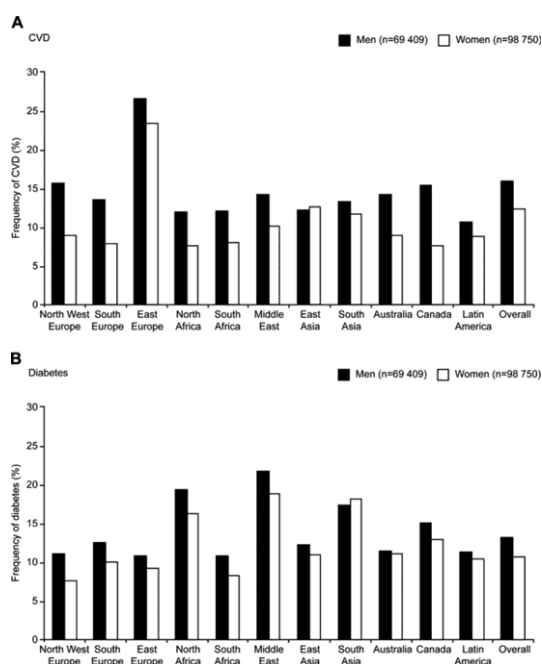


Figure 1. Age-standardized frequency of cardiovascular diseases and diabetes mellitus by gender within the different regions of the world (Balkau et al., 2007)

Due to the large amount of research in the past decades, the set of symptoms — collo- cating with insulin resistance/glucose intolerance, dyslipidemia, and hypertonia — called X syndrome and described by *Reaven* in 1988, has been broadened by several new elements.

In the possession of the newest scientific results, the significant international scientific associations, like the WHO (1998), the American NCEP⁷-ATP-III (Adult Treatment Pan- el-III, 2001), and the IDF⁸ (2005) have repeatedly modified the criteria system of metabolic syndrome:

- Primary conditions have been changed (e.g. abdominal obesity was not an indispens- able condition in 2001);
- Certain limit values have been tightened (e.g. in relations with high blood-pressure, or blood lipid-level);
- A set of symptoms has been linked to other pathographies (e.g. sleeping apnoe syn- drome, polycystic ovarian

syndrome, etc.) (Nádházy et al., 2008)

These slightly differing criteria systems were in use until 2009, when a unified attitude was accomplished at the Conference of Harmonization.

- 7 National Cholesterol Education Program
8 International Diabetes Federation

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International Associations Criterias
WHO (1998) <ul style="list-style-type: none">• Carbohydrate metabolic disturbance (blood sugar level on empty stomach $\geq 6,1$ mmol/l) and/or insulin resistance are primary conditions, And the measurement of other two risk factors: <ul style="list-style-type: none">• serum triglyceride level $> 1,7$ mmol/l and/or HDL-cholesterol $< 0,9$ mmol/l,• rate of waist/hip measurements $> 0,9$, or BMI > 30 kg/m²,• blood-pressure $\geq 140/90$ Hgmm, and consumption of antihypertensive drugs,• microalbuminuria.
NCEP-ATP-III (2001) <p>To assess abdominal obesity, only the waist-diameter is considered, BMI is not. Conditions of the diagnosis need to include three out of the five factors below:</p> <ul style="list-style-type: none">• blood sugar level on empty stomach $\geq 6,1$ mmol/l;• waist-diameter of men > 102 cm, of women > 88 cm;• serum triglyceride level $> 1,7$ mmol/l;• HDL-cholesterol decrease (men: $< 1,0$ mmol/l, women: $< 1,3$ mol/l);• blood pressure $\geq 135/85$ Hgmm.
IDF (2005) <ul style="list-style-type: none">• <i>besides</i> abdominal obesity (men: > 94 cm, women: > 80 cm, European limit value), further two primary conditions are needed for the diagnosis:• serum triglyceride level $\geq 1,7$ mmol/l;• HDL-cholesterol decrease (men: $< 1,03$ women: $< 1,29$ mmol/l);• blood pressure $\geq 130/\geq 85$ Hgmm;• blood sugar level on empty stomach ≥ 5.6 mmol/l or diabetes mellitus type II. diagnosed earlier.

Table 2. Shift of stress in defining metabolic syndrome between 1998—2005

In 1988, the WHO defined carbohydrate metabolic disorder (blood sugar level on empty stomach $\geq 6,1$ mmol/l) and/or insulin resistance as primary conditions to diagnose the syndrome. The definition formed by NCEP-ATP-III in 2001 is the most extensively applied criteria system. It considered only the waist diameter to evaluate abdominal obesity, but not the BMI.

The criteria system defined by IDF in 2005 already included abdominal obesity as a primary condition. This was the first instance that attention was called to the ethnic diversity of increased risk factor rating by the waist diameter. (Zimmet, Alberti, 2006)

In 2009, at the "Conference of Harmonization" a unified position and criteria system was set up by reconciling the results of former research (Alberti et al., 2009) and the following consensus was reached:³⁴⁵

- Metabolic syndrome is a sum of risk factors relating to cardiovascular diseases and diabetes mellitus type II. These factors can be the following: hyperglycemia, high blood pressure, elevated triglyceride level, low HDL cholesterol level, or obesity (especially abdominal obesity);

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- Risk factors occur more often together than separately (and the reason is often unexplained). The syndrome is the sum or the combination of these risk factors;
- The syndrome is widespread and shows growing frequency worldwide. This tendency is closely bound up with rising obesity and inactive lifestyle;
- An agreement has been reached that abdominal obesity is not a compulsory condition, but the measurement of waist-diameter continues to be a useful pre-screening tool. Three existing terms out of the five risk factors supports the diagnosis of metabolic syndrome. The international associations have accepted the same limit value,

except the value of the waist diameter, for which different limit values are suggested per ethnicity and global region;

- The most extensively accepted risk factors of the metabolic syndrome include the following: atherogenic dyslipidemia, high blood pressure, and hyperglycemia. Atherogenic dyslipidemia is the sum of lipoprotein disorders, such as the elevated level of serum triglyceride and apolipoprotein-B, increased LDL⁹ level and decreased HDL level. Most of the patients suffering from metabolic syndrome also have abdominal fatness and insulin resistance;
- Metabolic syndrome is not an absolute risk indicator since it does not include many of the absolute risk terms like age, gender, smoking, positive family anamnesis, physical inactivity, LDL and total level of cholesterol. These terms altogether with the risk factors of metabolic syndrome are referred to as cardiometabolic risk. However, metabolic syndrome in itself without the other risk factors can double the instances of cardiovascular diseases and fivefold the instances of diabetes mellitus type II in 5–10 years. (Alberti et al., 2009)

The term cardiometabolic risk

The systems (Faringham, SCORE) that are created to estimate cardiovascular risk and based on the specifications of both the cardiovascular risk deriving from the components of the metabolic syndrome and the traditional risk factors — like age, gender, smoking, blood pressure, total cholesterol level — often underestimate the cardiovascular risk of individuals with medium risk-level, especially of women. (Benczúr, 2008) Therefore it is accepted that all risk factors need to be considered, meaning that besides the criteria of the metabolic syndrome the importance of other cardiovascular (absolute) risk factors — like age, gender, smoking, positive family anamnesis, physical inactivity, LDL and total cholesterol level — is indisputable. All these together need to be considered to assess the prognosis. These changes of approach led to the creation of the term “cardiometabolic syndrome”. (Després, Lemieux, 2006) Accordingly, an individual having at least three of the “traditional” risk factors (smoking, abdominal obesity, hypertonia, hypercholesterolemia and/or high LDL-cholesterol and low HDL-cholesterol level) and at least one of the “residual” risk components can be considered a person with high risk-level, even if the individual’s SCORE value is less than 5% (medium risk-level). (Farsang, 2012):

- cardiometabolic disorder (increased blood sugar level on empty stomach, impaired fasting glucose – IFG or impaired glucose tolerance – IGT);

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- increased blood sugar level on empty stomach, postprandial triglyceride level;
- high uric acid level;
- obstructive sleeping apnoe;
- chronic obstructive pulmonary disorders;
- erectile dysfunction;
- insulin resistance;
- indicators of inflammation and prothrombotic state;
- presence of atherogenic lipoproteins.

In accordance with the agreement of the Harmonization Conference, the Hungarian criteria system to diagnose metabolic syndrome was defined by the principles of the 5th Hungarian Cardiovascular Consensus Conference:

- abdominal diameter > 102 cm for men, > 88 cm for women;
- serum triglyceride level > 1,7 mmol/l, or being under treatment;
- a HDL-cholesterol < 1,0 mmol/l for men, < 1,3 mol/l for women;
- or being under treatment;
- blood sugar level on empty stomach > 5,6 mmol/l or diabetes mellitus type II. Identified;
- blood pressure \geq 130/85 Hgmm.

⁹ low density lipoprotein
Three existing criteria out of the five listed above verify the metabolic syndrome and there is no difference among the importance of each criteria. (Szollár et al., 2012)
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Pathogenesis of metabolic syndrome

The importance of many pathogenic factors is emphasized in the development of the metabolic syndrome. According to a point of view, *abdominal (visceral) obesity* is the deciding factor. (Fabbrini et al., 2010) The increase of the abdominal adipose tissue is significant from not only the energetics aspects, but it is also the “mobilizing” organ of general endocrine, when the adipose tissue outflow of several hormone, inflammatory and thrombogenic mediators produces the low-level inflammation – the essence of the syndrome – and all of its consequences. (Szollár, 2010)

Insulin resistance

In 1939, *Hinsworth and Kerr* experienced a smaller effect in one third of the cases when insulin was administered to their patients with diabetes, meaning that these patients had reduced insulin sensitivity. Insulin resistance can be defined as a state of having smaller than regular biological response to a regular dose of insulin. Insulin takes its biological effect primarily in the adipose tissue, the muscle tissue, and the liver. Therefore insulin resistance can develop in these organs and tissues. According to the assumptions, insulin resistance is developed first in the adipose tissue; insulin resistance of the muscle tissue and the liver is a consequence. (Urich, 2005)

By increasing insulin resistance, vasoactive substances, hormones, and cytokines produced by the adipocytes facilitate the development of VLDL¹⁰ in the liver, therefore it boosts the accumulation of lipoproteins rich in triglycerides. In addition, the decomposition of li-

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poproteins rich in triglycerides decreases due to the reduced activity of lipoprotein lipase. (Harangi, Paragh, 2008) The outflow of adipose acid from the fat cells in the insulin-resistant adipose tissue is increased by the decreasing lipogenesis and the boosting lipolysis. Although the primary reason of insulin resistance of the skeletal muscle and the liver is the higher concentration of FFA¹¹; the hormones produced by the adipose tissue, the adipocytes (leptin, resistin, adiponectin), and the inflammatory mediators (e. g. TNF- α , IL-6) also significantly impact the insulin sensitivity of the liver and the muscle tissues.

Leptin is produced in larger amounts in the subcutaneous adipose tissue and it regulates the energy homeostasis. Thanks to the leptin, the plasma's FFA-level is reduced, that protects the cells from lipotoxicity. In case of obesity, the plasma's FFA-level grows, that refers to leptin resistance. The increased leptin-level correlates with the visceral obesity and the insulin resistance. The growth of resistin, IL-6, and TNF- α -level boosts the insulin resistance. Adiponectin — a favorable anti-inflammatory hormone — improves the oxidation of adipose acid, reduces the level of triglyceride, and boosts the glucose metabolism by increased insulin sensitivity. (Urich, 2005)

The occurrence of metabolic syndrome and the significance of cardiometabolic risk in the military

The number of servicemen meeting the criteria of metabolic syndrome in NATO and the NATO armies has grown parallel to obesity. (Ceppa et al., 2008), (Costa et al., 2011) The middle-aged force is affected mainly, similarly to the civilian population of countries with advanced industry where the frequency of metabolic syndrome was already 20–30% in the

90's. *Kaffka and his team* (Kaffka et al., 1999) researched a German flight navigator crew of almost 10,000 members to evaluate the risk of the occurrence of metabolic syndrome. They defined the frequency of obesity, hypertonia, and dyslipidemia as individual risk factors, or their combination. The military and the civilian control group of the flight navigator crew were evaluated to be in good condition from the aspect of metabolic syndrome occurrence and no significant difference was found between their states of health. They found this to be the result of regular and a high-level of medical check-ups.

According to a French study from 2008, that examined the anthropometric data and lab results of servicemen aged 20–58 (n=2045), it was found that those meeting the criterias of metabolic syndrome had higher BMI and waist diameter (BMI average 29.5 \pm 3.4 kg/m², waist diameter average 103 \pm 10 cm). Individuals with no risk of metabolic syndrome had average BMI of 24.8 \pm 2.9 kg/m², and average waist diameter of 88 \pm 9 cm). (Ceppa et al., 2008)

A study carried out among American trainees presented results that the occurrence of 30 kg/m² BMI was around 14% and the frequency of smoking was around 30%. Comparing these results to previous data, it was found that the trainees are less fit physically and have excess weight, which derives from obesity. (Pasiakos et al., 2012)

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¹⁰ very low-density lipoprotein

Cardiometabolic risk in the military forces of the Hungarian Defense Forces AARMs (12) 2 (2013)

The cardiovascular risk factors, like smoking, physical inactivity, and BMI level in the representative sample of the contractual and the professional forces of the Hungarian Defense Forces are as follow (the control group included Hungarian civilians older than 15):

	Never smoked		Currently smoking		Abandoned smoking	
	Men	Women	Men	Women	Men	Women
Civilians (n=1179)	35	59.8	36.9	24.6	24.5	12.4

Servicemen (n=4247)	43.9	51	33.9	31	22.2	18
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Table 3. Frequency of smoking (%) by gender of civilians older than 15 (ELEF, 2009*) and servicemen older than 18 (source: medical check-ups in)¹²

The table presents that the rate of non-smokers is almost two-times higher among women than men. The rate of female smokers is higher among servicemen than civilians.

Physical activity was evaluated through questionnaires. According to the answers, servicemen are more active physically than the Hungarian civilian population. A quarter of the servicemen and half of the civilians do not do any kind of sport activities. 25% physical inactivity was measured among servicemen — meaning that a quarter of the soldiers do not do sports or exercise regularly — is very high compared to the physical expectations (Figure 2.).

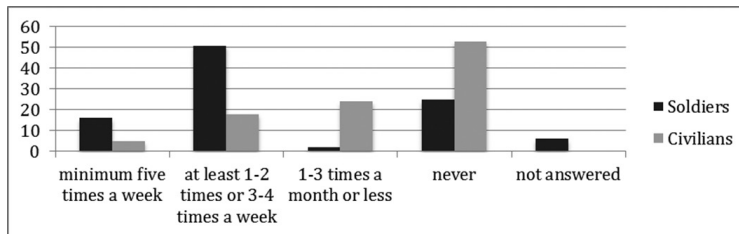
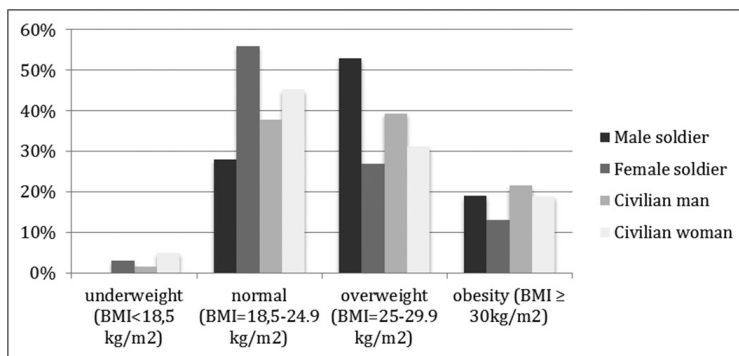


Figure 2. Indicators of physical activity (regular exercise and sport) among individuals older than 30 in the Hungarian Defense Force in 2011 and individuals older than 15 in the Hungarian population in 2010* (servicemen and civilians) (Eurobarometer, 2010)

Obesity occurs a lot among foreign and national military forces. Abdominal obesity in the staff of the Hungarian Defense Forces often goes together with high blood pressure — the most frequent health issue requiring medicinal therapy, — hyperglycemia, and dyslipidemia (Figure 3.). Women in the military have the most satisfactory BMI, better than civilian women have. In the military sample of ages older than 30, there are no slim men and only a few women, which means that body weight increases by age. Most of the men with excess weight belong to the military, however on the bases of BMI it is impossible to differentiate between greater weight of muscle and true obesity. Civilian men and women are more overweight.

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The information value of the data collected is limited because active servicemen at fit-to-work age are compared to civilians, which has a significant rate of individuals older than 65.



12 Medical check-up of the European population (ELEF) 2009. Data of the Central Statistics Department of the Hungarian Defense Forces based on a health-check carried out in 2011
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Summary

The first step of cardiovascular illness prevention is to define the risk status, for which using the SCORE table — considering the samples of the European population — is still recommended. (European Guidelines, 2012) The table presents the possibilities of fatal cardiovascular disorders expected in the next 10 years by age, gender, systolic blood pressure, smoking, and serum cholesterol level. The relative exposure based on the same age and parameters can be defined individually. The prevention team includes the family doctor, who filters the individuals with exposure, prepares risk assessment, and takes care of further treatment. Following the complementary non-invasive cardiology

examinations, the cardiologist sets the medicinal therapy and prepares intervention if necessary. Prevention needs to include communication towards the population and education. Hungary is one of the countries with high-risk, therefore the table in accordance (Vértes, 2013) is recommended to be used.

Based on the cardiometabolic risk factors, servicemen are more exposed despite the positive physical activity indicators. To reduce this risk, primary and secondary prevention is a fundamental task in military health-care as well in order to maintain capable forces.

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Recognition of Initiative in an Infantry Company's Battle Exercise to Support Tactical Overall Analysis

SORMUNEN, Jari¹, ESKELINEN, Harri²

The scientific goal of this paper is to demonstrate, from the viewpoint of tactical overall analysis, how different quantitative (e.g. distribution analysis) and qualitative research (e.g. text analysis) methods could be used to support the traditional ways (tactical maps and event catalogues) of analyzing tactical phenomena — in this case the initiative in a battle — and how different types of instruments could be utilized and developed (e.g. NASA-TLX) for analyzing subjective human factors during the battle — in this case especially the feeling of having initiative. In this paper, as an example, numerical values are calculated to determine whether there is a correlation between the casualty ratio and initiative. The results are verified based on battle space situation pictures. In addition, the analyses of distributions describing the variation of the feeling of one's own force and of the adversary of having the initiative are used to support the results showing which fighting side has the initiative.

Keywords: Military tactics, tactics, infantry, company, attack, initiative

Background and Introduction

The tactical basic research, “Success Factors of Company Attack” (SCA–research), which was carried out in the Finnish Defence Forces (FDF) during the years 2004–2007 forms the empirical background of this paper. The SCA–research focused on analyzing different individual effects of selected measurements explaining variables. The variables were selected from the areas of tactics, situational awareness, battle task load, human factors, background factors and response variables. During this research, 59 attack exercises by infantry companies were analyzed.

Table 1. shows the extent of the SCA–research. The research material included the results of soldiers' interviews after each attack exercise, questionnaires filled out by the soldiers at seven measurement (progress) levels of the attack, tactical maps, event catalogues and written reports prepared by the data collectors.

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Qualitative analysis	Quantitative analysis	Integrated tactical analysis
614 written reports	≈ 22000 distribution analyses	≈ 2100 calculated characteristics
590 tactical maps	≈ 101 000 correlation calculations	≈ 300 tested classifications of success factors
118 event catalogues	≈ 32 000 mean value analyses	≈ 30 variable groups
		≈ 130 measured variables
		≈ 130 observed factors

Table 1. Extent of the SCA research.

The initial situation of the attack exercise is illustrated in Fig. 1. The blue infantry company is attacking the red regiment's headquarters (see the large ellipse in Fig. 1). The battle task was to beat the red units.

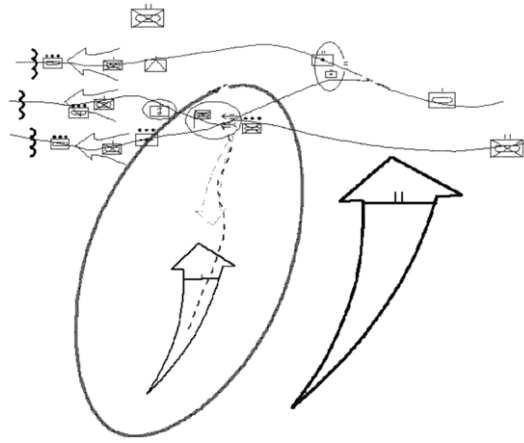


Figure 1. The initial situation of the attack exercise, edited from Sormunen and Eskelinen (2010).

It is necessary to present briefly some key results of the SCA–research to fully understand the scientific approach of this article. Firstly, the questionnaires filled out by the soldiers showed that in the seven most successful attacks, the leaders had a different overall picture of the battle compared to the seven most unsuccessful attacks. The leaders of the successful attacks felt more strongly that they had the initiative, they were less nervous; they assumed that their own forces were more powerful compared to the adversary’s forces and they did not feel to be much in a hurry to give their orders and take action. (Sormunen, Eskelinen, 2010) Fig. 2 illustrates the largest differences between the measured variables in successful and unsuccessful attacks. The interesting observation is that both the leaders’ and soldiers’ answers in the interviews and questionnaires indicate the significant role of initiative in the success of the battle (see the black bars in Fig. 2).

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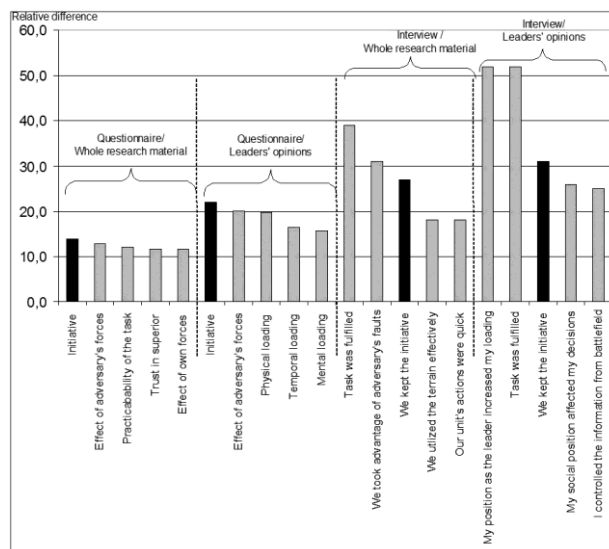


Figure 2. Main results from the background research indicating the significant role of initiative in the success of the battle, results collected from Sormunen and Eskelinen (2010).

This brief review of the SCA–research gives us the justification to study further whether it is possible to recognize the initiative somehow from the battle space and if so, what relationships and connections can be found between different tactical variables and initiative. There are at least three interesting aspects: First, what is the connection between the timing of the tactical actions and initiative? Second, what is the connection between the casualty ratio and initiative? Third, can we just trust the soldiers’ feeling of having initiative or do we have to recognize initiative in more objective ways?

The research material used in this paper consists of 590 schematic and illustrated tactical maps to describe the situation and 118 event catalogues to describe the actions taken in the battle space. Also 103 written reports and numerical values of 118 measured tactical variables and perceptions of 130 observed factors were utilized to compose this paper (Sormunen, Eskelinen, 2010).

Tactical Viewpoint and Research Methods

In the literature dealing with tactics, e.g. (Rekkedal, 2006), (Kesseli, 2001) the FDF regulations and field manuals, e.g.

(Komppanian taisteluohje, 2008), (Prikaatin taisteluohje, 1984) and in recent tactical research (Huttunen, 2010), initiative is regarded to have an essential impact on the success of a battle. In the literature dealing with tactics (Kuusisto, 2004), in the FDF regulations and field manuals (Komppanian taisteluohje, 2008), (Prikaatin taisteluohje, 1984) and in tactical research, e.g. (Huttunen, 2010), (Lind, 1985) situational awareness is also regarded to have an essential impact on the success of a battle. The SCA research showed that the largest differences between the values of measured variables were found in the mean values of initiative in successful and unsuccessful attacks.

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To be able to define the critical time windows for the analyzed tactical actions and to recognize initiative, the observation points and verifiable time delays were needed for the state space model. The first observation point was set to the battle engagement moment of the company. The second observation point was set to the start of the weapon effect. Two time intervals were determined from the background data between these two observation points. The first time interval covered the time which the leader used to decide and order the actions. The second time interval covered the time used to perform the actions to start the weapon effect. The tactical analysis of initiative produced three types of information about the differences recognized between the initiatives of the infantry company and its adversary:

- Separated or individual actions indicating initiative
- Continuous flow of action indicating initiative
- The feeling of having initiative.

The dependency of initiative on the fulfilment of the battle task and the suffered casualties was defined by establishing probability values of initiative and the corresponding casualty ratio at each measurement level. The next step was to calculate if the advantageous initiative indicates a positive progress of the casualty ratio with a high correlation.

The phenomenon of changes in initiative was studied from the Battle Space Situation Picture (BSP) series of successful and unsuccessful attacks. It was also studied whether the observations from the BSP together with the quantified results from the written reports supported each other. The final step was to compare whether the real initiative led to success in the battle.

Analyzed Written Observations

As the background information from the SCA research has shown, the leaders' and units' initiative greatly affected the performance of the unit. Therefore, it was justified in this paper to collect results which deal with the connection of initiative and the success of an attack. The written reports were analyzed based on the traditional qualitative method illustrated schematically in Fig. 3.



Figure 3. Qualitative method to analyze the written reports

The analyzing method applied produced three types of information about the recognized differences between the initiatives of the infantry company and its adversary:

- The feeling of having initiative
- Separated or individual actions indicating initiative
- Continuous flow of action indicating initiative.

By quantifying the written observations collected by the data collectors during the SCA research, three main results were achieved. Approximately 39% of observations dealt with such aspects as "initiative was taken", "was kept", "was developed" or any other "positive" phenomenon connected with initiative. A typical observation was "The attacker aimed to take and keep the initiative and succeeded well in this". Roughly 41% of observations dealt with such aspects as "initiative was lost", "was not utilized", "was wasted" or any other "negative" phenomenon connected with initiative. A typical observation was "Now the initiative was

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given to the defender and the defender was able to stop the adversary's attack with a small amount of soldiers". In approximately 20% of observations, it could not be established which fighting side had the initiative. A typical observation is "The initiative alternates significantly between the yellow and blue side".

Aspects Dealing with Time and Timing

To integrate the quantitative data and the previous qualitative background information to support the evaluations made in this paper, we had to determine the most important aspects dealing with time, timing or speed connected to the initiative based on the written reports by the data collectors. The principle is illustrated in Fig. 4. We must take into account the entity and the time window in which the action should be carried out: tactically justified action in the battlefield based on initiative requires exact timing and enough speed to succeed in the battle.

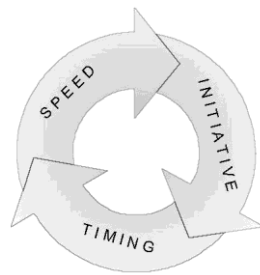


Figure 4. Connection between initiative, timing and speed.

During the qualitative analysis, the following question was discussed: What words and expressions were used to describe time aspects, timing, relative speed and initiative? Based on the written reports of the analyzed attack exercises, some examples of expressions dealing with time, timing and speed are presented in Tables 2 and 3.

Timing type	Examples of collected observations during the research
Type 1	“Indirect fire was received at the right time”
Type 2	“At these positions, the culmination of the battle is reached by utilizing well-timed and appropriate situational evaluation of the adversary and one’s own forces”
Type 3	“The battle plan of the COY is determined based on the accuracy and real timing of the reconnaissance information”
Type 4	“In an attack where timing was linked to zero hour, time was wasted in waiting at the footing and initial attack position levels”
Type 5	“In the attack, the (trained) manoeuvre was quick, but the manoeuvre was carried out too late”
Type 6	“In a battle where tactics were selected freely (tactics C), the delay in command and control led to a delay in the main part of the unit manoeuvre”
Type 7	“PLTs did not take action until the adversary had acted, and even then the PLTs reacted slowly”

Table 2. Examples of expressions dealing with time and timing.

Speed type	Examples of collected observations during the research
Type 1	“The STPs, together with the leader’s insufficient orders, reduced the speed of advance”
Type 2	“Surprise together with high situational speed was emphasized in our own actions because the purpose was not to lose the advantage gained”
Type 3	“It should be possible to adjust the speed of action flexibly during an attack”
Type 4	“The option of utilizing the tactical speed of tanks was not utilized properly”
Type 5	“The FCC and COYCOM evaluated the speed of advance of the COY in the (current) terrain”

Table 3. Examples of expressions dealing with speed.

From the entire research material, seven types of timing dealing with battle situations of analyzed attacks could be found. In addition to this, the classification of the qualitative analysis produced five types of speed which are relevant for analyzing different tactical phenomena connected with the time window in which the tactical action should be carried out to lead to success in the battle.

Based on the results, the seven different types of timing are as follows:

- Type 1: Well-timed actions
- Type 2: Timing of situational evaluation (Well-timed evaluation)
- Type 3: Knowledge-based timing of actions (Acting in real-time)
- Type 4: Ineffectiveness in timing (Time is wasted on secondary actions)
- Type 5: Timing or time ratio dealing with trained and unexpected situations
- Type 6: Timing (time delays) of command and control chains
- Type 7: Timing of action of one’s own force which is forced due to the adversary’s actions.

The five types of speed which are relevant for analyzing different tactical phenomena are

as follows:

- Type 1: Absolute (max./min.) value of the action
- Type 2: Speed of the action combined with the surprise effect
- Type 3: Adjustable speed or flexible speed adjustment based on the battle situation
- Type 4: Tactical motion speed
- Type 5: Estimated speed for a manoeuvre or an action.

The evaluation criteria are constructed from the previous twelve items for analyzing aspects which deal with time, timing, the speed of actions and initiative. The literature dealing with tactics contains qualitative results that support these observations. For example, Rekkedal (2006) has proposed a connection between the leader's will to take initiative and its effects on the timing aspects of a battle.

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Soldiers' Feelings of Having Initiative

In the SCA research, soldiers' feelings of having initiative were measured by questionnaires and interviews. The results showed that the distributions of the results, which indicated that the soldiers on both fighting sides had feelings of initiative, partly overlapped (National Defence University, 2009). It is therefore interesting to study if the quantified results from the qualitative analysis of the written reports from the SCA-research support this finding of overlapping distributions.

In the background research, the soldiers of both fighting sides were asked to evaluate their own feeling of having initiative at each measurement level of an attack by marking a point on a line 100 millimetres long indicating the strength of their feeling (see Fig. 5). With this measurement arrangement, quantified data was collected continuously. This way to produce quantified and scaled data made it possible to carry out the mathematical analysis dealing with the feeling of having initiative.



Figure 5. Measuring and quantifying the data dealing with the soldiers' feeling of having initiative.

The NASA Task Load Index (NASA-TLX), presented originally by Hart and Staveland (1988), is a subjective, multidimensional assessment tool that rates perceived workload on six different subscales: Mental Demand, Physical Demand, Temporal Demand, Performance, Effort, and Frustration. Twenty-step bipolar scales are used to obtain ratings for these dimensions. A score from 0 to 100 (rounded to the nearest five) is obtained on each scale. A weighting procedure is used to combine the six individual scale ratings into a global score; this procedure requires a paired comparison prior to the workload assessments. Paired comparisons require the operator to choose which dimension is more relevant to the workload across all pairs of the six dimensions. The number of times a dimension is chosen as more relevant is the weighting of that dimension for a given task for that operator. A workload score from 0 to 100 is obtained for each rated task by multiplying the weight by the individual dimension scale score, summing across scales, and dividing by 15, which is the total number of paired comparisons. (Rubio et al., 2004) Based on the observations of one of the developers of NASA-TLX (Finomore et al., 2009), the use of NASA-TLX has spread far beyond its original application area and focus during the past 20 years. In this paper, just the principle of measuring the level of the feeling of having initiative is adopted from the NASA-TLX method.

A number of tools for the evaluation and prediction of mental workload exist. Most of these methods fall into the three following categories: performance-based measures, subjective measures, and physiological measures. The performance-based measures are grounded on the assumption that any increase in task difficulty will lead to an increase in demands, which will decrease performance. Subjective procedures assume that an increased power expense is linked to the perceived effort and can be appropriately assessed by individuals. Physiological indexes assume that the mental workload can be measured by means of the level of physiological activation. (Rubio et al., 2004)

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Different types of instruments could be utilized for analyzing subjective human factors, e.g. vigilance under different workloads. For example, Finomore et al. (2009) have compared the output of the Multiple Resources Questionnaire (MRQ) and NASA-TLX in different task types and operating environments. In this comparison, the MRQ indicated that the workload was greater when observers operated in a multi-task environment as compared to a single-task environment, a dimension to which the NASA-TLX was not sensitive. In this paper, only the NASA-TLX principle to measure the feeling of having initiative has been utilized, and therefore, all of the evaluation criteria of the original NASA-TLX method must be adjusted. These types of restrictions must be understood when evaluating the observations presented in this paper.

For tactical analysis, it is necessary to establish which fighting side has the initiative at each moment of the attack

and how strong the initiative is. This is carried out by calculating the size of the overlapping area of the two distributions at each measurement (progress) level of an attack describing the variation of the feeling of having the initiative of one's own force and of the adversary (see Fig. 6). The probability that both sides feel they have the initiative is calculated.

The probability of the different opinions between the two fighting sides about having the initiative is calculated by applying the simple Eq. 1.

$$z_p = \left| \frac{\mu_b - \mu_r}{\sqrt{\sigma_b^2 + \sigma_r^2}} \right| \quad (1)$$

where

- z_p = Normal distribution coefficient
- μ_b = Mean value (own side)
- μ_r = Mean value (adversary)
- σ_b = Standard deviation (own side)
- σ_r = Standard deviation (adversary).

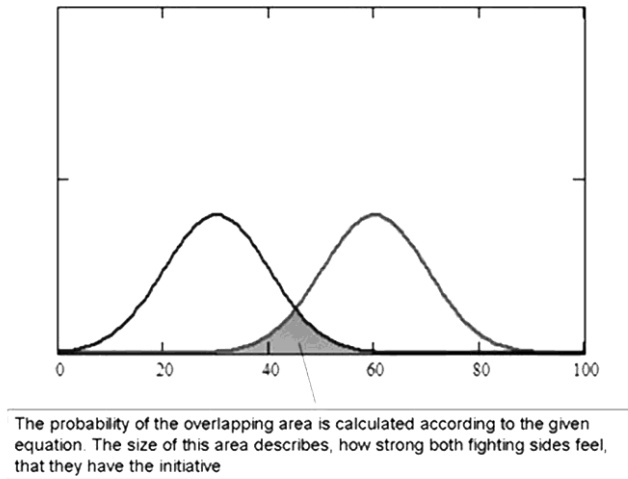


Figure 6. The overlapping area of the two distributions describing the variation of the feeling of having the initiative.

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The required numerical data for initiative analysis is compressed in Tables 4 and 5. The measurement level describes the progress of an attack exercise. The soldiers' feelings and opinions dealing with initiative were measured at all seven levels with the previously de- scribed relative range of 0...100 mm.

MEASUREMENT LEVEL	BLUE COMPANY			ADVERSARY		
	Initiative		Cumulative casualties [%] on average	Initiative		Cumulative casualties [%] on average
	Mean μ_b	SD σ_b		Mean μ_r	SD σ_r	
1 Deployment area	80.64	15.71	0.00	50.93	33.90	1.14
2 Footing	83.71	14.19	3.86	48.64	35.96	9.14
3 Initial attack position	83.21	13.87	3.86	48.57	35.94	9.43
4 Battle engagement of the 360unit	81.93	12.17	5.86	46.62	36.28	21.29 AARMS (12) 2 (2013)
5 Battle engagement of the soldier	81.00	14.39	10.86	47.46	37.26	30.43
6 Battle in adversary's position	80.86	11.99	15.00	27.33	26.47	47.00
7 Attack objective	78.50	20.40	20.14	32.00	32.53	58.57

Table 4. Soldiers' feeling of having the initiative in successful attacks.

MEASUREMENT LEVEL	Initiative			Cumulative		
	Mean μ_b	SD σ_b	casualties [%] on average	Mean μ_r	SD σ_r	casualties [%] on average
1 Deployment area	68.07	30.77	0.00	67.64	28.50	0.00
2 Footing	66.00	25.70	3.29	65.17	32.31	3.29
3 Initial attack position	68.00	24.80	3.57	62.92	31.78	3.43
4 Battle engagement of the unit	70.57	20.88	6.86	57.93	31.55	5.43
5 Battle engagement of the soldier	54.42	19.31	23.14	53.17	30.82	23.57
6 Battle in adversary's position	53.15	24.47	31.29	50.57	29.07	28.43
7 Attack objective	39.55	25.35	38.86	65.55	26.37	35.43

Table 5. Soldiers' feeling of having the initiative in unsuccessful attacks.

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When we calculate from Eq. 1 the overlapping areas of the distributions describing the differences of soldiers' feelings of having the initiative on both fighting sides at each measurement level, we are able to draw interesting conclusions: The comparison between the overlapping areas of the measured feelings of having the initiative in successful and unsuccessful attacks shows that in unsuccessful attacks, the results of one's own and one's adversary's overlapping areas are 1.7 to 2.3 times larger at levels 1–5 and 7. A larger range of critical distances at different levels also indicates that the shape and the sharpness (standard variation) varies greatly in unsuccessful attacks at the most important measurement levels affecting the success of the battle. On an average, the calculated risk P of contradiction between who has the initiative is 2.1 to 2.7 times higher in unsuccessful attacks at levels 1–5 and 7. It is noticeable that at measurement level 6 the risk P in successful attacks is only 0.03. Furthermore, the overlapping area at level 6 in unsuccessful attacks is up to 6.6 times larger. These results show that at measurement levels 3, 4, 6 and 7, the feelings of having the initiative in successful attacks differ enough to justify the continued comparison between unsuccessful and successful attacks to recognize the other possible characteristics describing initiative.

According to the calculated results, in successful attacks, the correlation between the remainder of feelings of having the initiative at both fighting sides and the casualty ratio is remarkable, $|r| = 0.694$. However, the coefficient of determination as a percentage is only 48%. In unsuccessful attacks, this correlation is only $|r| = 0.430$. The corresponding principle shapes of the correlation curves are presented in Fig.7.

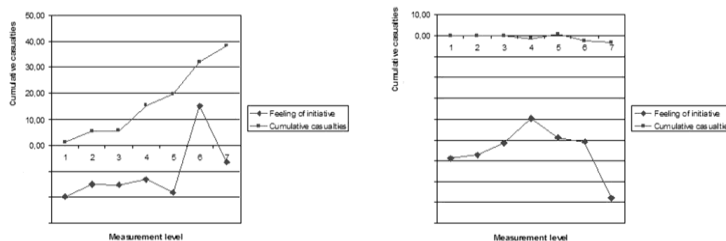


Figure 7. Cumulative casualties and the feeling of having the initiative: successful attacks (left) and unsuccessful attacks (right). The shape of the curves illustrates the connection between the casualty ratio and feeling of having the initiative.

Although the analyzed results of initiative indicate a remarkable difference between successful and unsuccessful attacks, these results only deal with the feeling of having the initiative. Therefore, more weight is given to the results gained from the tactical maps to find out how initiative affects the result of an attack. Two practical case examples are presented in Fig. 9 and Fig. 10.

The presented Eq. 1 is valid only when both distributions describing the feeling of initiative of the fighting sides follows a normal distribution curve. In this case, the normality of the analyzed curves has been checked both near the mean value (Kolmogorov-Smirnov) and at the ends of the distribution curves (Anderson-Darling). If needed, e.g. the combination of normal distribution and Weibull distribution is available to calculate the probability of the overlapping area. (Kapur, Lamberson, 1977)

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Observations from Tactical Maps and Event Catalogues

When recognizing and analyzing initiative, tactical maps and event catalogues are in a key role. Items to be recognized

and their possible indicators are presented in Table 1. The principal flowchart (see Fig. 8), which includes feedback loops to check also the right timing of each tactical action together with situation evaluation, is formulated to model recognized tactical phenomena.

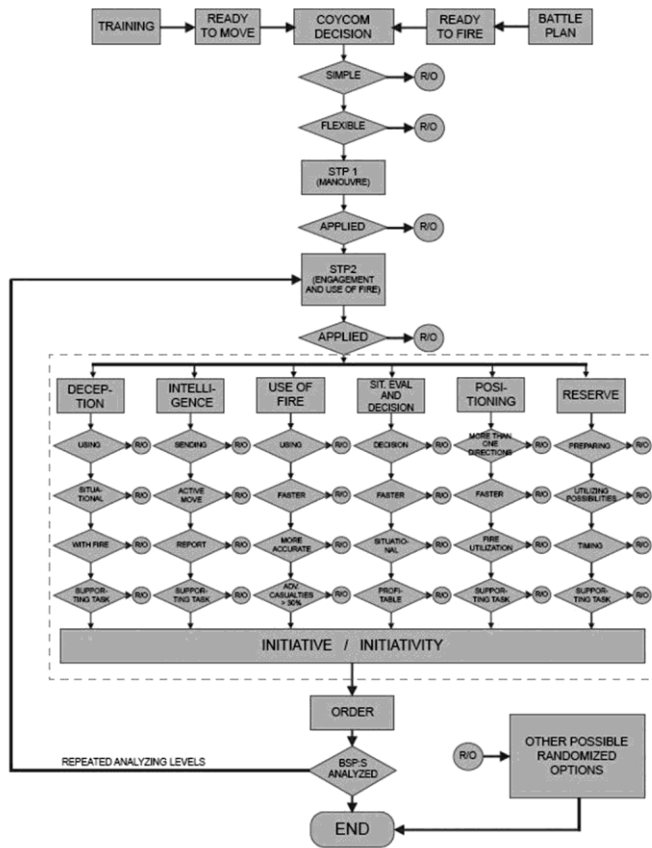


Figure 8. Flowchart for analyzing attacks (notice also the right timing of actions and situation evaluation).

When analyzing, it is sometimes impossible to express the items presented in Table 1 with the absolute answers “no” or “yes” within the flowchart.

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Tactical phenomenon	Tactical maps		Event catalogues	
	Item	Probable indicator	Item	Probable indicator (note)
AARMS (12) 2 (2013) Changes in initiative	Readiness to manoeuvre	Positioning related to terrain and adversary	Readiness to manoeuvre	High/low
	Readiness to use fire	Positions of mortars, anti-tank and light weapons	Readiness to use fire	Sign/order Preparations Signal links
	Decision making	Action/no action Action according to decision	Decision making	Decision/no decision Content and pursuit
	Deception	Patrol/subunit manoeuvre Use of fire	Deception	Sign/order and timing Content and pursuit
	Manoeuvre	Battle pull	Manoeuvre	Sign/order
	Use of fire	Casualties	Use of fire	Timing

	Reserve	Subunit position	Reserve	Order/sign Subunit readiness
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Table 6. List of items to be recognized (dealing with initiative) and their possible indicators.

Let us present a simplified example of the utilization of Table 1. During the background research, tactical maps were drawn at each measurement level of an attack and in every situation a remarkable or unexpected tactical phenomenon took place. Therefore, it is relatively simple to analyze the unit's positioning related to the terrain and adversary and see if it enables initiative and if some other positioning of the unit might have been even more advantageous. At the same time, the data collectors made notes to describe and evaluate the readiness of the unit for the planned manoeuvre. By recognizing these indicators from tactical maps and event catalogues, it is possible to start analysing whether the initiative was utilized or not.

By combining these aspects with the presented flowchart in Fig. 8, we realize that the relevance, importance, right sequential order and timing of the followed items change constantly with the situation. The evaluation of these features is possible either relatively or qualitatively in a specified situation. This enables the expression of the differences between one's own forces and the adversary using the terms "more" or "less" and "faster" or "slower" corresponding to the simplified values of "yes" and "no".

The first example presented on the map (see Fig. 9) shows that initiative could be recognized in this battle according to the following criteria:

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- The dotted lines show the trained, planned and prepared manoeuvres of platoons or other elements, which are planned for use in fulfilling the battle task "beat".
- The tactical symbols show how the leader has planned to utilize trained, planned and prepared reconnaissance to support situation evaluation and decision making. It is essential to notice that unlike in unsuccessful attacks, in this case the leader has used his initiative to carry out reconnaissance processes actively and early enough.
- The tactical symbol shows that the leader has shown his initiative in combining the plans of trained manoeuvres with the timely and justified use of indirect fire.

To shed more light on the use of tactical maps, a second example is presented in Fig 10. It shows that initiative is recognized according to the following criteria:

The maneuver of the deception patrol is identified with an arrowed dotted line.

The purpose of the use of the deception patrol was to mislead the adversary's attention

to the unit's left flank for the time needed to carry out the blue company's main maneuver.

In addition to this, the initiative and the brave use of the deception patrol resulted in remarkable casualties for the adversary, yet keeping one's own casualties relatively low (after the maneuver, the casualty ratio was 76%/23%).

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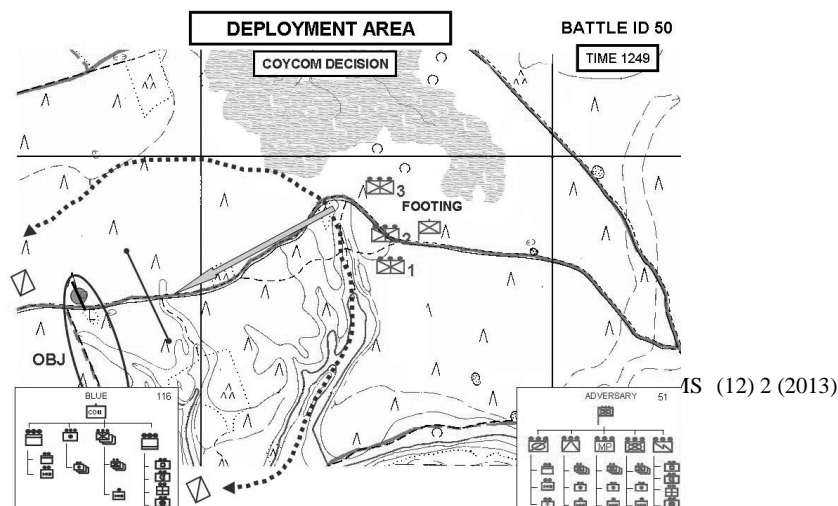


Figure 9. An analyzed example of how initiative had an effect on the leader's decision-making in the deployment area in one of the successful attacks.

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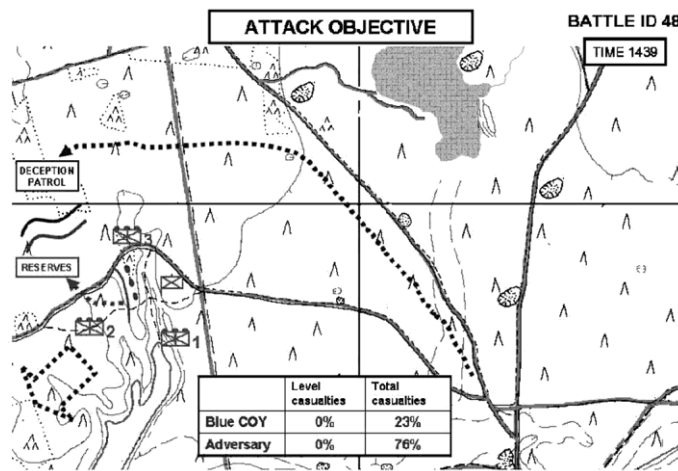


Figure 10. An analyzed example of how initiative has shown and has been utilized in the battle before reaching the attack objective in one of the successful attacks.

By applying the previous flowchart model, it is possible even to calculate the number of observed characteristics indicating initiative. When analyzing the source material from the background research, the results showed that the number of positive replies to the questions in the flowchart was on average 2.3 times higher in the seven most successful attacks compared with the seven most unsuccessful attacks.

Conclusions

This paper has shown that initiative has a key role when analyzing the aspects affecting the success of an attack. Different qualitative and quantitative tools were utilized to verify the results dealing with initiative. During this verification process, we noticed that to form a reliable overall picture of tactical phenomena, it is advantageous to integrate different analyzing methods and collect enough data and information of different types from the battle field. Sometimes there is a chance to utilize distribution analysis to illustrate the possible differences between the fighting sides.

When summarizing the results of the qualitative analysis of the attack exercises especially in terms of initiative, it was shown that an almost equal amount of positive and negative observations about having the initiative were recorded. Approximately 39% of positive observations and approximately 41% of negative observations of initiative were directly connected with timing or a time window. The utilization of initiative requires exact timing and enough speed to lead to success in the battle. This means that the reasons for either the failure or success of an attack are connected with initiative, and furthermore, with time and timing.

The main result of comparing successful and unsuccessful attacks was that the dominant phenomena causing failure are found from aspects dealing with initiative. On the other hand, the primary aspect which unfavourably affected the result of the attacks was that the leaders had lost their freedom of action by giving the initiative to the adversary, making it impossible to affect the adversary in creative ways. In literature dealing with tactics, these aspects have

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been emphasized e.g. Liddell Hart (1954). In addition to this, the leader has not been open to looking for new possibilities to take initiative. These types of aspects have also been noticed by General Tynkkynen (1996). Hannah et al. (2010) have identified the importance of the leader's character, but they also integrate the leader's skills, knowledge and competences with different types of roles which the leader might have in the battlefield.

The quantitative analysis conducted in this research has shown that there is a positive correlation between one's own strengthened initiative and an advantageous casualty rate together with the fulfilled battle task. Based on the analyzed situational maps of different attacks, this paper has shown how strongly the initiative of one's own force affects the success of an attack and how initiative or actions of initiative can be observed in the situational maps. According to the results, a larger number of observations of one's own initiative indicated better success in battle. In addition, the analyzed numerical values have indicated that leaders seem to have a strong feeling of initiative in successful attacks.

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Protection and Safety of the Application of Radiation Sources in Medicine

TISZOLCZI Balázs Gergely¹

Since the discovery of the X-ray and radioactivity the largest user of radiation sources is medicine. That is the reason why the end of the 19th century and the beginning of the 20th century brought significant changes in healing, compared to the previous ones. After Wilhelm Conrad Röntgen — the latter Nobel Prize winning physicist — discovered X-rays they were named after him, and mankind's desire to be able to "see into" the interior of the human body became a reality.

Introduction

After its discovery, the medical diagnostic application of X-rays rapidly spread because of their great importance. At the same time, especially in military field conditions, an increasing number of physicians and their patients suffered from more or less radiation exposure, the damaging effects of which on living tissues became widely known only years later, after some tragic events. In the years following the revolutionary realization of Röntgen, several discoveries of similar significance happened. In 1896 Becquerel discovered radioactivity, the Curies discovered polonium in 1898, Becquerel discovered α and β radiation in 1900 and Villard discovered γ radiation, which are summarisingly called ionizing radiation, based of their physical effects on materials. In the course of experiments made with radioactive materials, scientists experienced that the radiation of materials is similarly harmful to X-rays. (Fehér, Deme [ed.], 2010: 17–18) The early reactions of tissues after high-dose exposure, e.g. skin redness, became obvious early on. However, it took experts a long time, several years, to realise the risks of cancer varieties caused by long term damage, e.g. ionising radiation, the effects of which incubate for a long time, and low-dose radiation which accumulates even after the recovery of the tissue without any trace and does not cause any other tissue reactions. Some decades later epidemiological analyses proved without doubt that ionising radiation does increase the incidence of cancer. (Fehér, Deme [ed.], 2010: 65) After the realization, radiation protection gradually became more emphasized in technological applications in addition to properly tailored technical protection, strict, administrative and organizational security measures, which are still essential conditions for the applicability of the radiation sources. During the first, almost fifty-year long period of radiation protection, the misuses of radioactive sources had hundreds of victims. Thanks to today's techniques and the development of radiation protection as a field of science the much more widely used sources cause far fewer tragic events. (Fehér, Deme [ed.], 2010: 22)

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All things considered, mankind has been affected by significant radiation exposure originating from artificial sources since the very end of the 19th century. However, ionising radiation does not reach the population just because of technological development, as the biosphere has always been exposed to radiation coming from natural sources. (MVM, 2013) Most of these so called natural radiation sources maintain a background radiation. The one source of background radiation is the high-energy cosmic radiation coming from the Universe and the others are the natural radioactive isotopes (^{40}K , ^{238}U , ^{232}Th) existing in the Earth's crust, with half-lives of billions of years for their fission products. (Fehér, Deme [ed.], 2010: 429) The division and the scale of the exposure descending from natural and artificial radiation sources and reaching the population is introduced on Table 1.

Natural	(2,4 mSv/year)
cosmic external	0,3 mSv / 10,26%
cosmic internal	0,015 mSv / 0,53%
crust external	0,5 mSv / 17,70%
crust internal	1,6 mSv / 56,63%
Artificial	(0,4 mSv/year)
nuclear industry	0,0002 mSv / 0,01%
medicine	0,4 mSv / 14,16%

Fall – out radiation (atomic tests)	0,01 mSv / 0,35%
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Table 1 (MVM, 2013)

The annual average radiation exposure on the Earth's population per capita in effective doses and the percentage of man's radiation exposure from various sources

As it seems in Table 1, 97 per cent of all the artificial radiation exposure for the Earth's population is caused by irradiation for medical purposes (MVM, 2013) In Hungary, the average natural radiation exposure per capita is 3 mSv a year, whereas, the average exposure per capita coming from artificial sources is about 1 mSv a year, which almost exclusively derives from medical sources. Nearly everybody has already encountered medical radiation exposure, especially when the number of X-ray examinations is very high. Due to the proportion of the examinations' frequency, approximately 90 % of the medical radiation exposure on the domestic population is exposure to X-ray diagnostics and 10 % is exposure to isotope diagnostics. In harmony with this data, most people work in the medical X-ray departments from the working areas applying ionising radiation, but the number of those employed in nuclear medicine and in radiation therapy is also quite significant. Physicians or other experts of health care such as medical physicists ask for or carry out examinations and have a determining role in choosing the measure and the way the radiation exposure affects patients, and in keeping the risks to health under control. (Fehér, Deme [ed.], 2010: 449) However, not only patients' appropriate protection, but also that of the persons taking care of them and working in the effective range has to be assured. The character of the multiple risks originating from the use of radiation sources means significant tasks for the specialists of occupational safety working in health care. The reason for that is the fact that ionizing radiation sources and

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equipment producing ionizing radiation are considered to be critical applications from the viewpoint of human health and safety in medical practice.

The users and those persons who are responsible for safety have to acquire and apply numerous personal, administrative and physical-technical specifications and requirements besides the basic knowledge of technology and radiation protection. To do so — together with the magisterial and decision maker's activity — they have to keep risks at the lowest level possible.

In this article I do not want to give detailed descriptions about all the necessary conditions of safety use and protection. My only goal is to provide an overall review — through the relevant laws, standards, magisterial recommendations and guidelines — about the organizational, human and technical information that should be fully known by those who are responsible for protective operations in order to suit the requirements coming from comprehensive safety challenges of the use of ionizing radiation.

In a few words about ionizing radiation²

A chemical element is determined by the number of protons of unit positive charge to be found in the nucleus. Besides the protons, electrically neutral neutrons build up a nucleus. In the various nuclei of a certain chemical element the number of protons is always determined, at the same time; the number of neutrons may vary. Atoms have various neutron numbers, but the same proton numbers of the isotopes of a chemical element are determined by the number of protons. Isotopes can be either stable or instable. Instable atoms are called radioactive isotopes. A stable nucleus does not dissolve and does not emit any radiation. The reason why an instable nucleus is instable is that it can get into a stable or more stable state through a radioactive transformation. In Nature, spontaneous processes always come off towards greater stability. Every element has radioactive isotopes; what is more, their number is far higher than that of stable isotopes. Radioactive isotopes dissolve spontaneously. In the meantime, they emit radioactive radiation. This process is called radioactivity. Unstable elements that emit radioactive particles or energy are called parent elements and the emerging ones are termed daughter elements.³

Three types of radioactive (ionizing) radiation are known and two of them are used in medical practice. They are beta and gamma radiation. Alpha radiation can easily be absorbed, but in the human body it is very dangerous, so it is not applied in medicine. During alpha decay an alpha particle is released from the nucleus which consists of two protons and two neutrons (helium nucleus). This kind of transformation is typical of elements with a large mass number. Another characteristic of alpha radiation is the short range of absorption so as an external source of radiation it is less dangerous to the human body. It can be absorbed in the upper skin layer or in the air at a few centimetres distance. From the point of view of protection the most important task is to prevent it from getting inside the body, as it can cause massive damage due to its large ionizing ability.

² The content of this chapter is based on a note from the homepage of Paks Nuclear Power Plant. http://www.atomeromu.hu/download/3217/Alapfokozatu_sugarvedelmi_ismeretek_jegyzet.pdf (downloaded: 01 08 2013)

³ A daughter element often becomes a parent element in the course of a subsequent decay.

Beta radiation is formed during beta decay of nuclei. Two types of them are known. The negative beta decay, in which there are high energy electrons and the positive one, when positrons leave the nucleus. The ionizing ability of beta radiation is smaller than that of the above-described alpha radiation, so it has a larger penetration ability that can range from some centimetres to 10–15 meters in the air, depending on its energy. Its effective range is a few millimeters in human tissues. We can easily protect ourselves against it, putting a plexi- glass between the source of radiation and its user.

Gamma radiation consists of high-frequency electromagnetic waves that are formed when a nucleus transits from an excited state to a lower one. This is the so called gamma decay. The protection against it is possible by using elements of high atomic weight and density (usually: lead).

X-radiation, similarly to gamma radiation, is also a type of electromagnetic radiation. The beam particles of electromagnetic radiation are called photons. In interactions a gamma-ray photon and an X-ray photon behave exactly the same way. The difference is that gamma radiation derives from the nucleus, while X-radiation is formed on electron shells. Depending on the mechanism of the formation we can speak about braking or a characteristic type of X radiation. The first one is generated by braking electrons, while the other is formed after ionizing an electron on an inner electron shell.

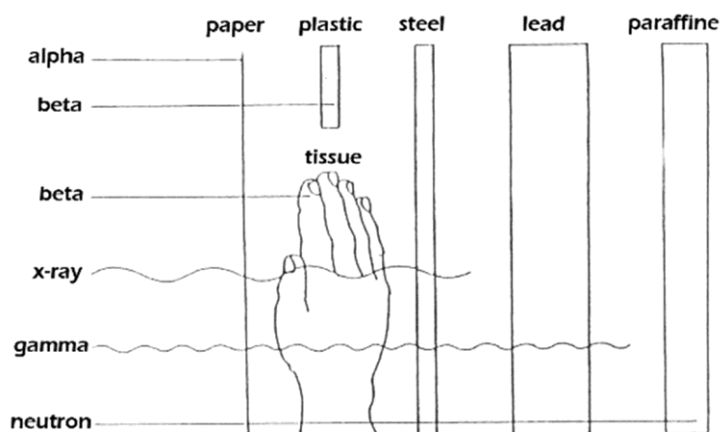


Figure 1⁴ Absorption and penetrating capability of ionizing radiations

Workplaces and technologies using ionizing radiation sources cause health hazards to living organisms of various types and at various degrees. A lot of serious health-damaging radiation effects are well known and caused by the nature of the radiation and its mode of action within a living entity. The most remarkable are as follows: burns, some types of cancer, development of different mutations or leukemia. The effects on health are generally divided into two main sections: radiation injury occurs when only some organs or tissues of the body are damaged and radiation sickness occurs when the whole organism suffers from those impacts. An additional partition criterion can be the time of emergence of the symptoms, which may be an early one (they can be seen within hours or days) or a late one when

4 http://www.atomeromu.hu/download/3217/Alapfokozatu_sugarvedelmi_ismeretek_jegyzet.pdf
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years or decades elapse before the presence of the effects. In addition, the health effects of the radiation can be somatic (provoke harms to individuals), or genetic, when they generate irreparable lesions in the offsprings' organisms. The harmful effects of ionizing radiation are described by so called dose quantities. The degree of the biological mutation of the organism is correlated with the dose⁵ the body is exposed to, which is characterized by the absorbed energy. However, the extent of the body's damage depends not only on the absorbed energy, since the different radiation can interact in different ways with their environment, analyzing the severity of the effect, it is not enough to determine how much energy is transferred to the body by the radiation, but we also need to know what type of radiation it is. Taking into consideration the type of the radiation, we can then speak about an equivalent dose. Besides the type of the radiation and the energy, the various sensitivities of the various tissues are taken into account with a so called weighting factor (effective dose).

From the point of view of radiological protection, the biological effects of ionizing radiation can be stochastic and deterministic, based on dose-response relationships. One of the characteristics of the deterministic effect is that the damage must occur above a certain dose level, called threshold dose (the severity of the effect depends on the magnitude of the absorbed dose). It is typical of stochastic effects that they do not have a threshold dose, each dose has a given probability of biological changes and that likelihood grows in direct ratio with the increasing dose. Depending on the nature of the medical activity, the used technology and the quality of the applied materials, the employees and those who are in the scope of working can be exposed to external radiology on the whole body, on individual parts of

the body, by inhalation, ingestion, through mucous membranes and through different injuries on their skin. As to the sources of radiation we can distinguish sealed and unsealed⁶ sources, which determine the exposition possibilities.

Some typical uses of ionizing radiation in medical practice

The application of the radiation formed during the decay of radioactive isotopes is typical for many areas of medicine both for diagnostic and therapeutic purposes. In this part of the article I give an overall review about them.

Nuclear medicine is a medical diagnostic, therapeutic and research activity done with unsealed radioisotopes. Its methods are based on the application of radiopharmaceuticals (isotope labelled organ-, tissue- and function-specific compounds). If we transfer these compounds into the living body — due to their chemical, biochemical specialities — they can be attached to certain normal or abnormal structures thus they can be used for examining the structures and for radiation therapy. For diagnostic work those radiopharmaceuticals are used where the radiation can be detected externally with special detection equipment (such as a gamma camera). (Szilvási, 2004) A piece of the most frequently used equipment is the positron emission tomograph, also widely known as PET. The essence of the procedure is

⁵ See Decree No. 16/2000 (VI.8.) EüM of the Minister of Health concerning the phenomena.

⁶ Radioisotopes are utilized as sealed or unsealed radiation sources. We can speak about a sealed source of radiation if the radiation of the radioisotopes we wish to utilize can get from its canning into the environment, but the formation of the radiation source prevents the radioactive material from entering the environment. When radioactive material is not canned or covered in another way, i.e. radioactive substance may pollute the environment and get into human organisations, we talk about an unsealed radioactive source. (Fehér, Deme [ed.], 2010: 140)

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that positive beta active isotopes (called markers) emitting positrons are transferred into the patient's body (typically ¹⁸F, ¹¹C, ¹³N and ¹⁵O are used) and the repartition of the materials can be detected by a PET camera through the perception of positron emission accompanying annihilation gamma rays.⁷

The various diagnostic X-ray procedures represent a different technology, but they are among the most commonly used methods and technologies. These are publicly known, because they are the kind of technologies one can meet in everyday life very often. This may include dental X-ray, chest X-ray, mammography, computer tomography, and so forth. Part of the rays are totally absorbed in organs and another part of them can pass through the body (by passing through different tissues they also can be absorbed in varying degrees, at most they lose some of their power). The third part is scattered and changes its direction. A special X-ray film is taken beyond the studied area on which the X-rays passing through leave a sign with a chemical reaction. This is called an X-ray shadow (Németh, 2011), which helps to detect abnormalities. Although we spoke about it before, it is worth mentioning again that medical X-ray radiation is not formed by radioactive decay. X-rays come into existence in a special vacuum tube, and then they leave it and pass through the body. The most basic (and easily described) method of production is that electrons are accelerated; next they are made to crash into a metal target (often made of wolfram). In this metal target the electrons suddenly slow down, and if they are at an energy level high enough, then braking X-radiation is formed.⁸

Angiography is slightly different from "classic" X-ray diagnostic procedures. This is an examination method (with X-rays) of those blood vessels that ensure the blood supply of the various organs of the body. The organs which X-rays can freely pass through (such as blood vessels) do not give an X-ray shadow. If we are curious of possible aortic stenosis and embolisms of different parts of blood vessels we have to inject them somehow with substances absorbing radiation. These substances are so called contrast media. Since the blood flow washes the contrast media out of the blood vessels quickly, we have to inject them directly into the studied area which can be achieved manually through catheters. The doctor can see the emerging picture under a fluoroscope or using digital images. (Szabó, 2012)

The further major use of radioactive sources is radiation therapy, which is based on the cell-killing effect of high-energy ionizing radiation. It is especially used for the treatment of various tumors. The radiation can result in damage to the genetic material in the concerned tissue (DNA), thereby the multiplication of cancer cells is reduced. Although the radiation has an adverse effect on normal tissue as well, the radiation sensitivity of cancer cells is generally greater than that of intact ones, so this way a highly selective effect can be achieved. (Horváth, 2013) Numerous types of radiation therapy are known.

AA RMS therapy can occur with a γ radiating source of very high activity⁹ (TBq order of magnitude) that is mostly a ⁶⁰Co (cobalt canon), placed relatively far from the body. The radiation source is situated in a protected storage unit of the head section, which is set in the proper position at the beginning of the medical treatment with mechanic control. At the end of the us-

⁷ <http://www.meridianmc.hu/index.php?title=Amit%20a%20PET/CT%20-%20vizsg%20E11atr%20F31%20tudni%20E9rdemes&p=rovat&c=45> (downloaded: 18 08 2013)

⁸ <http://hu.wikipedia.org/wiki/R%C3%B6ntgensug%C3%A1rz%C3%A1s> (downloaded: 01 08 2013)

⁹ Activity is the number of dissolution processes that happen in radioactive materials within a certain unit of time.

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age it goes back into the storage unit automatically.¹⁰ A linear accelerator is a special electron accelerator developed as an

external radiation source for patients who suffer from cancer. Electrons are accelerated with a high-frequency electromagnetic field and then maneuvered on a target (tungsten) which decelerates it, and hereby a — so called — braking X-ray radiation is created. In practice the direct use of electrons can occur. The shape of the radiation field is designed in the head of the machine by movable collimators (beam control device).¹¹

First of all, the applications of brachytherapy are special from the viewpoint of radiation protection at places of work. Brachytherapy is executed only by using the after-loading method to reduce the radiation exposure of the personnel. After the transfer of the inactive applicators (usually tubes in small diameter and varied geometry) into the patient's body (into the ventricle, or directly into the tumor), the radioactive sealed source from the protected storage of the computer-controlled device goes automatically to the position desired during the irradiation, and remains there for the period of time predefined when the irradiation was being planned. (Ésik, 1996: 44–48) ⁶⁰Co, ¹⁹²Ir and ¹²⁵I isotopes are applied to the treatment most often.

Radiation protection in medicine

The use of radiation for medical purposes started in Hungary in the early years of the 20th century, which was followed by radiation protection only about 20 years later. To ensure that the objectives and principles of radiation protection progress, we need, above all, a proper regulatory system. Over the years, a standard system of regulation of radiation protection has evolved. For the first appearance of radiation protection standards in our country we had to wait until 1949, when the radiation protection standard finished in 1942 finally came into force. In 1952 the first health ministerial decree in radiation protection was released, it was called “Protecting Measures Concerning Medical X-ray Units”. These days the Hungarian basic safety regulation is the Decree No. 16/2000 (VI.8) EüM of the Minister of Health (VHR) which was based upon the 1991 official statement of the International Commission on Radiological Protection and on the International Basic Safety Standards of the International Atomic Energy Agency. The Hungarian regulations meet those of the European Union. (Fehér, Deme [ed.], 2010) The above regulations are enforced by the special radiation hygiene authorities in Hungary. This special field of radiation hygiene deals with the industrial and medical application of ionizing radiation, and the radiation protection and safety of radiation workers and the population. (Fehér, Deme [ed.], 2010: 53)

The general effort of radiation protection is to defend human beings and the environment while using ionizing radiation from its harmful effects without unnecessarily restricting the activities. The radiation protection system consists of three basic principles: the justification of use, optimization, as well as the establishment of dose limits.

- *Justification of medical exposure.* Medical exposure shall show a sufficient net benefit, weighing the total potential diagnostic or therapeutic benefits it produces, including the direct benefits to health of an individual and the benefits to society, against the individual detriment that the exposure might cause.

10 http://www.honcology.hu/portal/page/portal/OOI/MEDICAL_ATTENDANCE/medical_departments/MD_10/keszulekek_2012.pdf (downloaded: 04 08 2013)

11 Ibid.

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- *Optimization of medical exposure.* All doses due to medical exposure for radiodiagnostic or interventional radiology shall be kept as low as reasonably achievable consistent with obtaining the required medical information, taking into account economic and social factors. For all medical exposure of patients for radiotherapeutic purposes, exposures of target volumes shall be individually planned, taking into account that doses of non-target volumes and tissues shall be as low as reasonably achievable.
- *Dose limits for medical exposures.* The dose limits are not applicable to the medical exposures of patients, but the optimisation of the radiation protection of patients includes the application and use of diagnostic reference levels. Diagnostic reference levels mean dose levels in medical radiodiagnostic or interventional radiology practices, or, in the case of radio-pharmaceuticals, levels of activity, for typical examinations.

In medical practice, planning and keeping doses (diagnostic or therapeutic) of irradiation carried out on purpose for the patient's own good at the minimum level necessary are mainly medical tasks. So at this point we discuss “only” the possibilities of protection against exposures related to work¹² or deriving from unwanted incidents. Of course, adequately organized protection can guarantee not only the safety of employees but the safety of those who are in the within the scope of operation and/or have resort to the services. Furthermore, data collection in connection with the radiation and their evaluation, and the constant monitoring of health and physical conditions of individuals are also parts of the protection as secondary prevention. Mainly those medical procedures are not subjects of this article that can be regarded as tertiary prevention that stop or slow down the worsening of patients' states.

While optimising protection, we have to pay attention to the scientific and technological level of the age, economic considerations, social factors, and individual sensitivity. The physical defence of the radiation source against theft, unauthorized appropriation and other illegal activities means a further protective task.

The above, altogether, means that the skills and abilities of various experts from different special fields are necessary for organizing effective protection. All of these should be done despite the fact that the general rules of radiation protection cannot wholly achieve their goals due to the special system of aims and the operational features of the

healthcare system. This job with great responsibility must be realised in a complex way, which can be achieved by realising varied organisational–administrative, personal and technological–physical conditions.

Supervision and control by the authorities

It is possible to apply radiation sources exclusively in the way it is determined in the provisions of law and under official supervision. Equipment generating ionizing radiation used for medical purposes (such as X-rays, accelerators, etc.), ionizing radiation emitting materials (radioactive materials), and activities relating to these naturally belong to this regulated group.

The supervisor tasks of first instance authorities have been carried out by seven regional Radiation Hygiene Centres working as parts of the Capital– and County Government Offices in the new governmental system since 1st January 2011. The radiation–protection authority

12 All the radiation exposure that may reach employers while they are working.

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of second instance is the Office of Chief Medical Officer (OCMO), which belongs to the National Public Health and Medical Officer Service (NPHMOS). The NPHMOS consists of the OCMO and the national institutes under its leadership. One of these national institutes is “Frédérich Joliot–Curie” National Research Institute for Radiobiology and Radiohygiene, which is a special institute for radiation protection belonging to the NPHMOS, and the only institute in the country that deals with radiation protection at places of work as its main job.

In their framework, Radiation Hygiene Centres issue licenses, at first level one, for the storage, use and application of radioactive materials, the foundation, production, operation, reorganisation, repair, terminating of operation, dismantling of non–nuclear facilities and equipment, furthermore, the operation, maintenance, and terminating the operation of equipment creating ionising radiation. (EüM, 2000) The Radiation Hygiene Centres supervise the facilities and activities with legal permission at a frequency determined by law (taking the dangers of the facilities and activities into consideration when setting the frequency), for example places of work with X–ray therapy, teletherapy, are checked after loading and the accelerators are checked annually. When controlling, the authority makes sure that the dose limits are kept, employees’ medical check–ups are done, employees, patients, environmental protection and training are secured and the other rules depending on the characters of activities are observed. It also measures the above with gadgets. If deficiencies are revealed, it takes the necessary measures to terminate them.¹³ The OCMO (based on the opinion of NRIRR¹⁴) qualifies and permits equipment emitting ionising radiation or containing a radioactive source of radiation and personal protective equipment from the viewpoint of radiation protection. The equipment/protective equipment may only be distributed and applied if it has the radiation protection qualification. (EüM, 2000)

The equipment forming ionising radiation is work equipment and as such, they prove to be dangerous implements according to Act XCIII of 1993 on Labour Safety. Workplaces using ionising radiation are determined as dangerous workplaces. The main rule is that the employer orders the operation of dangerous facilities, places of work, equipment and technology in writing. Moreover, he supervises dangerous technologies and dangerous work equipment from a safety point of view for maintaining safe technological conditions. However, the sphere of authority of occupational safety authority does not include the radiological hygiene duties related to labour. (OGY, 1993) Another interpretation is that the above tasks cannot be qualified as radiological hygiene ones, but as occupational safety ones as concerns radiation safety. At the same time, it is a practical experience that the occupational safety authority does not require or check occupational safety commissioning or periodical supervisions since the permissions issued by the Radiation Hygiene Centre and the check–ups periodically done can be regarded as equivalent to them, from a safety viewpoint. Certainly, the conditions of safe work not endangering health have to be assured at working places with ionising radiation. That is why employers’ other occupational safety duties, such as risk assessment of the activities, the ergonomic suitability of working places, etc. still remain and they are examined by the occupational safety authority.

The appliers of radioactive material locally records the whereabouts, physical and chemical features and the activities related to the radioactive materials in their ownership and they

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13 <http://www.antsznydr.hu/index.php/sugaregeszseguegyi-decentrum> (downloaded: 15 08 2013)

14 “Frédérich Joliot–Curie” National Research Institute for Radiobiology and Radiohygiene (abbreviated in Hungarian: OSSKI)

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serve the central register with data. (OGY, 1996) In Hungary the organisation of atomic–energy supervision is the Hungarian Atomic Energy Authority (HAEA). HAEA keeps a central record of radioactive materials, which contains their whereabouts, physical and chemical features, the appliers of atomic energy and the activities related to them.

Appliers’ obligations

The VHR prescribes for the employer the obligation of setting up a radiation–protection service and nominating a person in charge of radiation protection. Among others, it is the job of the service of radiation protection to check whether the radiation–protection condition of the direct surroundings and the area of the facility and of the personnel working there meets the requirements set by provisions of law, standards and internal rules. The service of radiation protection consists of at least one local radiation protection officer and his deputy. The organization and the operation of the service of radiation protection are under the supervision of the Radiation Hygiene Centre. One of the most important jobs of radiation protection personnel is to make the Workplace Radiation Protection Regulations which is approved by the Radiation Hygiene Centre.¹⁵ The plan for the prevention of accidents and measures (workplace emergency plan) is a compulsory element of the rules and it has to involve the order of preventing possible accidents, their handling, the possibilities of arrangements and obligations. The possibility of extraordinary events has to be estimated depending on the applied materials and technology and the character of possible events have to be determined. Accordingly, an individual plan of accident prevention and arrangements have to be worked out. Care has to be taken to teach the contents of this plan and have it practised.

The employees of work places with a radiation hazard are divided into two categories from the aspect of their potential exposure. The employees in Class “A” are those in whose case there is a chance that their annual effective dose exceeds the value 6 mSv. Class “B” is for all the other workers. It is obligatory to check each employee in Class “A” with a personal dosimeter for radiation exposure coming from an outside source. The gadgets necessary for the check–up are obtained and issued to employers by NRIRR. Employers make sure via the service of radiation protection that the employees whose radiation exposure has to be checked by the authorities on a regular basis should get the dosimeters and wear them during the whole worktime and activity. Those who display activity are obliged to wear them. If they do not do so in spite of a warning or they do not use them properly, the employer should forbid them to do work. The service of radiation protection is obliged to register the dosimeters.

In some special cases, it has to be made sure that the risk is kept on a level as low as possible from the viewpoint of the population, the users, and the environment concerned. It is such a precaution that when diagnostic or therapeutic treatment is applied with radioactive isotopes, the patients — before leaving the medical institution — have to be given written information on the methods of reducing the radiation exposure on people who get into touch with the patients and the risk of the treatment.

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The personal conditions of safe application

Only those persons may show activity in the area of ionizing radiation who have participated in an examination–obligatory training and retraining of radiation protection,¹⁶ and passed the exam. We can distinguish three levels of training of radiation protection: those who work in a sphere connected with an activity of radiation danger, but do not work with a radiation source, are obliged to attend a training of basic–level radiation protection. The employees who work in the range of action of radiology and medicine, employing ionising radiation, including the applicators of sealed and unsealed radiation sources, handle the radiation source independently and/or supervise a range of action like that or work in the health–care system applying an ionising source of radiation occasionally, have to take part in a course of radiation protection on an extended level. Those who work in a sphere with the risk of increased exposure of ionising radiation, either as independent workers or as leaders or as supervisors, etc. need comprehensive training

Act XCIII of 1993 on Labour Safety declares that workers in Hungary have the right to safe and healthy places of work. It is obvious that the surplus exposition at workplaces with radiation is the biggest source of danger, which can be the consequence of operation or that of an unexpected event. In harmony with the Act above, the VHR ordains that employees’ annual radiation exposure from all sources may not exceed the dose limit value that is set by the safety rule relating to it. (EüM, 2000) Provided an employer creates the personal and material conditions of working ordained in statutory provisions and standards of radiation protection, and the general and local regulations of radiation protection are kept, then the radiation health–care risk will not exceed the level of risk in other branches regarded as secure throughout the whole work. (OSRI, 2011) Of course, in spite of this, danger to health originating from an unexpected event cannot be excluded. Therefore you must make sure during the application that the risk of unexpected events should decrease, their formation should be preventable, their results should be avertable and the damaging effects of possibly escaping radioactive material and ionising radiation should be reducable to the level as low as possible that can be reasonably achieved.

As secondary prevention, besides the exclusion of endangering factors or their reduction to the reachable level as low as possible, the working conditions, the preliminary and regular medical surveillance of employees’ health, job prohibitions and the occasional aggravation of dose limits play an important role in prevention. On opinions about the suitability to the scope of activity, employees are obliged to participate in a pre — and periodical employment medical examination so it can be determined, what strain the load/stress caused by an activity done in a certain scope of work and at a given place of work means for the person concerned. Before one is set to work, it is necessary to apply the pre–employment medical examination on him or her. Until suitability is judged or in the case of unfitness, the employee

cannot be employed in the set scope of work. In the case of employees exposed to ionising radiation, i.e. those working with medical X-ray machines and accelerators, those who do oncological ray treatment, furthermore, those employed in isotope-laboratories Type "C" have to submit to annual medical checkups. A final examination has to be done after a four-year exposition to ionising radiation at the end of the activity or labour relation. Another limitation is that

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pregnant women or women who have given birth to a baby shortly before and juvenile workers may not be employed at work places where they could be exposed to ionising radiation. (NM, 1998) In the case of increased exposition an out-of-turn examination is compulsory. The medical checkups of those employed in organised employment (with exceptions determined by law) is on the first level done by the occupational physician authorized to provide occupational health service who has a contract with the employer. In dealing with risk, it is an important principle that the introduction of a measure reducing a certain risk cannot cause any other kind of extra risks or risks that occur in another place, for example frequently used personal protective equipment, especially lead aprons for protection against radiation, in various places of work with X-ray in health care. When wearing them, you should reckon with secondary risks, such as illnesses of the bones and the muscular system. The surplus risks occurring when wearing personal protective equipment have to be taken into consideration when the person's medical suitability to work is judged. Besides work done sitting for a long time means unilateral burdening in the course of several diagnostic procedures and at places of work with monitors. The biological effects of radiation are determined basically by the dose. The two essential factors modifying the effects of radiation, the kind of radiation and the tissue sensitivity, though temperature also needs to be taken into account. Above normal body temperature, human cells become more sensible to radiation. They especially make use of it for improving the effectiveness of various radiation therapies. Besides the temperature, the individuals' physiological condition also influences the effects of radiation.¹⁷ In places of work, not only the check of the radiation level of the surroundings is important, but also the monitoring of the air condition, the formation of appropriate ergonomic conditions, their regular supervision, suitable time to relax, furthermore, proper meals and social conditions for employees. Beyond working time, organized recreational programmes and facilities may also help to maintain the proper physiological state. At workplaces with radiation, it is also important to inform workers about the risks of personal habits (e.g. the effects of smoking, alcohol, etc) in the framework of work- and radiation protection training related to the activity.

The technological possibilities of radiation protection

National standards involve the formation of various places of work with radiation hazard and the regulation of working processes in detail. The standards describe the requirements of the architecture and the mechanical systems of workplaces with radiation danger, the unexpected events, furthermore, the questions of the realising radiation protection. It is regarded to be a general principle that collective protection has a privilege in comparison with personal, when protection is planned. An area in workplaces with radiation danger that is supervised in an analogous way according to the regulations of VHR has to be indicated. Those area of work are regarded as controlled areas, where the annual individual radiation exposure deriving from the activity may exceed the effective dose of 1 mSv and in the case of the crystalline lens, the skin and the limbs, one-tenth of the relating value dose limits, and where the spreading of radioactive pollution and the possibility of radiation exposure have to be limited. The order sets the requirements of creating controlled areas and the rules of motion within

17 The content of this chapter is based on a note from the homepage of Paks Nuclear Power Plant. http://www.atomeromu.hu/download/3217/Alapfokozatu_sugarvedelmi_ismeretek_jegyzet.pdf (downloaded: 01 08 2013)

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them, entering and doing work there. According to VHR the Workplace Radiation Protection Regulation determines the system of safety and security requirements to be minimally kept relating to the area supervised (the working area where it is not necessary to keep the special radiation protection measures ordained for the controlled area). However, regular control over the supervised area has to be exercised. (EüM, 2000)

As it was mentioned before, brachytherapy is exclusively done with the after-loading method in order to reduce the radiation exposure on the personnel, the staff carrying out the intervention should not be affected by the radiation, and the apparatus can be controlled from another room.

In teletherapy the most important radiotherapy sources are the linear accelerators (LIN-AC). Besides the LINACs, there are cobalt irradiators too. The radiation of high energy irradiators cannot be absorbed in patients, it goes through them. The primary, scattered and leakage radiation reach the walls and scatter into the maze. The bunker walls and the entrance maze have to be planned to resist these radiation.

During some working processes, such as traumatological and other operations, or in the case of mobile X-ray machines, in hospital wards, when the photos are not taken in a place created for this purpose and screened, that is why

scattered radiation reaching the crew may occur more easily and in larger doses. In sick-wards they often apply lead plates of various sizes with a suitable support to protect the other patients during taking mobile X-ray photo- graphs.

Reducing the time of exposition to a level as low as possible and increasing the distance between the radiation source and the employer (time- and distance protection) is not always a technological one, but it is a collective protective measure. The aim of applying the tools of an isotope laboratory kept on compulsory store, i. e. tweezers, forceps, is also to enlarge the distance between the radioactive source and the hand/body so the dose affecting the employees can be decreased to a fragment. In the case of unsealed isotopes, actions accompanied by crumbling and evaporation may be carried out in local exhaust boxes.

It is also an important principle of occupational safety that dangerous things should be replaced by harmless or less dangerous ones so we have to endeavour to use smaller activity radiation sources.

When collective technological protective arrangements cannot be applied or their efficiency is not suitable, it is reasonable to use personal protective equipment against various radiation. Their protective abilities are given in so-called lead equivalents that equal the protective ability of the lead that is the same size as the indicated value (thickness in mm: 0.25;

0.5; 1; etc.) The most frequently applied protective equipment (mainly in places of work with X-ray and some places with isotopes) are lead coatings, lead aprons, lead collars for protecting thyroid glands, lead glasses and mouth-masks to prevent the inner radiation exposure deriving from crumbling and evaporation. Besides, some injectors for injecting radioactive isotopes are also coated with lead to protect the employees' hands and fingers. Choosing the proper equipment and protection level requires great expertise. Determining the order of using personal protective equipment is a special occupational safety activity.

The continuous application of the achievements of technological development is another important requirement for employees' safety. Because of X-raying during heart catheterization, the radiation exposure of those who are in the room is added up in the course of daily examinations, and it is quite significant even though it is obligatory to wear lead aprons.

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These days we can improve the safety of the procedure with the help of robot technology. With its application, medical specialists can supervise the catheter from a laboratory further away from patients' beds. With this procedure, the radiation exposure of the doctors doing the operations can be decreased significantly compared to the traditional technology. Besides minimizing the radiation dose suffered by employees, the procedure reduces the frequency of articular diseases due to wearing a lead apron. (MTI, 2012)

Unusual crumbling, evaporation, splashes and physical injuries, e. g. a pin-prick during injecting contrast material, the consequences of accidents, technological deficiencies and irregular work (for example lack of an exhaust box, improper exhausting, the bad technological state of the place of work, lack of personal protective equipment, etc.) may happen when the job is done with unsealed radiation sources. Therefore you must keep an emergency set in stock in the place of the activity applying radioactive preparations. One must assemble the emergency set taking into consideration the technological processes, the employees' number, the character and danger of the applied material.

One must give special attention to the proper operation and maintenance of the collective and personal protective equipment as they are very important for the employees' protection throughout their lifetime.

Summary

Creating working conditions that are safe and do not endanger health in connection with the application of ionizing radiation in health care means quite complicated tasks and obligations to the employees whose main orders concerning the application of radiation sources and radiation protection are determined in the Workplace Radiation Protection Regulation. At the same time, almost all internal regulations of health and security at work have a chapter on radiation (regulations of occupational safety, fire protection, etc.) The well-co-ordinated work of several experts and special fields is needed for taking protective measures and a far-reaching authority and supervising system takes care of keeping the rules and making the realization easier. Naturally, what has been written down here is only of summarising ~~ARMSC (18:2013)~~ to call the attention to the requirements in a form within the understanding of everybody with a high-level knowledge of the given technology and the professional requirements of radiation protection, and the widespread application of the legal and standard rules redownloaded in this writing are necessary for realising complex protection.

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