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POSSIBILITIES FOR INNOVATIVE SCIENTIFIC APPROACH: INFORMATION VISUALIZATION AND EXPERIMENT IN INTELLIGENCE RESEARCH

Dejan Ulcej[1], Uroš Svete[2]

Abstract

In addition to universal social changes, the information revolution also brought a lot of innovation to the workings of intelligence services, which are traditionally the part of the national security system that is conducting data analyses and for which information is the primary product. If in the past the main problem and challenge has been the timely acquisition of data, today most agencies are faced with an entirely different problem - information overload. This problem is being tackled by technical as well as systemic measures that combine various types of intelligence work. However, there are still unanswered questions regarding the applicability of intelligence products for decision makers. Here we have to point out information visualization as the subject of an interdisciplinary scientific research that definitely shows a lot of potential in the context of the defense science as well. This article points out three key requirements that allow the application of information visualization to defense research: (1) the concept of the intelligence cycle can be used as a good basis for the information that is subject to visualization; (2) the quality of decision-making support information depends on proper visualization; (3) the first two requirements offer a stable theoretical and empirical basis for the introduction of innovative scientific methods in the field of defense science, such as experiments.

Keywords: intelligence, information quality, information visualization, experiment

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1 Dejan Ulcej is a Ph.D. candidate and post-graduate student at University of Ljubljana.

2 Dr. Uroš Svete is an assistant professor at Faculty of Social Sciences, University of Ljubljana.

Introduction

The security environment today is probably the most unpredictable, dynamic and complex in human history, which puts decision-makers in the public and private sectors that are expected to make fast but deliberate decisions in an almost impossible position. The reason is without a doubt an economic, political, and especially a perceived globalization that is based on informatization or rather the ubiquity of information and communications technology. The development and interconnectedness of information and communications technologies (ICTs) such as the Internet, email, satellite television and mobile phones are diffusing globally at an impressive speed. The Internet is undoubtedly the most striking example. From only a handful of websites in the early 1990s, the Internet grew to contain several million websites at the turn of the millennium. Moreover, the costs of producing, using and communicating information have constantly decreased, making ICTs available to an increasing number of people all over the world (Eriksson and Giacomello, 2007). Today, more than one billion people are using the most popular social network on Web 2.0, which is characterized by Collaboration, Web as Platform, Crowd-sourcing, User-centred DesignPower, Decentralisation, Dynamic Content (Svete & Kolak, 2011), and we are progressively moving toward a third generation of the world wide web or the "internet of things". Such circumstances are without a doubt an exceptional organizational challenge for both, the entire field of national security and especially the intelligence services.

In this dynamic environment, all modern organizations have to be responsive, proactive, flexible and think ahead; these are also the primary responsibilities of individual decision makers. The aim of decision-making has to be changing a complex situation into a desirable outcome in the future (Bennet & Bennet, 2008: 4). There are three levels of decision making: tactical, operational and strategic decision making. Tactical and operational decision making pertains to short term and medium term goals and is used to deal with relatively structured (basic) problems. Strategic decision making focuses on the politics and orientation of an organization and is used for solving less structured long term problems. Decision making can take place under vague and uncertain circumstances, i.e. when the nature of the problem and the future outcome of the decision are unknown (Drummond, 1991: 12-13, 22). In these cases, the best support for making decisions is the information gained by processing and contextualizing data. However, information does not count as "good" if it is not useful for the decision maker or has no added value for him. It is rather difficult to determine the true value of information, although it can be evaluated based on the indirect usefulness to the decision maker. A more important factor of defining "good information" is the quality of information. Information quality depends on several defining factors, systemized by Eppler (2006) through the so-called framework of quality information. The advantage of Eppler's information quality framework is that it can be used practically as well as for research purposes (Eppler, 2006: 58). His name usually comes up in the field of economics, although he has the potential to be applied to the field of intelligence, which is also one of the goals of this article. It is especially reasonable to consider his work in the context of gathering information for strategic decision making or strategic intelligence. The latter is conducted by intelligence agencies from the private as well the public sector, and they all have one common feature; they focus mainly on external environments, which is why all their activities are directed outwards. The final products of strategic intelligence are intelligence items of various formats, complexity, content and temporal orientation (Herman, 2003: 105; Moss & Atre, 2003). Regardless of the type of intelligence product, the main goal of strategic intelligence is the provision of useful information.

Information and communications technology gives us the ability to automate some data processes and present them in various multimedia formats. But a technical approach does not suffice, since there is always a human at the end of the information chain that receives the information and makes the decision, which is also the main purpose of information, intelligence and, last but not least, technology itself. If we cannot present the data in a way the decision maker can understand and absorb the necessary information from it, we have failed. If the decision maker understands the information but does not need it – which means that the information is not in accordance with his needs – then we have failed again (Chen, 2006: 27; Drummond, 1991: 118). In order to be successful, we need to understand the human, which is why psychology and neuroscience can be of great help, since they both deal with perception and cognitive activities in humans. These disciplines and fields of research that deal with information technology helped create a new interdisciplinary field – information visualization. The main idea behind information visualization is to support cognition and take advantage of human perception by using visual representation (Card et al., 1999: 6). A lot of empirical research has been conducted in this field, especially experimental studies, whose results helped in the development of advanced information visualization techniques. However, these scientific methods have not yet been applied to the field of defense science research and therefore we cannot know for sure, if information visualization would improve the efficiency of intelligence products and what exactly its application would mean for the end user – the decision maker. These products are still based on text, while visualization techniques are given very little attention. This article will suggest new scientific approach and provide an answer to this challenge.

If we take into account that we live in a time, in which the overflow of information presents a serious challenge for intelligence activities, it is necessary to find the proper solutions in the context of defense science research and think out of the box. Until now, the research of intelligence and the national security system in the field of defense science relied primarily on basic political and sociological qualitative and quantitative methods as well as on systems theory, which also held a special place and meaning in research. However, it seems that we need to integrate information and communications technology within the interdisciplinary context of defense research and also think about – although it is a rather complex task in social sciences –the application of an experiment. This is, in our opinion, the right approach that will offer a scientific and verifiable answer on the effect of visualized intelligence information on decision making and will also redefine the use of the experiment in the field of social sciences.

Contemporary security environment in globalization era

The process of globalization in the 1990s has fundamentally altered the understanding of security. The importance of a global security was reinforced based on increasing interdependence of all subject in the international community. These developments rendered wars between great powers obsolete, but inner conflicts based on nationality, ethnicity and religion intensified (the wars in former Yugoslavia from 1991-1999, in the former Soviet Union, Somalia, Rwanda, Yemen, Libya, Syria, Iraq etc.).

The processes of globalization had among others the following impact on security:

- Bigger security threats that transcend country limits (for example, weapons of mass destruction, international terrorism, degradation of the environment, natural and other disasters, the possibility a global meltdown of the financial system, global warming, the risk of nuclear accidents, cyber threats).
- A tighter cooperation between countries. Globalization processes have so far developed some elements of a global culture (for example, a global economic system, communications and a global culture). The importance of cooperation between countries and other subjects of international relations for the provision of

national and international security as well as to refrain from confrontations and fierce competition like during the cold war.

These changes have been largely responsible for eliminating tension and distrust in international communities and at the same time created new opportunities for more cooperation and fewer conflicts in international relations. This could be the start of a new era, where matters of security would finally be resolved through cooperation and not through competition and conflicts. But despite all the good prospects, these changes don't seem to happen, mainly due to the strengthening of conflicts and a destructive, forceful resolution of international and interethnic disagreements and disputes that relativizes, threaten and sometimes even negate the positive effects in the international environment. Here we only need to mention the use of new information technologies, which are not only a source of new threats but can also lead to the creation of new security mechanisms. This is first and foremost a security challenge for individual countries, based both on cosmopolitanism and increasing interdependence, but also anti-cosmopolitanism, which sees globalization as a threat to national identity, political sovereignty and national economic interests. Therefore, future development trends and directions of the international community cannot be predicted with high certainty.

The increasing number of subjects in international relations can be regarded as a significant factor that contributes to the creation of a new international geopolitical environment, which today is less stable and more unpredictable than in the past. While the increase of number and diversity of countries in international relations during the past few years is merely a consequence of separation processes and the subsequent creation of new countries after the collapse of multinational socialist states, the increasing number of various other subjects in international relations in the past few years is mainly due to the end of the four-century long period of sovereignty of a system of national countries that was replaced by a pluralistic system that is characterized by competition and coexistence of both national and trans national, regional, local and even tribal structures (Drucker, 1994: 2). This developing, mutipolar world paints an unstable picture, which is why it needs structures that will work in this changed political and security circumstances. The critics think that – because of globalization – the world will be culturally homogeneous but with more crime, conflict escalations and unstable democracies (Frost, 2002: 35).

The old nation states, even the strongest among them, struggle to accomplish traditional tasks in an increasingly interdependent world, therefore the confidence in the state as a guarantor of social changes and progress is declining (Kegly & Wittkopf, 1997: 12-13). Consequently, the role of non-state subjects in international politics is increasing through various factors, like the development of communication and transportation technologies, the limited ability of countries to satisfy all needs of its individuals, government crises of global proportions, the globalization of national economies and a diminishing sense of security. Other very important consequences are the changes in the national security system, which is one of the cornerstones of a Westphalia (national) state and its sovereignty. Especially due to the nature of today's threats and the presented international environment, power and influence of intelligence and security agencies increased dramatically. However, the agencies are often not up to the tasks (for example, the search for Iraqi WMDs, the failure to prevent acts of terrorism). Due to the fact that the environment alone is a relatively independent variable, we ask the question whether it is possible to improve the operation procedures of these agencies by using modern information technology for the preparation of information (in terms of content and form) that will present a sufficient support for decision makers.

Strategic Intelligence

In theory, all organizations obtain information about dangers and opportunities from the environment, but in practice such information can be difficult to obtain, since the gathering of quality information requires a lot of time, money and skills. The biggest problem is finding reliable, relevant and up-to-date information, because if the information does not fulfill these criteria, it only diverts attention and steals the time and energy of decision makers (Drummond, 1991: 22-28). Organizations can obtain quality information only through an organized and systematic approach, which in the field of intelligence is defined as an intelligence cycle. This is a procedure of interrelated activities that include the planning and direction of tasks, data collection and processing, data analysis, the preparation of finished intelligence and the transfer of such intelligence to the end user that makes a decision. It can be applied both within government agencies as well as the private sector, in all state, political, economic, financial and security fields. The intelligence cycle is completed when the intelligence product is delivered to the decision maker (Črnčec, 2009: 86; Herman, 2003: 100; Šaponja, 1999: 9). In reality, the intelligence cycle is in constant motion, since in the individual phases the customers or end users constantly demands additional information, which makes the intelligence cycle actually a communication matrix between analysts that produce finished intelligence products and the end users that use them (Johnson, 2009: 33).

Every intelligence procedure starts with the preparation of a plan at the strategic level, where the key requirements are defined and guidelines for the desired information are set. At the national level, these guidelines are defined by the legislative and the executive power, and in a company they are defined by top management. The following strategic plan is then a basis for the intelligence process during which the analysts process the received data to such an extent that the result is an intelligence product. Once an intelligence product is ready, it is then tailored to the needs of the user. There are several types of these final products. Intelligence products in the field of political security are daily reports, alerts, periodic reports, analyses, assessments and forecasts (Lowenthal, 2009; Šaponja, 1999), and in business terms these products are ad-hoc reports, OLAP analyses, queries, reports via dashboards and scorecards etc (Turban et al., 2008). Our research focuses especially on those final intelligence products that contain the assessment of some outer environment, whether political and security or business related, and the predictions of what might be happening in the future with that specific environment. These are long term products of strategic importance or strategic intelligence. Political and security products are meant for the highest representatives of the executive and legislative branch of a country, whereas business products are meant for the top management of a company. Strategic intelligence relates in particular to the analyses of an organization's external environment (Internet 2; Digman, 1990: 282). In business, strategic information is mostly used for performance analyses, to gather information about partners, suppliers and the competitors, to determine future trends etc (Moss & Atre, 2003). In the field of politics and security this information is usually used for strategy and defense and consists of speculative evaluation reports, assessments and predictions (Herman, 2003: 105, Šaponja, 1999: 164). Therefore we will be interested in quality information that is gathered through defense and strategic intelligence (in the field of politics and security) and competitive intelligence (in the field of business). It is interesting to examine these two types of operation together, since both (1) are externally oriented, (2) they both rely mainly on external data sources, (3) in both types of products information is evaluated and predicted with a degree of probability and (4) in both cases the users of the final products are decision makers on a strategic level.

The need for quality information on the strategic level is much higher, since decisions have a long term impact. If a strategic decision is made on the basis of bad information, there is a chance that during the next five years we will be on the wrong path, which can be fatal for our security policy or business model.

Eppler's information quality framework

Quality of information can be defined as capability for use of information. With the increase of data quantity, information quality is the key factor in an effective organization. Quality of information should not be understood as an equivalent of a physical product, because some characteristics of information, such as timeliness, have to be modified every once in a while. Furthermore, quality cannot be precisely measured, since it is an immeasurable category that derives from an intellectual process. Various disciplines deal with quality information; from accounting, medicine and law to cartography and other sciences, but in all of them quality depends on the information being received in the right format, the right quantity, at the right time and by the right people at reasonable expenses. The most common criteria used for quality information in most of the disciplines are accuracy, timeliness, reliability, relevance, topicality and objectivity (Eppler, 2006: 1-11).1

For the purpose of gathering quality information Eppler developed the information quality framework, which identifies 16 criteria and parameters that every analyst should consider during the preparation of information products for organizations. This quality framework can be used for a number of purposes; the evaluation and improvement of quality information as well as the management and control of information (Eppler, 2006: 65). First and foremost it should be used as instrument that provides a set of concepts for analyzing and solving issues related to quality information. The framework gives researchers and leaders of organizations the opportunity to (1) deal with the issues of information quality in a systematic way, (2) analyze these issues and find its sources, (3) evaluate solutions for these issues based on analyses, (4) provide the necessary funds for the preparation of solutions and (5) learn and understand all four previously defined processes (Eppler, 2006: 58).

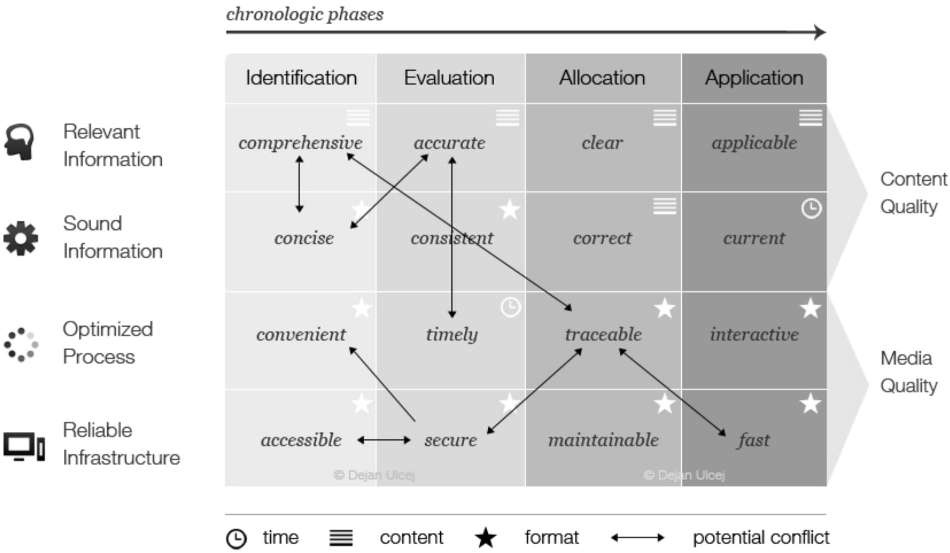
Eppler's framework consists of four main components. The first component relates to the horizontal structure shown in Picture 1 that consists of 16 parameters that are distributed into four groups of criteria for quality information, based on their relationship to the user community (relevant information), the information product (sound information), the information process (optimized process) and IT infrastructure (reliable infrastructure). When we talk about the relevance of information, we ask ourselves if our information is elaborate, accurate and comprehensive

[1] Eppler reviewed all kinds of criteria and pointed out 70 of the most commonly used and discussed criteria in literature about quality information (Eppler, 2006: 71).

enough to be easily applied. The relevance of information depends mainly on expectations and needs of users. The other group of criteria evaluates if the information is concise, consistent, accurate and up to date; in other words characteristics that are completely independent of users. The third group of criteria relates to the process of content management that is used to gather and distribute information. The main focus here is to determine whether the information process is suitable for users, administrators and authors of information and if information delivery is timely, traceable and interactive. The last group deals with criteria of a reliable information infrastructure and concrete questions like is there a simple way to access the system, is the system secure, can it be maintained and how fast is it. On the other side of the horizontal structure we can determine the second framework component. The criteria for relevance and sound information fall into the category of criteria that relate to the quality of content, whereas the criteria for process optimization and infrastructure reliability relate to the quality of the transmission medium (Eppler, 2006: 66-75).

The third component of Picture 1 represents the vertical (chronological) structure that is divided into four phases and represents the information's life cycle from the user's point of view. This is a sequence of questions that help the user to (1) identify (where is the information that I need?), (2) evaluate (can I trust this information?), (3) modify (can this information be adapted to suit my situation?) and (4) use the information (what is the best way to use this information?) (Eppler, 2006: 66). The last, fourth component of Eppler's framework is the categorization of criteria in accordance with three dimensions: time, content and format (Eppler, 2006: 11). Content is more important with criteria that deal with information relevance, i.e. where the aspect of the user is vital. When we talk about sound information, all three dimensions are important, since these are the most important characteristics of quality information. The remaining criteria relate to the quality of the transmission medium, therefore the more important dimensions are the format of information and time of their delivery. The arrows on Picture 1 illustrate the possibility that the improvement of one parameter of information quality compromises the quality of another. For example, timely information may be less accurate, because there was not enough time to prepare it. In such cases, it is best to find the optimal compromises between criteria (Eppler, 2006: 81).

Picture 1: Eppler's information quality framework



Source: Eppler (2006: 68)

Strategic intelligence products can contain huge amounts of quality information. If, however, the situation calls for a quick decision of the responsible person, the products need quick cognitive processing and decisions have to be made. This may cause various issues if the already finished intelligence products are unattractive, complex texts that need a lot of attention, although there is very little time to make a decision. Therefore it makes sense that, while preparing intelligence products, analysts should keep in mind that "a picture is worth a thousand words" and offer decision makers a graphical representation of the content. The human visual system is capable to search for hidden patterns with high sensitivity and discover them quickly, given that they are graphically displayed (Card et al., 1999: 8). Information visualization is an interdisciplinary field that deals with the graphical representation and cognitive processing of data. As an independent research discipline, information visualization is only a decade and a half old and has the elements of computer science, statistics, psychology, graphic design, semiotics and other disciplines.

Information Visualization: An Opportunity for Decision-making Improvement?

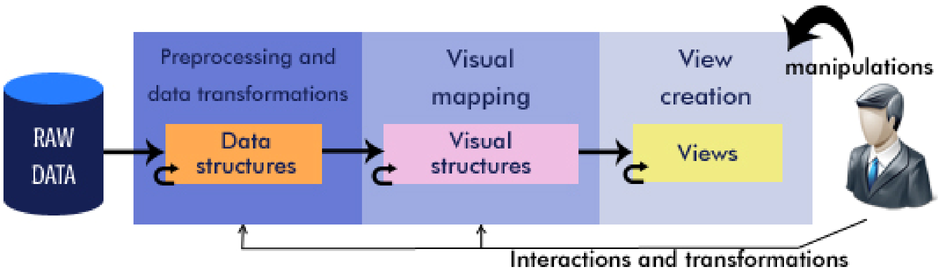
Information visualization is often equated with data visualization, although these are two different concepts that differ in the similar way information differs from data. Information visualization is not equal to scientific visualization. The first is based on visual representation of abstract data, whereas the second is a visual representation of physical data (Card et al., 1999: 7).1 The most widespread definition is from Card, Mackinlay in Shneidrmann (1999: 7), who define information visualization as »the use of computer-supported, interactive, visual representations of abstract data to amplify cognition«. Spence (2007: 5) defines information visualization as »the formation of mental images in the mind«, adding that information visualization has nothing to do with information technology. Ware (2012: 2-3) describes this definition as "out-dated" and says that information visualization is a graphical representation of data and concepts that is used as a cognitive tool for the support of decision making. Thus, the important element here is – regardless of the medium – the external factor that triggers cognition and through which all other cognitive processes are activated. Visualization is therefore not only limited to one (graphical representation) or the other phase (cognitive process) but covers both the stimuli that convey information and the cognition and cognitive processes relating to this information.

Information visualization is being researched as a concept based on a visualization reference model that was developed by Card, Mackinley and Shneiderman (1999: 17). The reference model is suitable for a simplified description of information visualization in phases that follow a logical order and that can be used as an "information visualization plan" for the graphic designers and researchers. The model is represented in Picture 2 and is read from left to right. When raw data is transformed into organized data structures with exact relations between various variables we obtain the data that is subject to visualization. Then we define the visual structures for this data; this process is called visual mapping and needs a lot of attention if we want an effective visualization. It is vital that the data does not change during modelling (Card et al., 1999: 17-23; Tufte, 2009). Visual mapping basically means that the data structures are defined with a space substrate, graphical elements, and retinal characteristics (Mazza, 2009: 20):

[1] Abstract data does not exist in the physical world (financial data, presentation of hierarchy, etc.), while physical data derives from it (molecules, crystal growth, the human body, changes of the Earth's surface, etc.) (Card et al., 1999: 7).

The spatial basis: dimensions (variables) in data;
Graphic elements: everything that we can see in a space (points, lines, surfaces and volumes);
Retinal or pre-processing features: the features of graphic elements that our eye is sensitive to (size, orientation, color, texture, shape, intensity and position).1

Picture 2: Reference model for information visualization



Source: Card et al. (1999: 17), Mazza (2009: 18)

The last phase of preparing information visualization is the generation of views. If the visual representation is in a format that allows interaction, usually a user interface is used to change either data input or graphic perspectives, which in turn creates a feedback loop (Card et al., 1999: 17; Mazza, 2009: 18). If we are dealing with graphic representations like printed reports, then we are talking about passive interaction, since it demands from the user active eye movement, more concentration and a higher number of cognitive processes (Spence, 2007: 167).

For visual mapping it is not only important to pay attention to the authenticity of data but also to properly apply pre-attentive (retinal) characteristics. Visual perception and cognitive processes are probably the most important concepts of information visualization, although today not all people would (yet) agree. The development of advanced computer visualization techniques simply cannot use our full perception capacity, if we ignore the rules of perception and cognition during the design of these techniques. Cognitive neurosciences, and its sub-category cognitive psychology, are academic fields that are concerned with the study of biological processes in the brain, which is why we expect that in the future this discipline will play a vital role in information

[1] They are called retinal features, because the retina in our eyes is sensitive to them regardless their position. The human eye processes these features swiftly and without the need to activate selective attention, which is why they are quickly stored in our sensory memory (Card et. al, 1999: 29; Few, 2004: 98; Trstenjak, 1971: 256).

visualization. Processing visual information is much more complex and does not only include cognition processes but also visual attention, memory and other higher cognitive processes (Raskin, 1999: 344). Cognition processing starts with the visual stimulus of receptors in the eye and continues with image processing in the visual cortex in the back of the brain. If these retinal characteristics are formed properly, they stand out and force their way inside, that way patterns are quickly recognized and the brain can process them faster in the form of signals (Trstenjak, 1971: 256). Another important concept regarding perception are the so-called Gestalt principles or rules pertaining to the visual cognition of patters, shapes and visual organization. According to these principles, people should not watch and see the world as fragmented individual parts but as structured entities or forms (Butina, 2003: 56).

When we talk about cognitive activities in the context of information visualization it is necessary to understand that everything that enters into the nervous system through our sight is perceived in the brain, where it becomes meaningful (Butina, 2003: 8). Based on how long information is stored in our memory we distinguish sensory, short term and long term memory (Ware, 2012: 377). The visual or iconic sensory memory stores pictures of objects for about 250 do 500 milliseconds. Visual memory acts as some kind of "environment scanner" that scans unconsciously and automatically, which means that it is a process we cannot control. Some information from visual memory is then transferred to the short term or working memory, where it stays from a couple of seconds to one minute. Information is transmitted in the form of chunks. If we do not recall them after that, they will be forgotten, otherwise they are transferred into our long-term memory that acts as our "hard drive" (Few, 2004: 92; Mazza, 2009: 34). After processing, the external object that we see becomes a mental image of the external object (the world) and is a thought that can be recalled from our memory, even if we cannot see the object (Butina, 2003: 8-12). Mental images can have a different source (e.g. auditive), although the most common form of visualization among humans is still a visual image or visualization in form of mental pictures (Spence, 2007: 5; Sternberg, 2009: 260). However, mental visualization varies from person to person, which is why we cannot claim that it is easier for all people to visualize things. Some are better at processing images and others at processing words, therefore graphic representation of data is not necessarily always better than text (Mayer & Massa, 2005). The hypothesis on visual-verbal cognitive abilities of people is certainly an important starting point in research of information visualization.

An overview of previous defense science research

Intelligence in the context of defense science has so far been studied in two ways: at the beginning as an integral part of the national security system, while later it was used mainly for the analysis of conflicts, where its role and importance are evidently and steadily increasing. In this context, research was based on the basic primarily quantitative methodology of social research with an emphasis on systems thinking, normative legal analyses, the concept of crisis management and qualitative social science methodology (Malešič, 1996). The latter was applied – of course taking into account all limitations of such an approach – mainly in military sciences or in sociological studies of modern armed forces. If, despite the limitations, the main qualitative methods – the interview and participant observation – are useful for studying military organization (Vuga & Juvan, 2013), the much bigger question is can it be used for studying (secret) intelligence agencies. The research of these agencies can be very hard for the science community due to the specifics of their operation; however, they should not be ignored in defense and security studies. Therefore current analyses of their work focus on their role in modern conflicts and fight against (international) terrorism, combining the defense-strategic and also a wider security political qualitative approach (Svete, 2012).

Information visualization is a completely different story, rather rare in defense science. It could be put into the context of the increasing importance of information and communications technology as a subject of study and a research tool in the field of defense science, however, the application of visual information knowledge in defense science can be a very challenging task. Not so much in a theoretical sense, where we only combine visual information with intelligence operations, but rather in the sense of selecting the right empirical scientific methods. Defense science research was thus far based on scientific methods that are more common in other social studies, which is reasonable, since research goals were set accordingly and have produced good results.

Experiment in Defense Science: Application of Information Visualization Empirical Research Methods

Information visualization took its research methodology from psychology and human-computer interaction. Information systems that allowed visual representations of data have evolved mainly on the basis of empirical evaluations involving controlled experiments with users, tools and implementation of tasks. Today, empirical evidence is an integral part of the knowledge about information visualization that reveals what works, what doesn't work and what needs to be further explored (Chen, 2006: 174). Chen's (2006: 174-185) meta-analysis of experimental research in the field of information visualization shows that despite having different approaches and purposes, the authors of experiments focused mainly on questions pertaining to the users and their cognitive abilities, the visual search and scanning of information, visualization designs etc.1 Studies that were part of the meta-analysis generally included accuracy and efficiency as the two key dependent variables, which produced the measurements that led to the findings that research in the field of information visualization lacks a systematic approach and consistency. The main challenge of experiments in this field remains the preparation of realistic and practical tasks for users which would help us understand the reactions of people to different visual and spatial clues (Chen, 2006: 181).

Therefore the key question pertaining to innovation and research is how information visualization affects the recipients of finished intelligence products. Are they able to understand the intelligence information faster or better if the information is backed with information visualization techniques or if the information is prepared in a more traditional way – mainly with texts and numbers? In what way can information visualization be helpful? Do they relate better to the intelligence product if the information is visualized or text based? Considering the need to understand the cognitive characteristics of the decision makers that are confronted with information visualization of finished intelligence products and taking into account the systematic approach of the empirical research of information visualization, it would be very difficult to use traditional methodology, which is why we need to consider the application of a controlled experiment in the context of defense research. However, such an approach raises countless question regarding ethics and security in both defense research and the whole of social sciences, especially in the field of intelligence, which is not exactly known for its openness for conducting research. Furthermore, an experiment also requires "the most natural conditions", which can be questionable in some fields (medicine) and sheer impossible in others (astronomy). Nevertheless, the experiment gave science its fundamental trait – the verifiability and repeatability of scientific results, while at the same time allowing quantification and precise measurements. The experiment opens a new chapter in the methodological development of the defense

[1] The meta-analysis of empirical studies of information visualization includes 35 experimental studies between 1991 and 2000, with as many as 32 studies conducted between 1996 and 2000. The main purpose of a meta-analysis was to find an invariant pattern throughout the whole collection of empirical evidence (Chen, 2006: 175). More information about meta-analysis: *Chen, Chaomei (2006): Information visualization: Beyond the Horizon. London: Springer.*

science, while information visualization is provided with empirical data about users, visualization resources and the related tasks from the fields of politics and security as well as economics.

If we want to carry out a controlled experiment, we need to ensure controlled and artificially prepared circumstances in which one can systematically manipulate the independent variable for the study of its impact on two or more independent variables (Johnson, 1992: 88). In our case the artificial circumstances need to represent the decision maker as the recipient of a strategic intelligence product, who must get to know and understand the contents of this product in order to make a decision. While the intelligence product indeed refers to a fictional report with made up data, it is still the closest thing to a real intelligence product as described by publicly available sources. The report includes the political and security assessment of made up areas and subjects as well as the assessment of the competitive environment of a fictitious company; so the content of the report would focus mainly on security and economics. The participant of the experiment (the decision maker) would then have to read/review the report, familiarize himself with the content and react by answering basic questions related to the understanding of the content as fast as possible. In addition to answers related to the content it also makes sense to ask the participant about his thoughts on the report – whether he liked it or not.

To ensure a correct methodology, the report is handed out to two groups of participants – the experimental group and the control group. So one time the participants will get a text only report and another a report enhanced with information visualization techniques, but all will be performing the same tasks – answering similar question with the same level of difficulty. The independent variable is therefore the report format, since its being manipulated. The key dependent variables being measured are the efficiency of the intelligence product and attitude towards the product, which means that the research will be set in a comparable framework of the existing empirical studies of information visualization that will guarantee a systematic research. In order to ensure the measurability of the variables, these two (latent) variables need to be broken down into measurable dimensions. Efficiency is measured by the time needed for the completion of the task (answering all questions), the (in)accuracy of the answers and the request for additional information. These three dimensions are used to measure the speed of completing tasks and the participant's understanding of the content. Although the request for additional information is indeed a somewhat unusual variable, it would be a great help in determining the presence of a feedback loop in intelligence – namely to discover whether it is more common in text only reports or reports containing visualization techniques. The second dependent variable – the attitude towards the product – can be measured by two dimensions: the valence of emotion and activation. These two dimension are used to determine if the participant's attitude towards the visualized information is more positive that the attitude towards textual information. Considering that the valence of emotion and activation – according to present knowledge – has not yet been measured in the context of information visualization research, this method is a new empirical contribution of psychology to this field.

It is necessary to include as many people as possible in the experiment, since larger samples guarantee a more credible result. Above all, a careful sampling process is vital. Two groups of 20 people, so at least 40 participants, would suffice. However – as past research experiences show – it is necessary to consider that among the participants some will have different visual and verbal cognitive abilities; this is also pointed out in the empirical research conducted by Chen (2006: 174). This is why it is essential to test the visualization capabilities of every single participant in the experiment, whether with mental rotation or a questionnaire about object and spatial perception. From the standpoint of scientific rigor, competence and ethics of profession, such experiments cannot be conducted without psychologists, which is why their presence is mandatory. When the experiment is over, the gathered data will be processed with statistical methods – best done with a (multivariate) analysis of the variance.

Conclusion

Postmodern society, in the contemporary, temporal sense of society, rather than the unhelpfully vague sense of the 'anything goes' relativism and diversity of 'postmodernism', can usefully be related to the invention of the Internet and the broader late-20th century transformation in information and communication technology (ICT). The global transfer of information amongst those not stymied by the digital divide is accompanied and reinforced by the increasingly easy passage of people and goods across international borders. ICT is at the root of globalization as reincarnated for the present age (Held and McGrew in Gibson, 2005). And in such circumstances, in which the speed of social changes is in a way dictated by the technical as well as practical value of technology, the bottleneck of the evolution of information and communications technology is the human, who with its limited capacity for processing information is simply unable to follow Moore's law anymore. This conclusion presents one of the biggest issues today, especially in the field of intelligence, which is still searching for its identity after the collapse of the relatively predictable bipolar world with long development cycles, clear protagonists and somewhat symmetrical development of mostly military threats. The requirements and expectations of decision-makers are ever growing, but on the other hand it is precisely the confidentiality of these services that often provides and excuse and an excellent safety net for the errors of politicians as well as military commanders and their decisions. Although for the time being we cannot increase a human's capacity for processing data with hardware, we are still increasingly trying to include the characteristics of an individual in data research. In this context, information visualization is, in our opinion, a great opportunity for a conceptual and methodological development of defense science and all its applications, and with the simultaneous use of a social experiment it gives much desired precision to defense sciences. It is true that the impact of information visualization on the decision process is scientifically very difficult to study, especially if taking into account the "classified information", which is why the experiment is an actual attempt to simulate the circumstances the decision makers have to face in their work. The presented interdisciplinary concept of research work could be a great new asset for scientific developments in the field of defense and security sciences, while the findings of the experiment could have a clear applicative potential in strategic, governmental, security and business environments.

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