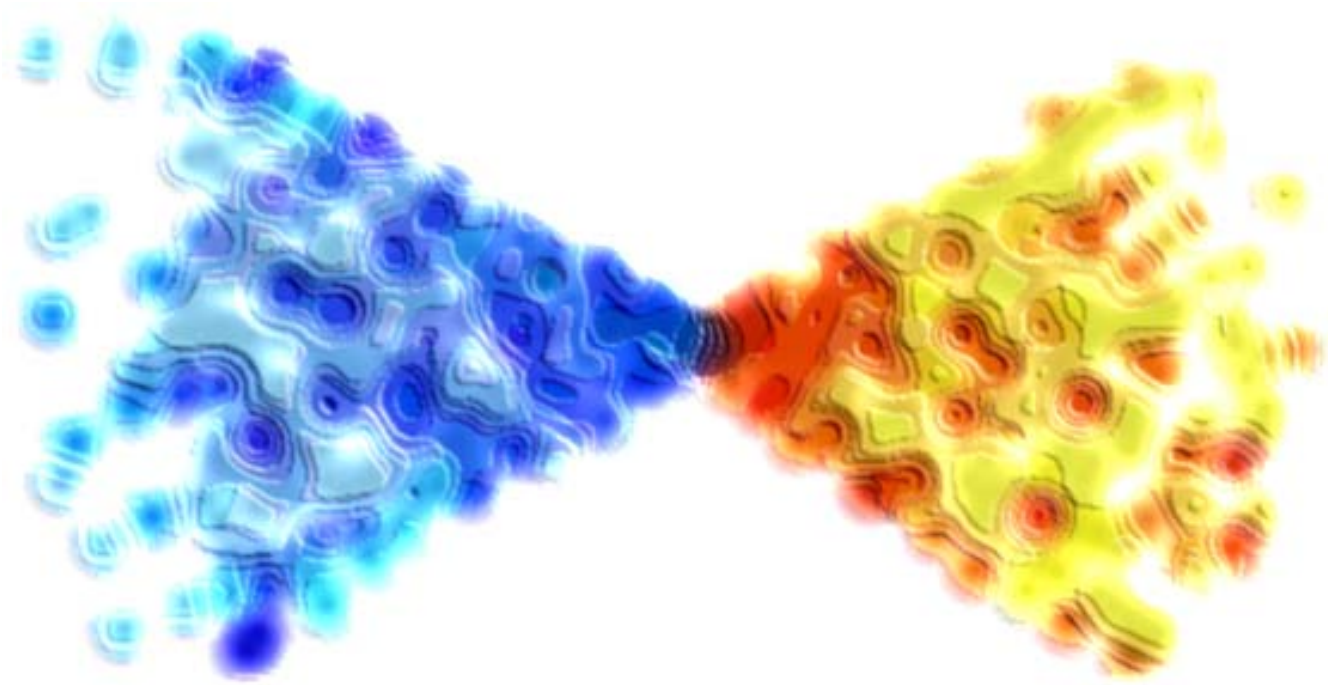
Aspects on Availability

A teleological adventure of information in the lifeworld

Lieutenant Colonel, G.S. Rauno Kuusisto



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Lieutenant Colonel, G.S. Rauno Kuusisto

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ABSTRACT

Availability is a feature of information. Availability is frequently connected to information security. So it is now. But in this thesis, the viewpoint is slightly different form the usually understood context of information security. Here, availability is dealt with as a compulsory feature of the information, which is essential to make as optimal decisions as possible for making the future. Security is understood as a state, which will be reached by using information that is available. The approach to security in this thesis is broadly understood as “making security with available information”.

The overall frame of this thesis is based on European philosophy represented by Henri Bergson, Martin Heidegger, Karl Popper, Hans-Georg Gadamer and Jurgen Habermas. The philosophical approach is chosen to be able to deal with the rather broad and abstract wholeness of the overall problem. The philosophical approach is something new for the researcher, as well, thus offering new challenges and an opportunity to learn something new and broaden the worldview. The philosophical background is supplemented with theories about time, information and knowledge management and problem solving to reach more practical solutions. Finally, a representative entity of the information availability environment is analysed to validate the philosophical-theoretical construction.

The hypothesis of this thesis is formulated around the theories of time, information and problem solving concluded with the description of social systems conducted in the theory of communicative act by Jurgen Habermas. Research questions will deal with the combination of time and information to reach understanding to construct a model, which is used to solve information availability issues in temporally demanding decision-making environment.

This thesis is hermeneutical, reaching towards understanding those phenomena that concern information availability. Features of availability that are dealt with are connected to information itself and the purpose of using information, the refining process of information in a purposeful action, and time from few viewpoints. All this is connected in a context of a social system. On the basis of all this, a suitably abstracted model is constructed to understand how information can be used and what kind of aspects availability contains.

On the basis of that, a complex entity of information availability in a temporally demanding decision-making environment is analysed. This entity contains the temporal and meaningful divergence of information. This system is solved on the basis of the theoretical frame. A new kind of solution to model the use of available information in a temporally demanding decision-making environment is constructed. Finally a number of new research questions will emerge, which is well suited to the science philosophical frame that is selected to be obeyed in this thesis.

KEYWORDS: Making security, availability, time, information, social system, decision-making.

PREFACE

A human being is collecting experiences, thinking and generating new information through his whole life. Self-expression will arise from that entirety. It could be thought that a scientific thesis is one form of self-expression, as well. But that shall be expressed in a form that is confined by the rules for making true, truthful and justified science. Making science contains always at least a small amount of the personality and experiences of the scientist himself. From that viewpoint, it should be rather essential to enlighten the reader about what kind of personal history has had effects on this thesis.

I have two hobbies, which have had significant effect on my thinking. One is astronomy, especially cosmology, which has led me to think about the origin of perceived phenomena. This has had actually rather remarkable effect on the way of my thinking during at least some 35 years by now (2004). When thinking about the origin and the structure of universe, those phenomena that are observable do not necessarily explain the real nature of the wholeness. This wholeness can be explained and thus modelled rather adequately for certain purposes. These models are valid for these particular purposes, but they are concealed by certain attributes (like time, space, speed, energy, power, etc.) When considering complex phenomena, the wholeness is frequently very hard to explain in its entirety. But two interesting viewpoints can be found. First, for certain purposes, a locally functioning model can be constructed. Second, the more abstract this model is, the broader is the spectrum of divergent phenomena that can be explained with it.

Another target of my interest has been electronics, and further on radio amateur activities. This has lead to plan and build several receiving and transmitting radio equipment during time. The radio amateur hobby actually led to a career as signal officer in the Finnish Defence Forces in 1977. So, the origin of my thinking is in the trial to understand why things manifest themselves the way they do, and the origin of action is in the trial to broaden my personal communication space. This worldview shows itself hopefully interestingly in the structure of this thesis and its results, as well.

During my military career some important cornerstones that have lead to the present state can be pointed out. After I had served as a communication trainer for a few years in various places, an opportunity to get familiar with electronic warfare popped out some twenty years ago. After doing both communication and electronic warfare against it for some years, an insight of systemic nature of this combination came out. Everything affects everything. This does not happen randomly, but all phenomena of a determined context have relationships and they are interacting dynamically. Denying the availability of information – or a part of it – will lead to delays and the incorrectness of acts. Electronic warfare and communication seemed to form a very fascinating combination, and led me to think of time-criticality of action and the role of information in a completely new way. Information seemed to have a situation dependent value and there seemed to be a huge variance of information that was reachable. This information happened not in all cases to be relevant at the very moment it was available. Command and control seemed no longer to manifest itself as a series of acts, but a complex system dependent on the information available. Availability seemed to be dependent on time, mutual working environs (space), the

needs of the user of information, the motives of the producer of information, the rules that interaction has (including deliberate disruption), and the needs of mutual understanding. In this phase the pattern of my thinking was rather fuzzy, partly obscure, and the overall structure was hard to formulate. The theory behind those thoughts was missing. About one and a half year ago (spring 2003), I found couple of small notebooks from the year 1987. They contained some idealistic, but rather interesting points[1]:

- "It seems that we have lot of to learn about mutual information management and about the will to understand themes unprejudiced. To proceed in understanding, the wholeness should be understood."
- "Managing knowledge, and filtering incoming information will produce know-how."
- "One has to understand the meaning of available information and the meaning of filtering and arrangement of that information to understand how to gain better know-how."
- "Command and control shall have one precondition: To use and arrange the information that is coming from the entire working environs."
- "Individuality should not be suffocated. If this is done, the ability to innovate and produce ideas will melt away and the growth of know-how will terminate."

These thoughts were made without a theoretical background and at the moment they look like rather obvious. Anyway, they show that I had a burden of agony to understand what is taking place in information processing in an entity and why. Fortunately, the general staff officer course in 1990 - 1993 gave a splendid opportunity to carry out interesting research work in the context of the general staff officer thesis. I produced my thesis in the spirit of positivism. The thesis dealt with the abilities of tactical electronic intelligence. The nature of that study was theory forming. A theoretical construction about speed, range and accuracy of gathering intelligence information and further about the ability to serve commanders in their decision-making was made. For the first time in my personal history, I studied time and information together. I developed a time-dependent model about the serving capabilities of information producing systems. That research work was most interesting and led me to think and study more about command and control warfare and further on, information warfare. At this point the entity grew so big that a solely practical or purely technical viewpoint became impossible.

Changing position from the task of the chief of Research and Development Division of the Army Signals School to serve as a senior scientist in the Finnish Defence Forces Technical Research Centre opened possibilities for theoretical studies, as well. Theoretical studies about organisation security, information and knowledge management and futures studies became somewhat familiar. At the same time, my main task was to participate in the process to produce long-time research goals of information technology for defence purposes. Once again, available information and its time dependency got a new perspective. The value of information, and the moment when it should be available for making choices or binding necessary resources pointed out to be somewhat important. This importance seemed to reveal itself in the same way despite the organisation and its tasks. Only temporal

[1] Notebook called "ajatuksia" (i.e. thoughts) from the year 1987. Referred parts are dated October 6, 1987.

perspective, and the quality of information seemed to be different between these cases. This difference seemed to be dependent on the pace of the demand for making choices. At war, when a brigade is fulfilling its task, a few hours will be the eternity. On the other hand, when trying to create security feeling for nationals for the future, the time axis is tens of years. Both cases need available information, but the temporal dimension is totally different. Time proved to be bound to the actor, who is acting in a determined situation in some context.

These experiences – among many others – formed the path that finally led me to wonder how these items are connected together. A need to understand has been a strong motivation for me during all these years. Now it seems to be possible to make some efforts to extend this understanding and put it into an explicit form. One factor has affected my self-expression a lot. I am a visual thinker. That has always shown in my appearance. So it will be now – this thesis includes a lot of figures.

My dissertation project ignited truly in 1999 and accelerated to its full speed in September 2002, when I had a splendid opportunity for few months to concentrate on my research work and start the documentation phase of this thesis, as well as write publications. From the beginning of the year 2004, I have acted as a researcher in a Finnish Defence Forces funded research project and continued publishing. This publishing work has been mainly completed in the research team first led by my professor, Tuija Helokunnas, who through some fortunate occasions became my wife, and who later on moved to serve the Finnish Defence Forces. Our research team extended and focused more towards defence studies and we continued our publishing work together. Especially those parts of this mentioned research work, where my own contribution has been comprehensive, have been used as publications of this thesis among some publications solely of my own. Research is teamwork and it shall have a customer. In spite of the team nature of research work, every individual thesis is a manifestation of its constructor.

I would like to thank all those people - family members, friends, colleagues, superiors and scientists - who have supported, understood and encouraged me during my dissertation process. Especially I would like to thank colonel Alpo Julkunen, who had a broad vision about the necessity of scientific competence in the Finnish Defence Forces Technical Research Centre and who arranged me the possibility to carry out research work as a visiting researcher. That event kicked me into the real world of science, and later on made me happy and human. I would like to thank all those people with whom I have had stimulating discussions during this process in the Finnish Defence Forces Technical Research Centre, the National Defence College, the Defence Staff, the Finnish Futures Research Centre, the Tampere University of Technology and the Helsinki University of Technology. Professor Aki-Mauri Huhtinen encouraged me to delve into the world of philosophy and the philosophy of science. Professor Teemupekka Virtanen has virtuously kept me on the move. Ronja Addams-Moring and Laura Loikkanen have advised me with the English language. My superiors, colonel Jorma Aherto, professor Vesa Tynkkynen, and general Aarno Vehviläinen, as well as his successor, general Pertti Salminen have arranged for me the opportunity to complete my dissertation project. I would like to thank my pre-examiners, professor William Huthcinson and docent Osmo Kuusi, who gave me most valuable feedback to finalize my dissertation. Further more, I would like to thank my opponent, professor Matthew Warren, who made a long journey to be able

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Finally I would like to thank my wife Tuija who has had faith when my own has temporarily dipped…

1. Introduction

1.1 About the title

The title either raises the interest to read the entire text or will cause the potential reader to abandon the reading project. The title should allow the researcher to cruise somewhat freely in the space of interest. On the other hand, it should keep the entity together, to make it understandable inside certain bounds. The title should be timeless, but it should allow timeliness. It should allow create something new and connect it to what already exists.

The title is “Aspects on Availability”. According to Merriam-Webster’s 2003 dictionary, the word “aspect” has its heritage in Latin language and it means originally “to look” or “to look at”. Nowadays it means various things like:

1. A position facing a particular direction. (e.g. a conjunction of a body in a solar system, a house facing to a determined direction, the manner of presentation a plane faces a fluid stream).
2. Appearance to the eye or mind.
3. A particular status or phase in which something appears to be regarded.
4. The nature of the action of a verb as to its beginning, duration, completion, or repetition without reference to its position in time. (Merriam-Webster’s 2003, 72)

Availability is the quality or state of being available or an available person or thing. Availability originates from 1803. Available is an older word and originates from the 15th century. It means:

1. Having a beneficial effect (Which is the archaic meaning of the word available).
2. Valid (having legal efficacy, being well grounded of justifiable, being at once relevant and meaningful, being logically correct, and being appropriate to the end in view).
3. Present or ready for immediate use.
4. Accessible (capable of being reached, being within reach, easy to speak or deal with, capable of being influenced, capable of being used or seen (available), capable of being understood or appreciated).
5. Obtainable (Obtain: to gain or attain usually by planned action or effort, Prevail: to become effective).
6. Qualified or willing to do something or to assume responsibility.
7. Present in such chemical or physical form as to be usable. (Merriam-Webster’s 2003, 84) (Explanation in parenthesis are from Merriam-Webster OnLine)

It could be stated that using the word “aspect” will guide this study to reflect on timeless thinking about subjects under concern from certain angles. Purposefulness is built in the word “available” – it has connotations about benefit, relevancy, understanding, meaningfulness, efficacy (the power to produce an effect), efficiency, effectiveness, and immediate usability. On the other hand, it does not restrict the nature or character of the item under concern. Neither does it restrict the temporal

nature of the item under concern, but only the use of this item. It could be stated in a very generalised form that if information is available, it is supposed to be useful in immediate beneficial action.

The subtitle is "A teleological adventure of information in the lifeworld". Again, according to Merriam-Webster's 2003 (relevant pages) those words can be interpreted as follows:

1. Teleological is "exhibiting or relating to design or purpose." (1284)
2. Adventure is "an undertaking danger and risk, an exiting or remarkable experience, an enterprise involving financial risk." (18)
3. Information is e.g. "the communication or reception of knowledge or intelligence." (641)
4. Lifeworld is "the sum total of physical surroundings and everyday experiences that make up an individual's world." (718)

It can be stated that by the subtitle the item under concern is confined to the slightly risky business of processing and producing information to cause purposeful action inside the environs, where a purposefully acting entity will make decisions. In other words, the angle of interest is set to how the overall information potential can be exploited to cause purposeful action. The question, in what kind of situation information is used is not dealt with. Instead of that the question, what kind of information shall be available, is pondered. According to the complete title, availability of information gaining purposeful action is studied.

1.2 Background

Arman Matterlat (2003) writes in his book "Histoire de la société de l'information" about the history of information age. He states that society, which we are calling the "information society"[2] is not the phenomena of the contemporary world but has its roots in the Enlightenment. The societal change that took place in Europe some three hundred years ago created a good platform to the growth of physical movement. The system of apparently secure national states created an opportunity for organized and determined competition in the economical area. This was a key to growing welfare. The physical movement brought among itself the movement of information, as well. Eventually this caused the phenomenon that is at the moment called "network" or "networking". (Matterlat 2003)

Manuel Castells defines network as a set of interconnected nodes. The phenotype of those nodes depends on the structure and the viewpoint. (Castells 1996, 470) The whole can be regarded as a system of networks. This whole will transpire divergently depending on the angle and level where it is observed. Networking is a way to proceed with purposeful action in a community[3]. Networking has a strong connotation of exchanging purposeful information or action among various actors. When considering both Matterlat's and Castells' thinking about networking, it seems

[2] A very well known presentation – I would like to say a classic – about the concept and phenomena of modern (at this moment!) information society is Manuel Castells' trilogy from 1996, 1997 and 1998.

[3] Networking is the exchange of information or services among individuals, groups, or institutions. It is the cultivation of productive relationships for employment or business, as well. On the other hand it means the establishment or use of a computer network. (Merriam-Webster's 2003, 833)

that humans have the inevitable desire to find out some kind of solution to feel secure in that environment, where they or the nearest (either physical or mental) group is. During the Enlightenment people desired physical security after a long era of disastrous wars, and at the present people will seek security feelings in an economically driven world trying to get one's part of this economical welfare to maintain one's position in that economical context. Three hundred years ago the security feeling came from a secure physical structure and nowadays it comes from a secure economical structure.[4] For the future, the security feeling might be bound to the infrastructures of information. Security will be made by available information.

A human being is a conscious creature (e.g. Damasio 2000, Dennett 1999) and thereby uses appropriately understood information to outline the system consisting of oneself and the environment. It could be thought that a human being is seeking the feeling of security by trying to understand information that is available. According to Martin Heidegger (2000), a human being is a future oriented entity, who will search for the better, and is searching it from the assumptions about futures. But time is inevitable and a human being is limited on the temporal axis, as well. That is why everything cannot be done. To gain desired goals, ordering significance is necessary. This cannot be done without understanding spatially and temporally available information and its use.

Information surrounds us. We are part of widely networked environment. Every person is involved in this network in a specialised way. Relationships are most complex containing bindings to working organisations, families, and hobbies. Those relationships are changing during time, thus being dynamic. The overall field of information, trough which we are interacting with this complex and dynamic systems, is huge. Through technology a human being is extending his ability to gather information from the space ever wider. Vice versa, technology gives new possibilities to enlarge ones capability to affect wider spaces. This space of observation and acting has dramatically and revolutionary increased a few times in human history. The latest one is caused by information technology and technologically aided networking, which has created a possibility to make information available over the whole globe. The amount of reachable information has dramatically increased. The background of this development is described in Manuel Castell's trilogy of information society. (Castells 1996, 1997, 1998) But has the average personal capability developed to deal with this information increase? That issue is most interesting, but it is not the topic of this thesis. Instead, availability is discussed in the field of information use in purposefully acting organisations.

Gurpreet Dhillon (1997) has approached security from the viewpoint of information systems security. He uses a humanistic approach. He deals with organisational security aspects from the basis of the complexities of social phenomena. Via a rather broad literature analysis, he ponders the field of information system and security research in the matrix of the philosophy of science and the emergence of change. This field is concretised in figure 1.

[4] Actually this is not so strict. Obviously a human being is seeking security from environs, which are understandable. Security feeling raises from that environment, where one is acting.

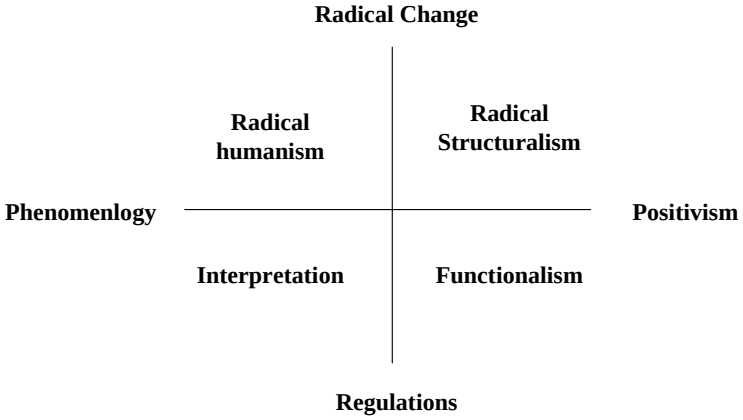


Figure 1. The field of security research by Gurpreet Dhillon (1995, 8 – 28)

Dhillon states that greatest amount of all research is dealing with those items which exist in the functionalistic corner. This kind of research combines positivistic science tradition into such societal thinking where activities are adjusted by normative regulations. The interpretive paradigm stresses that social reality is "a network of assumptions and intersubjectively shared meanings."[5] Reality is forming from the basis of the activity of interacting individuals and it is renewing continuously. Radical theories are stressing the necessity of radical change. According to radical humanism an individual is interacting with ideas or ideological superstructures thus being more effected by those than normative regulations. Radical structuralism is aiming to change prevailing structures, thus causing inevitable conflict with those, who wish to maintain the status quo. Theories used to do research from those viewpoints are e.g. as follows:

1. Functionalism – system theory, contingency theory.
2. Interpretation – structuration theory, phenomenology, hermeneutics, semiotics, contextualism.
3. Radical humanism – critical theory, anarchistic individualism.
4. Radical structuralism – conflict theory. (Dhillon 1995, 8 – 28)

Information availability is a part of security, as well. Security is a somewhat complex concept itself. In his doctoral thesis Teemupekka Virtanen analyses what security might be. He states that security has several viewpoints and he nominates the following ones. Security is:

1. Emotions from a subjects' point of view. An individual likes to feel secure, because the thinking of a human being is a combination of facts and emotions.
2. A profile as a part of every product and service.
3. Cost.
4. Optimisation to gain the best possible result in the complexity of benefit and losses.
5. Conflict between individuals and organisations.
6. Preparedness to anticipate possible risks and reject them in advance.
7. Bureaucracy to administrate all necessary tasks properly. (Virtanen 2002, 1 – 3)

[5] Dhillon is referring here Burrell and Morgan 1979, 28.

According to Jayaratha (1994), to whom Virtanen (2002, 4) is referring, information security function contains information processing and usability, educational and learning, information system development, management and control, and strategy and planning.

Edward Waltz (1998) defines information security attributes as follows:

1. *Availability* provides assurance that information, services, and resources will be accessible and usable when needed by the user.
2. *Integrity* assures that information and processes are secure from unauthorised tampering (e.g. insertion, deletion, destruction, or replay of data) via methods such as encryption, digital signatures, and intrusion detection.
3. *Authentication* assures that only authorised users have access to information and services on the basis of controls: 1) authorisation (granting and revoking access rights), 2) delegation (extending a portion of one entitys's rights to another), and 3) user authentication (reliable corroboration of a user, and data origin). (This is a mutual property when each of two parties authenticates the other)
4. *Confidentiality* protects the existence of a connection, traffic flow, and information content from disclosure to an unauthorised user.
5. *Nonrepudiation* assures that transactions are immune to false denial of sending or receiving information by providing reliable evidence that can be independently verified to establish proof of origin and delivery.
6. *Restoration* assures information and systems can survive an attack and that availability can be resumed after the impact of an attack. (Waltz 1998, 301 – 302)

Whitman and Mattord (2003, 10) define availability as follows: "Availability enables users who need to access information to do so without interference or obstruction, and to receive it in the required format." Users in their definition are not only humans but computer systems, as well. According to their thinking availability does not mean that information is automatically accessible to any user, but it needs verification of the user to become reachable to that nominated user. "The information is said to be available to an authorised user when and where needed and in the correct format" (Whitman and Mattord (2003, 10). This definition does not compromise the dictionary definition by Merriam-Webster in spite of the connotation of accessibility described above. Accessibility can be understood as a feature of availability, when acting in such environments where purposeful action is desired. Authorisation can be understood as the power to use that information which is offered to someone who is allocated to a certain decision-making position in an organisation.

From the basis of the frame described above, this thesis deals with information availability in the context of organisational decision-making situations. Understanding and increasing knowledge are seek to be better prepared to set demands to develop secure information systems. The focus is mainly set on information processing and usability, emerging possibilities to affect information system development. In this thesis, information refining is dealt with, so according to the frame expressed above, the content of this thesis is set mainly in the mixture of emotions, profile, optimisation, conflict and preparedness. When abstracted, the security viewpoint is the human oriented process of using secured information to

gain goals in organisation. The availability of information in an organisation is approached via philosophical frame in the context of networked environment. When approaching the field of security from Dhillon's viewpoint, an interpretive research approach will be used with a suitably courageous seasoning with radical humanism. Figure 2 depicts the frame where this study is situated.

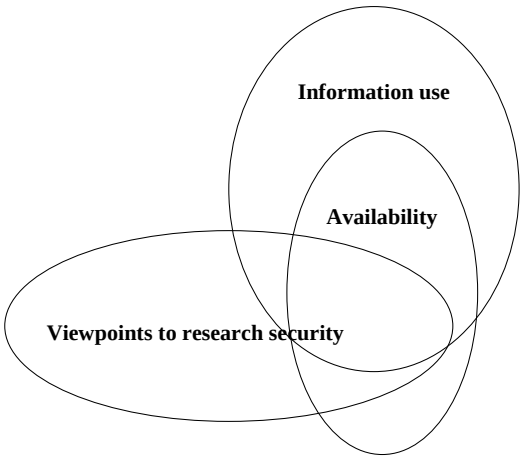


Figure 2. The overall frame of the thesis

1.3 Analysing content – the idea and starting point

The idea of this study is to create understanding about availability of information in the context of planning action, making decisions and directing resources in time-critical situations. The purpose of this study is to formulate a sufficient enough abstraction to be able to create possible solutions in the area of secure information handling in various cases of purposeful action. The main customer of this research is the Finnish Defence Forces. This research does not aim to solve any determined problems – on the contrary, this work will probably raise more questions, than it will answer. This study offers a theoretical construction for further development of information processes in a military context. This theoretical construction is validated with sufficient series of cases. The theoretical construction for understand those cases is a collection of multidisciplinary sciences. The starting point for theoretical exploration is European philosophical thinking.

Philosophical problems will not arise on the basis of empirical observations. They are not resolved with empirics, either. They are conceptual and general by nature. Thinking is used to find out solutions without reforming to demonstrations or empirical results. Philosophical problem solving gains to reach an overall, but still a general view. (Haaparanta – Niiniluoto 1993, 90 – 91) The starting point of this thesis will be philosophical. The main reason for that is that the problem area is somewhat broad and multi-disciplinary. The philosophical approach is therefore acceptable, even recommendable. This wholeness contains so many observable items that getting an overall picture of the whole area in a completely empirical way would be rather time-consuming operation.

The tradition of science is another issue that shall be considered here. Philosophy does not use empirical results, but in technical science those are mostly relevant. A pure philosophical approach cannot be acceptable in the paradigm of technical

science. That is why some examples are used to validate the theoretical construction that will be built in this thesis. Anyhow, this thesis is not a very traditional technical study. In the entire context of the paradigm of technical sciences, this study is a bit closer to information sciences and industrial management than to traditional engineering. So, the strategy of constructing this study can be adopted from the tradition of industrial management (e.g. Olkkonen 1994).

The whole of the frame of reference of this study is structured using the working methods described in Soft Systems Methodology created by Peter Checkland. (Checkland and Scholes 2000) Methodology is briefly introduced in P1. When CATWOE-analysis and core definition are defined, the overall frame of reference will pop out somewhat easily. ”CATWOE” (Checkland and Scholes 2000, 35, as well as Hofman et.al 2001) defines the customer (C), actors (A), transformation process (T), worldview (W), owner of the process (O), and environmental constrains (E). The customer is the one the transformation process affects. Actors will get the transformation process to proceed. The transformation process itself is the function that transforms the input of the system into output, or these phenomena that are observable in the output. The process is the internal code of acts concerning the transformation of input resource to convert to the output of the system. The worldview makes the whole system meaningful in the context of its purpose. The spectrum of those views is divergent. The view that answers the research question shall be chosen. The owners of the system are those who can radically effect, or even stop the process. Environmental constrains are those phenomena and processes that are constant during the transformation process. These constrains have their effects on the system, but they are not directly controlling it. (See P1) The core definition tells that the system:

1. Which is owned by O,
2. When acting according worldview W,
3. With activity of actors A,
4. Will fulfil transformation process T,
5. Which is confined by environmental constrains E,
6. Will gain the result X to the customer C (Travis – Venable 2003)

Let us consider the study through the core definition. In a scientific way of thinking, the owner of the whole research process is scientific thinking. If the patterns of thinking cannot be justified, the result will not be qualified. The worldview is formed around the tradition of science and the personal history of the researcher. Actor is the researcher himself and the transformation process will be the overall methodological frame of making results. Environmental constrains are those confinements are forming the frame inside which thinking proceeds. In this case, those are the availability of information, the experience of time and the military context. The customer is the information using process of planning, deciding and directing resources. The result is considered to be a validated model of understanding dependencies of that process from the viewpoint of information availability. The core definition will be the starting point of studying items under interest. So, let us construct one:

> ”The research will produce justifiable and applicable understanding about the availability of information in the process of planning, deciding and directing resources in a military context. The study should be justified in the mixture of scientific traditions of technical, management and military science in a sense that the personal contribution of the researcher himself is sincerely observable.”

This core definition can be verified by the method Juha Varto (1995, 89) is expressing. “A good question is formulated into a form where something is asked as something in a context.” If the core vision above is referred to this method, the following items can be pointed out:

Something – the availability of information
As something – as an enabler of purposeful act
In a context – in military solutions

So, it seems that we have a rather good and verified frame of reference there. This shall orient the thoughts to formulate the hypothesis and accurate research questions.

1.4 What will be studied?

In spite of approaching this research process by using rather a lot of philosophical literature, the nature of this thesis is not philosophical, but orienting to gain understanding behind technological solutions. This thesis wanders between social community, (e.g. organisations), and those technological extensions people are using to reach sufficient amount of available information.

The hypothesis of this thesis is that the suitably abstract model of information availability in the context of time critical purposeful act can be formulated around Habermas’ theory of communicative action, when seasoned with the philosophy of the human mind and time, and concepts of information and knowledge management.

The hypothesis is constructed to be rather open thus directing thoughts to reach understanding of those features and phenomena that might be important, when dealing with information availability in decision-making environments. The hypothesis assumes a social system with temporal qualifiers as a platform of decision-making situations. The hypothesis directs the research process towards finding out an abstraction that could be used, when analysing information availability and information flows in decision-making systems.

The theory of communicative action (Habermas 1984, 1989) will contain a combination of information and communication in social systems. Actually, the part where Habermas is combining communication and information into the theory of social systems will be most relevant.

Derived from the hypothesis and remembering the purpose and the title of this thesis, the research questions are formulated as follows:

1. What kind of generalized model can be created to analyse information availability in the decision-making process?
2. How is time involved in the concept of availability of information in the context of making choices and directing resources?
3. What kind of information components shall be available in different points of the decision-making system?
4. How can this model be exploited to analyse decision-making information systems?

5. Why is analysis of information availability in temporally demanding decision-making environments important?

The outcome of this study will be expanded understanding about the availability of information in spatially and temporally limited situations. Before proceeding to that contribution, a brief pondering about research strategy and methodology should be made to legitimate chosen working methods. Certain subjectivity, which is unavoidable in this kind of case where the researcher is practically experienced on the area, should be reasoned. In order for subjectivity not to affect the results of this research, a discursive image of reality is used. This will be explained in chapter 2. This reality image leads to the certain way of forming the structure of the whole thesis, as well. In a discursive reality, seemingly unconnected items and events will discuss (or interact in other means) with each other and finally, after a sufficient amount of interaction, a comprehensive entity will emerge. All items and events have their effects on forming the wholeness. In discourse, mutual effects will reveal themselves and a comprehensive understanding about the system will finally occur.

2. Methodology

2.1 About the philosophy of science – possibilities for thinking

2.1.1 About traditions

Science is an institution and action (Varto 1995, 70). It is a way to do something in a nominated context. It is a frame that is an essence to produce content. Content will rise from the will to find out something new about something. Results will be produced via suitable ways of perceiving and thinking.

Science can be approached through different traditions. These approaches get their strength on the basis of various trends of the philosophy of science. To gain understanding about how it could be possible to carry out plausible research work, a brief consideration about the philosophy of science may be relevant. Three courses of thinking are discussed here and it is pondered whether they could be appropriate in the context of this research. Those branches of scientific thinking considered here are positivism, hermeneutics and phenomenology.

The tradition of science specifies i.e. which kinds of worldviews the paradigm is based on and how this paradigm is applied. In an ideal case the paradigm describes the mutually understandable way of thinking that is not supposed to be dubious. This paradigm sets the norms of making science in the context of this paradigm. It includes the worldview on which the scientific community lays its basic assumptions about those items and issues that it deals with. On the other hand, if the paradigm is too stabilised and it does not allow information flow from or to other paradigms, thinking terminates and new kind of information does not have opportunity to grow. From that point of view, it might be fruitful to ponder what possibilities the philosophy of science can give to this thesis.

2.1.1.1 Positivism

Positivism is an empirical way of thinking. It considers that science and thereby reliable information can only be based on what can be reached by experience or making observations. According to positivism, science is an entity where everything can be explained by similar natural laws. Positivism has in its strict form terminated in the 1950s, but its spirit lives on in such names as pragmatism and operationalism. In a positivistic way of making science, certain laws about the environment under interest are verified by making observations and further on finding out proved logical consequences. Theory is the basis of empirical measurements. Reality should not to be experienced directly but through a model that describes this real world. Only those real world events that can be explained by this model are studied and proved. A subjective attitude is strictly forbidden, because personal values of the scientist may cause erroneous results. (Hetemäki 1999, 165 and Olkkonen 1994, 26-27)

A strict adherence to positivistic thinking may confine the possible area of research. It seems obvious that at least three items will make the positivistic approach more or less not so optimal in this research: 1.) The overall frame of this research is a complex system on several functional and ontological levels, 2.) The personal

experiences of the researcher are somewhat difficult to filter out of the results, and 3.) The combination of the items dealt with in this research work is rather new and explicit, and proven information about measuring the relevant items is less frequently available. A holistic picture about the complex and unpredictable system is somewhat difficult to gain by a strictly positivistic attitude to science. All items and their mutual interaction are rather difficult to measure and put under the same theoretical model. (See P1.) The writer of this dissertation has been personally involved in the area of this study for some two decades. Inevitably this has effects on the contents of this research. It is somewhat difficult to filter out experiences and past life. This does not mean that the positivistic approach will be abandoned totally in this thesis. But the positivistic approach cannot be the overall philosophical approach for the whole of this research.

2.1.1.2 Hermeneutics

Hermeneutics can be considered as a dogma of interpretation. It explains the contents of concepts and the expression and the meaning of texts. Hermeneutics inherits from the classical ancient time, and later on in the western civilisation it was used especially in a theological context. After the 1960s hermeneutics has developed in the European philosophy as a way of thinking when the humanistic scientific problems are dealt with. Hermeneutics emphasises the extract of the understanding, the interpretation, the language and the communication to reach understanding about the nature of human activity. It is considered that human action takes place in some perceived context to which the (human) actor itself gives new meanings. The researcher cannot explain human activities in the objective way only, but the interpretation is a mutually interacting process between the researcher and the research object. The researcher is actively involved in that process. The whole research process gets input information from the historical story (pre-theoretical knowledge) of the researcher, theoretical thinking of the researcher, and the research object itself. The interpretation cannot jump over the border of linguistic obstacles or the frame of mutually understood history of the subject and the object. That is why only one, absolute truth is impossible. The truth is context bound. (Hetemäki 1999, 79)

According to Varto (1995) the hermeneutical approach has its foundations on three basic assumptions that should be fulfilled before starting the process. First, we shall have something as a given world. This world is something based on which the research process shall be completed. It is a collection of the environmental facts. Second, we shall have the viewpoint. This will project out the aspect to the world. It has its origin in how we see or will choose our way to see our environs. Third, we have a pre-understanding about the environs. This is how we position ourselves in the world. Those three pre-conditions shall be opened to understanding before actual hermeneutical process can be launched. This logic is found from Habermas' thinking about the philosophical hermeneutics, as well (Habermas 1984, 135).

Hermeneutics contains different approaches. Those approaches share some common factors. According to Oesch (1994) those factors are: The linguistic nature of understanding, the pre-understanding and the self-understanding as primary points of departure of interpretation. Further more, Oesch (1994) states that according to the basic question of the hermeneutics "How an individually constructed consciousness

can reconstruct and further more be able to know objectively the individuality of the research object" does not eliminate the subjective nature of the producer of the text or other item that is under research interest. This means that the subjective nature of the objects under research interest should be recognized and taken into account. But subjectivity of the researcher should be documented adequately to find out the preconditions of the whole research process.

Gadamer (2004) states that the task of hermeneutics is to explain how the reader of the text will reach the understanding of that text through participating the process of creating the mutual meaning between the text and the reader. Hermeneutics will aim towards those actions that are performed to gain undisputable mutual understanding. Before starting to study the text, the researcher shall study the origin and validity of his pre-understanding. This does not mean that one should abandon his pre-understanding, but to recognise and realise it. In this phase the relevant questions to gain desired understanding shall be formulated. Those questions will determine the hermeneutical interpretation process. Self-understanding is essential to the hermeneutical process. One has to be able to see his restrictions in understanding the text. One has to have an ability to learn through the whole interpretation process to gain desired interpretative abstraction, which was set in the phase of setting relevant questions. The interpretation shall be performed in and for that situation where the researcher is. The researcher brings into his known, subjectively understood world some unfamiliar objects and items and compares them with each other. Through this, the new details coming from the unfamiliar wholeness will be interpreted and put into the understandable entirety of the so far subjectively understood world. New details will enrich the wholeness of the old world, and new details to understand the completeness of the new world will arise. In this way, the overall hermeneutical process will progress towards the desired abstraction, which was set when relevant questions were constructed. (Gadamer 2004, 29 – 39) In a hermeneutical process the details are relevant, but they shall be percolated to reveal the real nature of the researched phenomenon. In the natural processes time and complexity act as a filter. In time, only the nominated information, which is meaningful for the situation under immediate concern, will manifest itself as relevant on a subsequently abstract level. The hermeneutical process will carry out this percolation in a single process. The meaning of hermeneutics is to reveal the real nature of the phenomenon under interest at such abstract level, which will explain its behaviour in the mutually understood world of both the text and the researcher. The level of abstraction is set on the basis of the analysed pre-understanding of the researcher.

In a hermeneutical approach the object of the research is a phenomenon that should be interpreted. This is called generally the text in spite of its true nature. The starting point of research is some limited problem concerning this text under concern. The researcher interacts and communicates with this text and relates the original problem to more and more wider contexts. The research develops as a hermeneutic spiral, where theoretical knowledge, finding relevant research material, interpretation, the classification of information and the formation and development the theory are interacting with each other producing understanding and awareness of new characters of the original problem. A hermeneutically thinking researcher chooses his point of view of studying the problem. Presenting this worldview is at least as important as the final findings about the phenomena under research interest. Hermeneutical way of thinking refers the text under interest to an increasingly

comprehensive whole during the entire research process. Finally, the research process produces the level of abstraction that the researcher has set in the beginning of the research process. The hermeneutical interpretation process consists of:

1. Choosing an object to study.
2. Setting limits to the problem of interpretation.
3. Expressing the hypothesis for the interpretation.
4. Testing the hypothesis by comparing it to the features of the research object.
5. Adjusting the hypothesis (if necessary)
6. Validating the hypothesis through referring the research object to the theory. (Haaparanta and Niiniluoto 1993, 63 – 67)

A hermeneutical way of thinking aims to understand the overall meaning of phenomena under interest in one context. The most important method in hermeneutics is to observe the research object alternatively as a whole and as details. The researcher should be able to identify his valuations and the scientific tradition of his research area. This wholeness leads the researcher from abstract[6] to ever more and more closer to the concrete and verifiable results. A hermeneutical way of doing research can be seen as a dialogue between the researcher and the research object, where the researcher is interpreting the message of the research object into such symbols that he is able to understand. (Huhtinen 2002, 36 – 37)
What does this all mean? In the hermeneutical approach the following items should be recognized:

1. There is no absolute truth.
2. The research process gets it strength from the researcher's knowledge and experiences, the data and information coming from the research object and from the theory, and the researcher's thinking.
3. The research cannot be done without having at least one commonly understood and accepted item between the researcher and the research object.
4. Subjectivity is present to some extent.

The truth is bound to the overall context of the wholeness of the frame of reference of the whole study. Understanding of research items will increase during the whole process. Strict predictions cannot be set in the beginning of the hermeneutical study. Instead of that, a certain level of abstraction is set in the beginning of process and during research process more and more understanding will develop to finally explain that abstraction. Both ways to proceed, from theory to practice and from practice to theory, are allowed. Pre-knowing will define which way will be chosen. Certain subjectivity should be allowed in the hermeneutical process, but it should be documented in such a way that the reader of the research report is able to understand what are the preconditions of the study and how subjectivity has affected the process. Hermeneutics is both a way of thinking and a method. The hermeneutics approach and way of thinking can be seen in Fig. 3 of P2.

2.1.1.3 Phenomenology

Phenomenology is a doctrine of phenomena. In modern philosophy it is somewhat an essential branch that was developed by Edmund Husserl. (See Husserl 1995) In the phenomenological way of thinking, all advanced impressions and theories

[6] Here abstract is understood as a concept that has not been proven, not as an expression of a unified theory.

concerning the research object are left out and the goal is to reach the core idea of that object as clearly as possible. It is considered that knowing is not just recognising and perceiving the objects of the outer world. Fundamentally in phenomenology it is a question about what can be known, what is the ability to know. (Hetemäki 1999, 57)

Juha Varto states that phenomenological philosophy of science will take into account the world as it manifests itself to observers. This means that the wholeness is seen in its historical existence. This approach is holistic thus abandoning both clear subjectivity and clear objectivity. The ultimate idea of the theoretical approach is that the world outside the perceiver is left totally alone. It is touched by no means. Instead, the perceiver is trying to see the world from some viewpoint. The reality is what it is, but the perceiver is not going to change it by any act – not even by measurement. The ultimate theoretical approach will free the perceiver from the boundaries of perceived or remembered reality and will allow him to understand the perceived target as something, as a phenomenon. This phenomenon is not connected to the real world situation, or to the objectives of a perceiver. It is connected only to the perceiver's personal capability to know. (Varto 1995, 71 - 77)

The idea of phenomenology is to unfasten the phenomenon under interest from the situation and make an image of it. This image is situated into other situations and the manifestation of the phenomenon is studied in the context of those new situations from the viewpoint of what can be known about this new combination of the phenomenon in acquisition in that new situation. The determination and the explanation of this context will not be founded on the dynamically changing personal needs of any person, but only the situation and the phenomena themselves. The determination and explanation of that context will be found in the perceiver's capability of knowing. That is the reason why the capability and the ability to know are set to the ultimate research question of phenomenology.

2.1.1.4 Comparison of approaches

Positivism represents the way of thinking that in its extreme will not allow the observer to involve the existence of the observed target at all. Observations are made from the outside and a model of the function of the observed target is constructed. The existence of the observed phenomenon or construction is explained with this model. Positivism is well suited to deal with the problems that can be explained by determined models in a context where certain preset pre-assumptions are valid. The positivistic approach is very suitable for studying such situations where defined problems shall be solved. It is not suited for research situations where the natural laws are not defined or the whole situation is so complex that getting results by observing, measuring and modelling will become too time-consuming.

The hermeneutical approach constructs a sufficiently determined understanding from some viewpoint in a defined world or environs on the basis of the existing knowledge. The overall knowledge about the target of interest increases during the hermeneutical process. The hermeneutical approach develops understanding about those phenomena or constructions that are under study. The hermeneutical approach is based on the mutual interaction of the researcher, the research target and the information that is produced by others. This approach is well suited to problems

where the area or the study is rather clearly determined, the researcher has sufficient enough knowledge or at least enlightened pre-assumptions about the research area and it is possible to create new knowledge from some, perhaps new viewpoint. This approach is not suited as an overall frame for research situations where the strictly defined problems shall be solved or where the overall knowing about the researched items shall be analysed.

The phenomenological approach accepts the world as it is. The item under interest is detached from the context and its behaviour, interaction, existence or being is studied as an image of itself. This image may be cited in other situations and this new context may be studied to reach understanding about the limits of the ability to know about this phenomena. The phenomenological approach is suitable for research situations that contain a collection of phenomena, whose features and interaction should be studied. This approach results "the limits of knowing" of each phenomenon itself and the interacting system that they form. The phenomenological approach will produce a construction of reachable knowledge about the items and the system that they form. As a co-product, a collection of open questions will occur. The phenomenological approach does not suit research problems that aim at problem solving or reaching the preset understanding level. Phenomenology is reaching the limits of knowing, so it is a good approach when determining the field what kind of research can be made and where. Subjectivity is denied in the research situation itself, but subjectivity is powerfully present in the limits of knowing. Phenomenological results are dependent on the researcher's ability to know. In that sense it defines the knowing limits of the researcher himself in the area of the research interest.

2.1.2 Truth

After discussing how to approach the scientific thinking, it may be fruitful to delve briefly on the problem of truth. Why it is relevant to discuss the aspects of truth? In this thesis there are two reasons. First, the concept of truth shall be discussed in the context of the paradigmatic environs of this thesis. Second, the concept of truth is relevant from availability's point of view. It should be understood what preconditions are set for understanding the information that is supposed to be available. Here, truth is discussed from five viewpoints. Three theories of truth presented by Kuusi (1999) referring to Niiniluoto (1980, 1987) and Peirce (1931 – 1935) are introduced and referred to the philosophical hermeneutics by Gadamer (2004) and the communicative approach by Habermas (1984, 1989, 1994).

Kuusi presents three significant theories of truth, which are the correspondence theory, the coherence theory and the pragmatism. (Kuusi 199, 3 – 5) The correspondence theory states that truth is a relationship between belief and reality. This theory assumes that there is some kind of non-changing state of affairs (i.e. reality) outside the observer against which the observer is referring his subjective thinking (i.e. beliefs). The truth reveals itself through those expressed contents of thoughts that correspond to the phenomena, which really exist in reality. In common sense this means: "What I can observe and I can understand about the reality of itself in the context of observable and thinkable space, is true". The coherence theory states that the truth is formed with a system of mutually effecting judgements. The judgement is true if this mutually communicated and accepted system of several

judgements will exist coherently. Again, in common sense this means: “If I can understand the relations between all these statements and I can understand and accept the contents of those statements, the truth is found.” The third theory presented by Kuusi is the pragmatism. The concept of truth is connected heavily to the perceiver itself. The truth is bound on the holistic concept of a human being. Truth is restricted by the ability to know and operate of the one, who is defining the truth. The truth is not only bound to the objective world like in correspondence theory. Commonly simplified: “What I can prove to be workable in practice is true”.

When referring to those three theories, the coherence theory seems to be the most obscure of them. It does not take into account reality itself but only interpretations of it. Those interpretations shall be combined as a mutually understood system that will form the truth. The coherence theory deals with a combination of viewpoints aiming to achieve a mutually understood construction on which further activities can be based. The pragmatism is rather strictly bound to the interactive reality of an active human being and his surroundings. When thinking about the information, pragmatism does not necessarily deal with truth, but the certainty of the information under concern. The correspondence theory will take the objective world as it is, without trying to determine the truth beforehand, but aiming to find the truth using reasoning as evidence. It seems that this would be a rather good scientific ideal of the truth. At the same time, it should be remembered that the world as an entirety does not work according to the scientific ideal of the truth. The expressed and commonly understood truth is frequently rather far away from it, as we can perceive daily from the mass media.

According to Gadamer (2004), the truth is in one way or another bound to the forms of speech. Information is presented or it is made available in certain ways by communication. Gadamer defines the truth of the act of speech as its suitability to the theme. The truth of speech is “the compatibility of speech with the theme under concern”. In that sense, truth is “uncovered”; it is open to the whole interactive event. Further more, he states that verifying a phenomenon afterwards does not define the information about this phenomenon as true, but only certain. (Gadamer 2004, 16 – 18) According to Gadamer, truth is connected to an information exchange situation. In this situation, the speech shall correspond to the theme to be true. On the other hand, Gadamer states that truth is inevitably bound to interaction, thus evolving over time (Gadamer 2004, 27 – 28). According to this thinking, any of those three concepts of truth presented above cannot be claimed as “non-valid” or “valid”. The concept of truth is bound to the situation, the viewpoint, and the purpose of defining something as “true”.

Let us further discuss truth with the concept of communication. Communication is changing the messages and interpreting them to a subjectively understandable form. (E.g. Habermas 1984) A scientific document is a message, as well. It should be expressed so that it is understandable and believable in context.

The language of science is most allegorical. (Habermas 1994, 19) Science is made for some purpose in some context. Its expressions are bound to the era, the situation, the moment, the purpose, the paradigm, and to the subjective worldview of the researcher, as well. Further more, according to Habermas (1994, 21): “The discourse theory of truth is only trying to reconstruct the intuitive information of every

competent speaker about the universal meaning of available demands of competence." According to this claim, the value of truth is relative to the moment and the context in the frame of reference where the research object, the researcher and their mutual environs are interacting.

New ideas will arise from the individuals. Communities may renew only through their members. A community tends to institutionalise its features[7]. Permanence will create the feeling of security, so institutions do not change very easily. The change will always arise from juxtaposition. (Habermas 1994, 27) If one desires to produce new knowledge, he must be able to arrange himself outside the situation, the moment and the space in concern, and perceive it from the outside. In this way it may be possible to set the perceived phenomena and the perception process in such a composition where the researcher's perceptions will increase the understanding about the wholeness and offer more relevant ways to join the perceptions and the perception process to the research situation. This kind of process will decrease the effects of subjectivity and truth may be considered not only as separate truths of the separate objects, but as the truth of the whole research situation. It could be considered that a same kind of concept of truth should be valid through the entire research situation. This kind of thinking is very near to the hermeneutical process. Habermas is linking the concept of truth rather tightly to the dynamic process of the scientific work.

The truth should be based on the information that is available for everyone. (Habermas 1994, 65) According to this statement, the complete truth consists of several individual ideas of the subjective concept of truth. Truth is always some kind of compromise where both individual insights and the community's demands are mixed to form a generally accepted basis of expressing thoughts. The concept of truth evolves over time and it differs from one community to another. According to Habermas' thinking, truth is context-bound and evolving. There is no determined "dogmatic" truth in spite of the fact that the truth shall be based on mutually available information.

The basis for this reasoning is found in Habermas' communicative theory, as well. The concept of living in society[8] is based on the concept of three sub-worlds (see Popper 1972, 106), which are the objective world, the subjective world and the social world (see P2 and P4). In this context, the subjective world will interact with communication. To gain understanding, the communicative act should be able to be validated by the following questions:

1. Is the message true?
2. Is the message acceptable in its normative context?
3. Is the message expressed the way it is meant to? (Habermas 1984, 99-100)

When applying this thinking to the concept of truth, it could be expressed that an item is true if it is understandable, acceptable, believable and sincere in context. But what is context? According to the hermeneutical approach, context is a combination of the researcher and the research object. If a researcher can produce understandable,

[7] See von Solms (2000) in P6. Interesting mutuality can be seen in his thinking. Institutionalisation is preceded by technological and managerial phases.

[8] Society here should be understood broadly. E.g. scientific community can be understood as society, as well.

acceptable and believable information about a research object in context, it will be true. Verification for this thinking can be found e.g. in the thinking of Juha Varto (1995), who states that scientific truth is a way something is revealed, when this something is examined from the given points of view. (Varto 1995, 84) This has consequences for the availability of information, as well. It is not enough that information exists, it is provided and it is expressed. The information-receiving subject shall understand and accept it, as well.

There is a certain difference between the scientific truth and the common belief of the truth. The scientific truth should be objective. Objectivity arises from the interaction between the researcher and the research object through making conclusions based on undisputable evidence gathered during the research process. In the same kind of circumstances, the scientific truth should remain no matter who the researcher is. On the other hand, frequently in the every day life, judgements are made from a subjective base of thinking based on the personal experiences. The concept of truth may be based on revelations, beliefs or intuitions. In that case, the manifestation of truth will change when the person changes. This difference shall be considered when discussing the information availability. The scientific truth is based on the inevitable evidence that can be justified by the perceived facts. Any other evidence is disputable and therefore it shall be abandoned. In common life these kinds of restrictions are not necessarily effective. People will consider their judgements true, whether they are based on observations, intuitions, beliefs, assumptions or other subjective claims. It should be understood that decisions are made in this kind of environment. Information is differently available in the scientific process than it is in the every day decision-making process.

2.2 Research strategy – the way to approach the field of problems

The research strategy of this thesis is approached through paradigms about the tradition of industrial management. Consideration is made about five paradigms presented by Neilimo and Näsi 1980 and Kasanen et.al 1999. Those paradigms are concept analysis, nomothetic, decision-making analysis, action analysis and constructive. Table 1 presents those paradigms in the matrix of approach.

Table 1. Paradigms according to Kasanen et al. (1999, 317, Kuvio 6.)

	Theoretical	**Empirical**
Descriptive	Concept analysis	Nomothetic Action analysis
Normative	Decision-making analysis	Constructive

The aim of the concept analysis is to make new constructions of concepts. It is based on the earlier concept analysis or the empirical results. Its scientific ideal is information concerning facts, values and norms. Empirics do not lead to verification. Empirics are used to the argumentation to give examples of the concepts. The method is philosophical hermeneutics. Results of the research conducted in the spirit

of the concept analysis are statement-like or recommendations. The nomothetic approach reaches for the explanations or causal consequences. It is based on a positivistic way of making science and its scientific origin is in natural history. Empirics are essential and the methodological rules are strict. Results are verified models. The decision-making analysis is meant to develop the methods for the problem solving. It has background in the game theory, decision-making theories and the positivistic attitude. Empirics contain application examples. The strategy is more or less logical and mathematical. Methods are axiomatic, thus determining the departure point of the research process rather strictly. This is obvious, because the results will be the solutions for precisely defined problems. Action analysis aims to gain understanding. This strategy aims to find teleological explanations to the phenomena. Answers to the question "why" are to be found out. It is based on the traditions of the humanism and the action research. Empirics are involved in the research through only few groups of interest. Empirics can be shown as examples to validate the results. Results are explanative conceptual systems on various ontological levels. The constructive strategy aims to find out solutions for well-defined problems. This strategy is based on previous knowledge about the problem area under the interest. The scientific ideal relies on mathematics, logic and applied science. The empirics are gathered on those items or groups that are supposed to be involved in the problem-solving situation. The method is a combination of modelling, problem solving and consulting. The results are the constructions of technical norms that work in practice. (Neilimo - Näsi 1980, 65 and Kasanen et.al 1999, 302 – 317)

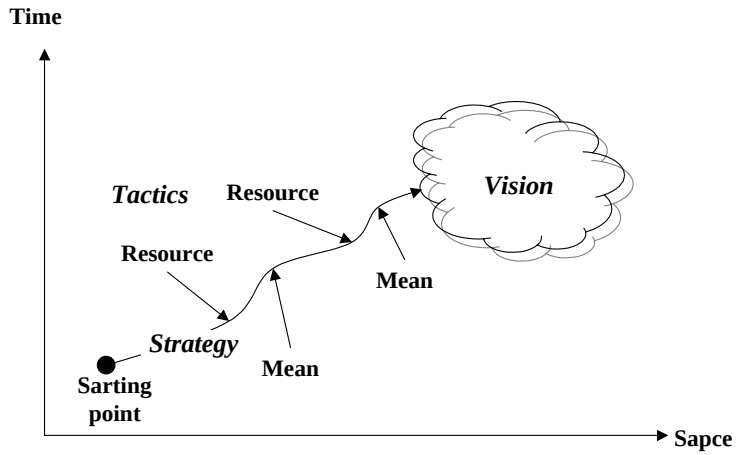
In this thesis a somewhat strong philosophical approach is chosen. Empirical results are used to validate the conceptual construction that is built up during the research process. When comparing this research strategy to those paradigms presented above, it could be noticed that the paradigm this thesis will mainly follow, is action analytical, but strongly pointing to the direction of the concept analysis. Table 2 will depict the position of this thesis in the matrix presented in Table 1.

Table 2. Positioning the thesis in the matrix of paradigms

	Theoretical	**Empirical**
Descriptive	Concept analysis	Nomothetic Action analysis
Normative	Decision-making analysis	Constructive

2.3 Forming the strategy

Through the concept of strategy, it is possible to link together theoretical viewpoints of this whole study. In general, strategy finds and defines the way – the path – to



reach goals. (e g. Näsi 1991, Pettigrew 1988) On the other hand, tactics is the way to use the means and the resources as optimally as possible. (Iskanius 1997) Strategy tells, how to reach the goals, and tactics tells what kind of resources and means shall be used during the path to the vision. See figure 3.

Figure 3. Strategy, vision and tactics

This research project is organised according to the structure depicted in figure 3. The reality is comprehended as discursive. In this kind of reality, understanding will arise from the exchanging of information between the interacting entities. This leads to a hermeneutical attitude of the world. New information coming from outside the subject is interpreted with an open mind to gain more understanding about the combination of the interacting phenomena of the world.

Action analysis and concept analysis are used as an overall research strategy of this research. Those strategies will form the path around which the interpretation of individual items of information, and growing knowledge about the wholeness will be bound. In the first stage of the research, where comprehensive concepts are constructed, concept analysis is strongly present. In the end phase of the research, where the conceptual construction will be validated, action analytical features will become visible.

Hermeneutics is the overall method of this research. Comprehensive abstractions will be inducted with analysing and combining the relevant details. An increasingly comprehensive wholeness is gained through combining relevant details. Further more, those generalised abstractions can explain detailed phenomena at several ontological levels. More and more understanding about the phenomena under interest will be gained during the overall research project until in the end, the divergence of practical cases will be explained by deducting those against the constructed theoretical framework.

Figure 4 shows the overall framework of this study. In the context of time, information is made available to cause beneficial action through the divergence of producing, transferring and using this available information. Time is dealt with both as an attribute of information and as a nominator of information relevancy and

availability. Information will be considered as utilitarian – in a positive way. It is seen that information will be used to create a benefit to its user. Information is a complex composition of several dimensions. Action is dealt with problem solving and decision making models. Finally, the clue to theoretical approach is to combine all this with the help of Jurgen Habermas' communicative theory (Habermas 1984, 1989) to build a comprehensive presentation of the systemic approach to information availability. This construction is tested in the context of the divergence of various classes of purposeful information, its refinement and expression, which are involved in the decision-making system.

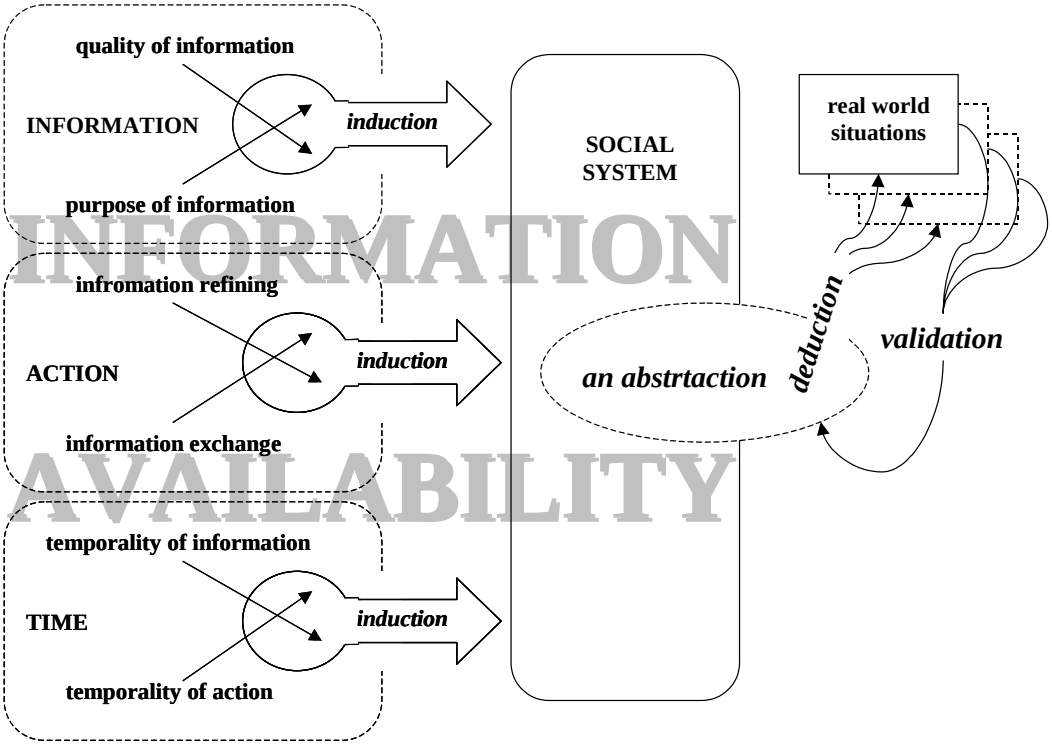


Figure 4. The overall frame of the thesis

In the context of technical science, it may be rather refreshing to remember what Timo Airaksinen (2003) says: "Science does not exist without technology." So, let's be faithful to the spirit of the technology in spite of the philosophical approach of this thesis and consider Airaksinen's statement as truthful. It can be considered that from the viewpoint of the philosophy of science the whole of this study follows the hermeneutical approach, which is seasoned with a handful of phenomenology recognising at the same time that there is no science without technology. Even in this study, despite dealing with rather abstract phenomena, the aim is to create understanding to be used to increase information and knowledge to finally find the technological solutions in the area of the secure information use and creating security through information.

3. About the theory – defining the background

3.1 Information

3.1.1 Classification of information

In the next, the information will be classified in two ways. First, the quality of information is discussed from the basis of the information and knowledge management. This approach is chosen because the information and knowledge management deals with the purposeful use of information. Secondly, information classes in a social system are analysed through Habermas' theories about communicated information. The reason why this seemingly extraordinary pair of approaches is chosen comes from the context of this whole research, where the information availability to cause purposeful action in a social environment is studied. After this analysis of information classes, a suitable abstraction shall be constructed for the further phases of this research.

3.1.2 Quality of information

The concept of information is discussed using definitions of Robert Thierauf (2001) and Edward Waltz (1998). Those definitions are described in table 3, and figure 5. Finally, those thoughts are referred to the ones Ronald Maier (2002) has presented.

Table 3. Information hierarchy defined by Robert Thierauf (Thierauf 2001, 8, Fig. 1.2)

Level of summarization	Definition	Problem Importance	Decision Approach	Nature of Problem
Truth	Conformance of fact to reality	Vital	Consensus	Structured to unstructured
Wisdom	Ability to judge soundly over time	Critical	Consensus	Unstructured
Intelligence	A keen insight into understanding important relationships	Extremely broad	Advisory	Unstructured and semistructured
Knowledge	Obtained from experts, based on actual experience	Major	Advisory group	Semistructured
Information	Structured data useful for analysis	Major to minor	Advisors	Structured and semistructured
Data	Unstructured data	Minor to trivial	Individual	Structured

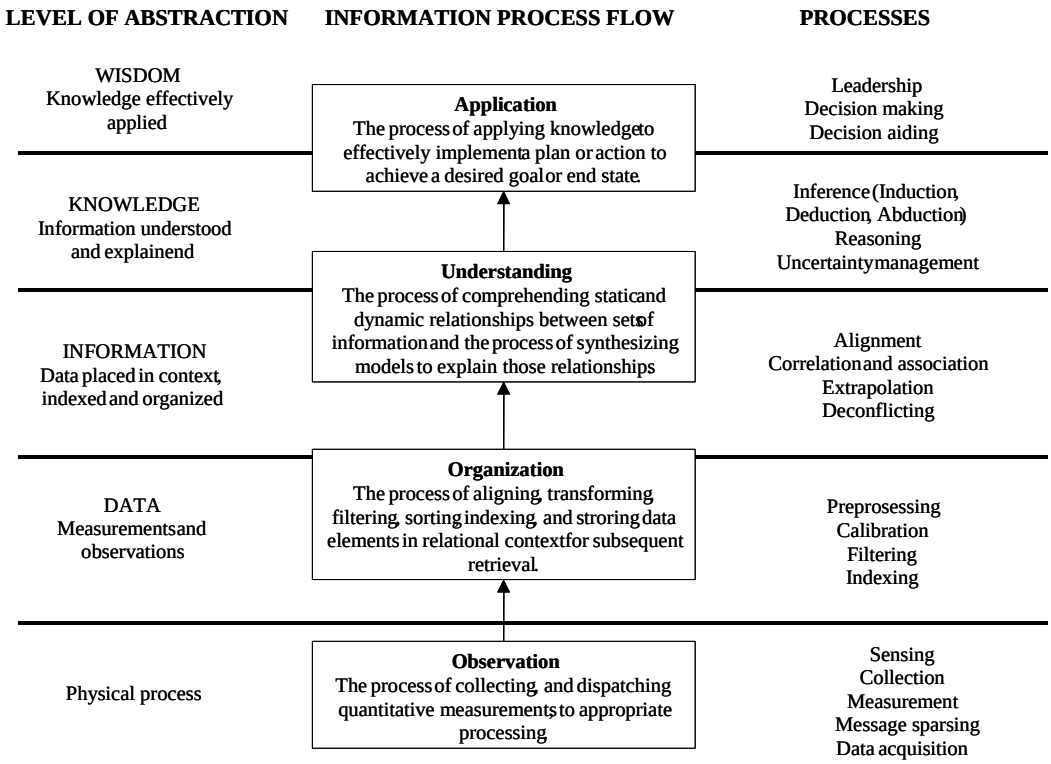


Figure 5. Information hierarchy by Edward Waltz (Waltz 1998, 51, Fig 2.1)

Theirauf approaches the problem of information classification through business intelligence. There, the viewpoint is focused on that information an organisation uses to gain advantage over the competitors. Thierauf deals with information in the context of a business system that contains both the organisational structures and the personnel. His information definition includes those structures with which information is gathered, documented and distributed. (Theirauf 2001, 9) When remembering the concept of truth, which is rather context-bound in decision-making situations, it is a bit risky to include the concept of truth above wisdom, on the top of the information hierarchy. Wisdom can be considered as a feature of a conscious entity. (See e.g. Damasio 2000, Dennett 1999) Truth can be considered here more like an agreement, thus being a feature of a paradigmatic community.

Waltz approaches the classification of information from the background of military operation planning and decision-making. Waltz does not make any difference for the hierarchy of information definitions, whether defined item is a feature of a human being, a community or a machine. On the other hand, the information process flow can be understood to be somewhat human. When the levels of this process are considered, clearly “human” aspects are found just from the top part of this hierarchy. The way Waltz’s definition differs from Thierauf’s one is in describing the way, how information is transferred from one level to another.

Maier (2002) describes a three-level model of information. This model consists of data, information and knowledge. This classification removes the dilemma of the information hierarchy of both Thierauf and Waltz, who are dealing partly with the features of human beings and social systems. Maier’s definition contains three

categories of information without taking account the environment where information exists or where this information is used for certain purposes.

Data are typically defined to be a representation of facts in a formalized manner, e.g., (Telecom Glossary 2000). Data are suitable for communication, interpretation, or processing by humans or artificial systems. When structured, data are turned into information, e.g., Niiniluoto (1997). Awad and Ghaziri (2003) state that information has a meaning, purpose and relevance. They emphasized that information is about understanding relations.

Knowledge is distinctly different from data and information. Knowledge is the ability to turn information and data into effective action (Applehans et al. 1999). It is a capacity to act, (Sveiby 2001). According to Maier, "Knowledge comprises all cognitive expectancies that an individual or organisational actor uses to interpret situations and to generate activities, behaviour and solutions no matter whether these expectancies are rational or used intentionally". In cognitive expectancies "observations have been meaningfully organised, accumulated and embedded in a context through experience, communication, or inference". (Maier 2002, 66) Knowledge grows through the whole life of an actor, and all new perceptions are interpreted against the organised, understood and accepted field of information. This very same idea about knowledge is found in the production of Merleau-Ponty (1968) and Bergson (1911). Incoming information is interpreted through a mental filter that consists of the internalised perception history of the entity.

Knowledge can be classified qualitatively, as well. Polanyi (1966) states that qualitative features of information are explicit knowledge and tacit knowledge. Explicit knowledge is deterministically exposable objective knowledge. Tacit knowledge is subjective, and it is based on the experiences of an individual. Tacit knowledge may be difficult to express in a determined or unambiguous way (Nonaka – Takeutchi 1995). Tacit knowledge is merely subjective knowledge – it is the knowledge that exists inside one entity. Explicit information may be data, information and knowledge. A knowledge creating process enriches data into knowledge during the process where existing information is combined to incoming new information. In that sense it resembles the hermeneutical process. The result is increased knowledge. Information transfers mainly as data or information, and only very seldom as knowledge. Knowledge is created inside an entity, like Nonaka and Takeutchi (1995), as well as Maier (2002) prove in their works. This process takes time. This process sets demands to the information transferring process, as well. It cannot be assumed that the mutual understanding via mutual knowledge will occur immediately. Explicit knowledge can be articulated or expressed, but tacit knowledge is difficult to describe. Tacit knowledge is often based on experience (Polanyi 1966). Rather than regarding knowledge as something that people have, it is widely understood that knowing is better regarded as something that people do (Blackler 1995). Knowledge seems to be dynamic and personal.

These features of information are described in P3 and P4, as well. Figure 6 will abstract the overall system of data, information and knowledge. As an example, the concept of Force XXI (Joint Vision 2020, 2003) can be used to understand the relations between those categories of information. Force XXI is data for a casual

reader, information for a military officer and knowledge for the developers of the Force XXI concept.

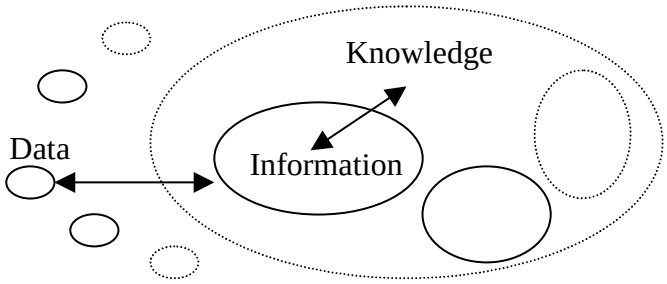


Figure 6. The mutual dependency of data, information and knowledge (See P4)

One possibility to abstract the classification of information is depicted in Table 4. Information processing, and features concerning only organisations or communities are excised to reach a classification that is universal enough to deal with such information processes where human beings are involved in the context of organisation. The refining process of information can be seen from that model, as well. The process is essential in understanding the temporal aspects of information cultivation inside an entity.

Table 4. Information hierarchy

Level of Information	**Definition**	**Process (examples)**
Knowledge	Analysed, proportioned, understood and explained combination of generalised information	Reasoning Justifying Uncertainty management
Information	Facts attached to context	Alignment Correlation Association Extrapolation
Data	Facts without contexts	Pre-processing Filtering Indexing

3.1.3 Information in social systems

This classification will help to understand the nature of information, which confines its availability in social systems. Further more, this classification helps to understand the process of transferring information through communication. This will explain the complexity of distributing and gathering relevant information to be used in the different situations.

Habermas bases his thinking about the relevant information on the theories of the social sciences. He combines theories about society, a human being as a part of society, and system thinking. (Habermas 1984, 1989) This approach will fit rather well into the organisational and inter-organisational environment, as well. Habermas uses the four-field social system where the information about resources, goals, values

and norms interacts in space and time. He makes a lot of thinking combining those items as the universal theory of the social system. In this thesis, the long discussion about the legitimation of this approach is omitted and only the final results concerning the combination of mutually influencing items of his discourse will be presented. Habermas is moving on a rather abstract theoretical level, but because the theory is universal, it could be applied to other social layers than societies, as well. Actually, Habermas is broadening his thinking to individuals as members of society (Habermas 1989, 249 – 256).

Habermas states that four basic classes of information direct an actors' activity. Those are values, norms, goals, as well as means and resources. (Habermas 1989, 235 – 250) These same basic items can be found in the background of any purposeful[9] action on any level – from the individuals through working-groups to organisations, from individuals through families to societies. Those items contain information that – when used – will orient an actor to adapt its being to better fit the entity. In other words, the actors in a system will change while interacting with each other by exchanging various types on information. This information concerns values, norms, goals, and means and resources. This information fulfils the demand of the functions about pattern maintenance, integration, goal attainment and adaptation. Table 5 depicts these dependencies.

Table 5. Information concerning action orientation and functions in a social system (Habermas 1989, 243, Figure 32)

Information concerning action orientation	**Functions that will use the information**
Values	Pattern maintenance
Norms	Integration
Goals	Goal attainment
Means, resources	Adaptation

It should be remembered that Habermas' interest is aimed at societal aspects, which guides his thinking to directions, where society as an integrative subsystem gets the role of the theory. In this thesis, the viewpoint differs from that and information and its purposeful use through availability gets the role of the theory. This results that the classification of information used by Habermas shall be carried away from the sociological context and situated as a phenomenon into the information availability context. This theory is presented in the context of the use in publications P6, P7, P9 and P10, as well.

3.1.4 Concept of intellectual capital and competence

Here the concepts of intellectual capital and competence are briefly introduced to supplement the information categorisation of Habermas. Those concepts are important in understanding the long-term information storage of the decision-maker. According to the dictionary, and in the context of this thesis, the word "competence" means "the quality or state of having requisite or adequate ability or qualities, and/or

[9] Saying "purposeful" may be a bit risky, because purpose is subject-oriented. One subjects' purpose is not always the purpose of another one. This can be easily seen in daily news…

having the capacity to function or develop in a particular way" (Merriam-Webster's 2003). Papers P3, P4 and P5 describe those concepts in the frame of the information and knowledge management.

It was understood already in the 1990s among the practitioners of the information and knowledge management that it is not sufficient to focus only on the management of data and information. The concept of intellectual capital was born. The current strategic competence management approach is based on the work of Prahalad and Hamel (1990), who introduced the concept of core competence, which refers to a certain organisation's own specific competencies that cannot be easily imitated by other companies and on which the company can develop its future activities. Competence is a more comprehensive term than knowledge. Within psychology, competence has been characterized as the ability of individuals to respond to the demands placed on them by their environment (White 1959). Organizations are only interested in the competencies that are relevant for the organizations and thus contribute to their intellectual capital (Helokunnas et al. 2003).

Intellectual capital management regards information and knowledge as an asset of an organization. It emphasises the value of the organization's information and knowledge. Steward (2001) stated that intellectual capital is knowledge that transforms raw materials, which can be either physical or intangible, and adds value to them. Typically, value is regarded as the trade-off between benefits and sacrifices (Parolini, 1999). (See P3 for more information.) Intellectual capital is a concept that has originally created to facilitate the attainment of information processes to the processes of tangible items. The concept of intellectual capital binds organisation intangibles with information to its action. This is a somewhat interesting approach, as will be seen later on. Theories behind the concept of intellectual capital were first developed in accounting and business economics. Currently there is no established definition for intellectual capital. As an umbrella concept it contains all intangible assets of an organisation. It covers information, knowledge and competence related issues from inter-organisational communication to tacit knowledge and from data storages to employee skills. According to a quite widely accepted view, intellectual capital consists of human capital, organizational or structural capital and social capital (Pike et al. 2002).

Human capital contains competence (skills and education), attitude (behavioural component of the employees work) and intellectual agility (ability to change practices, and innovativeness) as a manifestation of competence (Roos et al 1997). Structural capital consists of intellectual property, software, documents and methodologies of the organization (Steward 2001) and the organization itself (infrastructure, processes and culture) as well as renewal and development as a manifestation of organisational attributes and assets (Roos et al 1997). Social capital contains intra- and inter-organizational relationships with customers, suppliers, partners and networks (Nahapiet and Ghoshal 1998, Yli-Renko 1999). Social capital is needed when creating intellectual capital. Social capital resides in the relationships that are created through exchange between the actors of value nets and networks (Nahapiet and Ghoshal 1998).

Often intellectual capital is understood as a single organization's asset of information and knowledge. In a wider context, intellectual capital spreads over all the nets and

networks of organizations and nations. Structural capital includes the required information and communication technology infrastructure and the required information and knowledge management processes and the structures and cultures of organizations. Social capital contains relationships inside and between organizations. Human capital consists of competence, attitudes and the intellectual agility of people. (See P3 and P4.) The information and knowledge management approach is somewhat practical and object oriented, and it emphasises the use and usability of information to gain the desired results. Figure 7 depicts the system of intellectual capital.

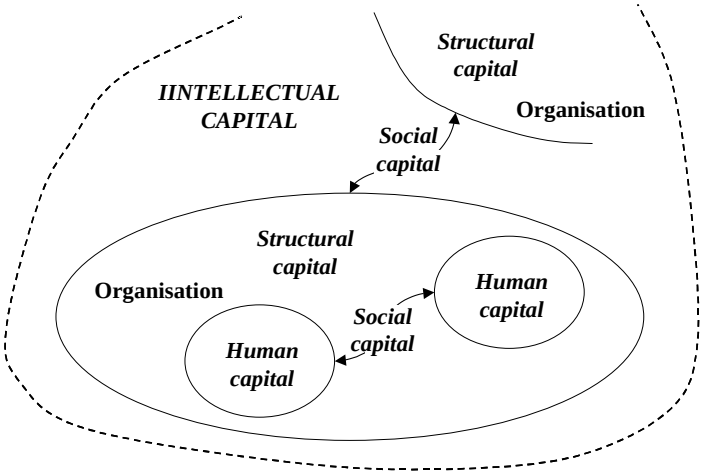


Figure 7. The concept of intellectual capital

In the context of this thesis, the human capital part of the overall concept of intellectual capital is dealt with. According to previous analysis, this contains the competence, the attitude and the agility. This structure gets interesting verification the Igor Ansoff's analysis about the facilities of the general management. According to him, the most important features of managers that should be taken into account when analysing the ability of the management are attitude, competence, capacity and power. (Ansoff 1984a, 141 – 142) Further more, Ansoff divides those features between the managers and the organisations. The four features mentioned above, when connected to the organisation, seem to be rather near the concept of structural capital. It seems that nothing very new is reachable with the concept of intellectual capital. Anyhow, that is not very relevant question in the context of this thesis. Most relevant is that the concept of competence exists. This concept contains all these remembered, learned, understood and accepted features of subjective knowledge, which will guide the interpretation and refining of incoming new information and decisions, as well. Competence contains the overall knowledge to be able and agile to act.

3.2 ACTION

3.2.1 Information refining

More essential than defining information is to understand what happens to information when it is prepared for use. How can the process where the data is transferred into the knowledge be explained? This question is dealt with from three

viewpoints. A SECI-model of Nonaka and Takeutchi (1995), the view of a human being composed by Antonio Damasio (2000), and the comprehensive thoughts of Ronald Maier (2002) are discussed. Finally an abstraction of those is refined to be used later in this study.

Ikujiro Nonaka and Hirotaka Takeutchi introduced in 1995 an information refining model that describes how the tacit and the explicit information will be forming and how it will interact, thus creating both new information and causing the information to transfer from one actor to another. This model is described in figure 8. The model has been used in both the research work and in practical solutions. (E.g. Happonen 2001, Suurla 2001)

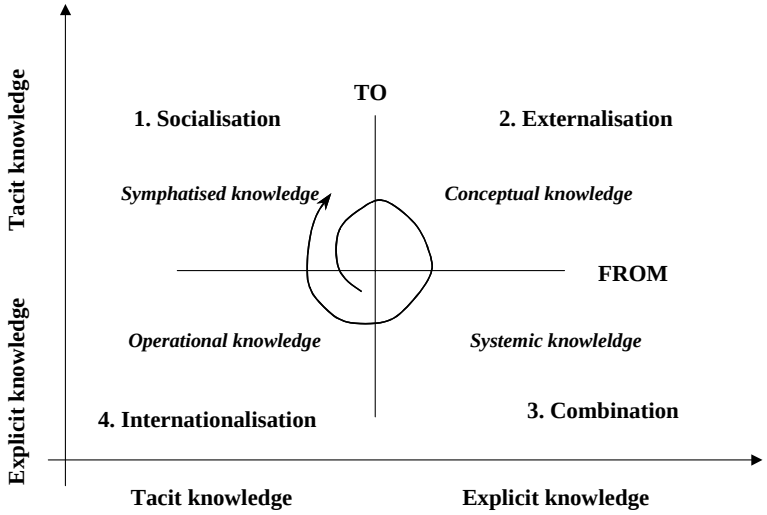


Figure 8. The SECI-model (Nonaka – Takeutchi 1995, 62 - 72)

The SECI-model describes how tacit information and the explicit information of the interacting entities is transferred and refined in a hermeneutical spiral through four phases. The viewpoint of this model is bound to organisation. It is supposed that the organisation will have the benefit of the individual's tacit knowledge to gain its objectives. The process keeps going continuously, and it is hard to say where it starts and where it stops. The model supposes that the overall tacit knowledge dispersed in the organisation will refine according to the following:

1. From the individual tacit knowledge to organisational tacit knowledge through the socialisation process. Here individuals will share their experiences and knowing with each other in a rather informal way. Technical skills, mental models or possible thoughts will be shared.
2. From the tacit knowledge to the explicit knowledge through the externalisation process. In this phase tacit knowledge is articulated in the explicitly expressed form to be mutually understandable. Concepts, models, metaphors and hypotheses are transferred into conceptual knowledge. This is the basis on which the cooperation will start.
3. From separate explicit knowledge to systemic explicit knowledge through combination process. In this phase the explicitly expressed individual knowledge will be combined to be mutually understood organisational knowledge. After this phase the available individual knowledge is adopted to the organisation and thus it will benefit the goals of the organisation.

4. From the explicit knowledge to the tacit knowledge through the internalisation process. In this phase organisational knowledge will eventually transfer into individuals tacit knowledge. The members of the organisation will learn what is necessary. The individuals will adopt the appropriate mental models, skills and know-how from the organisations point of view. (Nonaka – Taketutchi 1995, 56 – 78)

The process starts from the individual knowledge, and during the SECI-process it is finally transferred into organisational and inter-organisational information. The SECI-process will take place continuously on several structural levels. Figure 9 depicts the progress of this process on three levels.

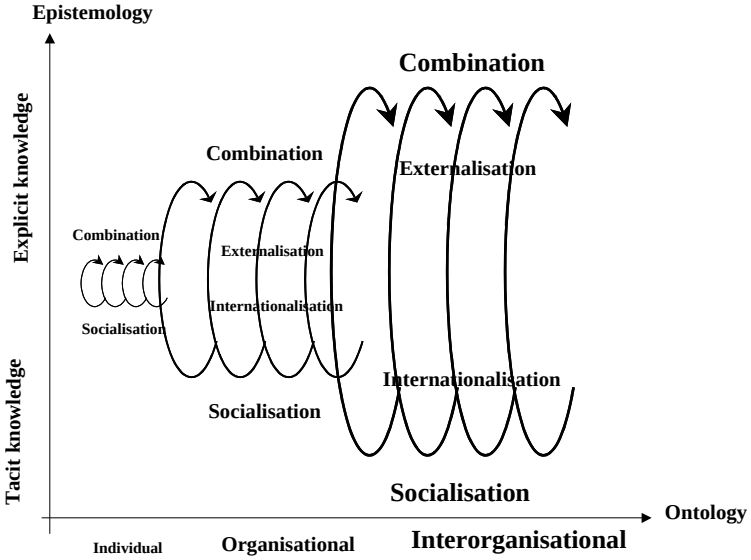


Figure 9. Progress of the SECI-process on three levels (Nonaka – Takeutchi 1995, 73)

The SECI-model describes the interaction of the information transfer between the system and one of its subsystems. It is a model of the information interchange between entities that represent two different ontological levels. It describes the potential of the mutual influence of the individual entities and the system that they are forming in the continuum of situations. This is an interesting starting point to discuss interaction in a social system. Later in chapter 4 this phenomenon is discussed in the frame of a social system. When considering the SECI model, it should be remembered that it is developed for purposes of being able to faster and more efficiently launch new and new kinds of products in the industrial environment. In such case, the organisation's demands are rule, and it is supposed that the members of the organisation will work efficiently to fulfil those demands. The basic assumption behind the SECI model is that the individuals give their knowledge to the organisation that refines this knowledge into mutual competence to achieve result. Further more, this mutual knowledge base directs the cognitive behaviour of the individual members of the organisation. The organisation has clearly expressed objectives, and the competence and the knowledge of the individuals is supposed to benefit the organisation.

What is interesting in this model is that it actually contains time. Because the background of this model comes from the business environment, time is supposed to be objective in the sense that the outer world, which consists of the customers and the competitors will determine the time allowed for the production process. The time dimension is in a way built into the model, but it is not expressed clearly. These time aspects will be dealt with in section 3.3.

Another feature of this model is that it does not determine the quality of the information refined in this process. Again, it is assumed that information under concern will contain all those relevant items that are needed to achieve goals. This is important. Nonaka and Takeuchi write about the long-term basis of making a benefit for the organisation. The members of the organisation are supposed to be loyal to the objectives of the organisation. Norms and goals of the organisation are figured to be "constant" – they are not supposed to be dubious. One of those norms is the use of the SECI model in mutual information processes. The value basis is supposed to be as unified as it shall be to gain loyalty to the organisation. The SECI process is a norm along which the organisational information refining process should be performed. The SECI-model describes a process that shall be used to get all existing information to all members of an organisation so that they can act in a way to achieve common goals. In that sense this model is somewhat universal. See one application in P6. But does the use of this process guarantee the availability of information to all members of the organisation?

Let us consider this question by help of Antonio Damasio's (2000) thoughts about how the human mind works when processing information. According to his thinking, knowledge is constructed during the process of interaction between the conscious human being and the outer world. (Damasio 2000, 174) The knowledge creating process inside a human being is continuous interaction between the perceptions and the memories. Knowledge is created combining the perceptions to the remembered information. It is essential that the observations about the outer world will be understood. Understanding depends on the storage of memories, i.e. the knowledge that already exists. A human being is interpreting observations through a mental filter that consists of those pre-assumptions that have formatted the mind during the individual's whole life (Merleau-Ponty 1968). Figure 10 describes this process.

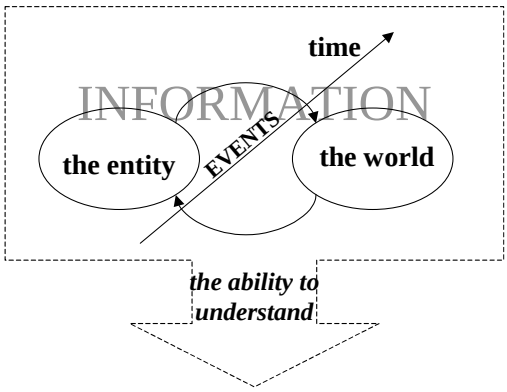


Figure 10. Knowledge-creation process inside the human mind (Applied from the basis of Damasio 2000)

The knowledge creating process is a process of understanding. The perceived events will be connected to those that are situated in the memory, the new information is created and situated back in the memory. Through this process the perceived data will refine as knowledge during time. This process reminds of SECI-process, but the viewpoint differs. In both processes, explicitly perceivable data is coming into the system and finally it will produce tacit knowledge. Incoming data and information will refine into the information and the knowledge during the thinking process. This process is depicted in figure 11. There the two entities interact with each other and build up new knowledge from the internal and external information flow. Entities A and B interact through the communication through which they are both getting and giving information. This information is refined inside these entities and will produce the new information and knowledge. Information change occurs mainly on the level of data and information, because the overall history of these entities is more or less different, thus preventing the total likeness of understanding perceptions.

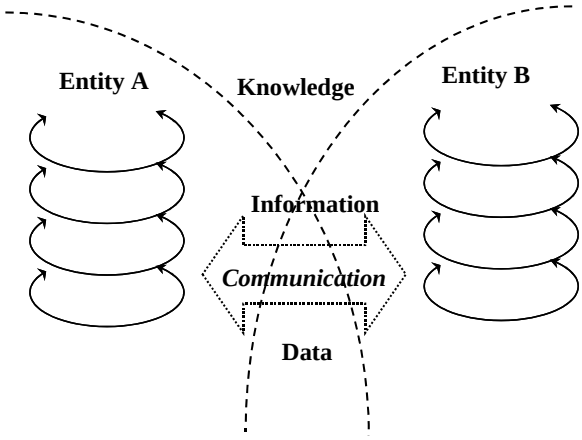


Figure 11. An abstraction of the information refining process

This process is expressed in a more abstract way in P2, as well. Ronald Maier (2002) describes this process in the context of transferring information and knowledge. He states that only data can be transported or communicated. Individuals and social systems interpret data (Maier 2002, 61). This statement can be interpreted as truthful. Anyhow, communication at the level of knowledge may be completed if the histories of the communicating entities are very similar. Then, with a very small amount of data, mutual understanding will occur and it could be stated that mutual knowledge is used to interpret the situation. In this example, the actual knowledge does not transfer in the communicative act, but only very abstracted data does. This data represents to both parties such level of knowledge that can be mutually understood during this very short communication event.

The same kind of structure is found from the thinking of Checkland and Holwell (1998). They state that discourse and argumentation are alternating in a systemic process. The incoming information will produce new information inside one entity. Habermas (1984, 1987, 1994) deals with this problem, as well. He thinks that there should be at least one mutually understood and accepted item to start the communication. Communication is the act through which understanding will increase. (See P5 and P7) All these authors deal with same problematics, but from different viewpoints. Nonaka and Taketuchi consider this process from the

organisation's knowledge increasing viewpoint, Damasio from the viewpoint of individual human beings, Checkland and Holwell from the viewpoint of problem solving and organisational development, and Habermas from the viewpoint of social interaction. But after all, the process seems to be rather similar in all the works mentioned.

3.2.2 Problem solving and decision-making

3.2.2.1 Modelling the process

The aim of this section is to introduce some decision-making and problem solving models to give an image about the process. The main functions of the decision-making that are essential in dealing with the question of information availability are found out. Four different models of problem solving and decision-making are introduced from different viewpoints.

Simon presented a model for problem solving in 1960 (Simon 1960). It contains four phases from the viewpoint of information processing (see figure 12). During the intelligence phase, sufficient information concerning the problem is gathered. This information can be situated anywhere on the temporal axis and it can originate either from inside or outside the problem solver itself. The intelligence function represents the output of information sources. In the design phase, adequate strategies for solving the problem are selected, and possible solutions are determined. Feedback to the intelligence phase is activated, if more information is needed. Finally, a choice is made and the solution is put into practice. (Marakas 2002, 56 – 59) This model is constructed to deal with determined problems. It actually does not include time as an attribute of the overall process. Either it does not take into account the relationship between time and information, or the quality and temporal origin of information.

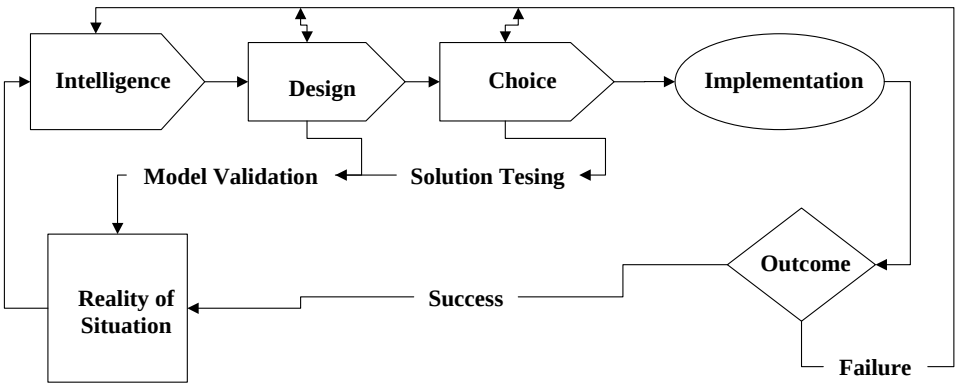


Figure 12. Simon's model of problem solving (Marakas 2002, 57, Fig 2-9)

John Boyd developed the OODA-loop (object, orient, decide, act). He was an air force officer and started his career as a fighter pilot. The OODA-loop is rather deeply analysed and presented by Hammond (2001). The OODA-loop is somewhat widely used in the western military context, (e.g. Waltz 1998). This model looks rather alike Simon's model of problem solving. Anyhow, the environment for which this model was originally created is totally different. Because of his background, Boyd originates his thinking from aerial combat, where the whole battle space should be

observed to choose a target and to survive. During observation that should be continuous, the environment is perceived. If something that should be reacted to emerges the orientation phase activates. Inside the orientation phase lots of information exists. It includes the future assumptions (win or die!), the lifelong professional competence (military and other training, personality), and the genetic heritage. After the orientation, a decision is made and the action proceeds. Feedback implications are wide and rather complex, consisting of both implicit guidance inside the decision-maker himself and those results that are gained. This model stresses the meaningfulness of using the information coming both inside the system (motives and competence) and from outside the system (observations). The information, which is coming outside the system itself acts as the trigger for putting action in practice on a certain moment. The OODA-loop stresses the meaning of quickly emerging issues in which the phenomena are known, but the space and moment are unknown. See figure 13 for depiction.

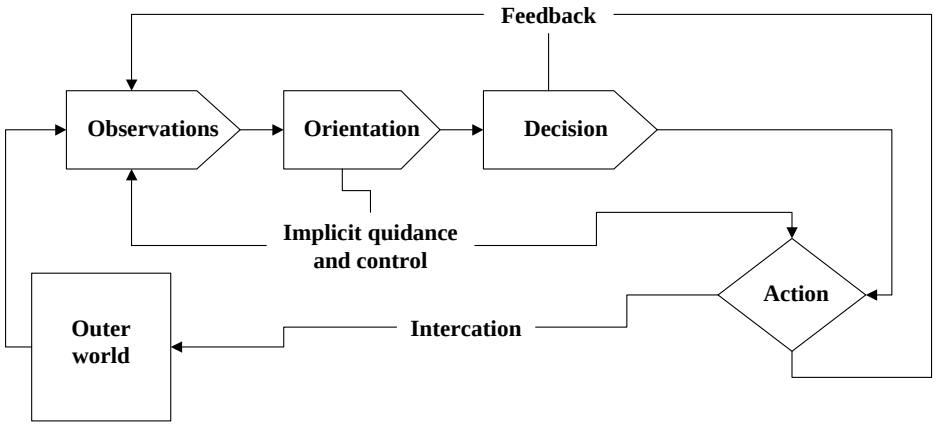


Figure 13. John Boyd's OODA-loop (Hammond 2001, 190)

While the Simon's model is suited for solving e.g. engineering problems, the OODA-loop is mentioned to model fast choices. It is rather interesting that both models look somewhat alike. But when analysing the information process in both models, differences will be found. The OODA-loop disperses used information into two phases according to the temporality. The present moment information is in the object phase and the other information (past and future) in the orientation phase. Temporality defines the quality of information, as well. Short-term information consists of facts and resources and long-term information such items like the task, personal military competence and the genetic heritage. Decisions are made quickly. Simon's model depicts the information gathering process in one phase, where feedback exists to allow the information gathering during the whole process. All information in this phase is called intelligence. The design phase refines all gathered information into solutions. A decision is made after a longish design and validation process. So, despite the similarities between these models, their use is different. This difference can be seen in the way these models deal with the temporality of the information sources.

After this brief discussion about the original meaning of two rather alike, but differently originated models, one more example of a decision-making model is introduced. This model is originally described by Rowe and Boulgarides (1994), and

it is depicted in figure 14. As it can be seen, it resembles to some degree those two models presented above. The stimulus arises when some kind of difference between the desired state of affairs and the current status is perceived. It makes the decision-maker to refine the combination of the stimuli and the personal and organisational expectations into a problem definition, where the right problems are validated to put the right activity into practice. If a problem definition is made for the wrong problems, the wrong activity will occur. The problem definition is considered to be a somewhat crucial phase in the process. A lot of both personal, organisational and inter-organisational information is dealt with. After the right problems are found, the alternative selections will be generated and finally the implementation of the most suitable solution will be put into practice. (Marakas 2002, 36 – 37) This kind of model is widely used for example in the military decision-making, as well. A rather good analysis about this is completed by Riihijärvi (1999), who compared the Finnish, the American, and the Russian military decision-making at the combined arms level. All processes are somewhat equal and they are mainly following the formula mentioned above.

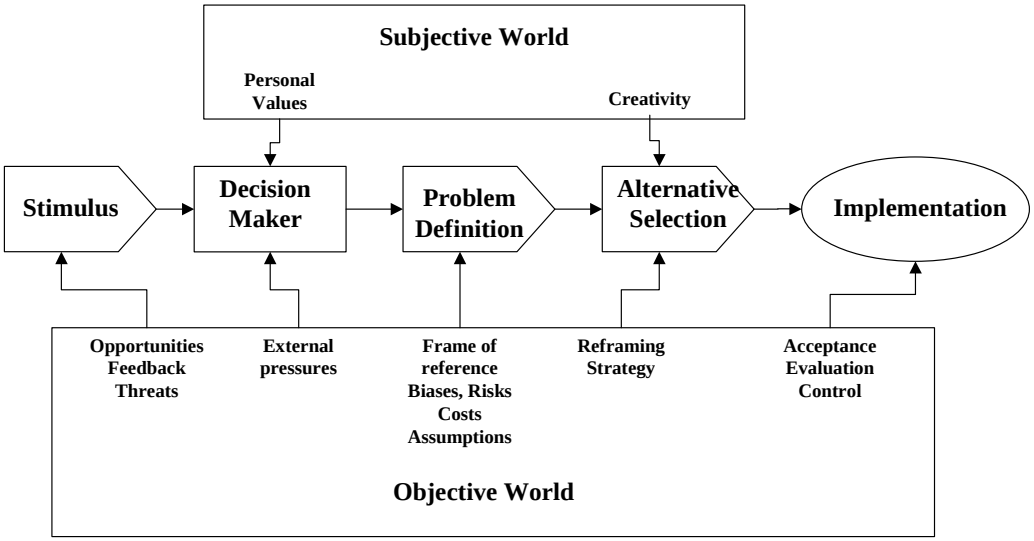


Figure 14. A suitably abstracted decision-making model of Rowe and Boulgarides (1985) (Marakas 2002, 36, Fig. 2-1)

It is interesting that this model deals with the information completely differently than the previous ones. Information is present at all phases. Information is divided into the internal (subjective) and the external (objective) information, as well. So, this model seems to be rather sufficient from the viewpoint of the divergence of information. It claims that information is present in all phases and its origin is either outside or inside the model, but it does not take time into account. It does not tell where on temporal axis the information originates. It does not tell how and when the interaction with outer world will be completed.

Let us jump from decision-making to the information management. Choo (1998) described an information management cycle that consists of defining information needs, acquiring information and organizing, storing, processing, creating, distributing and using the information. The approach of this model is the information management in a knowing organisation. Information needs will arise from the new challenges of the organisation. New situations will occur and the present day

situation no longer represents the image of the desired future. After the information needs are determined, the acquisition process will start. Gathered information is stored and the information is transferred into the refining process from both storage and acquisition processes. After that, the distributed information products and services for the information using purposes are completed. (Choo 1998, 260 – 268)

Further more, Choo (p. 268 – 269) states that "information use is the dynamic, social process of inquiry and construction that results in the making of meaning, the creation of knowledge, and the selection of patterns of action." The model that Choo describes deals solely with information management. It provides information services and products to e.g. problem solving or decision-making environments. It does not actually deal with time, but notes about the time-divergence of information are found e.g. from page 269, where Choo writes about the knowledge transformation process. He states that the knowledge creation process will convert organisational information into tacit, explicit and cultural knowledge in the context of the organisation. That is really close to Nonakas and Takeutchis SECI-thinking. See P5 and P7, as well.

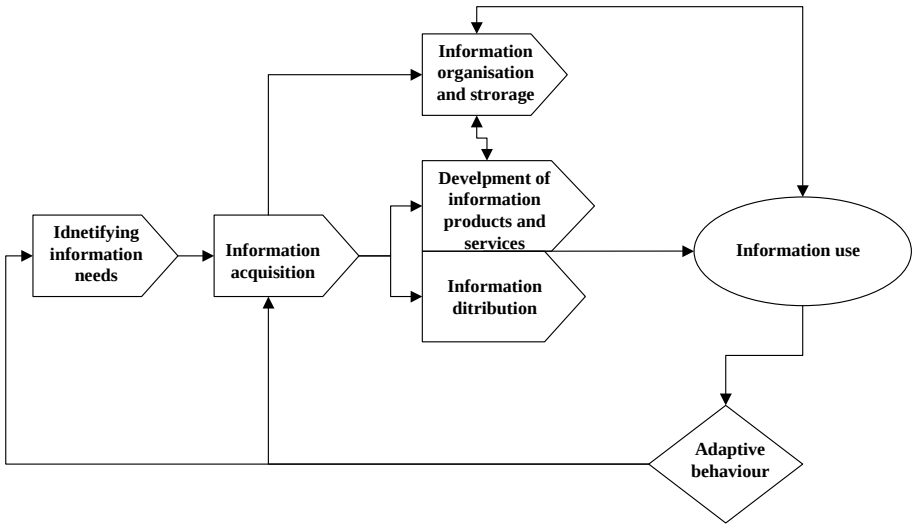


Figure 15. Model of information management presented by Choo (1998, 261 – 273)

Those models presented here arise on the basis of different needs and backgrounds, thus not being adequate to be used alone as a model in this study. When the divergence of those four models is analysed and refined toward their utterly simplified combination, a basic process model is found. All those models have an information input phase, an information refining and transformation phase and an information-using phase. Something from the outside is coming inside, where something will happen to it and finally it comes out causing something.[10] Something is lacking, though. The actual question, from where both spatially and temporally the relevant information comes from, is still open. The models do not clearly describe whether information needs for making choices and directing resources comes from the inside of an acting entity or from the outside. So, it seems rather obvious that the temporality of information availability and the mutual structure of interacting entities should be discussed, as well. Anyhow, on the basis of these models, a simplified

[10] Actually this is a classic process model, where something comes in something takes place to it and something comes out. This basic model can be found in e.g. Checkland and Scholes (2000).

abstraction was completed. It is depicted in figure 16. It is rather close to the utterly simplified system description, which is depicted in the figure 3 in P2.

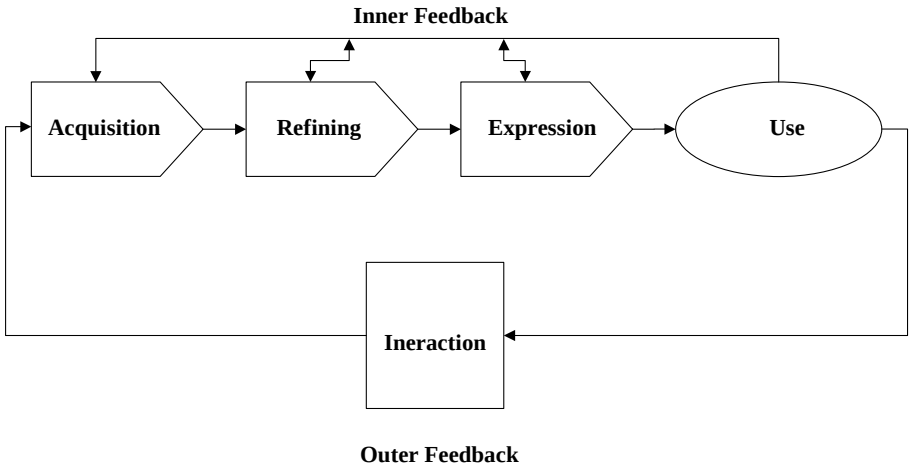


Figure 16. A simplified presentation about an information flow

3.2.2.2 Soft systems methodology as a depictor of influencing process

Originally the Soft Systems Methodology (SSM) was mainly meant to plan changes to organisations or activities inside them. In this thesis the SSM is used to understand systemic thinking and to structure certain parts of the research problem. In P1, the SSM is described to a subsequent degree. Here, some of the history of soft system thinking and system features is presented.

Soft Systems Methodology originated in the 1950s when Peter Checkland (Chekcland and Scholes 2000) began to develop a methodological frame to examine complex systems based on holistic thinking. It was noticed that in certain cases mathematically expressed general system theories did not give any results at all. A great deal of thinking was occurred during the next decades (1970´s and 1980´s) and e.g. Maturana and Varela developed a concept of autonomous living systems. This original thinking of theirs can be found refreshed e.g. in Maturana and Varela (1998). They present thoughts about biological heritage of human thinking. The most interesting point of their work concerning this study is that human knowledge in its entirety[11] is a holistic system containing divergent but mutually interacting levels. At the same time Karl Popper (1972) published his thoughts about knowledge and its evolution. He thinks that an entity is acting like a self-organising system. Certain parts can mutate without making radical changes to the structure on a higher level, but those mutations will change certain manifestations about certain phenomena of this higher system. Further more, only advantageous mutations will increase the survivability of an individual and the whole system. (Popper 1972, 257-280)

According to Chekcland and Scholes (2000, 18 – 19), a system contains structure and action. Structure consists of nodes and contacts between them, constructing a functional hierarchy. Action in this structure will emerge as outcomes, which are not

[11] Entirety is here understood as a whole system consisting of both individually acting entities and systems consisting of interaction of those entities both in time and in different situation in divergent contexts. (See Maturana & Varela 1998, the picture after every chapter).

clearly determined, but are typical for every hierarchical level. The idea equals the one that Popper (1972) has published. Survival is a vital feature of a system. The system will maintain its phenotype until its complexity forces it to form new kinds of patterns. Until change occurs, this hierarchically organised wholeness with emerging properties will have a possibility to maintain its structure if it has communication and control properties. (Chekcland and Scholes 2000, 18 – 19) This means that a system shall have the following features:

1. Structure containing nodes and interaction possibilities between them.
2. Action at the structure. This divergence of action will produce semi-determined outcomes in an emerging way.
3. Information gathering, refining and using properties as a necessity of the action, which ensures survival.

Semi-determination means that on one hierarchical level of the system only certain types of phenomena will occur. The emerging way means that the moment and place where those phenomena will occur inside the hierarchical level cannot be predicted for sure. These features of complexity are dealt with by e.g. Kauffman (1995), Holland (1995) and especially in an organisational environment by e.g. Keskinen, et al (2003). An interesting objection on the basis of this last mentioned book is that the more complex the environs are the more difficult is timing. Emergence is growing alongside complexity. Anyhow, emergence can be controlled to some degree to understand the meanings of the decision-making, and the command and control structures. A vital part of that is to understand what kind of information should be available to the process and how this information may be transferred into and inside the systemic structure. A most abstracted depiction of this process will be found in figures 2 and 3 in P 2.

3.2.3 Communication as a transformer of information

In this thesis, communication is considered as a tool with which information is transferred from one actor to another. Habermas (1984, 1989) argued that those who take part in interaction should have at least one shared item of knowledge. This guarantees that they construct their shared situation coherently. The shared knowledge is information with which the models for creating mutual understanding can be formed. Without the models the creation of understanding is not possible. A prerequisite is that people commit to believe in these models. This requires that information concerning these models will be communicated. The creation of shared knowledge answers the question “why?” - why those involved want to share their valuations and knowledge. Further more, in his thinking about the concept of communication Habermas unfolds attributes of a message. The message should be authentic; it should conform to the normative context, where the communication event takes place. It should be true, i.e. it should conform to the facts on view. It should be credible; it should fit into the subjective world of experience represented by the one who communicates. (Habermas 1984, 99 – 100) So, the one who communicates will provide messages that are verifiably true and could be believed in their context provided by the one who communicates. When the communication situation begins, the shared area of worldviews (S) of actors A and B is limited. After a temporally, qualitatively and quantitatively successful communication process, their worldviews have moved closer to each other. Understanding messages is not

possible if the communicating parties do not share insights about the world, the culture or the events of life at least to some extent (figure 17.).

Efficient and smooth communication is possible only when expectations, beliefs, worldviews and appreciations behind those insights are as common as possible. In a well-established communication relationship, referring to those basic backgrounds is rarely needed. In this kind of situation, communicated messages can be formed to deal with the new items, thoughts and events. The actual amount of transferred information can be minimized. (Nyman 2000, 26-27) So, it could be thought that by combining peoples´ worldviews beforehand, communication needs can be minimised and focused on the essential before the demanding act of planning and decision-making. (figure 18.) See P5, as well.

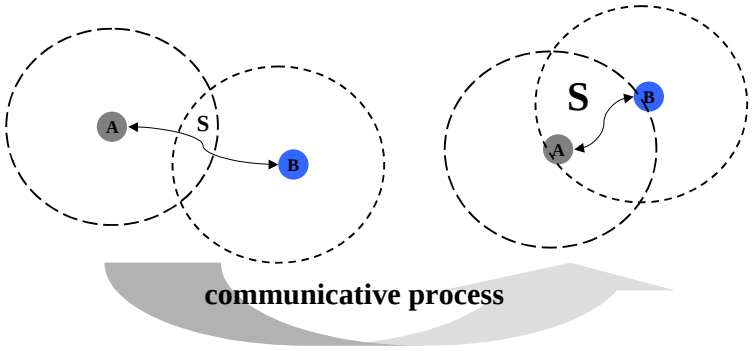


Figure 17. Bringing worldviews closer by communication

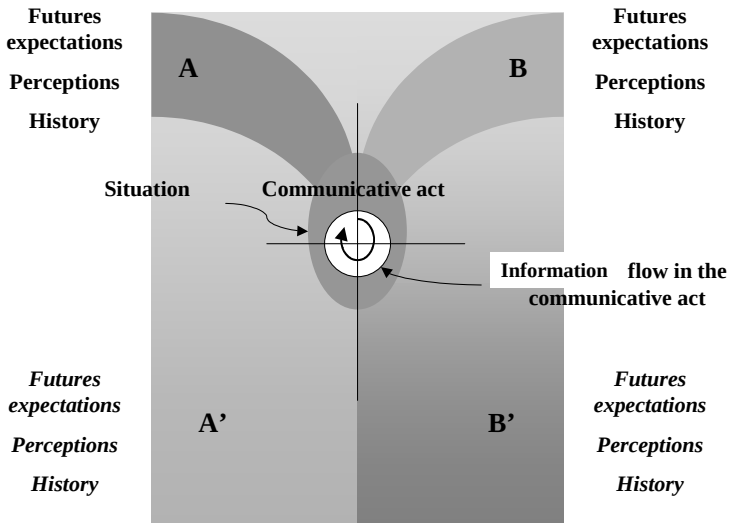


Figure 18. Communicative event between two entities

The organisational viewpoint will emphasise organisational culture as a background for mutually understood norms of communication as a nominator of information flows. (E.g. Schein 1992, Ansoff 1984a, Hofstede 1984) The culture in an organisation forms basic assumptions about how the organisation or its teams both perceive the world and make and act in it (figure 19.). Culture acts as “the mental filter” of the organisation. Anyhow, culture is not a faceless feature of the organisation. Culture shows itself as action that aims to maintain patterns. Information to perform this contains values. (Habermas 1989) Values are both

personal and collective. Igor Ansoff (1984b) states that there are three information filters while receiving, refining and distributing information. Surveillance filter defines, what kind of information is required, mentality filter defines, what kind of information is considered to be relevant and finally the power filter defines what kind of information is allowed to be used to gain desired results. The power filter can be considered as the "mental filter" of the organisation, which is not necessarily understood or even accepted by all organisation members but shall be taken account, when acting in the same organisation. So, culture can be considered as a collective construction, where the basic assumptions of all people involved are more or less effective. The most effective are those values that are released by those who have permission and ability to use power, i.e. leaders and managers.

Through culture, the organisation creates its stories to the world where it acts. The world constructs its image of the organisation by perceiving and interpreting those stories. The organisation gets its images, insight and attitudes through interpreting the perceptions it can have through this cultural filter, as well. The whole organisation and its teams inside it are witnessing the world and coming into the world through its culture. The leader is building the communication forum (Aula 2000) to connect his team to the world and to form mutually accepted rules within the team (figure 20).

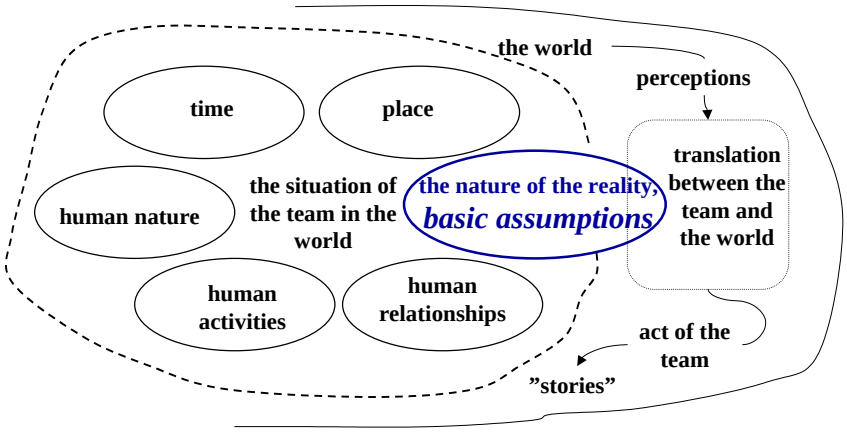


Figure 19. Culture (i.e. basic assumptions) is forming the basis of interpreting information between the world and the team. According to Schein (1987)

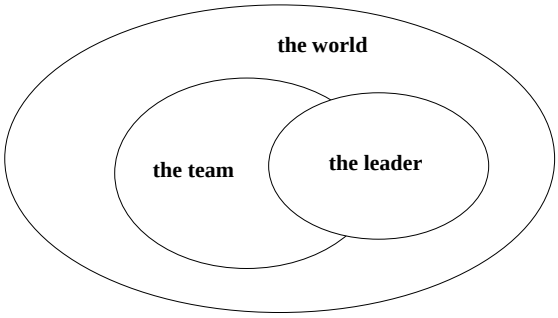


Figure 20. The leader acts as an interpreter between the world and the team. According to Schein (1987)

It could be stated that communication is somewhat important in leadership, management, and command and control. It has been estimated that 98 % of leading is communication (Aula 2000 referring to Senge 1990, 1999a, b). Communication is comprehensive process between those, who communicate. Its purpose, meaningfulness and significance change during the time, the space and the situation. To be effective, communication should be unceasing and interactive in its context. The more coherent mental models are created aftera communication event, the better communication has succeeded. (Åberg 2000, 34-48) Personal stories of actors are merged together during a communication event. An actor expresses itself through this story. It adopts information through perception and joins it to memories after processing it as a part of long-term mental models. This combination of present-day perceptions and long-term knowledge forms the story of this actor. Actors interact with these personal stories.

3.3 Time

3.3.1 Theoretical background

Attitude to time is culture dependent. (Levine 1997, Davies 1995, Pihlström 2000) Anyhow, this thesis follows the western way of thinking, thus leaving the ever so interesting cultural divergence of experiencing time without concern. In this context the issues that supply temporal axis information and how it is available are discussed. When dealing with purposeful action, the experience of time will bind those viewpoints together. Concepts of objective and subjective duration (the time elapsed between the starting and ending points of an event) as well as moment shall be discussed. The binding, how past, present and future are manifesting in information availability, shall be pondered. Finally, the temporal availability of information will need some enlightening. Before that, a theoretical background shall be formed. It is built around Ellis, J. McTaggart's (1908) thoughts about time-series, Henri Bergsons (1911) thinking about experiencing the temporality information, and Martin Heidegger's (2000) thoughts about experiencing time itself.

According to the modern physics time is one of the dimensions of the universe. It is considered to have its origin in the same moment as space when our universe originated (e.g. Hawking 1999, Davies 1995) In our universe time and space cannot be separated. In space, one can move rather freely from one direction to another, but in time only one direction is allowed. So they differ form each other. Anyhow, both have the feature that the experience of moving from one point to another needs some kind of fixing point that can be referred to find out either physical or temporal distance.

Time is a somewhat divergent problem, because the way it manifests itself depends on the fixing point against which the consideration is made. Time can be considered as a psychological issue, a sociological issue, a measurement issue, as a being of a physical theory, etc. Common for these viewpoints is that time without the "universe" – the fixing point against which the consideration is made - is absurd as a concept. Time will need a "platform", to which it is bound.

A good starting point for the discussion about time could be, what Emile Durkheim (1980) has thought about the concept of time in sociology. According to Hyrkäs

(1999) Durkheim states that time is an abstract and non-personal frame that surrounds the human race. It is like an endless map on which all duration will spread in front of us, and on which all events can be placed with help of various fixed points. Durkheim thinks that time will be realised with the connection of events. Events have their starting and ending moments and those moments will determine the durations of the divergence of events.

McTaggart (1908) stated that time does not actually exist. Time is the phenomena of an event-experiencing entity. McTaggart studied time with help of two time-series, A and B. Series A divides the temporal world into the past and into the future separated by the subjective experience of "now". Series B divides this world into the separate measurable moments, which have taken place either before the measured moment of "now" or will take place after it. Series A describes the world as a sliding duration, which is tied to the reality with subjective experience of the present moment. Series B fills the world with the temporally noticeable events that have the starting and ending moments. With these time series it is possible to find out explanations for the experience of time, the direction of time, objectivity of time, subjectivity of time, duration, moment and delay. An entity is moving through temporal space, experiencing subjective and objective temporal limitations and possibilities when trying to act more or less purposefully. P2, P3 and P4 have short descriptions about this thinking.

Figure 21 enlightens the difference between McTaggarts time-series. Time in series A can be characterised as time from the viewpoint of the subject who makes perceptions about the events of the world. With the help of the A-series, the subjective nature of time can be approached. The B-series deals with measurable time. It represents objective time from the viewpoint of a perceptive actor. Both series are attached by the field of experiences the observing actor has. With this field the actor will see meaningfulness for its[12] action. (Knuuttila 2000, 21 – 22) The A-series divides events as "taking place already" and "will be taken place" with the help of ever sliding, subjective moment of "now". The B-series will attach events to the explicitly determined, measurable moments of time. Those moments can be expressed e.g. by the help of a calendar or a clock.

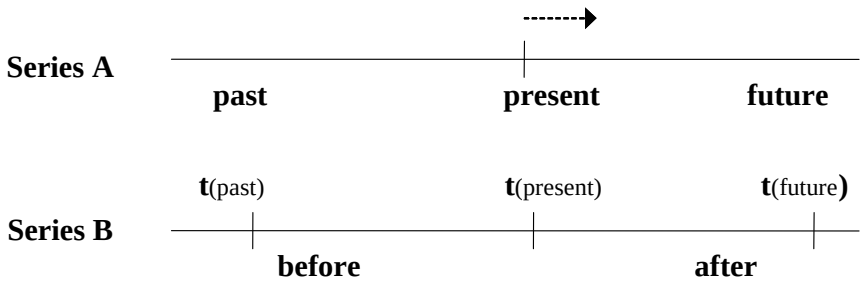


Figure 21. McTaggarts time-series (Figure formed on the basis of Niiniluoto 2000, 247)

[12] The pronoun "it" is used here, because the actor mentioned here can be other than human a being, as well.

3.3.2 Experiencing time

According to Ilkka Niiniluoto time can be dealt with both as a subjective and objective concept. The subjective viewpoint describes time as a status of mind, an experience, the way to percept, think and outline the outer world. The objective viewpoint understands time as a part of a physical reality. E.g. Henri Bergson and Martin Heidegger represent the former viewpoint and Isaac Newton and Albert Einstein the latter one. (Niiniluoto 2000, 246) If this division is abstracted to a more generalised form, it could be thought that the time of the perceiving actor is subjective and the time outside this actor is objective. Subjective time is connected to the perceiver itself as an experience. This subjective experience of time is seen through those inner and outer events that are perceived.

Time in Martin Heidegger's thinking is common time that is determined by daily and yearly events, like sunrise and sunset, appointments and acts (Heidegger 2000, 489). He thinks that a human being has a tendency to detach the concept of time from the context of the world and transfer it into personal experiences of the present moment. In that sense McTaggart´s time series A will become relevant. A human being forgets temporal dimensions of historical events and future planning and will deal with the future as a phenomenon "which is not yet, but will be" and the history as a story "which does not exist anymore, but has existed" (Heidegger 2000, 393 – 394). The continuum of life will flow through the present moments perception-window being dim in the past and in the future. At the present moment something concrete will be experienced, but the story of the past and expectations of the future will exist as memories or thoughts without the exact experience of time. The experience of time will exist via the continuous flow of perceptions and actions of the present moment. Time will be outlined through those events that will be manifested via the interaction with the world. (Heidegger 2000, 445 – 446)

According to Heidegger (2000), time is an experience, the way to perceive, think and outline the world. An entity is experiencing time by being in some context and via those events that the outer world offers. An individual has a tendency to detach the concept of time from the context of the ongoing situation and transfer it into the personal experiences at the moment of "now". So, an individual, when acting, does not remember the temporal dimensions of future expectations and historical memories. The events of the world flow onwards and an individual experiences the time, its moments and durations of the subjective and the objective events through his own experience.

In the human mind time passes, but does not come into existence (Heidegger 2000, 501). The present moment is not enough to explain the experience of time. A human being exists continuously as a perception making, acting and experiencing entity. He will experience this existence through interaction with the outer world. The experiencing of time will be one part of this existence. The temporal experience of a human being is a feeling. It is a construction of divergent moments. Those moments are indifferent fields reaching towards futures or pasts. (Heidegger 2000, 394 – 395) These fields are limited by the way, how one can experience time – how experienced he is to experience time.

Time has duration, order and direction. Order is defined by such concepts as before, after and simultaneously. Direction is inevitable and it points from past to future. Time as an experience divides into the axis of past, present and future. Present is experienced here and immediately and it has its own duration.[13] (Siitonen 2000, 147)
Time is experienced as duration. It will take some amount of time to do something. Some amount of time has passed from some event. A good (but creapy) example about this is in Antti Tuuri's book Talvisota (The Winter War), which describes the adventure of one Finnish infantry company during The Finnish Winter War in 1939-1940. (Tuuri 1989) Just before the outrageous war ends, and the enemy is bombing the position of a few survived soldiers (eight of the whole company), the book describes the feelings about being in this kind of situation. During the bombing there is no time. The feeling of subjective duration has vanished, because the objective world most probably will terminate the existence of every individual. Everything is controlled by the outer world, the subjective temporal axis, as well. After the fierce bombing is over and the cease-fire begins, this no-time experience vanishes and the feeling that all the time of the world is in use will arise. The objective world no longer controls the existence of any person, and the subjective temporal experiences can become a reality again.

The present moment is the temporal point where the observed outer image and the inner image that is mentioned to model perceptions will meet. (e.g. Damasio 2000, Dennett 1999) With the help of memory, lifelong experiences can be restored. Memory is important in understanding the present and planning the future. The concept of present is subjective. According to theory of relativity, all actors have their own coordinates, which may be connected to each other via three-dimensional space and information, which is travelling at the speed of light. Different coordinates have the temporal divergence compared to the present moment. In one coordinate the event is still in the future, when it is actualising in another one. (Oksanen 2000, 123) The concept of moment is hazy. Objectively, a comprehensively determined concept of moment does not exist in the interactive world.

Paul Davies (1994, 130 – 132) has stated that time is relative. This relativity is not confined only to the physical world, but to living entities, as well. The time that is experienced depends on the speed of information processing. The faster the process is, the more stretched the experience of time is. Fast can do more. The faster one has a temporal advantage over the slower one.

For Australian aboriginals events are more important than dates. Their concept of time is event-relative. (Davies 1955, 26 – 27) This kind of way to experience time seems to be natural. Experiencing time via objective measurements is a rather new invention and widely used only in a western cultural environment. Before the clock was invented, the experience of time was event-related. So it still is, if it is a question about such situations where something should be done immediately or without hesitation in context, where the objective world is very hard to control. Such situations are e.g. a battle, a bout of illness, a fire and an accident. The experience of time is always relative. It is related either to the objective world or the subjective one. The experienced time is relative to the events and the interaction. One entity's subjective time is another's objective. Time is basically experienced event-related,

[13] The experience of this duration seems to be about 20 seconds. (Kamppinen 2000, 269)

but experience about those events will help to estimate the temporal relations between different events and time measurement equipment. Figure 22 depicts the relationship of experiencing subjective time in the objective world. Let us quote Albert Einstein here (Levine 1997, 26):

> When you sit with a nice girl for two hours, it seems like two minutes; when you sit on a hot stove for two minutes, it seems like two hours. That´s relativity.
>
> (Albert Einstein)

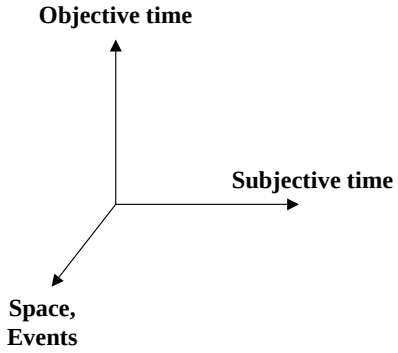


Figure 22. An entity will act in the wholeness of subjective experience of time, objective time and events

3.3.3 Temporality of information

On the basis of temporality, three types of information can be identified: the information about the past, the perceptions as information about the current situation and the information about the future (Bergson 1911, Damasio 1999). Information about the past, the present and the future contains data, information and knowledge. The current situation and imaginations about the future cannot be understood without the information about the past (Bergson 1911, Damasio 1999). See figure 23.

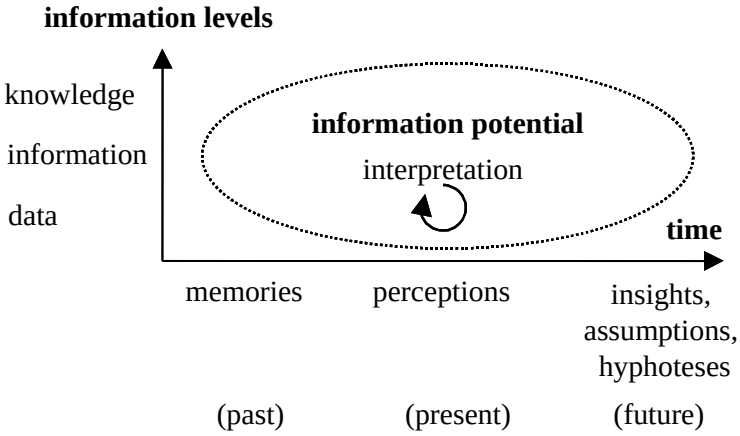


Figure 23. Memories, perceptions and insights are data, information and knowledge

Let us reinforce McTaggart's time series A with Bergson`s (1911) thinking about duration. According to Bergson (1911, 7) we will create ourselves endlessly in the

time by maturing via the change in our existence. Further more, the present state is a combination of all the past remembered at this situation. The potential of the coming future is formed by projecting into the future what has been perceived in the past, or imaging for a later time a new order of those elements that already have been perceived. (Bergson 1911, 2-6) Bergson's thinking is most helpful understanding the meaning of the past, the present and the future and their relation to information. The potential of the future activity is formed by combining the information and the experiences about the past and the present at the moment of "now". This means that the future potential cannot be formed without the experience about a past that can produce relevant information for the foreseeable future. Remembering the past makes us able to achieve our images about the plausible futures. Beliefs about the future or futures will correspond to the known reality of the wholeness of the system. Further more, this means that a successful entity must have somewhat broad experience about the world it is supposed to interact with, and an ability to learn. This requires a memory that is updated with reasonable information in a cycle fast enough compared to the on-going situation. This demands imaging, and a good process of thinking, as well. Refer to figure 24.

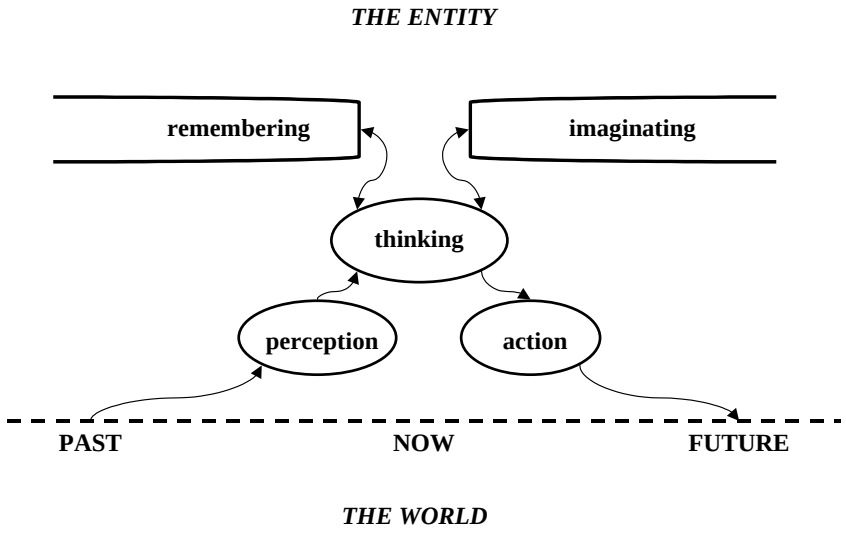


Figure 24. A Bergsonian view to interaction between an entity and the world

3.3.4 Temporality of action

The experience of subjective duration will arise from inside of the entity via the feeling of the temporal existence, which reveals itself through those events the entity perceives. The experience of the objective duration arises via observing the starting and ending moments of events of the outer world. In the case of objective duration, the outer world shows to the entity those events the entity cannot affect. These events will position the entity in the temporal world. The entity itself perceives the objective duration as inevitable if it cannot change the temporal dimensions of those events. De Spinoza is dealing with this in his "Ethics", stating that duration is non-defined continuing of existence. Further more, he states that duration cannot originate from the entity itself, or on the basis of why the entity exists. (de Spinoza 1998, part II, V) Duration does not exist because the defined entity exists, but because of what it does, e.g. how it interacts with other entities. Duration shows itself via interaction.

Robert Levine (1997, 38 - 48) states that the subjective experience of time reveals itself as follows:

1. Meaningfulness and enjoyment will accelerate the subjective time.
2. Busyness will make time go slower. The feeling of being busy is caused by the wrong dimensioning of the task.
3. The greatest is the number of all possible events, which can be ruled by an actor the faster the time is felt to flow.
4. Paying attention to objective time will cause the feeling that subjective time will flow more slowly.
5. The diversity of the task under control will accelerate subjective time. Dullness will slow the flow of time.

It seems that the objective control will slow down the subjective experience of time. Subjective control will accelerate the experience of time.

All events and acts have durations – they last a certain amount of time. Everything cannot be done because of the subjective and objective time limitations. One has to prioritise continuously. This cannot be made without understanding the meaning of temporal information, the meaning of experiencing time.

Information that is available is always historical, coming from the past. The main question is, how old it can be to be valuable? This problem is depicted in Figure 25. Actor A is launching information at moment (t_o), its transfer lasts (d_{tc}), and interpretation takes place ny actor B, (d_{tu}). The subjective moment of A at (t_o) shows to B at B's subjective moment (t_2). So, it should be asked, how long can time (duration) (t_2-t_o) be for that information to still be valuable to the actor B? It seems that we are bumping into the problem about the tolerance of the duration of lacking the contact. If contact occurs too seldom, the relevance of interchanging information will decrease or it may even become irrelevant. An actor should have knowledge about duration mentioned above to understand where and what kind of information it can have or should have. Everything is not possible. One has to accept that the decisions are made based on lacking and delayed information. One has to know the objective and subjective limitations of useful information caused by the temporal dimension. It is rather essential to know when information is valuable. If information is gathered too early, it will fill the memory with unnecessary items and if it is coming too late, it may cause erroneous conclusions.

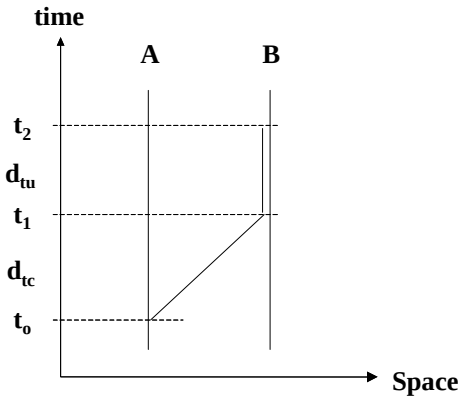


Figure 25. The origin of delay

The outer world allows the subject certain objective duration in a certain situation. To handle this situation, the actor needs to know its own temporal capability. The next two questions shall be answered. How much subjective time is required? How much subjective time the objective time will allow to be used? If the subjective duration is shorter than the objective one, the situation is in control and the actor can rather freely choose the moments for putting action into practise. On the edge of chaos, subjective and objective duration are nearly equal. Then the pace of action is extensive, but still under control. If the subjective duration becomes longer than the objective world allows, the actor will move into the reactive mode and it will become totally led by someone else but itself. In a mechanistic and static environment, it is rather easy to gather knowledge about both the subjective and the objective durations. Timing is somewhat simple in a static environment. But when the environment becomes unpredictable and the pace of changes fastens or surpasses the limits of information processing capability that the individual has, a transition from proactive way of acting via the edge of chaos to the reactive mode is inevitable. This is depicted in Figure 26. See P2, as well.

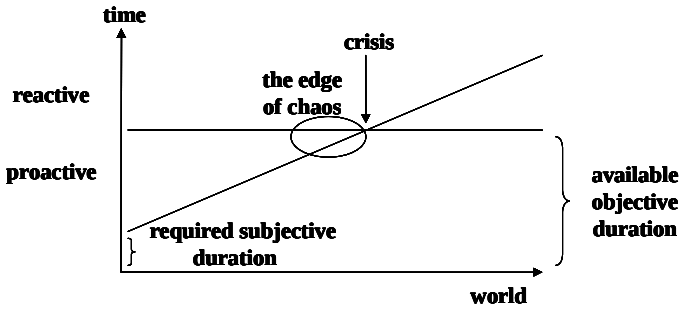


Figure 26. The relevance of time management

McTaggart's time-series B describes the moments of those perceivable or expectable events when some change will take place. When combining Bergson's (1911) thinking about duration into series B, it can be noticed that several events from the past will affect choices made at the present moment. All these events have their temporal lengths. It shall be understood where putting action into practice could be situated on the temporal axis. Making choices is always imaging the future. Futures cannot be imagined without remembering and understanding the past in the present day situation. To be able to make realistic imaginations, one must understand that the information put into use will be effective, i.e. objective duration can be exposed. The decision-maker must be aware of the duration of relevant events to be able to make temporally reasonable choices. Sun Tzu writes about knowing – among many other things. He claims that the key to the victory is the knowing of oneself, knowing the enemy and knowing the environment. (Sun Tzu 1963) This is true at temporal dimensions, as well. Knowing subjective time limitations and possibilities, and respective objective ones gives an actor a somewhat good opportunity to choose the right moments to put the desired affects into practice.

One must know its own temporal capabilities, as well, i.e. how long time an activity will take, how long the delay is, and when the activity will have an effect on the outer world. After that the right moment can be chosen. Experiences about success

and defeat containing temporal information are transferred into the memory and further to the future decision-making process. One has to know the world outside to understand the limits that the objective duration sets to it. It is not essential to notice all variables of time, but to "understand and be aware of those that pertain to the situation under concern" (Friman 2001, 161). The human capability to handle information is limited. Dealing with the temporal information will take resources from dealing with other information. When working in a temporally demanding environment, the possibility that something essential information is not considered is high. This essentiality may be either temporal or substance by nature. In both cases, the availability of essential situation relevant information is limited.

Brown and Eisenhardt (1998, 165) refer to Grove (1996) about understanding time in business. Grove philosophises:

1. Timing is everything.
2. Act early.
3. Act with runners, choosing the moment is essential.
4. The greatest danger is standing still.

Brown and Eisenhardt (1998, 163-188) write about pace and rhythm. Pace in their concept of thinking means basically the moment, and rhythm the duration between moments. Grove (1996) focuses on making acts at the proper moment. But this is not the whole truth in understanding the meaning of time. In addition to the right moment, the duration of various events and acts and effects must be understood, as well. Those durations depend on the attributes of the entities, their interactions, and the context of events.

Obviously it could be seen that understanding the duration (both the objective and the subjective) requires lots of observations about subjective and objective action, and thinking about the action under thinkable future interest. All this should be done over a suitably long period – the more complex the future problem is, the more resources (time and people) this process will require.

3.3.5 Conclusions about time

When dealing with time in the information processes, two main viewpoints shall be considered. First, the temporal label of information shall be taken into account. It should be considered whether the information has originated in the past, in the present, or in future assumptions. Figure 27 illustrates this issue. Second, when using information to cause interaction with the actor's environment, the durations of events and the moment changes shall be considered. In that sense, from the viewpoint of the subject's information process, the temporality of information and the temporality of activity occur.

Objective duration is in a way "inevitable". The subject has no direct opportunities to have an effect on those processes that are not in the field of interaction. Unidirectional information flow (from object to subject) does not allow affect the outside of the subject. The subjective duration is limited by those processes, which exist inside the subject. Those processes have their characteristic durations, and the response to the incoming information is always delayed. This time consuming process does not depend on the origin of incoming information or the temporal position of that information. If an entity is able to create the information about

futures, it can put action into practice without waiting for the outside triggering information. That makes proactive action possible when the actor is better prepared to choose the moment – or even master it. This is possible, if it has a good understanding about the temporal aspects of the available information. If the knowledge about the temporality of information and activity is adequate compared to the situation, the information refining and using process can be planned more properly.

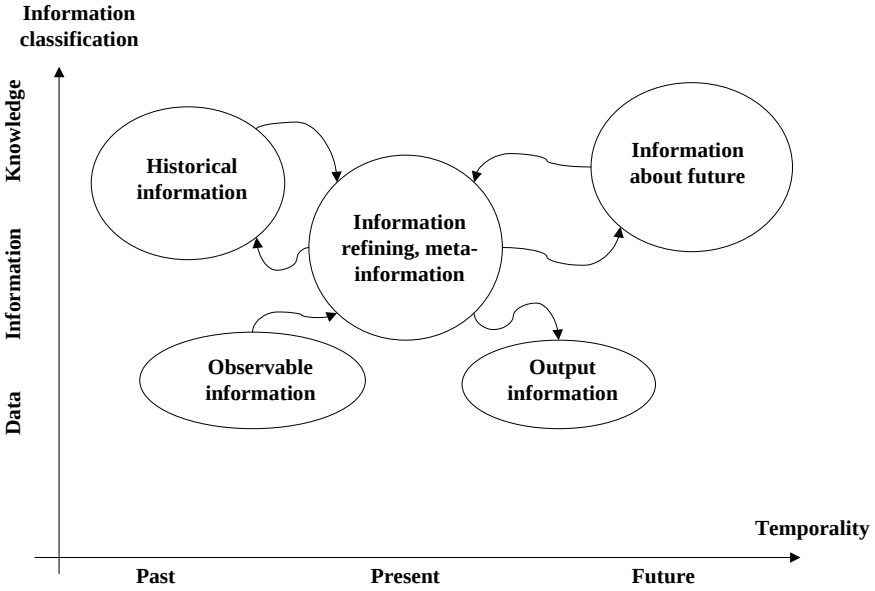


Figure 27. The temporal nature of information coming into the information refining process

The temporal features of information are the most complex and somewhat difficult to study. One example of thinking how to study temporality is in P2. From the temporal point of view, an entity is mostly working inside some objective duration. Superiors or clients have defined deadlines, the bleeding of a possibly lethal wound must be stopped before one bleeds out, car should have service after a certain amount of driving, etc. Those were examples where the objective duration was somewhat clearly determined. Anyhow, especially in chaotic environment a great deal of unpredictable action emerges (Kauffman 1995, Mannermaa 1991, 177 – 191). That will cause difficulties in dealing with the temporal axis. A feeling of hurry will occur when a divergence of issues occurs emergently (Saariluoma et. al 1998). This is unavoidable to some degree, but it can be controlled by understanding what is the meaning of the information about the past, the present and the futures and what is the temporal nature of the system where the actor interacts with others. The following short description of personal experiences of the temporal nature of information might be enlightening. This little story tells about the necessity to know the temporal nature of the information and the action.

> "On the basis of personal experiences arises the following description about managing expert work in a smallish research and testing group, which was completing both long-term (up to years) and short-term (days or weeks) research and testing tasks. This group had much more work, than it was able to handle. It was difficult to conclude the managing process of all tasks without knowing each researcher's personal capabilities. Overall results were shattering. Anyhow, in the beginning, I launched a very simple method of following the duration of

> different tasks of every person. Every worker wrote down in a common database how much time they had spent on the certain tasks. At the same time, I could follow which tasks were in process and which were completed. This simple method gave very valuable information for planning the future, because after a while I had rather explicit information about how long certain tasks would take and the personal capacity of every individual. After one year follow-up, I had a rather good picture of the temporal and know-how capability of each person and the team as a whole. Work for the next year was much easier to plan, negotiations with the superiors were easy and we gained the desired results on time for over 70% of all tasks that we had in the beginning of the year. It should be considered that the overall situation of all tasks in the beginning of the year was not 100% sure, but some tasks emerged as time went by. But why could we make such a good result? We were able to determine in advance the durations of the different types of tasks of different people. Deadlines of tasks were known, as well. It was possible to give suitable tasks for every expert in the beginning of the working period. Every expert was allowed to somewhat freely arrange his work on the temporal axis remembering deadlines and knowing his temporal capabilities. Everyone mastered his own temporal axis as freely as possible in the context of the agreed length of time. Finally, we gained for over 80% result of the completed tasks, and on time every year. I still think that it was rather good result."[14]

Very interesting reference to analyse the meaning of time comes from Igor Ansoff (1984a, 211 - 230), who has presented a four-view model of managing organisations. The crucial item in his model is the time that is available to reach required level of information to make relevant decisions and put them into practice. In other words, the model describes what is the relationship between the objective and subjective duration in the field of available information (refer to figure 26.). Further on, Ansoff describes possible strategies to respond the challenges of different decision-making situations. The main idea of this model is that the way to respond the challenges depends on the speed, how fast the new emerging issue reaches meaningfulness to the organisation. If it is assumed that the organisation's ability to respond is temporally equal in all situations (i.e. its subjective duration is constant), the way to manage the situation is different when considering the speed of necessary and relevant information will become available. If there is enough time (objective duration is shorter than subjective one), no problems will occur and action is smooth. This is the case that is described in the end-phase of the story above. If the temporal axis is in a way or another limited, two issues will emerge. Decisions are made either with the lack of full information, when they could be erroneous or decisions are made too slowly. The first case may lead to wrong action and the later one will inevitably lead to reactive mode to act. In the case description above, decisions were first made without proper information. All relevant information was not available. This led to improper action and partly even reactive way to act that caused unnecessary activity and lack of relevance in the output of certain tasks.

Ansoff claims that it is possible to accelerate the decision-making, planning and acting procedure by terminating unnecessary activities in planning processes, increasing resources, streamlining activities, etc. Ansoff claims that the outcome of an organisation can be improved by concentrating only to the necessary issues and items. This sounds reasonable but sort of peculiar, because what kind organisation can normally afford ineffective way to act? Ansoff recommends making plans in advance for temporally different situations. That sounds reasonable in business environment. But in military environment, where right timing is a necessity, temporal demands may be immense and resources may be just on the edge of their

[14] This story is based on the personal experiences of the researcher when serving as a chief of the research- and development division of the Finnish Army Signal School in 1996-1999.

ultimate limits Ansoff's advices are not always realistic, because all activities have already been streamlined to their ultimate. In time-critical situations, where the danger to slip to the reactive mode to act is continuously in close vicinity, new ways to streamline all activities will be most welcome.

What can be concluded from this on the basis of theoretical discussion and this short example? Managing temporal aspects is bound both to the temporality of action and the temporality of information. Knowledge about the spatial and temporal aspects of the entire system, where one entity is acting, is necessary. The following list will enlighten this. To be able to control ones activities in interacting system, the following items should be considered when information is used to achieve goals:

1. Knowledge of the interactive relationships of the whole system.
2. Sufficient number of tasks – too many will suffocate the actor.
3. Knowledge of the temporal lengths of different acts.
4. Long enough "mega-length" – an overall period of time (duration), during which all activities shall be done.
5. Suitable freedom to choose the moments to put decisions in practice.
6. Reserve of the subjective time.

Conclusively, the active entity shall be aware of two different classes of temporality. First, it shall be understood that the information has a time label. Information can originate from the past, the present and the future. The temporality of information shall be taken into account, when the availability of information from the subject's viewpoint is considered. The temporality of information determines the temporal origin of the incoming information, thus determining for its availability and the temporal value of that information for the action under interest. Second, when putting decisions and actions into practice, a suitable moment shall be chosen. This moment is restricted by the temporal nature of action. Every event has duration – they take a certain amount of time to complete. This second view of the temporality is derived from the subject's interaction with the objective world. This temporality is determined by subjective duration, objective duration and the moment, and it is strictly bound to the ongoing and the planned activities.

3.4 Conclusive combination of information, action and time

One attempt to depict the information-using process using Soft Systems Methodology as a structuring tool of a command and control process is presented in P1 and P2. The model presented in those papers has some shortcomings, which are discussed here. Finally a more adequate model will be completed.

In the model described in P1 and P2, There has been an attempt to include a too divergent collection of issues in one system description. This includes information flows, communicative acts, resource binding, problem solving, temporality and development of the process. Obviously a certain amount of fuzzyness will occur. Anyhow, the right phenomena are dealt with in this model, but the logic of this dealing is somewhat tottering because the divergence of the combination of phenomena contains activities, structures and information on different ontological levels. For details, see P1, figure 7, and P2, figure 1. For now, it seems that the attempt of making a system model of the information processes in the decision-making situations was not very successful couple years ago.

Let us collect all information about time, information and their teleological use, which have been documented in this research so far and make an attempt to put them together to formalise a systemic model of the information use in the planning and the decision-making situations. Figure 28 depicts this model. The viewpoint of this model is action. It is helpful when considering those phenomena of an entity's information processing which are present in the interaction between an entity and the objective world. The temporality and the quality of information is built into the entity. Compare to figure 27. Interestingly this structure resembles the one that Bergson (1911) has expressed about a temporally aware human being (see figure 24). Figure 16 gives an interesting viewpoint, as well.

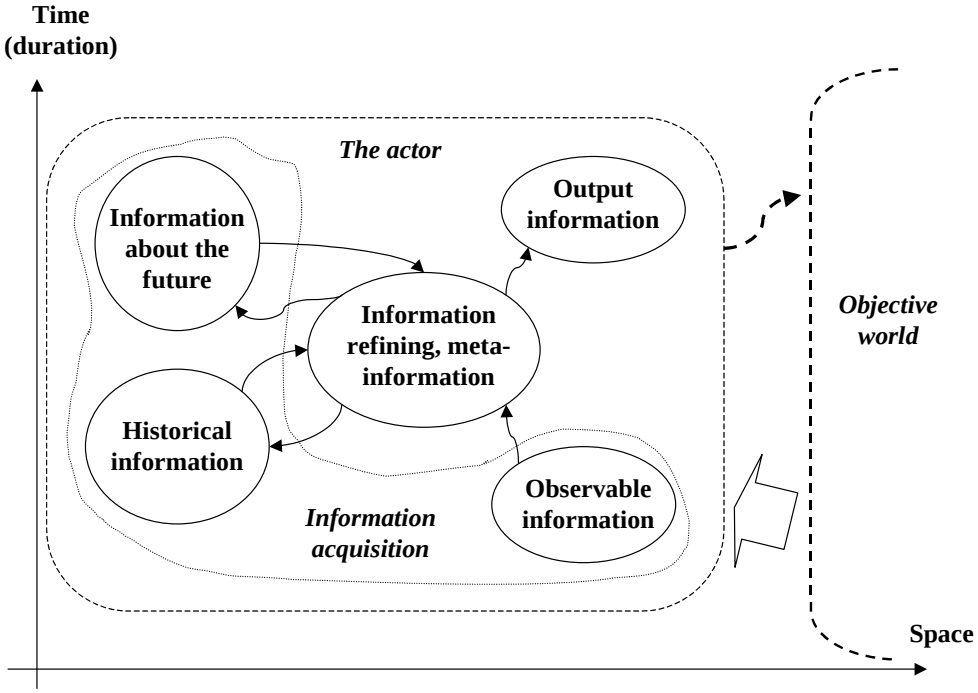


Figure 28. An abstraction about information process in a teleological action

A simplification of this model is in figure 29. There, the internal information processing depicting of the actor is reduced. The same expression is found from figures 2 and 3 of P2. In the next chapter, this construction will be introduced into the context of a social system and further on, in chapter 5, it is tested in real information environment.

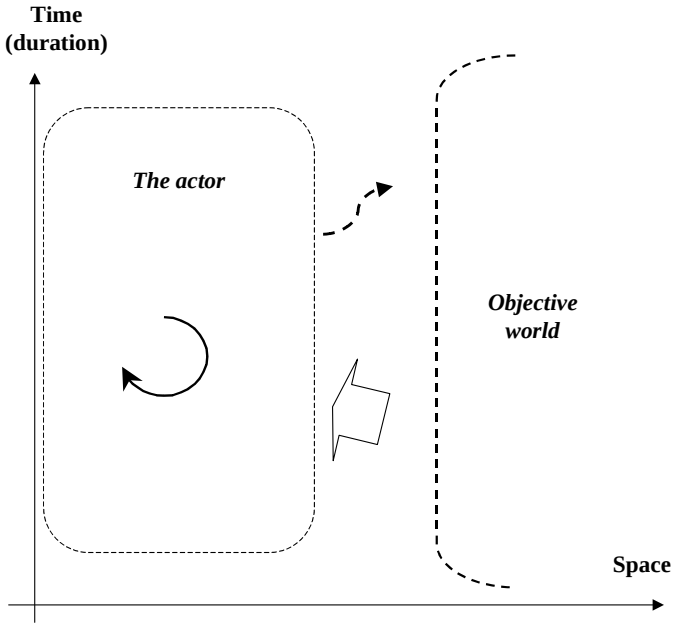


Figure 29. A simplified abstraction about information processing

4. INFORMATION AVAILABILITY AS A TELEOLOGICAL SYSTEM

4.1 Concepts of the lifeworld and the situation

In this chapter, the communicative theory of Jurgen Habermas (1984, 1989) is introduced to reach an understanding about those social situations where information is flowing. The concept of communication presumes that information transferred between those who communicate will reach the receiving party and be understood. If communication is bound on the purposeful action, the information shall be used to cause some effects as well. The communicative act produces information for the other processes. The communicative act is discussed in the context of the concepts of the objective, the subjective, the social and the lifeworld. Those concepts are dealt with from the viewpoint of information. This helps to increase the understanding about the wholeness of the environments, where the information is made available. Habermas' theory will enlighten this problem by connecting certain structural phenomena, action and information together to describe a social system. This system approach will be the basis for making a construction to understand the aspects of the information availability in the planning and decision-making situations.

From the viewpoint of information, the subjective world is a knowledge-based construction of one nominated entity. The objective world contains the potential of all information. (See P2, P4) The social world contains those mutual norms and rules that will direct interaction amongst each other. According to Habermas, the lifeworld is a structure of knowledge against which the interpretation of the communicated information is completed. It consists of a culturally transmitted and linguistically organised stock of interpretative patterns. (Habermas 1989, 124)

The lifeworld is situated in the background of an interacting entity. It is the knowledge-based frame of cultural assumptions and individual experiences, valuations, and know-how, which are unquestionable in the beginning of a problem situation. The lifeworld is assumed to be the "fixing point" of an interactive event. It is the knowledge-based forum where the communicative parties can meet to communicate to meet the requirements of the mutually understandable real world consisting of subjective, objective and social sub-worlds. (Habermas 1989, 126) Action is interpreted against that. Maurice Merleau-Ponty (1968) writes about fields through which the observations of the outer world are interpreted. This makes the perception process somewhat personal and dependent on the individuals' mental filters, which are formed through out life. Those mental filters look very much like the concept of the lifeworld, but they deal with the incoming information of one individual only. The concept of the lifeworld will take into account all information flows, whether they are coming in or going out of the subject. It takes into account the social environment, as well. In that sense, the "forum of communication" situates in the lifeworld. Communication forums are described in P5. von Krogh, et al (2000) describe this kind of structure in knowledge creating companies, as well. From the perspective of the participants of an interactive action, "the lifeworld will appear as a horizon forming context of processes of reaching understanding." (Habermas 1989, 135) The lifeworld is the overall subjective frame of knowledge, against which the interpretation of incoming and the filtering of outgoing information is completed.

The lifeworld can be considered as a structure of mutual knowledge. The concept of lifeworld can be considered as a helpful tool when discussing situations where purposeful actions will occur. It is a “static” frame against which the consideration of the events may be constructed. It can be considered that all information transferring activities will take place via the lifeworld. Information transferred in communication will have an effect on the whole of the system. Figure 30 enlightens the relationship of sub-worlds described earlier.

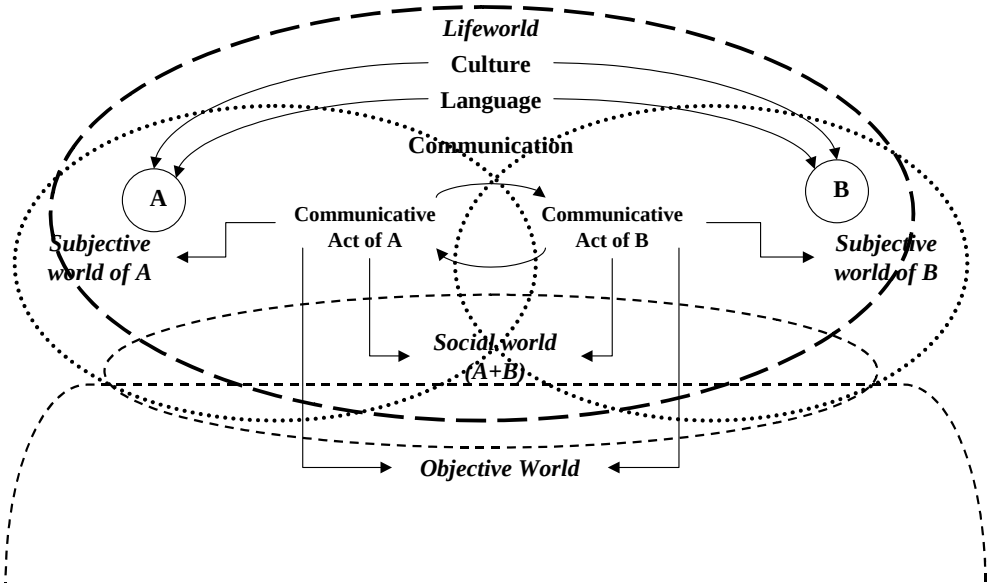


Figure 30. Sub-world relationships in communicative acts (Habermas 1989, 127, figure 20)

“A situation is a segment of the lifeworld contexts of relevance.” (See figure 31.) A situation represents a part of the lifeworld delimited by the interests and the aims of at least one participant. The concept of situation assumes that someone of the interacting entities has aims that can be realised as relevant via the interpretation of the situation. The situation is expressed through the goals and the plans of the action in a context of something understandably relevant. This context is determined and ordered concentrically and thus the longer the spatial-temporal or social distance is, the more difficult the situations are to understand. (Habermas 1989, 122 - 127) The problem about the tolerance of the duration of lacking the contact mentioned on page 61 will get verification on the basis of this theory. If the delay is too long, the information more or less loses its relevance. This increasing lack of relevance is situation-dependent.

The lifeworld is a structure of knowledge via which the information potential of the world is outlined. The situation is a structure of knowledge, which has potential effect on the world. It contains the interpretations of the relevant information and goals, as well as the plans that express the will to put something into practice. The lifeworld confines the possibilities to use the information potential that is present spatially-temporally in the subjective and objective worlds. The situation confines the use of this information in the system of subjective worlds, objective world and social world. When referring those concepts to thoughts about the temporality, it can be argued that the temporality of information is related to the lifeworld and the temporality of action is related to the situation. The basics of making information

reachable lay on the lifeworld, and the availability of that information depends on the situation.

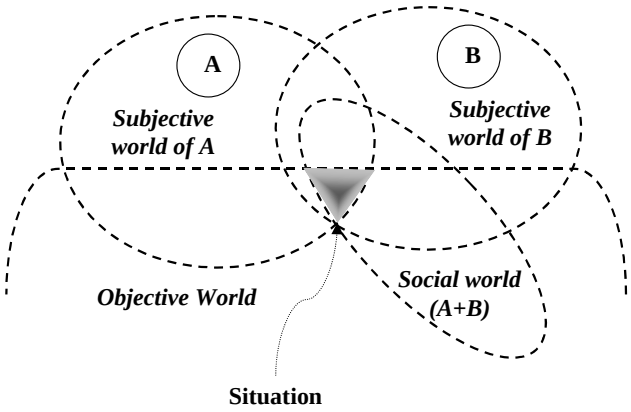


Figure 31. The concept of situation

Some consequences can be found on the basis of the concepts of the lifeworld and situation. The lifeworld confines the limits of the availability of information. It sets boundaries within which the understanding and the use of information can be realised. The meaning of the situation depends on the viewpoint. From the viewpoint of the actor who sets the goals, the situation limits the availability of both incoming and outgoing information. Goal setting and planning are realised by only the information that is available. A teleologically acting entity produces information through a mutual lifeworld to the outer world, which contains the objective, other subjective and the social sub-worlds. The availability of this information is bound again on both the mutual lifeworld and the receiving parties subjective worlds.

It seems rather obvious that a part of the potentially available information is missed during the process mentioned above. The farer away the mutual basis is from one subject to another, the more the availability of information decreases. It could be concluded that if situations concern something that is not relevant to the subject, the information about them is hard to understand. To gain mutual understanding, a lot of information shall be transferred. If incoming information is at the level of data and mutual interpretation constructions differ a lot from each other, the orientation for the situation will be most difficult and it takes a great deal of subjective duration. If an actor does not understand the incoming information, the results are poor. The concept of availability says that to be available, the information shall be useful in the context more or less immediately. If the situation mentioned above occurs, the information is not available. This has interesting consequences. To be able to cooperate in a multicultural, multi-competent or multilingual environment, a great deal of pre-work shall be done before the situations can be understood in a mutually equal way.

4.2 Systemic approach to social environments

Figure 32 describes a systemic approach to the action. It describes what kind of information exists and flows in the divergence of activities framed by certain structures situated in space and time. Information concerning values will determine a

general structural subsystem called culture. The function of culture is to maintain certain patterns of activity. Those patterns consist of cognitive interpretation schemes, symbolic expressions and value standards, like standards of solving moral-practical and cognitive-instrumental problems, as well as appreciations. Cultural orientations are both normative and motivational, the first containing cognitive, appreciative and moral and the latter cognitive, mental-emotional and evaluative appreciations. (Habermas 1989, 216 – 219, referring to Parsons 1951.) Information about values forms the long-lasting basis of information creation. Information about values changes rather slowly and it is more or less dependent on the culture under concern (Bell 1998, Hofstede 1984, Schneider and Barsoux 1997).

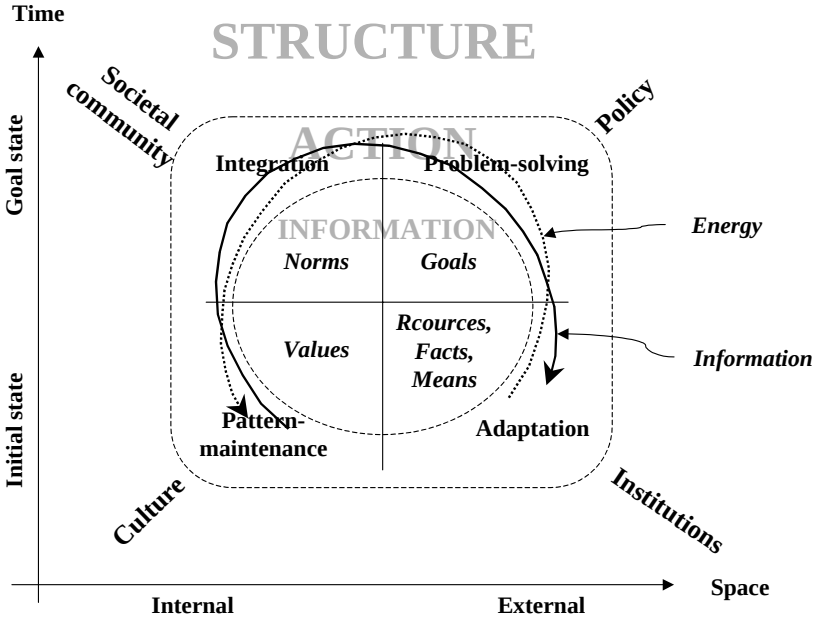


Figure 32. A systemic approach to social environments

Norms determine mutually expected rules, among which the subjects of community will perform their interactions. Norms entitle the members of the community to expect certain acts from each other in certain situations. That obligates members of this community to meet the legitimate expectations of others. Norms build up a system of controls and orient the actors' activities to fulfil normative validity claims. The acceptance of norms will lead to full integration and further more pattern modification. (Habermas 1989, 32 – 42) Understanding norms without acceptance will lead to various ways of action from seemingly complete integration of the norm-setting community to total ignorance of norms and drifting outside that community. The latter will take place if norms are not understood, as well. There, the dilemma of the subjective and objective world will be seen. The adaptation to the community will depend on the value-based judgement of the acceptance of those norms that are set by the community.

Goals determine the desired end-state of action. Goals direct resources and means as effectively as possible to gain success. Goals will provide information about politics, about choices made by the top management of one subject. This subject can be e.g. a state, an organisation, a team, or even an individual. Finally, the means and resources are used to put such action into practice, which will lead the actor to fulfil its goals as optimally as possible. The user of those resources is here called an "institution".

Originally in Habermas' theory this structure is economy. Anyhow, it could be thought that depending on the viewpoint, this resource-based structure may be something else, as well. E.g. from the viewpoint of defence at national level, this institution can be e.g. the defence forces. From the viewpoint of an enterprise, the institution can be e.g. the marketing, the production, or the research and development.

The circular arrow in figure 32, which is named "information", describes the direction of information coming into the information refining process. It shows that the values have effects on the norms, which both have effects on the goals and their attainment, and further more all those have effects on the using of resources and means. Vice versa, the arrow called "energy" describes those activities that are taking place in using the resources to change the values. (Habermas 1989, 235 – 250) An actor has a certain variety of resources, means and facts to put into practice to achieve attained goals. Further more, goals will have an effect on what kind of norms shall be completed to be able to act seamlessly together. After a certain length of time those norms will have an effect on the basic behaviour of those individuals who are acting together. Norms are refined as values during time, and the structure called culture is formed.

Structural phenomena of this systemic approach contain culture, community, policy and institutions. Information flows and activity described above will take place in these structures, which are subsystems of the whole social system. The cultural systems are more solid than the societal ones, which are again more solid than the political ones. This ontology may be applied to the organisational environment, as well. The organisational culture will remain at least partly in spite of the organisational changes, both ontological and normative. Policy, which determines goals, will change among the demands of the surrounding environment and information offered by norms. Finally, the using of resources and means will be mostly dependent on the goal setting and the demands of adapting to the objective world.

During time the system depicted in figure 32 attempts to reach the goal state that contains a normatively conforming community, which is setting the mutually accepted goals in the policy process. This state will be constructed on the cultural structures manifested by communicating the values, and on the use of the available resources. The system shall be able to maintain itself both internally and externally. Information about values and norms will determine the interaction against the system itself. The system, whether it is e.g. an organisation or a society, contains information about the values and the norms. This information will guide the goal forming and the use of resources. Information about the goals and the resources will guide the social system to perform suitable interaction with the outer world. (Habermas 1989, 234 – 245)

According to this thinking, a continuous process of the evolution of values and reconstruction of the norms is present in the system itself. Energy flows into the system as perceived facts, which will affect goal forming. Further more, goals have effects on the process of determining norms. Finally, when the norms are widely accepted, they will be refined as values. In every phase, a remarkable amount of abstraction will occur. A huge amount of detailed information is lost during every

phase, where abstraction increases. A mutual interaction with the objective world is performed by policy and institutional structures. In the organisational environment this means the manifestation of the will of the top management, and the optimal use of the organisational resources like information, time, material, personnel and money. Interaction takes place through the communicative process, where information about various items is changed between the subjective actors using the mutually understood codes. The whole interacting process is a series of situations where the mutual adaptation of interacting actors takes place.

Information has temporal value and activity will be put into practice at a suitable moment, taking into account both the subjective and the objective duration. The subjective duration will be determined by the capability of the information availability and refining, as well as the resource directing capabilities of the subject itself. The objective duration is determined by those parameters, too, but outside the subject itself.

This has interesting consequences in the military context e.g. from the viewpoint of information superiority (e.g. Waltz 1998, Joint Pub 3-13, 1998). The one, who gets more information from wider area and has the capability to refine that information quicker into available form for those who direct resources, will be superior. Information superiority is thus a means of putting action into practice not too early but before anyone else who is acting in the same context. Information superiority is also a means to choose whether to put action into practice or not. The basic thinking about the ontology of reaching information superiority is described in P4. The more long-lasting effects are desired, the higher in ontology shall operations take place. If very long effects are desired, then the theories about war and information shall be affected. If only short-term effects are desired, then various means of tactical actions described in field manuals shall be completed. On the other hand, to change the whole theory about war or information is a very long process and requires lots of energy in the form of the research and communication resources. It is costly.

4.3 Conclusive thoughts

Three kinds of classification of information can be found on the basis of the hermeneutical process. All these categories shall be considered when discussing information availability. Those categories are here called:

1. The refining category
2. The temporal category
3. The relevant content category

Refining category consists of data, information and knowledge. It determines the way the information is understood in the system that uses it. The refining process aims to change the incoming data into knowledge during time. Refining process takes time - it has duration. This duration is subjective and tells how long it will take until present incoming information has reached such level that it is useful for exploitation. Information is gathered, used and delivered as data, information and knowledge. Information is available only if it can be obtained in form it is needed. For a rocket engineer, how to use liquid hydrogen as an oxidiser of a rocket engine is knowledge, and thus available immediately for use. For a schoolchild this is supposedly data and takes several years to refine it to the available knowledge for rocketing. (Supposing that he/she will become a rocket engineer…) The more

complex and time-critical the situation is, the more there should be available knowledge (e.g. Friman 2001, Saariluoma et al 1998).

The temporal category tells where on temporal axis the information is coming into refining process will be situated. Information is temporally situated in pasts, in the present or in futures.[15] Information about pasts contains the suitable abstractions of remembered or documented histories. This information is used to fulfil those demands that are set by the ongoing or the foreseeable situation. The situation determines which past of all pasts will be remembered. Information about the futures contains assumptions about the development of the system - the continuum of the foreseeable situations - that the subject is involved in. It contains information about the desired futures (e.g. goals), as well. Information about the future contains fictive images based on the historical memories about where the subject is heading and how (Bergson 1911). Information about the present is the continuous information flow that is coming from both the state of the subject itself and observations about the outer world. This information is interpreted through the historically determined mental filter of the subject. This mental filter consists of the information about the history of the subject and its futures' assumptions. (Merleau-Ponty 1968, Damasio 2000) Incoming information is perceived through this filter. All information is not available. Only those items that can be perceived may be available.

Heidegger (2000) states that in human thinking no time labels are set on events that took place in pasts or will take place in futures. Pasts and futures are formed on the basis of the meaningful events. This same thought is found in McTaggart (1908) who states that the moments and the events are unique and situation-bound. The experience of the temporality of the divergence of events will be dim in pasts and futures. This can be expressed so that the origin of long refined information (which supposedly is in that case knowledge) cannot necessarily be found on the temporal axis. Neither can be the duration and the process of its refinement determined exactly. The longer the refining process is, the less the information changes during a short period. It could be said that e.g. information about values will change very slowly. This can be justified on the basis of affecting information flow called "energy" in Habermas's theory of the social system. As can be remembered, a lot of lower-level information will be abstracted at every change of system level. This same structure is found in the thinking of Maier (2002) who states that information can be transferred between entities only as data. Anyway, this "static", highly abstracted information will be available despite it is not being updated very often. It will be valid over long periods of time.

The relevant content category contains the information about values, norms, goals, as well as resources and means. According to Habermas (1984, 1989) these classes of information will determine the action of a social system. Information about these classes is exchanged during the interactive process. This information has both

[15] Pasts and futures are here expressed as plural. A subject has ever changing past. It communicates one past at one time to one other subject. When the situation of this subject changes, it communicates a different past. This leads to a situation where one subject has several differently expressed and remembered pasts among its counterparts. Every other subject will have a different image about the past of the first mentioned subject. One subject can have several futures assumptions and alternatives, which it communicates to the outer world with a process similar to the communication of pasts. One subject seems to have several pasts and futures. This personal story of one subject is seen divergently from the different viewpoints. This story evolves during time, as well.

temporal and refinement aspects, which make information about relevant content available for use.

Action is the combination of the teleological consequences of the available output information and the use of other (tangible or intangible) resources. With action the entity interacts with the outer world, giving energy there. To the outer world this action manifests itself as a part of the potential of available information. Using this information the outer world will adapt its behaviour to fit those challenges that the subject gives. Both the subject and the outer world will change during this continuous interaction, flowing from one situation to another.

Figure 34 depicts the overall system that contains the information flows causing the action on the structure. This represents the renewed systemic description of the first suggestion about the information node described in figure 7 in P1. Seemingly, some development during research process has occurred. This, renewed construction thus contains those structures, action and information flows which every one of the nodes of the case organisation presented in figure 5 in P1 keeps inside. As a quick reminder the figure of a case organisation is included here as figure 33. There the network and its actors including communication relations are described. Acting in a powerful vision field and guided by a clear mission, the organization plans and carries out its operations via strategic, tactical and operational planning. The thick arrows represent communication concerning orders instructions and observations. The thin arrows represent cooperation relations and the dotted ones spontaneous, social communication. Information flow from outer the world to the actors has been left out deliberately.

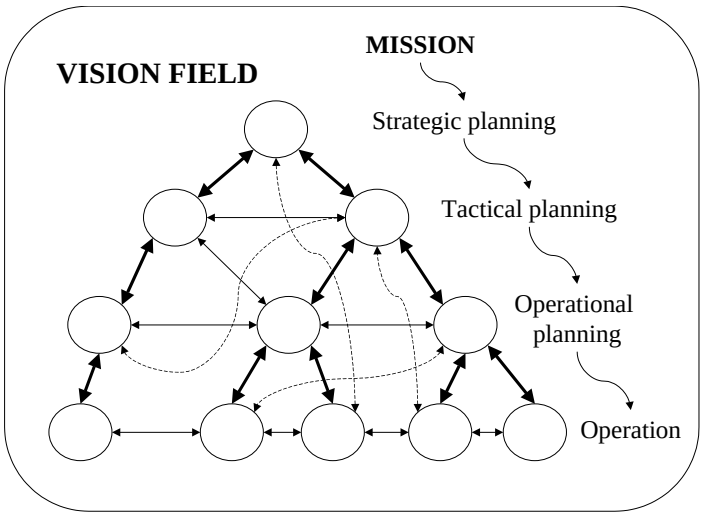


Figure 33. A case organisation presented in a straightforward way

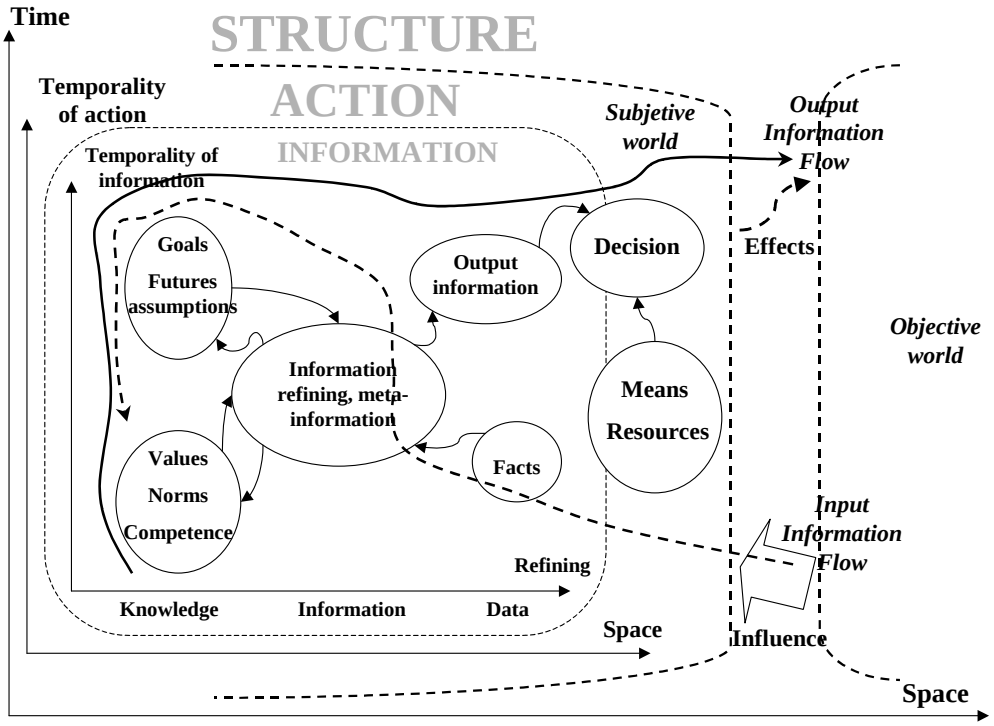


Figure 34. The systemic expression of information use

The system depicted in figure 34 is a comprehensive construction, where some main items are combined together to form a tool to aid thinking, when analysing the availability of information and information flowing in decision-making systems. Those main items are:

1. Information categorisation (data, information, knowledge) and the features of different information.
2. The in-human abstraction about information creation and use.
3. Information refining (intra- and inter-entity information flow, decision-making models)
4. Temporality of information and action.
5. The theory of social systems containing structure, action and information.
6. System thinking.

In the next the tool construction is explained in details.

Information categories containing the refining, temporal and relevant content are included in the systemic expression, as well. The overall presentation performs all information flows into the subject, inside the subject and out from the subject in a situation. When dealing with the availability of information, all these phases should be considered. Figure 34 shows how information use is constructed in a situation from the viewpoint of a subject. This figure depicts one actor, its action and information usage in a teleological act. Goals, norms and values are situated in the knowledge category. When referring to the thoughts of Maier (2002), knowledge directs attention to the gathering of information, as well as giving purpose for activities. The very same idea is found in the analysis of different problem solving and decision-making models presented in section 3.2.2. A rather powerful

verification for this thinking is caught from Henri Bergson (1911), who stated that a human being forms the future assumptions via that knowledge that already exists.

Future assumptions and expectations cannot be created from non-existent information. (See P3 and P4.) Making information about the future is widely dealt with in literature concerning futures studies (Bell 1997 and 1998, Kamppinen, et.al 2002, Kuusi 1999, Masini 1994, Rescher 1998, Sneck 2002, Sotarauta 1996, Vapaavuori and von Bruun 2003). According to this literature, the basic flow of making more sophisticated assumptions about the futures follows the following idea: Knowing the features, constructing the patterns, finding the possible futures, finding the plausible futures and finding the desired futures. According to Bell (1997, 1998) futures studies is based on the rationality of values. This means that judgments about the future information are completed via the whole knowledge base that exists in an entity. Future information is formed on the basis of the remembered and accepted knowledge. This is in accordance with what has been presented by Henri Bergson (1911).

When the concept of human capital (see P3) is connected to this, it could be stated that the human capital is actually an abstraction, which contains goals, norms and values on the individual level. Anyhow, it does not take time into account. It does not contain organisational aspects of information. Instead, the concept of competence is added to the knowledge of the present day and history.

Competence can be considered as a skill-based storage of knowledge, against which professional judgements are made. Values, on the other hand, are information, against which the emotion-based assumptions about the desired way of action are completed. Norms are between those two, describing the mutually accepted formulas to act in a particular community. Goals are information about a desired future. Goals determine the direction of decisions for gaining a better future for this information using entity. Facts are the incoming present day information about the situation of the mutual lifeworld. Facts act as a trigger to use all that information described above to produce output information to make decisions and to put in practice. Putting the decisions into practice binds the usable resources to the decision causing the action to change the objective world.

Let us delve into the system from the viewpoint of information flow. Two main flows of information will occur. The input information flow triggers the internal planning process, which eventually leads to making choices and binding up resources to put action into practice. Input data shows itself as facts. These are connected to the entities' internal information via reflecting this information on those future assumptions, which are finally shown as the mutually desired and plausible goals. The output flow determines the forms of showing the activity of an entity. It has its origin in the competence, values and norms, and it will finally produce the activity that is determined by the goals. As it has been stated before, the refining process will take place inside the subject itself. This process seeks the understanding on the basis of competence, norms and values. On the other hand, the information refining process containing the goal determination and the resource orienting seeks success, or at least the adaptation to the outer world. This process is future-oriented but past-bound. Incoming information is connected to internal, existing information to create new knowledge. This process is completed via reflecting all combined information to

internal future assumptions. In a teleological functioning entity, e.g. in an organisation, these assumptions manifest themselves via goals.

5 APPLICATIONS

5. 1 Validating conceptual construct

In the next chapter, few cases are presented to validate - each as its part – the conceptual construction that was conducted on the basis of the hermeneutical process in the chapter 3 and completed in chapter 4. The wholeness of the overall problem of information availability analysis is bound on the construction depicted in figure 34. The idea is first to test the functionality of that construction, and after that adjust the model to better fit the problem area. Finally, the model is validated more comprehensively by testing it with decision-making models presented in chapter 3.2.2, as well as some other thinking.

The discourse is started from the initial state of the internal information of the decision-making system. This is dealt with the case concerning the security culture forming process. This is described in P6 and P7. After that, the consideration is broadened to deal with the necessity of the information refining process to gain mutually accepted goals. This is approached by pondering one possible way to create new kind of long-term information to develop the ability of defence. The results are published in P8. After that, one example to produce situation-dependent facts for temporally demanding decision-making is performed. The phenomena concerning the production of electronic intelligence information is dealt with. This phase is broadened to consist of the work of the situational information gathering, combining and distributing section of the combined arms headquarters. The process is published in P9 and P10. This part deals with one of the intermediate output information of the information exploitation process. Finally all this is concluded by examining the decision-making process of the combined arms headquarters.

Those five different cases act as examples of the broad spectrum of information that is required for decision-making both temporally and content. Cases are considered from the organisations viewpoint. Organisation is considered as a whole that includes information functions described in following cases. Figure 35 depicts the idea.

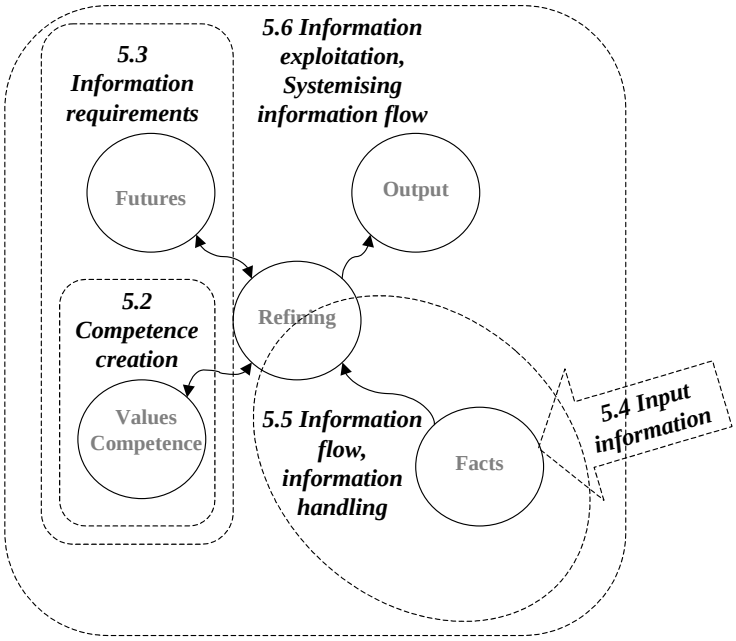


Figure 35. Positioning the cases into the tool depicted in figure 34

Chapter 5.2 describes one example of the basic competence that is essential to act purposefully in decision-making situations in nominated organisations. The case dealing with forming information security culture demonstrates that constructing the required competence is a long process. The closer the basic assumptions of people involved about the way to perform tasks are the easier it is to create adequate competence. To be able to deal with information to make acceptable judgements in an organisation requires suitably formed mental and power filters (Ansoff 1984b). Those filters will form during training and working in certain cultural environment.

Chapter 5.3 describes a situation, where information is required to launch long-term planning. This case describes those problems that may be faced, if cultural phenomena differ from one part of an organisation to another. This case manifests the need to understand the meaning of the power filter described by Igor Ansoff (1984b). This case demonstrates that information will not be available, if it is not understood and accepted. Those two cases mentioned above demonstrate the knowledge dimension of overall information. They demonstrate that there shall be mutual understanding about futures assumptions and goals, as well as adequate competence and mutual acceptance and understanding concerning values and norms before teleological act can take place.

Chapter 5.4 shows one example of the incoming information flow. This information flow is analysed from two viewpoints. It shall be noticed that this case describes only one incoming data flow. There are many others, as well. Chapter 5.5 describes one example of processing information as a part of the entire decision-making process. The case shows that information flows are not very strict and simple by nature, not even in military environment. The case shows that information is gathered, refined and distributed rather divergently even in rather straightforward situations.

Finally chapter 5.6 wraps all these cases together and shows one example of decision-making information categorisation. A combined arms decision-making and planning process is approached in two ways. First, it will be used as an overall frame to demonstrate one example of exploiting information is decision-making. Second – and in more exiting way – the process is analysed to separate information from the structure and action to streamline information processes instead of action processes. This analysis is used to demonstrate the power of the information process analysing tool constructed in chapter 4.

5.2 Information security culture – an example of forming a long-term knowledge-basis

The objective of this case is to bring in visibility the necessity that the judgements, and further on mutually beneficial decisions may be very difficult to complete without such long-term knowledge-basis, which will form a solid background for understanding the situation and its bindings to entirety. This item is approached by discussion about the forming a united security culture. This application is dealt with in papers P6 and P7.

Von Solms (2000) categorises information security into technical, managerial and institutionalisation waves. The technical wave addresses information security by using the facilities of computer systems. The management wave contains preparation of information security policies, procedures and methods as well as the nomination of the information security manager and staff. The institutionalisation wave covers standardization, certification, measurement and concern of the human aspect to information security. The aim of the institutionalisation wave is to build an information security culture in such a way that information security becomes a natural aspect of the daily activities of all employees of the organization. (See P6 for more accurate details.)

Organisational security culture is most obviously a part of organisational culture (e.g. Schein 1992), which concerns both internal and external security aspects of an organisation. The development process of a security culture can be seen to be equal to any culture forming process. When referring to Habermas' theory, forming a structure called culture will require a lot of energy. If it is thought that energy will be transferred via information, subsequently a great amount of information will be delivered. Therefore, some amount of time is required to perform changes in cultural structures.

Security culture is approached in the spirit of Dhillon (1997) and Schlienger and Teufel (2000), who emphasize the need for paradigm shift from a technical approach towards a socio-cultural aspect. The corporate culture determines how the nature of reality is seen in the organisation. According to Habermas' theory, culture is the structure that will act as a platform from which the information about the basic nature of the organisation will arise. (See figure 32.) On the other hand, culture will be the ultimate structural frame of the memory of the organisation, where all that information, which is considered the most valuable and preferable, is stored during the entire life on the organisation. So, culture is a structure where the information with the far most reaching effects, i.e. values of the organisation will be stored. When referring to figure 32, it could be seen that the energy to form the cultural structure will come via norms. Norms determine those rules that will be followed

inside the organisation to be able to work together as smoothly as possible. Norms and values are the internal information of an organisation, but they will be shown outside by performing actions aiming for goals that the organisation has. This means that the values of the organisation will be communicated to the surroundings through its activities. It is rather obvious that if a divergence of ambiguity of the basic assumptions of an organisation will occur, its activity will be seen as inconsistent. It is rather easy to imagine, what will happen to an organisation that gives an obscure image about its activities on the security front. It shall be stated that a unified image regarding security aspects must be communicated towards customers and other organisations that interact with the organisation. Otherwise the organisation will not be very credible. Especially if it acts in such business where security is essential. (See P7 for more information.)

The case study was completed in November 2003 at Tekla Corporation. The company in this case study has some 420 employees of which one fifth works in subsidiaries in Europe, America and Asia. The company has one business area developing military technology, thus having strict demands of security. This unit is situated in Finland and all of its employees are Finnish citizens. In that sense it is special for the whole corporation. The customer (the Finnish Defence Forces) has set strict norms for security demands and supervises the adherence to those norms, as well. The security policy has been revised and refined over the years and many of those people who were involved in forming the original security culture of the unit some ten years ago are still employed there. The case study was based on interviews and personal experience[16] gained under a period of four years. The personal values of the interviewer have been set aside while critically observing how the co-workers interact and behave.

The main findings were as follows. The value bases of the customer, the company and the employees were rather unified. Security demands came basically from outside the company. The customer had dictated certain norms that determined somewhat strictly how security aspects must be dealt with. Security policy was defined by combining two essential items: The demands of customer-determined norms, and the company resources, which were usable to perform relevant and desired security activities. Norms and values were communicated in a continuous process inside the unit. Habermas' theory stresses that a society will orient to plausible future via mutually accepted norms and will perform activities determined by goals (compare to figures 32 and 34). The basis for this process is in values and those resources that are available. According to this case, it seems that Habermas' theory of communicative act can be used to evaluate the process of forming a security culture. Another finding was that when forming a unified security culture at least the following things should be taken into account:

1. The quantity of the group that determines the possibility for continuous communication.
2. The unified set of values of the group members in the beginning of the culture creation process.
3. The normative environment inside the group, as well as the influence of outside demands.

[16] Kaj Nyberg, who is employed in the company, collected the empirical data. This is expressed in P7, as well.

4. Goals, which are set to perform plausible activity. In this case this is the foreseen end-state of the wholeness of the security.
5. Resources and means, which are available for the performance of plausible security enhancing activities.

It is interesting to refer this finding to the paper of von Solms (2000), who states that information security has three waves. Those are technical, management and institutionalisation waves. The technical wave is performed by directing suitable (generally technical) resources to gain enhanced security. It is rather easy to perform and usually results are immediate. The management wave contains policy-processes, norm forming, and both technical and other resource directing activities. It is rather comprehensive and takes much more time to perform than actions taken in the technical wave. The institutionalisation wave contains structures, activities and information both technical and management waves as well as value-forming processes to perform long-term effects to enhance security holistically. The institutionalisation wave takes the utmost longest duration to complete, because it needs a comprehensive process of forming new kind of cultural patterns.

Culture is a structure that exists to maintain patterns by value information. When again referring to figure 32, the way to information called values goes through norms. A lot of energy will be required to cause changes in such abstract information like values. This means a long period of continuous communication and performing norms. Norms are information that determines the mutually understood code to collaborate successfully. To change values, the norms must be accepted and internalised first. Information about norms shall be available before values can be changed.

The third point is that time shall be taken into account. Unified structures in complex environments will not arise suddenly. They need a certain amount of time to manifest themselves. Developing a culture will cause more or less changes to personally understood values. (See P5 and P6 alongside P7) The aim of forming a culture is to gain a structure on which a solid base for all activities can be built. For this structure to be unified, values of all interacting entities should be as close to each other as possible. The more divergent they are, the longer it will take to unify them. In the studied case, the value base was rather unified in all three parties, the individual workers, the company and the customer, thus making it somewhat easy to gain a unified security culture. In the case described in P7, this unity has been gained more quickly than in ten years. If it is taken into account that no security clashes has taken place in the case organisation, it could be stated that if strong security culture exists, a new member with a nearly unique value base compared to that of the organisation will adapt to the organisation’s culture very quickly. It can therefore be stated that if the value base is unified, a unified culture can be formed in few years. This culture can be maintained if motives and values of new members of the organisation are cleared and communicated in the recruiting process or at least in the very beginning of their career.

The time-divergent communication model described in P5, P6 and P7 is provided as a concept to understand the meaning of time when discussing the effects of information. The availability of information will most frequently be delayed. Availability requires that information is accessible and obtainable for immediate use

to have a beneficial effect. As it has been stated, before being available, the information shall be accepted and understood. Therefore, the deeper in the long-term memory of an actor the information will be situated, the longer will the duration of the change be. This means that changing values is a long-term project. Forming a unified value basis requires a lot of time. This task will be very difficult if the value basis between different actors of the whole social system differs a lot.

On the basis of this application, two overall conclusions concerning availability can be formulated. First, information availability is bound on lifeworld and situations. In spite of a huge amount of potential information, only those parts of it that concern the actor in certain situation in the context of lifeworld will be available. Second, information availability is bound to time in two ways. Action will provide a divergence of information to the common information potential. This will take place when some actor is active. This is naturally time-bound. When thinking about availability on the basis of figure 34, to perform a beneficial effect, information will become available after it has been refined in the complete process of planning of activity. Incoming information combined with existing information, will cause activities that can be judged to be beneficial for the actor itself. So, the overall duration, after which the whole of information that shall be used to cause "immediate beneficial action", e.g. being available, will exist. Information availability has a delay between the object and the subject. This is well seen in the security culture forming case. Information that concerns desired activity in relation to unified cultural behaviour, will be made available from the objects viewpoint for a long time, but from the subject's viewpoint it becomes available when it will cause actions.

Competence creation is a longish procedure. Adequate expert information is not available before competence has been created. This seems to take years. This has interesting consequences when thinking about military information operations, as well. Perception management information (which is meant to affect peoples thinking) does not appear to be available to the target society if it has totally different goals than the source society. Because the energy that is causing the change goes through goals, it will be most difficult to affect it, if the target society's aims are not known rather deeply. This could be an explanation for the phenomenon described by Hutchinson (2003). He states that in modern western military thinking, when performing information operations (see P4), the short-term psychological effects are performed rather successfully, but long-term effects are not. Cultural aspects are not necessarily taken account sufficiently when starting such processes where information about values is under deep interest.

5.3 Long-term information creation process for defense purposes

The meaning of this case is to bring into discussion the necessity of being able to choose the right methods to reinforce the incoming information to the final or intermediate output information. In addition, competence creation is essential to make relevant futures' assumptions to support decision-making.

The case, the partial conclusions of which are documented in P8, concerns technical research of the Finnish Defence Forces (FDF). The viewpoint is to look at the whole process from the perspective of the Finnish Defence Forces Technical Research Centre, whose task is to make the relevant information available for those decision-

makers who will make decisions about material purchasing for future defence purposes. A survey preceded the publishing of P8. The survey was launched in October 2001 and it was directed to key customers of the department of the Electronics and Information Technology of the Finnish Defence Forces Technical Research Centre. The main result of studying this case in 2001-02 is depicted in figure 36. This figure can be found in P8, as well.

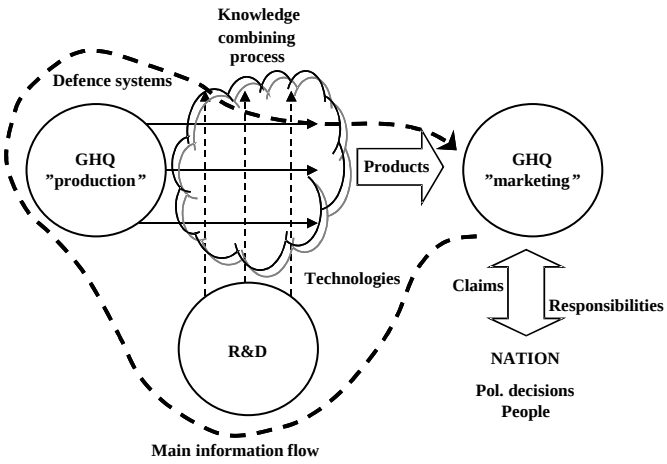


Figure 36. Solving the information availability problem when purchasing defence products

That figure gives a theory bound solution to those problems that were faced. The proposed solution was a "knowledge combining process", and some propositions to perform this process were made. The theory that was used here, was Nonaka's and Takeutchi's SECI-process, which was introduced earlier in this thesis. Some activities to improve information availability to decision-makers were performed before the research described here, but their effects seemed to remain rather modest. In this content, an analysis about the possible reasons for difficulties in information availability is made. But first, an introduction and results of the survey mentioned before will be completed.

The survey was completed for the purpose of developing customer relationships between those organisational parts of the FDF that needed information about information technology to launch material acquisition, and the Electronics and Information Technology Department of the Finnish Defence Forces Technical Research Centre. This department had operated for three years when survey was made. The survey was directed at seven representatives of main customer organisations in the FDF. The answers for the three main questions were sorted out with seven questions and free comments. All questions are included at the end of this chapter. The three main questions were:

1. Has the produced information been relevant and reached the customer? (In other words, has the produced information been available for the customer?)
2. Has the customer experienced to have influence to direct the research to the desired direction?
3. Has the organizing of the research been subsequent from the customers' point of view?

The overall analysis of the answers pointed out a few interesting viewpoints. This analysis is kept on a suitably brief level to be able to point out three interesting points

concerning availability in content, temporality and normatively. First, it was found, that customers experienced that the relevance and benefit of research results were rather good (an average of 3,7 on a scale of 1 to 5). On the other hand, nobody gave any comments about how the produced information has helped those representatives of customers in their work. This was a rather interesting finding. Some kind of dilemma seemed to appear between the numerical judgement and the absence of free word comments. Second, those customers who had been cooperating with the department from the beginning (three years) saw that the department was developing in the right direction (average grade 4). Those representatives of customers who had shorter experience of cooperation (one or two years) saw that the development of the department was not so optimal (average grade 2,8). The third interesting feature was that the organisation of research was experienced in a very dispersed way among new representatives of customers (average grade 2,3 with the average distribution of 1,5). On the other hand, old representatives felt that the organisation of the research projects was completed very well (grade 4,5).

In this kind of situation where something rather new is built up in the area of information products, the duration of gaining mutual understanding about the features of the product between the customer and producer will be at least two or three years. It seems that this duration is required to gain understanding about mutually accepted future. According to Habermas' theory, this future of the social systems contains information about norms and goals. So, in this case some three years was required to gain mutual understanding about futures' assumptions on the personal level. Before that, the product of the department (relevant information to material purchasing and technical development) was not so well available. If understanding remains only on the personal level without forming an organisational culture, it takes always two or three years to gain mutual understanding with a new representative of customer. When we know that an officer will occupy one position approximately two or three years on average, it is very easy to conclude that obviously the product (the relevant information) will nearly never be available to the customer organisation if mutual normative and cultural structures are not founded[17].

Goals are set in a normatively understandable environment on the basis of values, resources and means. Incoming information is in the first place interpreted through subjective goals. Information, which will support the achievement of personal goals, will be accepted. Information, which will not do that will be rejected or at least ignored. Therefore it is most essential to understand the goals of those actors who are interacting in the same system.

Both mutual goals and normative agreements were partly missing in the case documented above. In other words, mutually understood and accepted assumptions about the future were missing. Goals, norms and values are knowledge. Like Nonaka and Takeutchi (1995) and Maier (2002) have pointed out, a knowledge creation process takes its time. This explains rather well those difficulties, which were faced. Before mutually understood and accepted futures assumptions concerning both the direction where it is supposed to go, and those rules that are supposed to be followed, a somewhat great deal of information about these items shall be transferred. This

[17] Now, five years after establishing the research institute, normative actions both in the Defence Staff and in the research organization have taken place, and a mutually accepted future has good possibilities to form.

requires a lot of communication. Further on, that requires a lot of time. A unidirectional information flow does not guarantee understanding. Information is not available if it is not accepted.

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The questions:

1. Has the seminar system, where results of finished research projects are presented, been relevant as the medium of research information? (1 to 5) How would you develop this seminar system?

2. Have you received other reports, statements and advices from the department when you have asked for them? (1 to 5) What such information has been lacking you would have been interested in?

3. Has the information that you have received from the department been relevant and useful concerning your task? (1 to 5) How?

4. How well has your personal impression about long-term research work in the FDF developed during our cooperation? (1 to 5) What more information would you like to have concerning objectives and arrangements of our research activities?

5. Have you had opportunities to have an effect on the direction of the research work performed in our department? (1 to 5) How could that be improved?

6. Do you feel that our department is making its research work in right and relevant areas? (1 to 5) What should be researched more? What should not be researched at all?

7. How well do you think that the overall organisation of our research is completed? (1 to 5) How would you improve the organisation on the whole?

5.4 Gathering information – tactical electronic intelligence

The application introduced here considers tactical electronic intelligence. The purpose of this case is to show one example of the input-information processes of creating and updating the situation picture. Especially the temporal availability is discussed trough some mathematical modeling and simulation.

Tactical electronic intelligence is a tool for performing parts of information operations in the battlefield. It is rather limited both spatially and temporally. In this context, availability in space, and temporal availability are discussed[18]. The availability of electromagnetic radiation in space has been studied widely and therefore it is introduced only at the level of existence. It is rather obvious that radio waves are attenuating while propagating in media. (E.g. Lindell 1987) This phenomenon, combined to the physical limitations of receiving technology and the total amount of radiating energy in the working space will cause spatial limitations to the availability of electronic intelligence information. Considering the purpose of this thesis, a more accurate analysis of the spatial limitations of intelligence information gathering in the wireless communication environment is not purposeful. Obviously, spatial limitations will be found.

[18] Accuracy as an attribute of availability is ignored.

Much more interesting is the question about temporal restrictions of information gathering. The user of intelligence information shall be aware of the relevance, accuracy and amount of potential information. But at least as important is to be aware of the temporal possibilities and restrictions of getting this potential information. In the battle, to put in practice before the opponent, will be most relevant. To be able to put action in practice in a purposeful way demands suitable amount of information before action will take place[19]. It should be pondered, whether the speed of producing relevant information is adequate and what parameters will have effects on that. The next algorithm was developed to deal with this problem[20]. This algorithm and a simple computer program were used to simulate the temporal phenomena of gathering intelligence information about radio communication.

Precautions for this simulation algorithm are that all targets are spatially available, and all detections will occur with the probability of 1. The algorithm results the duration that the intelligence gathering system will use to produce adequate amount of information, when temporal parameters of intelligence system and target systems are known. Algorithm equalizes targets to a certain format, thus needing several simulations to give relevant results. In this case accurate results are not relevant, because this application is used as an example to demonstrate the meaningfulness of both objective and subjective temporal restrictions.
The following parameters shall be known:

- k = the amount of individual transmitters in a radio network [pcs]
- t_a = the duration of a transmission of one individual transmitter [s]
- t_q = the duration between the starting moments of transmissions of one individual transmitter [s]
- s = the proportion (between [0,1)), which shall be detected of all transmitters of one radio network to gain determined level of information [-]
- p_2 = the desired probability [0,1) to gain the proportion s of detections of one radio network.
- d = the amount of detections needed to resolve one radio network [pcs]
- t_k = the time, which the intelligence system stays on one channel [s]
- t_m = the time, which the system needs to switch from one channel to another [s]
- t_{min} = the minimum duration that the system demands to perform detection on one channel [s]

This algorithm deals with one radio network as an entity. Individual transmitters are dealt with statistically. Statistical parameters of temporal aspects and the sizes of networks shall be determined before using this algorithm. In this case, accurate parameters are not relevant. Simulation results presented here are based on fictive, but real-like parameters. In spite of those fictive parameters, the temporal nature of targets, features of the intelligence system, and their mutual interaction will manifest themselves real-like.

[19] Basically this is true in any case. The temporal dimensions will be emphasized in such environs where decisions shall be made quickly.
[20] The algorithm is presented in the general staff officer thesis of the author in 1993. Because that thesis is classified, thus not being publicly available, certain parts of the algorithm shall be presented here to perform adequate demonstration of the temporal aspects of available information in a temporally demanding environment.

After determining the statistical parameters of targets, the amount of desired detections shall be counted. The simulation presumes that all transmitters will transmit sporadically and without interdependence. This will cause a certain amount of error, but the calculation process will become much simpler comparing to a situation, where all radio networks are simulated according to true situation. Again, this error will not compromise the basic meaning of this simulation. The amount of detections will be calculated:

$$d = \frac{\ln\left(\frac{1-p_2}{s \cdot k}\right)}{\ln\left(1-\frac{1}{s \cdot k}\right)} \qquad (1)$$

When dealing with getting detections in a situation where intelligence system stays on a channel for a much shorter time (t_{min}) than a transmitter will be active (t_a), detection will occur almost certainly if the detector is staying on the same channel as the transmitter. This is reality in modern tactical electronic intelligence systems. In this case the time needed to get one target completed is:

$$t_1 = \sum_{n=0}^{d} \frac{t_q}{k} \qquad (2)$$

The overall time to perform the desired amount of intelligence information will therefore be:

$$t_{tot} = (t_k + t_m) \cdot IP\left[\frac{1}{t_k + t_m} \cdot (t_1 + t_k + t_m)\right] + N \cdot (t_k + t_m) \qquad (3)$$

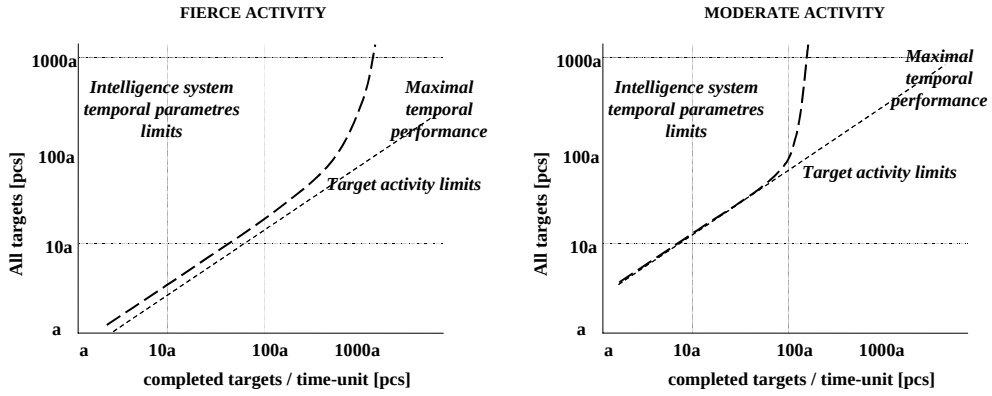
Here *IP* sets the following expression as an integer. *N* determines the overall number of all detection scans.

Interesting features can be discovered on the basis of those three formulas. First of all, the desired quantity of information (1) will determine together with the target activity (2) and system parameters the overall temporal performance of the whole system containing the targets and the intelligence gathering subsystem. The availability of information is dependent on three main questions:

1. What do we want?
2. How is the target operating?
3. How good is our system?

The third formula (3) shows the temporal relations of the target system and the intelligence system. If the intelligence system is ultimately broadband and gets detections in zero time, the formula (3) reduces to (2). This means that in this case a superb technological solution alone does not solve the intelligence-gathering problems. It will help, but the final limitations will come from the outside of the intelligence subsystem. In this case, limitations originate from the activity of the radio networks. Inductively this application will show that availability of information for decision-making is always limited. In this case both spatially and temporally.

There are thousands of individual targets on the battlefield. Their activity varies depending on the overall activity of troops and the purpose of each troop. (Kuusisto 2000) Deeper analysis about the communication dynamics is unnecessary for the viewpoint of this thesis. Instead the differences between fierce and quiet tempo of overall activity of targets is discussed. Let us assume that communication activity during the fierce combat activity is about ten times greater than in the latent phase. Some contours were formed after several simulations[21]. These are depicted in figures 37 a, and 37 b. Some conclusions can be made about those curves. Temporal parameters of a signal intelligence system can be optimized, if the behavior of the target system is known well enough. The ultimate speed is not a necessity. The system should be quick enough, but not too quick. The system shall be adaptable to the overall situation – it should be good enough, but not too good. This piece of knowledge may save a lot of money when systems are purchased.



Figures 37 a and b. Limitations of the system performance

According to figures 37 a and b, it can be noticed that there will be a limit to the speed of gathering information. This limit does not depend on the temporal parameters of the intelligence system, but on the activity of the target system. The overall performance is determined mainly by target activity if the intelligence system is technically good enough. The maximal temporal performance can be determined if the behavior of the target system is known. The intelligence system can deliver information available to the decision-makers only as quick as the target system will allow. Technological improvements do not give any added value to the system after reaching certain limits. Temporal limitations of the entire system will set the limit to the maximal intelligence information flow. If the target is more dynamic than what the information gathering system can follow, this system will produce out-of-date or partial information. In that case, the system is limited by subjective time limitations. These two temporal limitations will set the overall performance of the information gathering system. Temporal performance is always limited and it is determined by both subjective and objective durations. Temporal availability of information is therefore always limited. Part of incoming information will always be aged, thus losing its value to the user in that particular situation.

[21] Contours presented here are evocative and calculated using fictive data. Their only purpose is to demonstrate the phenomenon of the objective and the subjective temporal dependencies of a system.

It seems that objective duration is inevitable. Trying to improve one's own performance towards the ultimate does not guarantee temporal superiority, because the objective world does not always act the way the subjective actor wants. It can be concluded that it is not always necessary to try to gain the best possible technical performance. To be good enough is sufficient. The wholeness of the acting environment is full of situations where one's own performance shall be optimized. If this is considered via temporality, a good picture of the objective and subjective duration is a necessity. The understanding of temporal parameters of the objective world will give valuable information when determining the technical specifications of the information gathering systems.

When referring to figure 34 on page 77, two viewpoints can be found. First, the intelligence system itself as an active entity will gather information from the target system, which in this case can be considered as the objective world. With its activity the objective world will produce an information flow for the intelligence system that gets facts about radio communication activities as input information. In this phase this input information manifests itself as data, like frequencies, activity patterns and sites. This data flows through a refining process into system memory, where it is stored as data, information and knowledge.

Second, a system is never alone, but frequently a part of bigger system of systems, subsystems of which are interacting with each other in ways that are dependent on the relationship of incoming and outgoing information and actions of those subsystems. Interacting entities are continuously producing information with their actions to the mutual objective world. There this information potential is waiting for to become available for someone. Radio traffic is not available information for a combined arms headquarters, but for a radio intelligence unit it is. On the other hand the picture about electronic situation is available for both of them. The combat plan is not available for the radio intelligence unit, but its effects will be observed through the radio traffic this intelligence unit is monitoring. The very same situation will make different information available for different actors. This is obvious. What is the big deal? The big deal is to understand what information can be available for desired purposeful action. This will become clear, if this intelligence case is approached from the headquarters viewpoint.

Figure 38 shows temporal aspects of information and activity in the case of military decision-making in battle. The main focus is set on the temporality of getting relevant information available. The curve that illustrates the temporal development of getting the relevant information in the intelligence process is calculated with the help of formulas 1, 2 and 3. After receiving the task, a keen information gathering and planning process will start. In figure 38, this is marked as a thick bar called "Planning cycle". When this cycle ends, a decision shall be made and putting action in practice will start. It is essential to notice, that the time reserved for planning is limited. This means that time reserved to information gathering is limited, as well. As has been stated before, temporal performance of the information gathering system depends on both its own temporal parameters and the activity of the target system. In the fictive case of figure 38, the temporal limitation of headquarters sets the limit for the amount of incoming information to about 40%. Why so? The activity of the target system does not offer more than this 40% of all possible information during the time window, which the headquarters can allow. This time window is objective

duration from the viewpoint of the radio intelligence unit. Only 40% of the total amount of outer information will be available for the decision-making in determined time frame[22]. Even though this example is fictive, it is truthful. It demonstrates the phenomenon rather well. Important to notice is that even though the potential of all information (see P2, figure 6) is theoretically reachable, only part of it is available. This availability is limited both temporally and spatially.

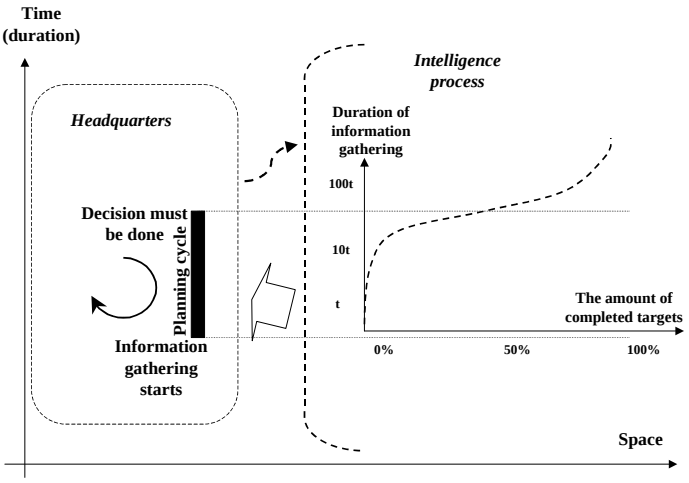


Figure 38. Temporal availability of information and activity

5.5 Information availability at the situation centre of the headquarters

The meaning of this section is to clarify the information process, which has widest effect on the decision-making process in the headquarters. The situation centre forms the ever-updating picture of the situation by combining the incoming information about the ongoing situation and distributing this picture to the higher echelon, subordinate units and its own headquarters' decision-making process. The situation centre makes available the information about "what and is taking place and where". One of the information inputs for this picture is e.g. the information flow from the electronic intelligence, which was dealt with in the previous chapter.

This empirical part of the study deals with the first layer of the information refining process of the headquarters´ planning process, which will be dealt with in the next chapter. Information flows were studied during a combat exercise in May 2004 in the southern part of Finland. The idea of the study was to find out how information in the boarder line of the headquarters and the combat units and other headquarters is made available to use for the headquarters planning process and for the subordinate units, the neighbouring units and the higher echelon. The situation centres of three headquarters were studied. These headquarters are here called "A", "P" and "H". The situation centres were situated at every headquarters and they formed the boarder line of the perceptions of the headquarters concerning either the incoming information or the released information about the situation.

The concept of situation officer gains to reduce the communication and need to react for present moment issues between higher and lower organization levels, as well as

[22] Of course, other intelligence sources are in use, and great deal of information exists already in the memory function of the headquarters.

to direct mutual resources as quickly as possible. This resource-directing task was not studied in this case. In time-critical situations information should flow only on and to the right level. The commander and the planning organisation should not be burdened with too detailed information. The situation officer acts as a “filter”, allowing each level to concentrate on their core tasks. Situation officers are positioned in the situation centre at the headquarters. The structure of the situation centre contains the situation master, situation officers and information interfaces. The situation master leads and manages the action of the situation centre.

The basic idea of the case is presented in P9 and the description of the study is in P10. The idea for this research was born during the same kind of combat exercise in May 2003. Administrative preparations took some six months, the preliminary thinking of the main content and research questions about one week for the researcher and the final brainstorming of the survey took only two very intensive days for three researchers. The actual research took some 50 hours containing the delivery and collection of the survey forms, observing activities and making some interviews. The preliminary analysis of collected data took another very intensive day and the final analyses took a few more days.

The main method was a survey reinforced with observation and interviews. The survey was directed to the situation officers and situation masters of the situation centres of those three headquarters. The relative amount of incoming and outgoing information divided by medias was asked. Four medias could be chosen: Face to face, paper maps, communication equipment (like telephone, radio, fax) and computer based information systems. Secondly, three most important information sources and information targets was asked about. The choices were: Higher echelon, the commander, staff officers, fellow situation officers, subordinate units, and neighbour units and cooperation parties. Thirdly, the three most relevant items of information concerning situation awareness during the whole research period (the period about 50 hours mentioned above) was asked about. 56 persons returned the survey form properly filled out. To brighten the principles of interpreting the surveyed data the survey was supplemented by interviewing the key actors, and observing the working procedures in situation centres.

The information under interest is here divided into three categories spatially and into two by origin. Spatial categorisation contains the situation centre, own headquarters, and the units and the headquarters outside own headquarters. This division originated on the basis of the task of the situation centre. It has three main tasks: It refines all incoming information as the ever-changing situation picture, it releases this picture to the own headquarters to form a basis for the planning process, and it releases refined situational information to the other units.

Situation officers were asked to specify the three most relevant information sources and information targets. Results are presented in figures 39 and 40. The total number of nominated information sources was 169, and targets 165. Relative amounts of those were calculated. It seems that about half of the information flows between the situation centre and the higher echelon, sub-units and neighbours. This means that about half of the information flow circulates inside own headquarters. Slight differences were noticed between headquarters. Because the sample was rather small, very profound conclusions cannot be made. Anyhow, one interesting feature

concerning the outgoing information flow of the situation centre at headquarters H was found. There the output flow was directed more to serve the own headquarters than the outer units. Several reasons, like different working procedures or culture, the personality of the commander, the chief of staff, or some other notable officer, the situation, the degree of training, etc. may have caused this difference. Those reasons were sorted out one by one. The situation was the same for all, the degree of training of the personnel was alike, and the technical control and communication system was the same. Two explaining features were left - the personality and different demands of commanding personnel and the physical structure of the headquarters. The effects of the first one are very difficult to prove and some uncertainty will leave to the results. The headquarters H had rather compact structure, which allowed people to quickly wander from one working place to another. So, the situation officers could walk to the planning section to release their information, and vice versa the planning officers could easily walk to the situation centre to discuss the situation around the map. This structural phenomenon can explain the difference between headquarters H and the other ones.

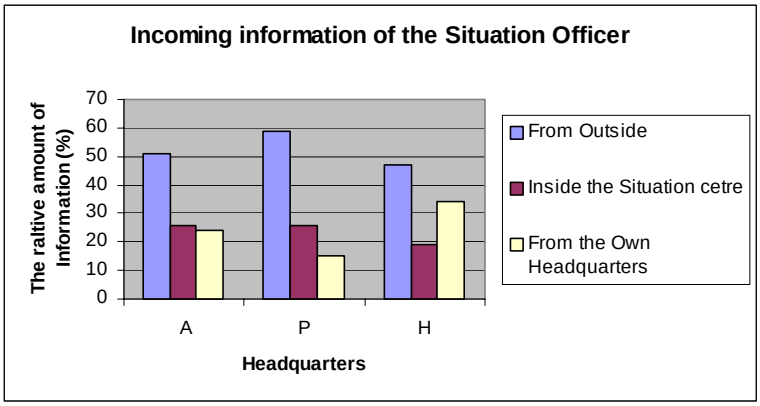


Figure 39. Information sources of the situation officer

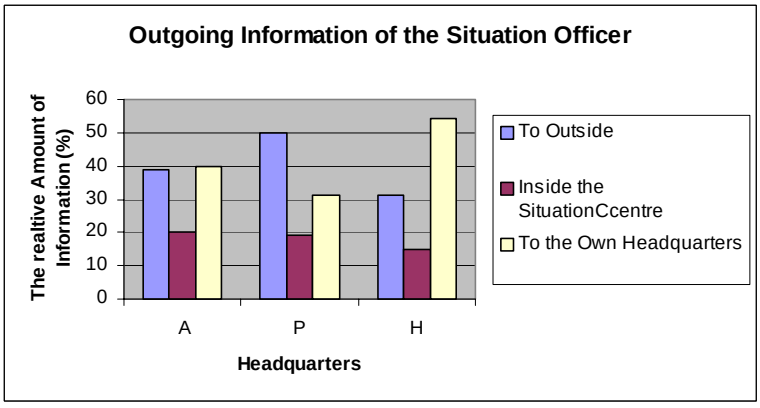


Figure 40. Information targets of the situation officer

On average, it seems that the situation picture refining process requires the relative amount of about 20% of information exchange inside the situation centre. Because the task of the situation officers is to gather, refine and distribute information, they communicate in one way or another nearly continuously. About one fifth of the information exchange time was used to talk with the nearest colleagues to refine the

image of the situation to be used in other processes outside the situation centre. About half of the time was used to receive and collect information from outside of the headquarters and the rest of time to collect and receive information from the own headquarters. See figure 41.

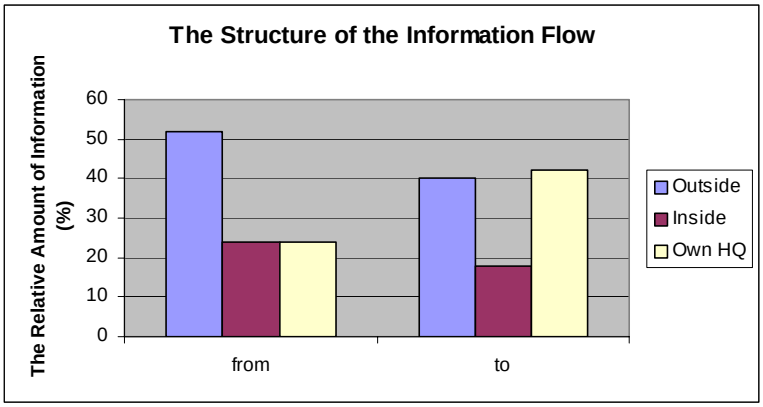


Figure 41. The structure of the information flow in the situation centre

It is interesting that the outgoing information flow differs from the incoming one. The amount of exchanging information with fellow situation officers is obviously equal to the amount of incoming information. This reveals that those officers really discuss among themselves to produce a mutual and combined image of the situation. The output information flow of the situation centre directs more information to the own headquarters than to the outer actors. This reveals that the situational information is used to support the planning and decision-making process of the own headquarters. The situation centre is a vital part in making situational information available to the headquarters to complete the combat planning adequately. The situation centre refines the incoming data into a more abstract form to produce information for the planning process. There, an organisational refining process occurs. The advantage of that is that the burden to deal with a vast amount of details is taken away from those who will work with future planning processes.

Further more, situation officers were asked to evaluate what is the relative amount of the use of different communication medias when receiving and distributing information. The results of those evaluations are depicted in figures 42 and 43. The overall sample of 56 answers divided about equally between the three headquarters A, P and H. The variance of answers was about 70% of each relative amount. Because the sample is so small in numbers very profound conclusions cannot be made. Anyhow, it seems that when considering incoming information, all three headquarters seemed to act equally. About two thirds of information is received via technological systems and one third via discussions, briefings and maps. When considering outgoing information, some divergence can be found between the headquarters. In A and P the situation is equal to incoming information, but H acts divergently. At headquarters H a lot of information releasing activities of the situation centre took place in discussions and briefings around the map.

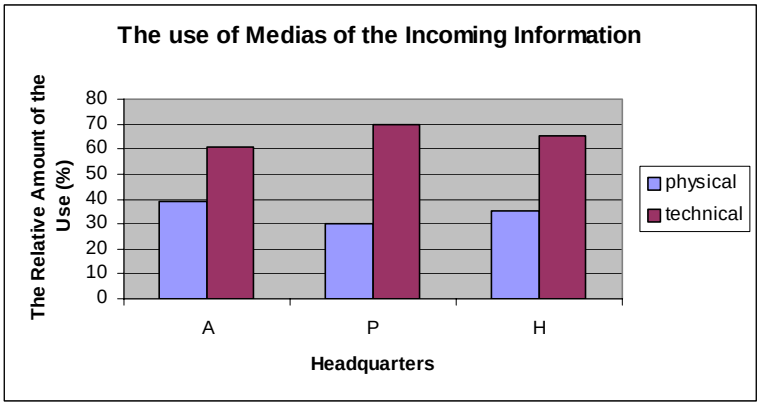


Figure 42. The use of the medias of getting information

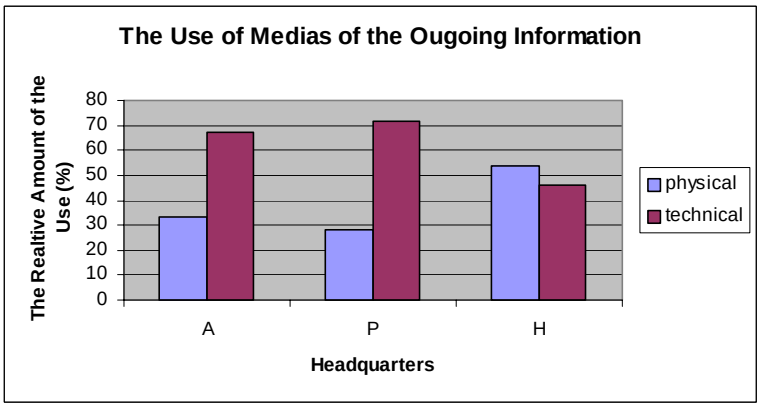


Figure 43. The use of medias when releasing information

On average, about two thirds of information flows are completed by technical means and one third by face-to-face communication, briefings and working with a paper map. Using technical means to make information available gives more time for the planning process. On the other hand, face-to-face discussions are essential to refine all incoming information to form a situational picture. The tacit knowledge about the features, the action patterns and the possible courses of action will percolate with incoming situational data to at least some degree to be expressed explicitly. See figure 44, which shows that about one third of the time is used around physical communication medias.

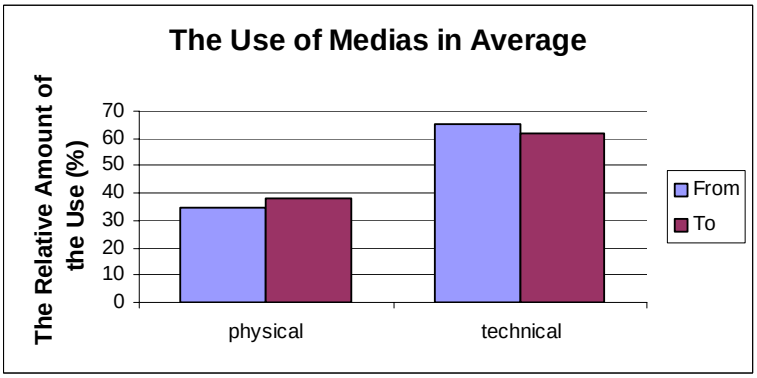


Figure 44. The average use of medias

Two more findings emerged while interpreting the results. First, the commander is not a very relevant source of information, but he is rather important user of the information that situation officers produce. This means that the situation centre supports the decision-making at the highest level, as well. It shall be remembered that this research was conducted from the viewpoint of the situation officer and this result does not mean that the commander gets about 15% of his information from the situation centre, but 15% of situation officers considered the commander to be one of the three most relevant information targets. This feature can be found documented in P10.

Another feature can be found from the internal information flows of the headquarters. The situation centre is a vital information component of the planning process. About one third of all important information exchange of the situation centre takes place with the planning part of the headquarters. On the other hand, one fifth of relevant information sources and targets of a situation officer are located in the situation centre. Situation officers construct their situational awareness by discussing with each other on the basis of that situational information which is received from the higher echelon, sub-units, neighbours and inside their own headquarters. Concurrently they take part the planning process by discussing with those officers, who are in charge of that process and distribute relevant information outside own headquarters. This is communicatively a very complex and demanding situation. This in-headquarters discursive process can be found emphasized in headquarters H. There, the situation officers found the commander and the staff officers to be more relevant information sources and targets than in other headquarters.

It was found that sources and targets of information divided somewhat equally in number between the three main actors: One’s own situation centre, one’s own headquarters and others, like the higher echelon, sub-units and neighbours. Anyhow, it seems that the information flow is directed more towards the planning process of one’s own headquarters than to the direction of troops. Figure 45 depicts this conclusion. The relative amount of the use of communication media varied between situation centres. This variation had correlation with targets of distributed information. The more face-to-face interaction and paper maps were used as communication medias, the more information for headquarters planning process was produced. The planning process still seems to need personal and comprehensive interaction to properly combine the knowledge.

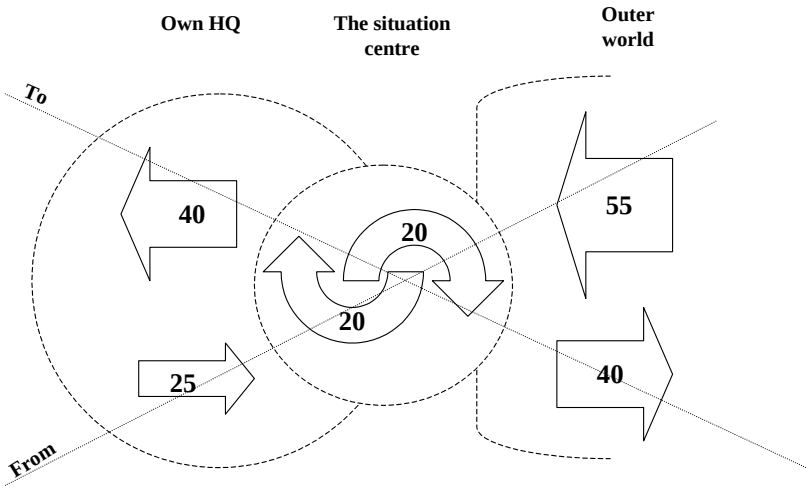


Figure 45. Abstraction of the information flows of the situation officer

The task of situation officer is to receive the information about movements, action and positions of own troops and the enemy, place that information into the situation picture and release that information to the other sections of own headquarters and to subunits. Situation officer acts as a buffer and transmitter without any authority to make any conclusions. Situation officers use information of those four categories determined by Habermas: Values, norms, goals, as well as means and resources. Values form the "fixed" knowledge basis for the interpretation of incoming information. Broadly taken, it can be thought that in the case of a situation officer working in the situation centre, the category called "values" contains all the knowledge and competence of an individual officer. This officer will make judgements and choices on the basis of that knowledge. It directs the information refining process of an individual. Norms are those processes that confine the way of performing one's work. Tasks and duties determine individual goals, those results that are expected to be reached. All this information affects the background of an individual situation officer. The information he is dealing with continuously is facts. He is using resources (i.e. own competence and knowledge) and means (communication medias and information combining methods) to create relevant new information to achieve mutually accepted goals. The next case will show what kind of connections this sub-process has with the complete decision-making process.

5.6 Analysis of the information process in the headquarters

Some findings to formulate a mechanism for more accurate validating of the theoretical construction were discovered based on of these cases presented above. The availability of information is situation dependent. The situation is confined by space and time. Further more, the availability of information depends on the viewpoint of the user. The availability of information is user related. The availability of information is a holistic matter. It concerns all entities that are acting on some kind of structures. The availability of information is not only a technical issue. Technology can be used to extend both spatial and temporal dimensions of the information user. To be available, the meaning of the information for the situation shall be understood.

Reaching understanding is a long process. Information about all four fields of the social system presented by Habermas shall be available. Information output from the system – i.e. the information the system makes reachable to others – is a reflection of its internal information, i.e. values and norms, as well as competence. This internal information is frequently invisible to others. The interest concerning total information of a social system frequently concentrates on means and resources and partly to goal setting. Only a fraction of interest is pointed towards values and norms, despite the fact that this information shall be available so that means and resources as well as incoming facts can be used in a teleological way. A study concerning information classes of published papers dealing with national defence pointed out that the assumption presented above about released information is true. A total sample of 663 RAND national defence related publications between the years 1997 and 2004 was analysed, and less than 2% of all papers focused on information about values and less than 1% on norms. Instead, about 12% dealt with goals, 25% with resources and 60% with means. (Litendahl, et al 2004) Anyhow, the internal information containing values and norms guides perceptions and actions. It confines the manifestation of an entity.

In the next sections, the decision-making procedure of the combined arms is analysed from the viewpoint of the information availability. Here the process description of the working flowchart of the planning and decision-making in the combined arms headquarters is analysed to find out what parts of it are information, action and structure. The process description is depicted in figure 46. This depiction is formulated based on the work of Hyytiäinen (2003, 179) who has adopted this process description from an official Finnish field manual concerning the combat of combined arms. This process description looks like a classical sequential process flowchart. Anyhow, in practice the planning process allows information exchange between different nodes, thus getting systemic features. On the basis of analysing the process, it will become obvious that this kind of systemic working method is essential to gain reasonable results in reasonable time. The process description in figure 46 shows action in the left side of the description, means in the middle and information products on the right.

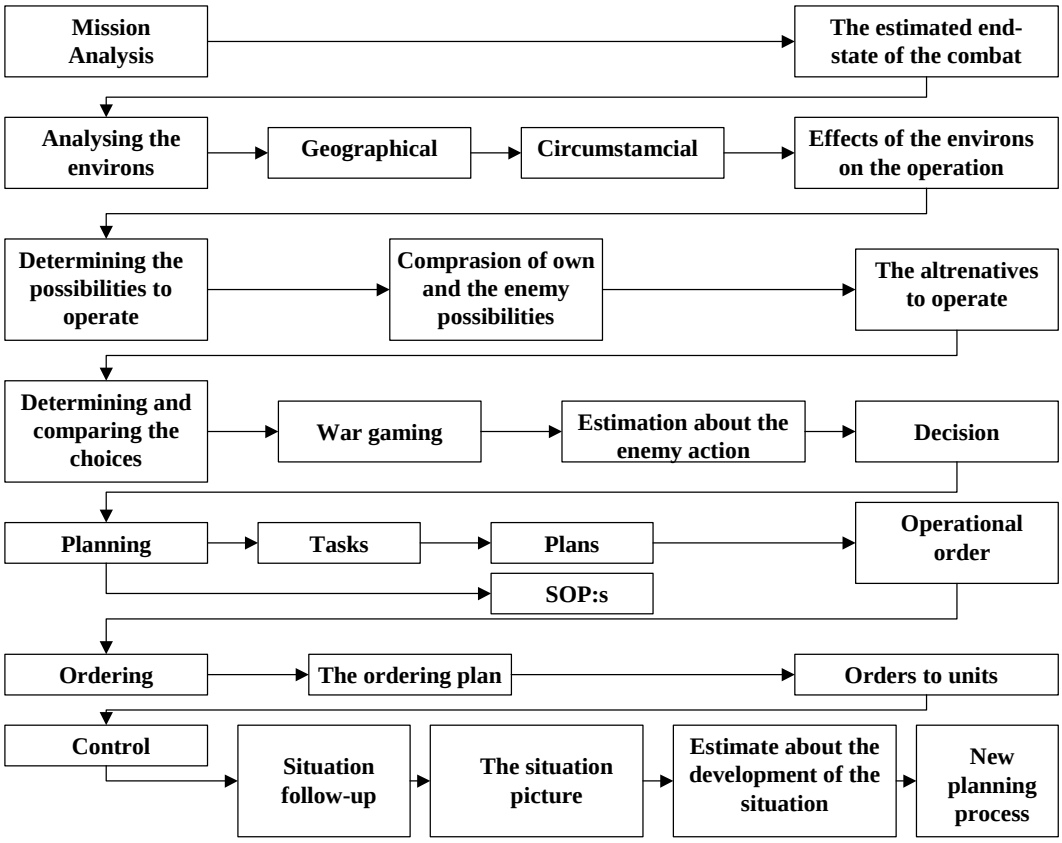


Figure 46. The process description of the situation estimation, planning and execution process in the combined arms headquarters

In the next sections, the process description of the decision-making and planning process is reconstructed. This is carried through using the tool constructed in the first phase of this research. Action, means and information are separated to get a clearer image of what kind of information is delivered to be available during the complete planning process. The main meaning is to take especially the means and other action apart from the information processes. When the process depicted above was reconstructed on the basis of the theoretical construction presented in chapter 4, it turned out to look like the one depicted in figure 47. It began to look somewhat fuzzy! This fuzzyness has its reason. The main reason is that in the original process description (figure 46), information, action and means are mixed together. The analysis of that is completed a bit later, but first some analysis about the information categories of the theoretical model shall be carried out. It is somewhat essential to understand what kind of information shall be available during every phase of the planning process. It is very essential to have skills, competence and methods to produce that information, as well. But those shall not be mixed together. Basic understanding about phenomena that has effects on the end-state of the process cannot emerge if structure, action, means and information are mixed together as a sequential process model.

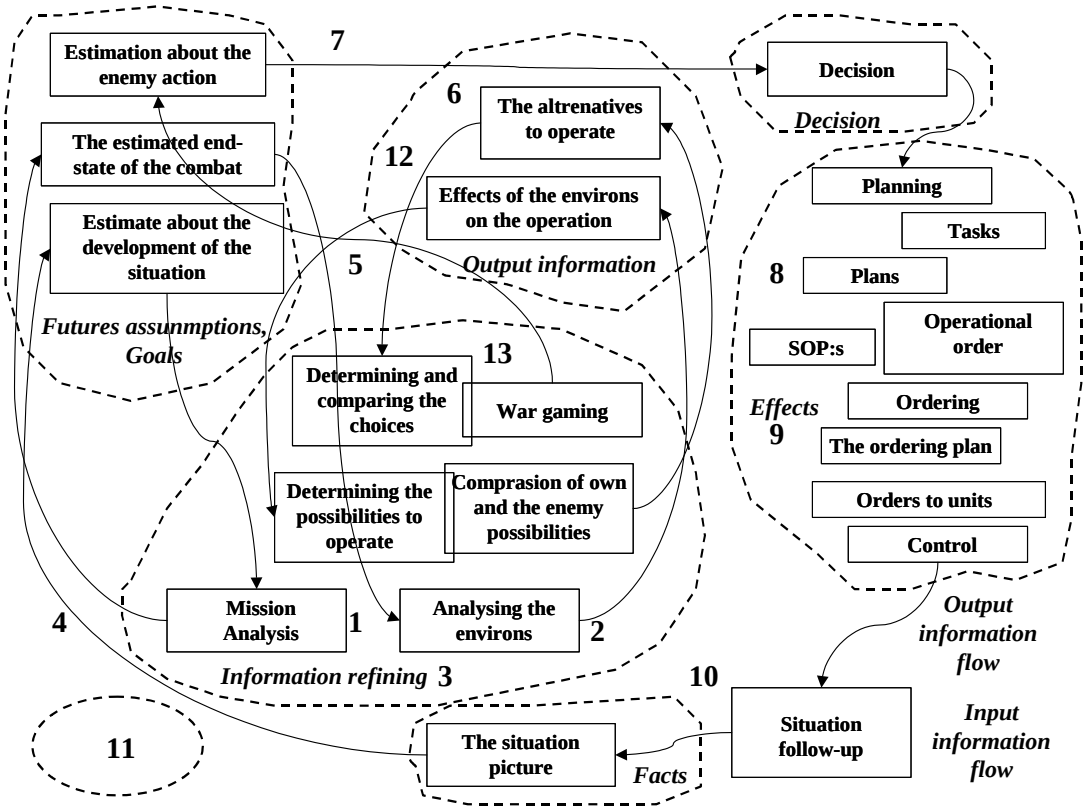


Figure 47. The process of planning of the combined arms depicted from the information flowing viewpoint

Output information is here determined as explicitly expressed intermediate information of the whole process, which purpose is to act as its part as an input information to the refining process. Output information is a product of refined data coming via input information flow and other output information products. Future assumptions are knowledge that will express the knowledge-based, more or less tacit intuition about the possible futures. In this case, they are enlightened estimates based on incoming facts refined through the thinking process based on the competence on the military area. Facts are data and information expressed in explicit and commonly understandable way. Information refining is the internal action phase to complete the output information products to eventually support the final choice, the decision.
In the next paragraph, thirteen different items concerning the original process are analysed. After that analysis, a new suggestion as the planning process is presented.

1. The input information to mission analysis comes solely from the estimate about the development of the situation. The mission is the ultimate goal of the unit. It has its origin in the task that is given to the unit. The task is a fact and it shall come through the refining process to be refined as a mission together with other tacit knowledge.
2. Input information to the analysis of the environments is lacking. This shall come through the information node called facts. This means that the overall process should contain other input information flows than the situation follow-up, as well. Two more of those have been found for now: the information about the task and the information about the environs.
3. It seems that too much emphasis is set on the way to execute something or to do some acts in a somehow determined way. The process description for the

planning process of combined arms headquarters seems to emphasize the normative perspective. It contains several instructive parts that direct to use some defined methods to produce desired information to be available for decision-making and the internal planning process. The process description is a mixture of rules and the desired form of some explicit information. The refining process is a collection of formalised methods. It contains sub-decisions (determination), comparison and war-gaming. But it does not contain thinking. As a whole, this part of the process is different from the other ones expect for the planning and executing part. These two contain action instead of information products.

4. Dealing with the situation picture differs from the other process. While in the other parts of the process the method of refining is defined, there it is not. The situation picture emerges straight away as an estimate about the development of the situation. No thinking phase is described here.
5. Actually a rather good feature is that information products have a relationship with the means that produce them. That is relevant. Anyhow, if information products and means (information and action) are placed sequentially one after another in a process description, it may cause confusion.
6. The alternatives to operate and the effects of the environs on the operations are obviously intermediate information products of the refining process. This information can be expressed explicitly, thus being easily available to further planning. This information fulfils the demands of output information. It is strange that according to the process description, this information is not used for decision-making, but only as storage for further planning procedures.
7. According to the process description, the final decision is completed from the basis of the estimation about enemy action. This estimation is the ultimate product of the chain, which begins (after mission analysis) from the estimated end-state of combat. This way of doing things may lead to the making of decisions based on information, where enemy action is imaginarily forced to fit the desired end-state that has been determined by the task the unit has. Actually, according to the process description, decisions are based on assumptions, not explicit facts. In the worst case, the output of this process may be conducted by decisions that are based on seemingly explicit, but really delusive information and illusions.
8. Determining the resources, or the information about them is not shown in the process.
9. The planning and executing process is described, and it contains those acts that shall be put in practice to produce combat activity. This part of the process description contains pure action, not information. So, for now, information, information producing methods and action have been found in the process. The planning and executing phase does not contain any feedback for the process using information. The effects of binding the resources and using the means do not seem to have any role in the decision-making itself.
10. The task of the situation centre was described earlier. It is shown in this process, as well. Here it contains the act of situation follow-up and the information about the image of the situation. The information refining process is not determined here, either. See item 4. The act called situation follow-up produces information called the situation picture.
11. The information exchange with the long-term memory is missing from the whole process. It does not even exist in the process. Information about the

skills, the competence and the processes is stored there. That is the continuously developing knowledge basis, from where the thinking capabilities to refine the circulating information flows will emerge.

12. It seems that the output information about possibilities to act is missing or it is hidden somewhere inside some other information.
13. Further more, the refining method of finding out the plausible ways of acting is missing or it is hidden inside the war-gaming. The refining method of sorting out the desired end-solutions is missing or hidden, as well.

The overall categorisation of information (I), action (A) and method to act (M) of the original process beginning from the mission analysis produces a chain like next: A-I-A-M-M-I-A-M-I-M-M-I-A-A-I-I-I-A-I-A-A-A-I-I. The process contains nine action phases, ten information products and five methods. In the next, this process is reconstructed to an information system, behind which exists action containing those methods that produce information products for the planning procedure.

Behind all this lays the structure on which the action takes place. In this case, the structure is the organisation and the division of labour. Further more, the action concerning information process contains those methods via which the most optimum information products can be made be available for the entire process. Obviously, those methods vary. Methods of making the information available are not dealt with in this thesis. In this case action contains resource binding, ordering, executing and control. Action is considered as those acts that fulfil the spirit of the decision. This phase is out of the focus of this thesis, as well. After all, information is the means to put something teleological into practice. Information is a tool to achieve the desired goals.

In spite of that action not being in the focus of this thesis, one feature about it shall be expressed. Two different kinds of action are required to complete the information process of overall planning. Refining involves a method to support thinking. Information requires a way to express it to be available for the refining process. Actually, this manifests itself rather obviously in the original process description. But that description is very action oriented. While considering means to support the thinking process, it does not express the means to make information available. It describes sequentially the information that shall be available. That is inconsistent. Vice versa, the description does not express what items in the refining process shall be thought of. It describes how the thinking should be completed. The whole process describes what information shall be available and how and in what order the personnel should complete their actions. Finally, it describes how the action orienting information will be delivered to sub-ordinate units.

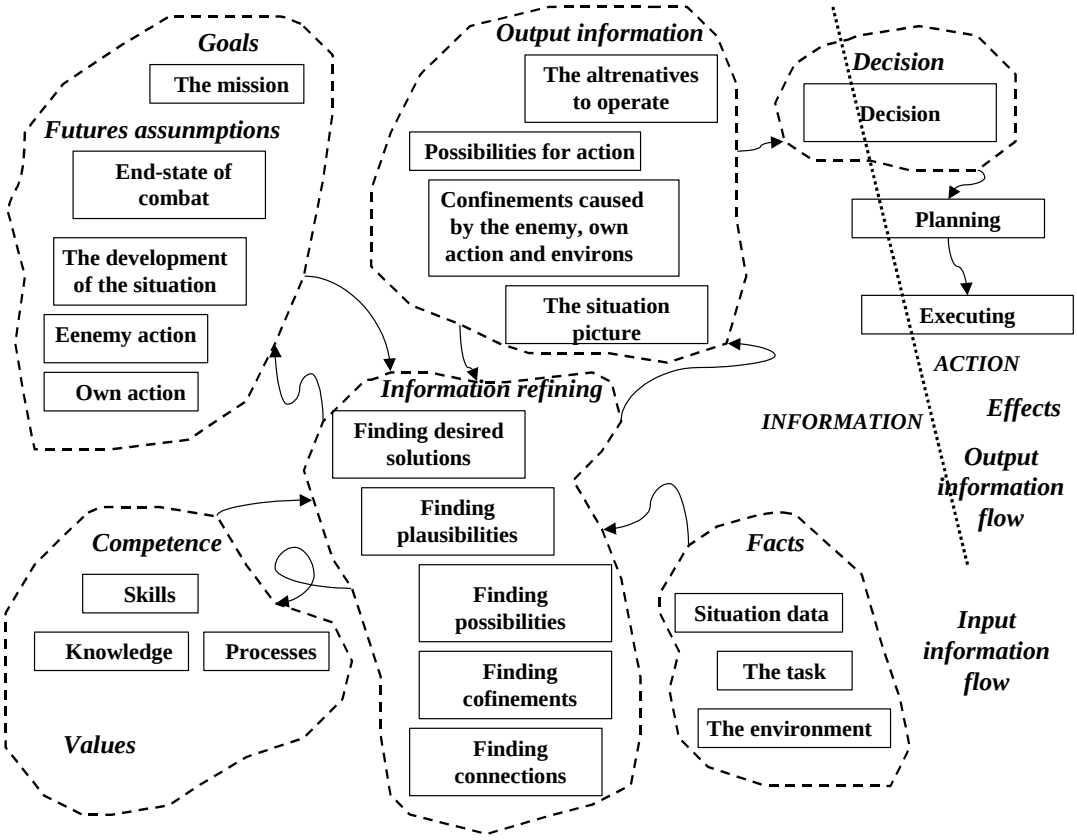


Figure 48. Internal information processes of the headquarters

Figure 48 shows the reconstructed information structure of the working process of the headquarters. Those thirteen pitfalls as well as sequential nature of the whole procedure, and the mixture of information and action have been removed. The means to conduct the information refining as well as the means to express different types of information are on the action layer under this information layer. The whole idea is to understand what information shall be available for what purposes and when. The main thing is not to determine how to think but what to think. In this model the incoming information is refined step-by-step from the basis of competence to future assumptions and further on to explicit output information, which again is the basis of decision.

The refining process progresses simultaneously on several layers that exchange information with each other. Action shows itself through the methods that are used in the information refining process. Five different thinking processes occur:

1. Finding connections contains those methods that are used to combine the divergent amounts of incoming data together, and with the existing information form suitable abstractions about this mentioned data.
2. Finding confinements contain those methods that are used to analyse the existing information to find out the limits of possible actions. An example mentioned in the original process description, is analysis.
3. Finding possibilities contain those methods that are used in a justified way to restrict the impossible courses of action. An example is comparison.

4. Finding plausible ways to act contain those methods that produce justified estimates about the probable choices. The method mentioned in the process description is war gaming.
5. Finding desirable solutions contain those methods that are used to complete the final solution on the basis of presented plausible choices.

Abstraction demands increase on every level. Obviously the competence demands will increase, as well. This has an influence on both the training demands and the division of labour. Understanding the desired state of the future determined by the mission, the capability of imagining the end-state of combat, and finding out the plausible alternatives to operate, and expressing them understandably are somewhat more demanding tasks than knowing one's own action and forming the the situation picture on the basis of finding connections of the incoming data.

Figure 49 depicts a new way to approach the decision-making and mission planning process of the combined arms headquarters. There, the square boxes depict the need to explicitly express data or information. The boxes with round corners depict tacit knowledge that cannot be expressed completely in an explicit way. The ovals depict the method that is used on every level to produce output information. The dotted line in the right side of the figure depicts the line between the explicitly expressed information and the tacit information. This can be seen as an information borderline between the external and internal information of an entity. This entity can be a human being or a part of an organisation. It shall be noticed that the refining methods are expressed explicitly, but the skill to use them is tacit knowledge and cannot thus be expressed explicitly.

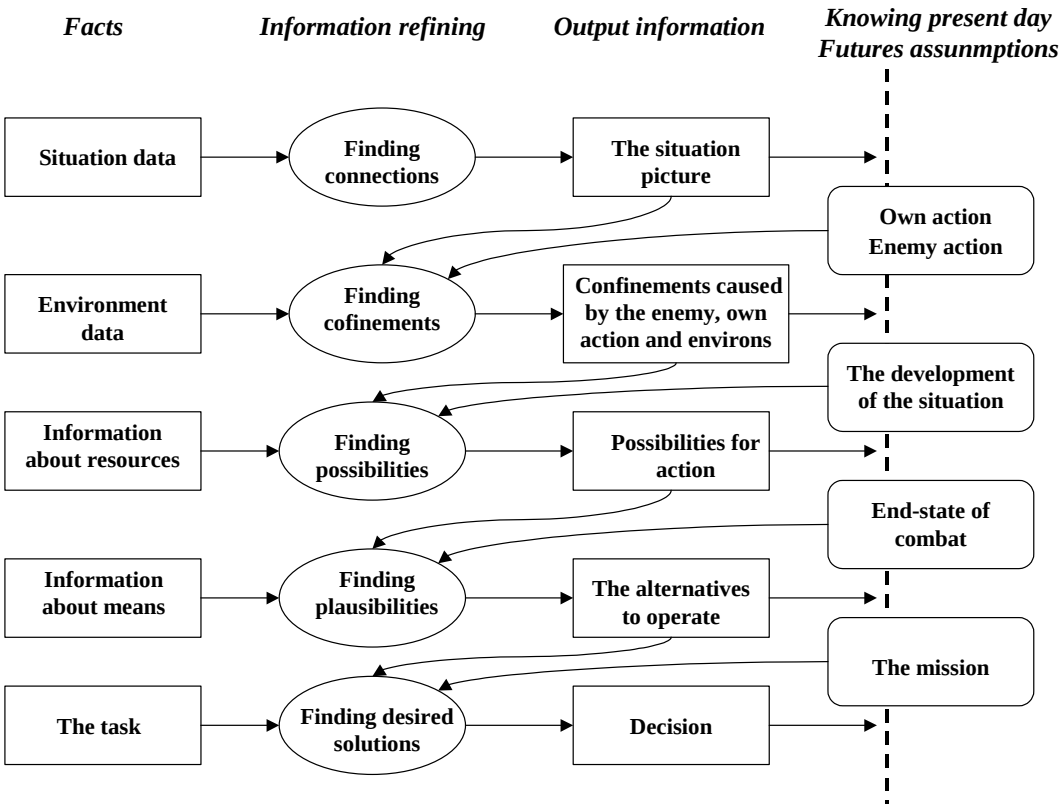


Figure 49. A suggestion for a new working procedure of the headquarters

Competence shows itself in the use of information refining methods as an ability to make higher-level future assumptions and as an ability to see further to the future. One example of that is the analysis of the task. Actually, the high level decision-maker will go through this whole decision-making process in his head before the whole planning session starts. He must have an ability to evaluate the whole process in advance to refine the task as a mission.

As can be noticed, this is a systemic model. Two kinds of information flows can be seen. First, from left to right, incoming data is refined via explicitly expressed information to enrich the tacit knowledge. The second flow needs more explaining. Attaching it to the figure was demanding, because the figure would have become rather difficult to read. As can be seen, there are five layers in that system. Every layer has a specialized task in the overall process. The layer that deals with situational information produces the ever-updating picture of the situation. So, the explicitly expressed input information of the layer is the ongoing flow about the places and activities of the enemy and one's own troops. The refining skill, which is needed here, is the ability to combine information and make suitable abstractions about it. This layer refines the flow into an explicitly expressed picture about the situation. This information product makes an input to the tacit dimension, where it enriches the internal competence to understand the enemy and one's own action. This kind of procedure repeats itself on the following layers, as well.

On the next layer, the confinements are sorted out. This means those restrictions and possibilities that the environment and the action capabilities that own and enemy troops have. This refinement process needs both explicitly expressed and tacit information. Explicitly expressed information is the situation picture and the information about environmental circumstances, like weather and terrain. Tacit knowledge of the action patterns of troops is needed. The refining skills contain both the ability to combine data and abstract it, and the ability to analyse the meaning of confining aspects in relation to the overall situation. The output information product, which shall again be expressed explicitly, is an abstracted analysis about restrictions and possibilities for action. The tacit dimension gets input information to develop understanding about the possibilities of the development of the overall situation. The people who are working on that layer shall have tacit knowledge about their own and enemy action patterns to be specialised enough to work there. The ability to perceive and understand the present moment is essential and enough, when working on those levels.

On those two layers that contain information about resources and means as input information the possibilities to act and alternate ways to operate are refined. The information of situation and environment, and the knowledge about the composition and the development of the situation, as well as the possible end-states, is used as a basis. Ability to understand, how the future may develop is essential on that level.

This chain of deduction can be continued until the ultimate decision-making layer is reached. There, all output information from the lower layers shall be available in explicitly expressed form. Of course, the nearest output information is relatively more meaningful than the rest. The facts category does not necessarily have to be available for other layers expect for the one that needs it. But the whole spectrum of

tacit dimension shall be available for the decision-maker. He must be able to know the action patterns, anticipate the change of the situation, foresee the end-state of the action and deeply understand the meaning of the mission as a part of the bigger continuum of action.

5.7 Generalization and other findings

The more generalised impression about this systemic model of making decisions is depicted in figure 50. The next issues can be sorted out:

1. The model defines the logical system that collects facts.
2. The information is refined from left to right. Incoming facts are combined to other information existing on the right level of the system and the refined abstraction about this combination is expressed as the output information on every level.
3. New information emerges on the basis of old information. This old information can be either explicitly expressed or tacit knowledge inside one active actor of the system.
4. Information is refined from top to down, as well. This process is fast in the decision-making system, but the competence to deal with increasingly abstract information begins from features aiming at understanding the meaning of the vision and is created during a long learning process.
5. On the first layer where situational information is refined and expressed, the number of alternatives is immense. Information is refined only a little. While abstraction increases whole information flows towards the ultimate decision, the amount of possible alternatives decreases. This is the power of the system. The desired ways to act are refined from the huge amount of detailed data in a logical process.
6. The refining of information can be well supported by technological solutions.
7. Output information as well as the explicit parts of basic knowledge shall be expressed in a mutually understandable form. This can be very well supplemented by technology.
8. The system contains logical phases where the information about the future is created and expressed.
9. The model tells what information shall be available when acting jointly, similiar of entities together, and when acting hierarchically, someone directing someone else. At the joint level, the information about futures is shared.
10. The requirements of competence increase from one level to the next. On the first levels the knowledge of the features of the working environment and the skills to use data connection methods are adequate. On the final level the knowledge of all levels reaching towards understanding of a large completeness is required.
11. Another power of the model bases on the competence of creating future information. The future information is created on the basis of knowing the features and those action patterns that are possible in a spatially and temporally confined working environment. The ultimate future information is the vision that confines the higher echelon requirements for the mission.
12. The model contains three main levels of thinking: the vision level, the strategy level and the operating level. The vision level contains the information and its refining processes that result in making choices to reach

the desired future. The strategic level contains those information levels where the anticipation about possible and plausible futures is completed. The operating level contains information that is used to understand and react to the existing world.

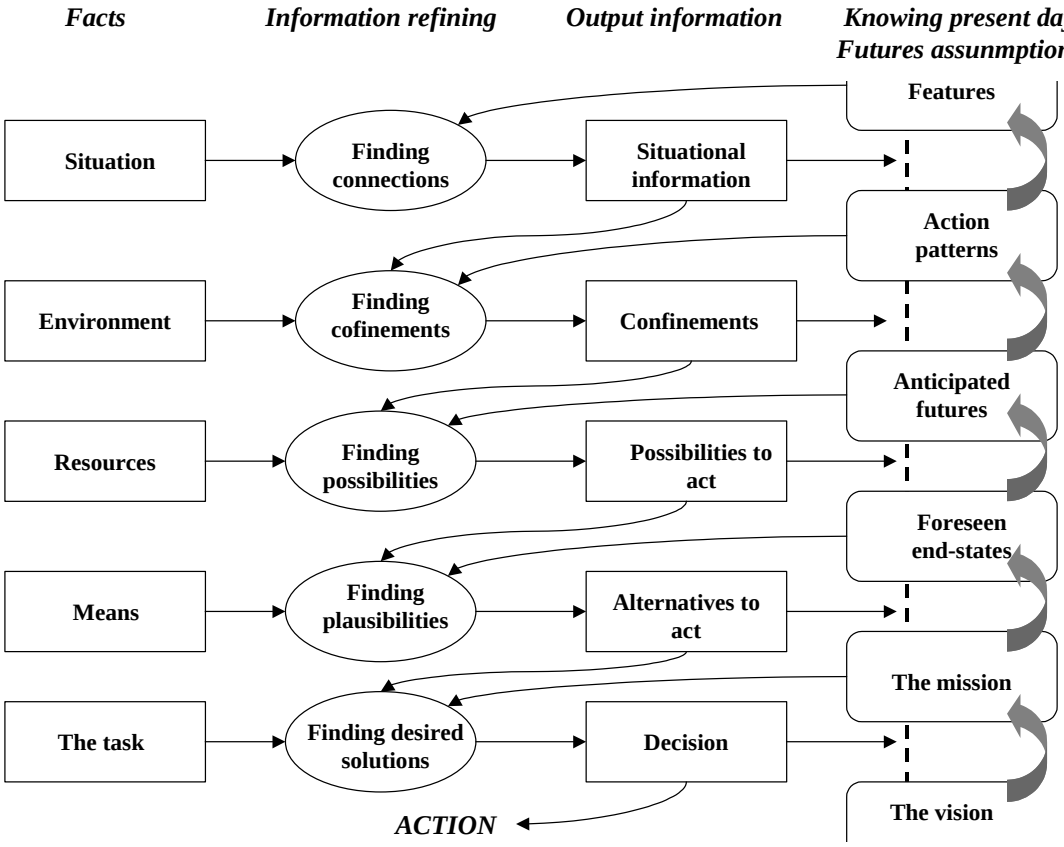


Figure 50. A generalized form of the information viewpoint for the planning and decision-making

On the basis of conclusions that are depicted in figure 50, the decision-making models described in chapter 3.2.2 were analysed. When referring to both the Simon's model of problem solving (figure 12) and Boyd´s OODA-loop (figure 13), two major items can be noticed: Those models are descriptions of one layer of the model described in figure 50, but they are missing the expression of information. These models do not tell explicitly that information shall be made available for decision-making. This expressing phase is assumed inside either design or orientation phases. When referring to Choo´s model of information management (figure 15), the latter problem does not exist. The output information category is expressed in Choo´s model and it is called "development of information products and services" and "information distribution". These three models describe the whole multi-layer process of exploiting information as a single layer, thus forgetting the need for the availability of rather different information in the decision-making system. Those models do not tell what really happens to the information during the process. They do not take a stance on what is the input information, what the future information contains, what kind of methods shall be used to refine the information, or how to make the output information available for further processing.

In the decision-making model of Rowe and Boulgarides (figure 14), the divergence of required information is stressed more. This figure is reprinted here as figure 51 to follow the next analysis more comprehensively.

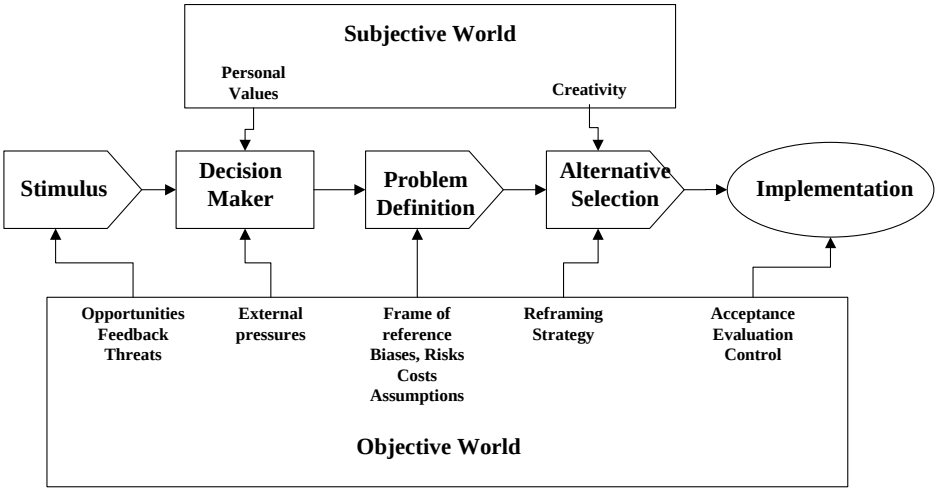


Figure 51. Decision-making model of Rowe and Boulgarides (1985) (Marakas 2002, 36, Fig. 2-1)

The subjective world contains the long-term information storage, including values and competence. The objective world contains those facts that are acting as input information to the decision-making process. This model is more like a process than a system. Information about the situation in this model is called “opportunities, feedback, threats and external pressures”. Information about the environment is “frame of reference, biases, risks and costs.” Information about resources and means are in the category of “reframing strategy”. Finally, the task is embedded in “acceptance, evaluation and control”. It seems that this model contains the layers of the systemic model depicted in figure 50. Information refining activities can be seen in this model, as well. Situation analysis is somewhere between “stimulus” and “decision maker”. Finding confinements and possible ways to act is included in “problem definition” and partly in the “alternative selection”, where finding the plausible ways to act exists. “Implementation” includes the finding of desired ways to act. As can be seen, the divergence of required information and the refining process could be found in this model. Anyhow, the expressing of the information is lacking as well as the interdependencies of the information products and refining processes. Time aspects are not well seen in any of those models.

The meaning of time in information availability in decision-making is manifold. Next items shall be taken into account when considering time:

1. The information refining process takes a certain amount of time – it has duration. Incoming facts do not exist immediately as output information. Knowledge does not emerge immediately.
2. Information refining process takes place in two directions. First, from input facts to output information and further more to enrich the tacit dimension of the knowledge. Second, the knowledge in the tacit dimension cultivates during time from knowing features via the ability to predict the future to the

skills of forming a mission in a larger vision field. Relatively spoken, the first process is fast and the second one is slow.

3. Incoming facts have a different up-dating cycle. In general, the fastest updating takes place whit situation facts.
4. Refining processes take their time that consists of the up-dating speed of incoming information and the performance of the refining process.
5. Expressing the output information – to make it available – takes time that depends on the used means.
6. Information has temporality. It concerns the history, the present day and the futures. Historical information exists in the memory, present-day information exists as the input facts, and future information exists as assumptions, anticipations and foresights concerning possible, plausible and desired futures.
7. Action has temporality. One of the very important features in decision-making is to put into practice at the right time. To be able to do that, the temporal confinements of information exploitation system of the own decision-making shall be known very well.
8. The overall temporal competence of the information exploitation process depends on the following items:
   a. The temporal competence of information gathering system.
   b. The temporal nature of the target, from where the information should be gathered.
   c. The refining methods.
   d. The competence of using the refining methods.
   e. The expressing method to make output information available.
   f. The knowledge about the acting environment and those mutually affecting actors that exist there.
   g. The competence of creating future information.
   h. The competence of understanding one's own mission in the more comprehensive wholeness.
   i. The ability to keep required information available to exploit information processing in parallel.

The interaction between technology and human beings can be seen in figure 50. In general, the role of the human being is high in the right lower corner of the whole system. In other parts, technology can be exploited more or less beneficially.

Sun Tzu (1963) writes about knowing the enemy, knowing oneself and knowing the environs. When all this knowing is adequate enough, one cannot lose the battle. Sun Tzu is speaking about the two first layers of the information exploitation model. During Sun Tzu´s time, the complexity of battlefield was not very high, and it is rather obvious that one could have won without anticipating the future. On the other hand, Sun Tzu continues by taking calculations into account. Only the one who calculates a lot can win. This expresses that Sun Tzu takes into account those latter layers as well, but he is not determining what they shall contain.

When considering the difficulties about discussing the focal products of the Finnish Defence Forces Technical Research Centre in section 5.3, some viewpoints can be pointed out. The cooperation between information producers and those who should need that information was not easy. In section 5.2 and in P8, as well, the "knowledge

combining process” is introduced to solve information exploitation and availability problems. The idea can still be considered to be adequate. Anyhow, this process does not tell what information shall be exchanged or what kind of information and on what level shall be available for the research institutes and for those, who will purchase defence products. When acting in a mutually beneficial relationship, the information exchange shall take place on the level of the possibilities and the alternatives to act. So, the mission, the foreseen end-states and the anticipated futures should be mutually understood and accepted. This means that information on the resources and the means shall be shared in the frame of reference of completing the task. This feature explains the low average and large deviation of the answer about the item of organising the research (see page 72). Consulting parties discussed but they discussed the wrong issues. So, the main problem at the time (2001 – 02) was that the mutual knowledge about the information that should have been available was obscure.

The positioning of the research party and the purchasing party should have been understood as equal and directing. Discussions about the resources and means of each party should have been completed to be able to create a real strategy for running towards a mutually plausible future. The product of the research institute was not available to the customers, because this discussion was not yet been completed in year 2002. The same kind of process shall take place on the level of distributing the information products of the research institute, as well. But then the discussion forum is different. A few years ago these two layers were partly mixed together, and lots of such information that did not interest the discussing parties was transferred. The process to launch right actions differs from that of making the information products available.

6. Conclusions

Explanations for a divergence of phenomena - “What and why is taking place in information processing in an entity” (see Preface) that were causing “the burden of agony to understand in researchers head” - were found. It seems that using philosophy as a starting point to reach the understanding about the information availability in organisations and those individuals who are acting in them leads to understandable results. A hermeneutical approach of thinking and creating new understanding suits rather well this kind of research work where seemingly totally different subjectively experienced phenomena will require such theoretical abstraction that will give explanation to them. The viewpoint was the availability of information. It was noticed that information, time and communication were the key assets when discussing information availability. Finally those parameters were combined via theory of social systems to form an abstraction that explained those phenomena which were experienced and studied earlier. It seems that the final theoretical construction explains the phenomena described in the validating cases.
The hypothesis and research questions were:

The hypothesis of this thesis is that the suitably abstract model of information availability in the context of a time-critical purposeful act can be formulated around the Habermas’ theory of communicative action, when seasoned with the philosophy of the human mind and time, and the concepts of information and knowledge management.

The research questions were as follows:

1. What kind of generalized model can be created to analyse information availability in the decision-making process?
2. How is time involved in the concept of availability of information in the context of making choices and directing resources?
3. What kind of information components shall be available in different points of the decision-making system?
4. How can this model be exploited to analyse information systems of decision-making?
5. Why is analysing of information availability in temporally demanding decision-making environments important?

When the hypothesis is set against hermeneutical thinking, it can be stated that the hypothesis represents a relevant question that is faithful to the pre-understanding of the researcher in the field of the research interest. The research interest aimed to understand “what is taking place in information processing in an entity and why”. Habermas’ theory of communicative act seasoned with the philosophy of time and the concepts of information and knowledge management appeared to be a rather good platform for reaching a more comprehensive understanding about the “teleological adventure of information in the lifeworld” in the problem area of “aspects on availability”. The hypothesis proved to be relevant. A useful tool and thinking aid to analyse information availability aspects was constructed and used to finally answer the research questions.

The research challenge that the hypothesis set was answered by two means: 1) A thinking aid that can be used as a tool, when analysing availability and the flow of information in decision-making systems was constructed, and 2) a model that tells the information viewpoint in decision-making systems was constructed, as well. The latter is a new insight at least in the context of military decision-making, where traditionally the action has been streamlined. The model that is constructed reaches to streamline information processes rather than action processes. It was most interesting to find out that human beings construct systems, which look like themselves. The idea about the information processing of a human being by Henri Bergson connected to the concept of social system thought by Jurgen Habermas seemed to produce a tool that could be used to analyse and streamline the decision-making models from the viewpoint of information availability.

Answers to the research questions were acquired. A generalised modelling tool has been constructed, time and information availability have been explained, sortie of required information components in temporally demanding decision-making system was found. This modelling tool was successfully used to analyse a series of information availability cases. The last question has partly been answered, as well. Analysing information availability showed its power when thirteen shortcomings were found in the decision-making process of the combined arms headquarters and the reconstruction of that process into a system. Especially it was noticed that streamlining information instead of only streamlining action might give additional advantage when considering the speed of decision-making process. The more final answer to this question will be expressed in the last section of conclusions.

The combination of time and information in the context of information availability proved to be rather meaningful. Information availability is bound to the time-dependent value of the different types of information. This time-dependence is both moment-bound and duration-bound. Information has short-term effects and long-term effects. The longer the desired effect is, the longer the information shall be available. Time really is meaningful, as well as the quality of information. Time is involved in the context of making purposeful action using information at least in two ways. Both information and action have temporal features and dependencies. Information has temporal features, it is pointing to the past, to the future, or it describes the present day situation. Action has temporal features. Information used to affect the acting environment shall be launched at the right moment and it shall be delivered for a suitably long time. Both moment and duration are situation-dependent.

The publications in this thesis were bound to finalize the research as depicted in figure 52. Papers P1, P2, P3 and P4 defined the starting point and information and time theoretical aspects of this thesis. Papers P5 and P8 discussed the information exchange and refinement in making information available to the decision information process. Papers P3, P6 and P7 enlightened the area of long-term information essentiality to be able to make choices at present day. Papers P9 and P10 describe one information sub-process in the overall information availability system. As it has been noticed, the coverage of the publications is not complete. Therefore the discourse was completed with a few other examples and considerations to cover the whole area of the information availability in the decision-making system.

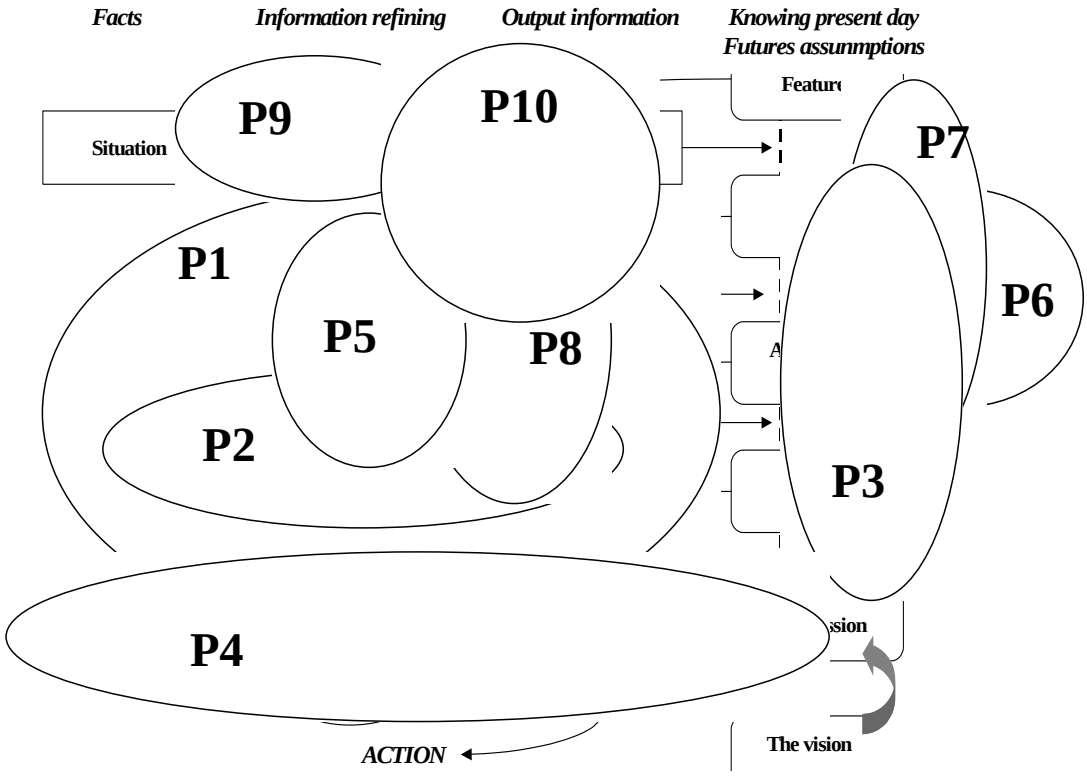


Figure 52. The coverage of publications

This thesis was constructed as a learning system. A variety of seemingly different cases were acting as the starting point for the research work. Despite of this virtual divergence, some common features and phenomena were found. As has been stated, time, information and communication combined to the system thinking in social systems appeared to produce understandable abstraction about the whole problem area. The whole research process remained faithful to the research approach stated at the end of chapter 2.3, “This study follows the hermeneutical approach, seasoned with a handful of phenomenology, recognising at the same time that there is no science without technology”. Hermeneutics can be found rather clearly from the theory forming part. Bit by bit, a theoretical wholeness was created. Phenomenology appears using applications. In this thesis, relevant items about empirical phenomena were chosen to validate the overall construction of the meaning of information availability in the decision-making and planning processes. The tool to analyse the information availability was depicted in figure 34. During the analysis process of the empirics, a few minor corrections had to be made to that tool. Output information requires a bi-directional relationship to the refining process. Means and resources provide information about themselves as input facts for the refining process. The action-planning phase shall exist in the process, as well. The final version of that method is shown in figure 53.

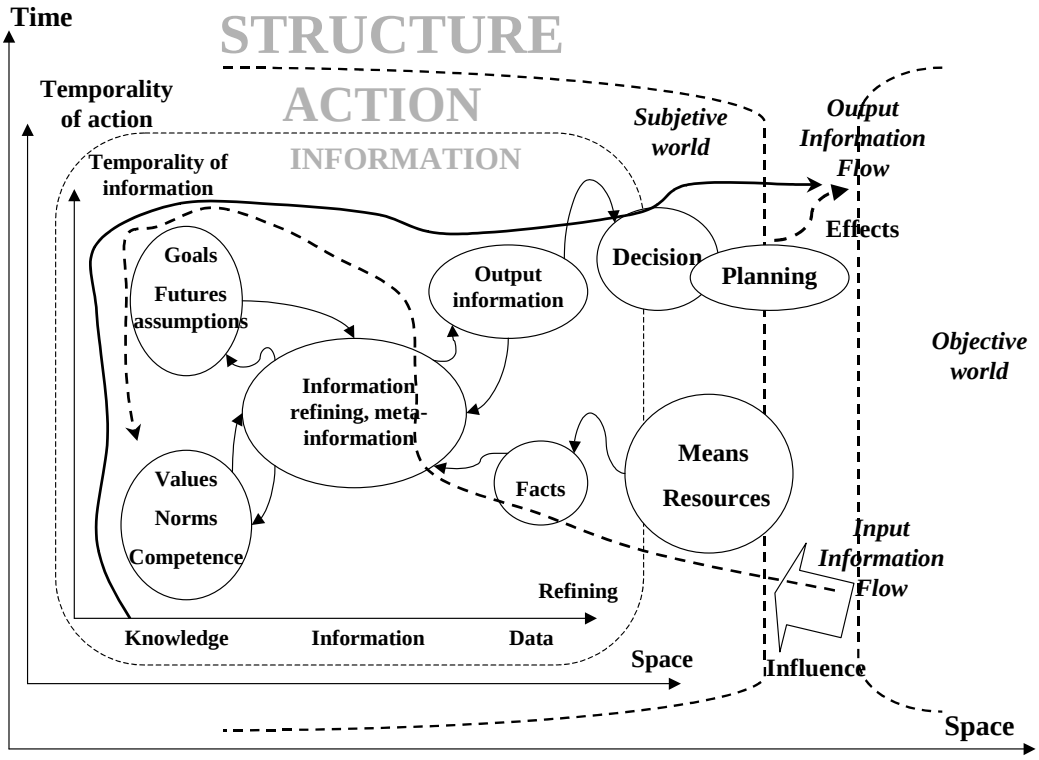


Figure 53. The systemic expression of the use of information

But was this research beneficial? Is the information reached in this thesis available to someone? The answer is already now positive. A research project lasting several years has been launched on the basis of the theoretical construction and its validation presented in this thesis. It seems that the generalised expression about making decisions in the complex information situation depicted in figure 54 gives a good starting point to evaluate other decision-making and information evaluating processes, as well. It is interesting to compare this product with the one presented in P1. This is depicted in figure 55. This system has a certain amount of those features that exist in figure 54, as well. But its structure is monolithic, thus losing the finesses that confines the temporal and categorical divergence of the information availability in the decision-making process in a temporally demanding and unreliable information environment.

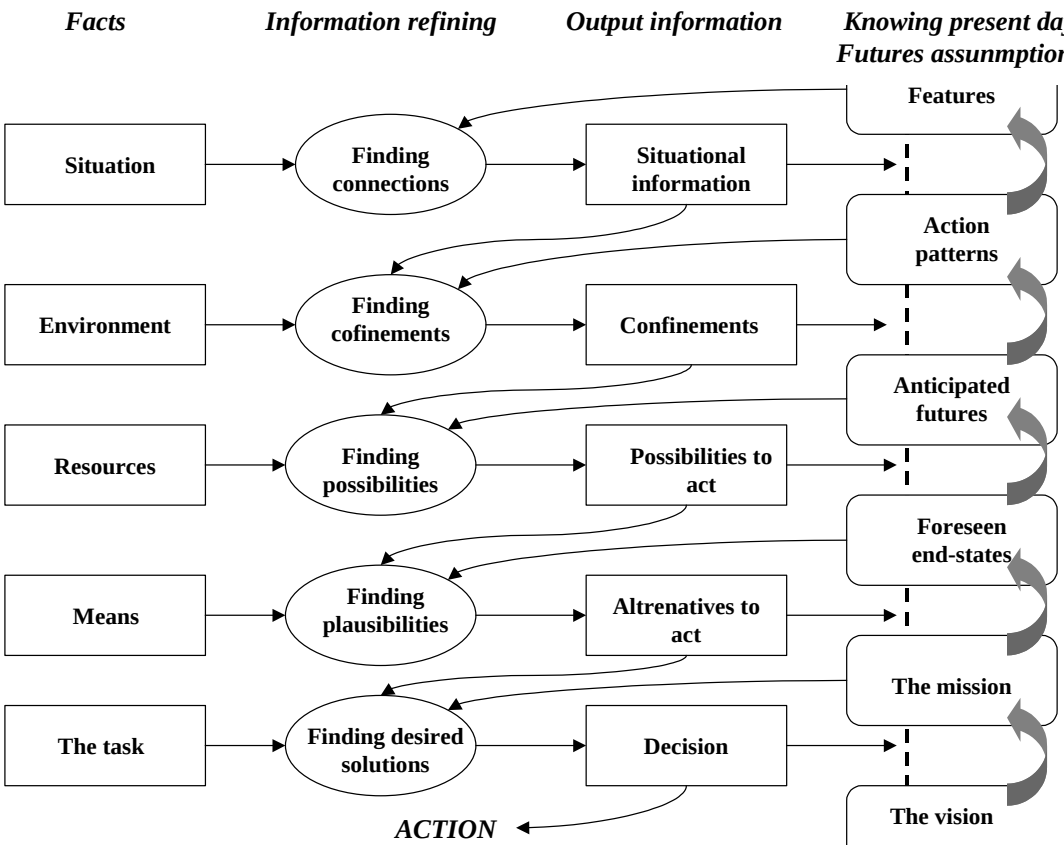


Figure 54. A generalised form for planning and decision-making from the information viewpoint

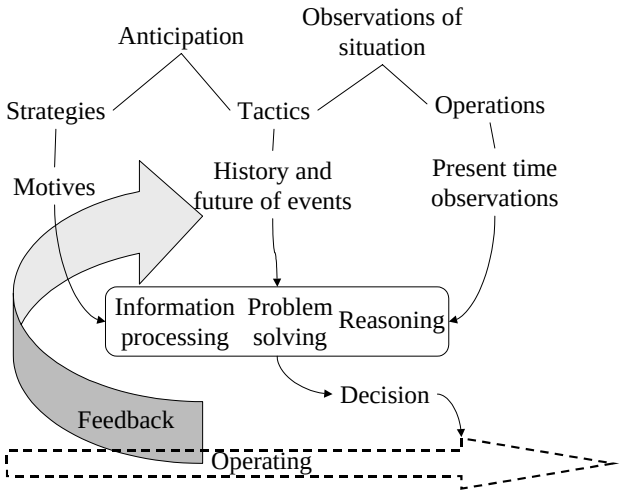


Figure 55. The pre-knowledge model of the information processes in the decision-making system presented in P1, figure 6

The concept of information availability is not an easy one. It seems that availability is a complex system in itself. This work gave some hopefully new starting points for discussing the overall field of security, information security and information availability in the decision-making and planning processes. A huge amount of

research work still exists after this project. Like the philosophical paradigm of phenomenology lets us understand, a certain amount of new questions will emerge during the research project. This has occurred, indeed. Lots of questions about the information and the time and their relationship in situations have merged.

In the spirit of phenomenology, a vast number of new research topics emerged especially in the last phase of this research work. Some items will be expressed here:

1. Technological solutions concerning information refining algorithms.
2. Technological solutions concerning the expression of output information.
3. Anticipation algorithms.
4. Producing and expressing futures' information.
5. Technological support for gathering and up-dating the input facts.
6. Enhancing decision-making systems.
7. Finding solutions for training people.
8. Finding weaknesses in command and control systems.
9. Finding ways to protect against information warfare attacks.
10. Solutions of situation picture at joint level and hierarchical level.

That list gives the so far final answer to the last research question. Information exploitation in a temporally demanding decision-making environment consists of the divergence of such special requirements for both the technological solutions and for human behaviour and their interacting that will produce a vast amount of relevant research. Analysing the information availability opens opportunities to focus the further research. It reaches towards the limits of knowing…

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LIST OF PUBLICATIONS

1. Kuusisto, R., “Soft Systems Methodology as a Tool in Studying the Performance of Leading”, proc. of 2002 IEEE International Engineering Management Conference, st. John’s College, Cambridge, pages 368 – 371, ISBN 0-7803-7385-5, United Kingdom 2002.
2. Kuusisto, R. and Helokunnas, T., ”Experiencing Time in Leading Systems”, proc. of 2003 IEEE International Engineering Management Conference, Albany, New York, pages 415 – 419, ISBN 0-7803-8150-5, USA 2003.
3. Kuusisto, R., Helokunnas, T. and Ahvenainen, S., “Intellectual Capital and Time in Information Superiority”, Hutchinson, B. (ed.), proc. of 2nd European Conference on Information Warfare & IT Security, University of Reading, pages 201 – 208, ISBN 0-9544577-0-6, United Kingdom 2003.
4. Kuusisto, R. and Kuusisto, T., ”Time in Information Operations”, Slay, J. (ed.), proc. of 4th Australian Information Warfare & IT Security Conference, University of South Australia, Adelaide, pages 203 – 210, ISBN 086803995, Australia 2003.
5. Helokunnas, T. and Kuusisto, R., ”Strenghtening Leading Situations via Time-divergent Communication Conducted in Ba”, Van Beveren, J. (ed.), the E-Business Review, Volume III, the International Academy of E-Business, Nacogdoches, Texas, USA, pages 78 – 81. ISBN 0-970-7955-2-1, USA 2003.
6. Helokunnas, T and Kuusisto, R., ”Information Security Culture in a Value Net”, proc. of 2003 IEEE International Engineering Management Conference, Albany, New York, pages 190 - 194, ISBN 0-7803-8150-5, USA 2003.
7. Kuusisto, R., Nyberg, K. and Virtanen, T., “Unite security Culture”, Jones, A. (ed.) proc. of 3rd European Conference on Information Warfare and Security, Royal Holloway University of London, pages 221 - 229, ISBN 0-9547096-2-4, United Kingdom 2004.
8. Kuusisto, R., “Reaping Strategic Benefit by Understanding Innovational Information Flows in the Organisation”, Tretyakov, S. and Säily, J. (ed.), Digest of Technical Papers of URSI/IEEE XXVII Convention on Radio Science, Helsinki University of Technology, Helsinki, pages 68 – 70, ISBN 951-22-6170-7, Finland 2002.
9. Kuusisto, R., Huhtakallio, J. and Kuusisto, T., ”Situation Officer as a Decisive Enabler, Theoretical Framework to Analyse Information Flows and Action”, Jones, A. (ed.) proc. of 3rd European Conference on Information Warfare and Security, Royal Holloway University of London, pages 211 – 220, ISBN 0-9547096-2-4, United Kingdom 2004.
10. Kuusisto, R, Kuusisto, T. and Huhtakallio, J., ”Situation Officer in the Centre of Gravity of Information Flows”, proc. of 5th Australian Information Warfare and Security Conference, Edith Cowan University, Perth, pages 117 – 124, ISBN 0-7298-0569-7, Australia 2004.

CONTRIBUTION OF PUBLICATIONS

P1, "Soft Systems Methodology as a Tool in Studying the Performance of Leading"

Short description of the paper: This paper evaluates the possibility of using soft systems methodology as a research tool in order to find out limitations, performance and best possible processes of leading in an organisation. The studied organisation is acting in a critical situation caused by lack of proper information and time for decision-making. Outlines about methodology, case situation and system description are presented.

Own contribution: This paper is completely own production.

Contribution of other authors: -

The meaning of the paper to the thesis: This paper introduces Soft Systems Methodology (SSM) in the context of complex planning and decision-making situations. SSM is used to structurise command and control process and convert it into a systemic pattern. This is done to gain understanding about mutual effects of action, and about the information flows, which are gluing those activities together to reach as purposeful action as possible at the strategic, operational and tactical level. The paper reaches to find out the starting point to study information availability in decision-making nodes in an organisation, which acts in various situations. A reasonable abstract structure to model any information-using node at any level in an organisation was found. This same idea can be seen rather more accurately presented as the ending conclusion of the whole thesis.

In the model described in P1, too divergent collection of issues was tried to put in same system description. This includes information flows, communicative acts, resource binding, problem solving, temporality and developing of the process. Obviously certain amount of fuzzyness will occur. Anyhow, right phenomena were dealt with this model, but logic of this dealing was somewhat tottering because the divergence of phenomena contains action, structures and information and on different ontological levels, as well. This same problem occurs in P2, as well, but there it is not so critical. For now, it seems that the trial of making a system model of information processes in leading situations, was not very successful couple years ago. Anyhow, the overall idea of P1 was to find out simple systemic structure enough to model a node, which uses information, was successful.

P2, "Experiencing Time in Leading Systems"

Short description of the paper: This paper introduces, how time should be taken account in leading processes. Why time is so crucial, when leading situations are discussed? This paper results guidelines about the meaning of time in the context of complex and temporally demanding leading situation. It is pondered whether understanding objective duration and subjective duration, i.e. those time windows, which the acting environment allows and the actor itself requires, is essential.

Finally, it is discussed, what kind of problems may arise, when trying to study time experiences

Own contribution: The idea and main content, as well as editing work of the paper, is own production.

Contribution of other authors: Discussions about structure and how to connect together those phenomena dealt with the paper were done with co-writer.

The meaning of the paper to the thesis: The pre-assumption about the abstraction, which shall be set in the hermeneutical process of the complete thesis, is introduced in this paper. Figures 2 and 3 will depict this abstraction. An abstraction of simplest possible system to study information flows and information refining process are introduced in this paper. The issue, how the world of perceptions and the internal information of a subject differ from each other is introduced, as well.

Further on, experiencing time, and how these experiences can be seen outside the subject are introduced. The meaning of the temporality of action is dealt with. Finally, the potential of objective information is introduced. This potential is the overall information storage of the whole working environment, from where the available information will be sorted out for purposeful use.

P3, "Intellectual Capital and Time in Information Superiority"

Short description of the paper: This paper pays attention on the meaning of information superiority. Traditionally, the definitions of information superiority have emphasized the management of data and information. This paper describes and applies the concepts created in the fields of information and knowledge management and the theories of time to increase understanding about the contents of information superiority. The paper uses Popper's three worlds as a theoretical framework to classify the components of information superiority.

Own contribution: The combination of time aspects, communicative theory of Habermas, and outlining the system of intellectual capital and time via Poppers theories is own production.

Contribution of other authors: The idea of the paper was launched together with all three writers in few discussions. Especially discussions with the second writer were most effecting. The idea about connecting the concept of the intellectual capital to the wholeness came from her. Editing the paper to its final structure is the production of the second writer.

The meaning of the paper to the thesis: Features of information in the context of information and knowledge management are introduced. Especially interesting concepts from the viewpoint of this thesis are intellectual capital and competence. Time connected to the competence to use information in the context of information superiority is introduced. The meaning of information availability in critical competition environment is dealt with. The ultimately simple network of using and producing information – i.e. Bergsons five-node model – is introduced in the context

of time. Understanding the meaning of adequate duration, when performing certain activities is introduced in the context of military information superiority.

P4, ”Time in Information Operations”

Short description of the paper: This paper applies concepts created in the field of time theories to increase understanding about the effects of information operations. Traditionally, the definitions of information operations have inherently included the time aspect but the role of time has not been explicitly explained. The paper describes the nature of information from the past, current moment and future. The paper uses Popper’s three worlds as the theoretical framework to classify the environment of information operations. Short-term information operations have an effect on the operating level. They provide the operating level actors with power to select the moment of the implementation of the activities. This typically extends the duration given to perform the activities. Long-term information operations have an effect on the theories and mental models of information, war and information operations.

Own contribution: The idea of the paper, as well as ideas about time combined to information and using Poppers’ three-world model to describe the ontology of information operations, are mainly own production.

Contribution of other authors: The writing process was launched after discussion with the co-author. Finally the conclusive ideas for the final structure, and about one third of the content, are contribution of co-author. Editing was made together.

The meaning of the paper to the thesis: This paper describes the rough classification of the quality of the information. Features and mutual dependencies of data, information and knowledge are introduced. The meaning of the temporality of information is introduced in the context of quality classification of information. It is discussed via the concept of Poppers model of three worlds and the ontology of information operations about the meaning of subjective and objective duration, when setting different information available. It is noticed that information will be available only at certain levels and certain situations, not always in any place. Information availability is restricted by time and space. This space is not only physical, but mental, as well.

P5, ”Strenghtening Leading Situations via Time-divergent Communication Conducted in Ba”

Short description of the paper: This paper presents a time-divergent communication model in the context of leading expert work. It is assumed that in a turbulent expert personnel situation, leading process could become rather problematic without continuous communication not even during the actual leading process, but in advance. Considering leading in the context of time divergent communication, three different objectives can be found. First, the leaders of an organisation have to communicate its image in advance and in a powerful way to find those experts they need. Secondly, the leaders must influence to the employees so that they commit to the objectives of the organization. Thirdly, the leaders must be able to make the experts to deliver all the relevant information, knowledge and competence they have

to the organization. The prerequisite for the communication objectives to be reached is that a moment in the time-space, i.e., ba is created by the leaders and the employees.

Own contribution: The idea of the paper, and about one half of the content, especially aspects concerning communication and finally the time-divergent communication model are own production

Contribution of other authors: Ideas for the final structure of the paper, and binding into practice are contribution of co-writer.

The meaning of the paper to the thesis: A Japanese concept of "Ba" (the temporally-spatially allowed situation, where information exchange can take place) is introduced alongside the concept of "forum", where communication can take place. Those concepts are applications of the phenomenological concept of "lifeworld", which is the knowledge-based space of basic assumptions, on which the information exchange will occur. This paper introduces the meaning of mutual understanding as a pre-assumption for the capability to receive available information. Time-divergent communication model is introduced. This model is later used e.g. in one of the validating cases. Time-divergent communication model claims that the more long-term effects are desired the longer time the information shall be available to the one, who will be influenced.

P6, "Information Security Culture in a Value Net"

Short description of the paper: The objective of this paper is to increase understanding about the management of information security culture when acting in a global value net. Especially, the paper deals with information, knowledge and time as resources of the leading of information security culture. The paper regards information security culture as a system consisting of interacting framework and content components. Framework contains standardization, certification and measurement of information security. Content includes people attitude, motivation, knowledge and mental models about information security. Communication is a tool that the focal organization of a value net uses to create understanding and put information security in practice.

Own contribution: Dealing with culture as an abstract, dynamic system, considering communication as a tool in understanding the difficulty of maintaining unified culture, and finally the meaning of understanding the difference of the significance of different actors in network, were own contribution of this paper.

Contribution of other authors: Idea of the paper was born in few discussions with the first writer. The concept of value net came from the main author of this paper.

The meaning of the paper to the thesis: This paper describes the background of information security culture. Von Solms' thoughts about three waves are introduced to deal with the temporal challenges in creating security culture in complex working environment. Time divergent communication model is tested as a concept in the conceptual environment described in the paper. This paper acts as background study for one of the validation cases of this thesis.

P7, "Unite security Culture"

Short description of the paper: The aim of this paper is to study, whether a unified security culture is possible in culturally divergent environments. Security is considered as a whole, but the focus is set on the socio-cultural viewpoint. Long-term aspects of security are stressed. The meaning of security culture forming is discussed and some possibilities to create a holistic security cultural atmosphere are discussed. The problem is approached via Habermas' communicative theory, Hofstede's cultural findings and von Solms' thoughts about comprehensive concepts of security culture.

Own contribution: The idea of the paper, the theoretical approach via Habermas' communicative theory to culture forming process, conclusive work, and final structure as well as editing work are own production.

Contribution of other authors: Case study for this paper was completed by the second writer, and revising process was conducted by the third writer.

The meaning of the paper to the thesis: This paper introduces systemic approach to information flows in the context of creating security culture. The systemic approach presented in Habermas' theory of communicative act is applied to a case study about the meaning of unite values in creating security culture. The demanded duration to reach unified understanding about cultural aspects concerning security is dealt with. The role of this paper is to validate the final construction of dealing with aspects on availability. This paper contains a part of theoretical basis leading to the empirical study documented in P10.

P8, "Reaping Strategic Benefit by Understanding Innovational Information Flows in the Organisation"

Short description of the paper: In this paper it is pondered whether the principles of business managerial theories are suitable for understanding defence forces internal production management, as well. Defence products can broadly be understood as those acts, introductions and systems, which produce real security or secure feelings to the nation. In this paper, focal point is set to material acquisition coordination processes supported by technical research. It is assumed that successful acquisition demands good knowledge in both needs of the customer and the possibilities and restrictions of technology. This tripodic combination – technological (and other) research, development and other scientific work, knowing the customer, and purposeful production – will produce those kinds of products, which could be marketed to publicity legitimatically and justifically. But this transpires only, if information during total process is flowing in the right direction. Theoretical basis of making strategic benefit by understanding the meaning of information flow in the organisation is adopted from Ikujiro Nonaka and Hirotaka Takeutchi.

Own contribution: Completely own production.

Contribution of other authors: -

The meaning of the paper to the thesis: This paper introduces part of results concerning one of validating cases of this thesis. The paper describes, how the information can be organised to be available for decision-makers in long term planning and decision-making processes. This paper is a part of validation of the final result of the thesis. The paper actually tells that the as its part, the future can be completed via understanding futures technological possibilities in advance.

P9, "Situation Officer as a Decisive Enabler, Theoretical Framework to Analyse Information Flows and Action"

Short description of the paper: This paper delves in the world of combat information flow. We are introducing a concept called "situation officer". The task of situation officer is to release commanding and planning officers from the burden of masses of not so necessarily relevant detailed data and information thus leaving more time and thinking space to their main duties. On the other hand, situation officer is releasing necessary information to subunits to fulfil their tasks. We assume that via realizing the concept of situation officer the planning and decision-making cycle will be shortened and directing mutual information resources will be more effective thus giving better opportunities to perform activities more precisely both temporally and spatially. In this paper, we introduce one approach to the theoretical basis of information flowing, and the concept of situation officer.

Own contribution: The idea of the paper is own contribution. The theoretical frame, conclusions, completing the parts concerning the concept of the situation officer and editing are own contribution, as well.

Contribution of other authors: Draft about the content concerning the concept of the situation officer is contribution of the second author. The third author revised the complete writing.

The meaning of the paper to the thesis: This paper gives in compact form the theoretical framework and the description of problem situation, which lead to the empirical part of the studying the information flows of the situation centre in the combined arms. This paper as its part describes the theoretical frame and gives the problem definition for the research, which is described in P10.

P10, "Situation Officer in the Centre of Gravity of Information Flows"

Short description of the paper: This paper documents the second part of three-phased study about the management of information flows concerning situation awareness in military units. This paper is the continuation of two papers published in 3rd European Conference on Information Warfare and Security held in United Kingdom in July 2004. These papers introduced the theoretical construction used as a basis of this study. The main theory is based on the philosophy of social systems described in the theory of communicative act by Jurgen Habermas (1984, 1989) The aim of this paper is to introduce empirical results about managing information flows in the situation centre of the headquarters of combined arms. A brief introduction about the concept of situation officer and the theoretical background of this study is introduced. Second, the method of this study is described. Third, suitably abstracted results including depicting of information flows are introduced and conclusions are made against the

theoretical background. Three main items is studied: What kind of information is found to be interesting in situation centres, what medias are used to transfer information, and from as well as to where this interesting information is transferred? The main research method was survey complemented by interviews and observations.

Own contribution: The idea of the whole research and the paper is own contribution. The final interpretation of the empirical results is own contribution. Writing the paper is completely own contribution, as well.

Contribution of other authors: Final planning and executing the survey, as well as preliminary interpretation of the results was completed with co-authors.

The meaning of the paper to the thesis: This paper describes one validating case of the theoretical construction presented in the thesis. This validation information is based on empirical data, which was gathered during a combat exercise in spring 2004. Empirical data was gathered from situation officers acting in situation centres of combined arms headquarters. The method was survey complemented by interviews and observations. In this paper, some analysis concerning the more broad validity of the theoretical construction is made, as well.