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**CHOOSING INFORMATION SHARING STRATEGY ON COLLABORATION NETWORKS**

**Topic 3:** Information Sharing and Collaboration Processes and Behaviors

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## Abstract

It has been discovered that conflicts are complex by nature and crisis management requires more cooperation, coordination and coherence on all levels of crisis management activities. Comprehensive approach (CA) in crisis management can be seen as a means to an end. It is about developing a culture of cooperation and mutually understood and accepted practices to reach commonly understood goals. Comprehensive approach realization requires re-thinking of information exchange strategies between co-active parties. This article presents practical findings based on solid collection of theories about the necessity to rethink information sharing strategy on present day and futures collaboration networks. Finally, the findings are interpreted as information sharing policy suggestion using the theory of complex adaptive systems (CAS) as reference.

**Key words:** Comprehensive approach, complex adaptive systems, Information sharing strategy, Collaboration

## 1. Introduction

It has been discovered that conflicts are complex by nature and crisis management requires more cooperation, coordination and coherence on all levels of crisis management activities. There are also significant differences between various actors to approach the crisis management, both on values level and on practical problem solving level. Comprehensive approach (CA) in crisis management can be seen as a means to an end. It is about developing a culture of cooperation and mutually understood and accepted practices to reach commonly understood goals. (Defmin 2009, Intermin 2009) On the other hand, experiences from NATO operations has shown it essential that "planning and crisis management procedures are coherently applied and it (NATO) is able to co-operate with a range of partners .. (UN, EU, NGO:s, local actors) .. in the planning and conduct operations." It is also emphasized that when seeking cooperation with various actors there will be no overtaking authority to take a role over collaborative parties, because that "would be inappropriate and counter productive". (UKMOD 2005, USMC 2006, UKNATO 2009)

Based on the spirit of the experiences described above it can be argued that comprehensive approach is a concept that invites various organizations and other actors and stakeholders to collect together to deal with a common challenge in commonly understandable and acceptable way. Comprehensive approach is about getting together in a novel way to find solution and put in practice to gain something that is commonly understood in ever evolving complex networking environment.

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Comprehensive approach realization requires re-thinking of information exchange strategies between co-active parties. Cooperation in emergently evolving networked environment sets new kinds of challenges to both collecting required and necessary information and especially releasing right kind of information at right moments to relevant actors to enable efficient collaboration. Traditionally, information exchange has been conducted in content based way. This article presents practical findings based on solid collection of theories about the necessity to rethink information sharing strategy on present day and futures collaboration networks. Finally, the findings are interpreted as information sharing policy suggestion using the theory of complex adaptive systems (CAS) as reference.

## 2. Theoretical basis and hypotheses

Theory for deepen the understanding about complex information exchange situations originates to complex adaptive systems. (Holland 1995, Kauffman 1995, Ball 2004) In this paper, the human information exchange framework is based on communication philosophy (Habermas 1984, 1989), sociology (Parsons 1951, Luhmann 1999), cognition philosophy (Bergson 1911, Damasio 1999, Merleau-Ponty 1968), organizational culture (Schein 1992, Hofstede 1984), knowledge management (Polanyi 1966, Maier 2002, Nonaka&Takeutchi 1995) and decision support systems (Turban et.al 2005, Marakas 2003). Empirical material is collected during national and international inter-organizational cooperation exercises between 2005 and 2008. Individual results of those studies have been published on academic conferences and research reports (Kuusisto and Kuusisto et.al. from 2006 to 2008).

The theory of complex adaptive systems (CAS) by (Holland 1995) aims at to explain the chaotic nature of multi-actor interactive system on the viewpoint of one actor. The CAS theory seeks understanding of the adaptive behavior of an entity in its acting environment by categorizing its basic features. CAS theory divides these basic elements in four properties and three mechanisms. Properties are aggregation, nonlinearity, flows and diversity. Mechanisms are tagging, internal models and building blocks.
   1) Aggregation is a property of an entity. It defines that an entity seeks to categorize same kind of things in same kinds of classes, like vehicles, organizations, plants, animals, etc and after this classification treat the members of those classes as equivalent. All new perceptions are then situated into these classes to ease to understand the outer world. On the other hand, aggregation aims to explain, what a complex adaptive system does as a whole. It seeks to gain understanding about the behavioral phenomena of entities defined by certain plethora of classes.
   2) Tagging is a mechanism that gives a descriptive symbol for an aggregate. Tags guide entities with same kinds of phenomena towards to meet each others. Tag is a name or symbol to gather correspondence entities together.
   3) Nonlinearity is property that expresses that the outcome of the whole is not the sum of its parts. It describes that aggregation reaction rate cannot be predicted from aggregation rate or vice versa. The outcome of multi-actor inter-action

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situation cannot be deterministically counted by knowing the features of all entities.

4) Flow is property that tells what transfers between nodes. Flow can be information, material, radiation or symbol (like money). Common to all flows is that they depart from node to reach another node(s) via some connector(s). Nodes act like processors that refine or redirect flows. Nodes, connectors and flows vary over time that makes CAS a complex system. Nodes that are able to deal with relevant tags flown through them will more probably survive better that those that are not able to deal with those tags. Flow has two properties. The first one is called multiplier effect. It means that additional resource injected into a system produces a chain of changes via affecting the internal behavior or redirecting properties of nodes. The second property is the recycling effect. It is a feedback process, where output of a process has effects on the input stage of the process. In CAS environment several such feedback processes and interacting relationships are taking place simultaneously, because nodes are connected together via evolving connector network. A critical aggregate of tagged flows will have cumulative effects on the existence of the wholeness.

5) Diversity is property that tells that wholeness contains certain amount certain kinds of nodes that have suitable role in that wholeness. Divergent nodes do not appear accidentally or randomly but to fill a niche that is defined by the interactions centering on that agent. If a specific node is removed it will be replaced during time with another similar kind of nodes or its roles are transferred to other nodes. Diversity increases, when the wholeness that determine the acting environment changes. New kind of niche areas will emerge and new types of nodes will evolve. So, the gaps in the comprehensive system will be filled to keep the system running.

6) Internal modeling (or schema) is mechanism that causes certain behavior of an entity, when certain stimulus occurs. Internal models are the basis for anticipation and prediction. Models are derivatives of aggregations. Models are a combination of incoming stimulus, entity's existing information and entity's structural phenomena. Finally the model itself becomes a structural filter of the entity. Two kinds of models exist. The other one is tacit model that specifies entity's reaction to a stimulus. The other one is overt model that directs entity's behavior towards the futures challenges. The latter one includes the ability to anticipate the future.

7) Building blocks form the mechanism that enables to construct models in a simple way. Each block is tagged aggregation. Second level aggregations and models can be formulated by combining certain simple enough building blocks. Blocks are combined together in space in a certain order to form such models that can be tagged to be meaningful for the node. (Holland 1995, 10-40)

The world can be considered as a complex system of complex systems. It is neither random nor accidental. It is a collection of systems' elements with certain kinds of universal features and the continuum of their interrelations. This makes the world act in a non-deterministic way. This apparently fuzzy behavior becomes understandable if we perceive the system at the right structural level. (See Ball 2004, Kauffmann 1995)

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Complex adaptive systems theory describes fundamental phenomena of interacting community on the viewpoint of one entity. When this theory is applied to human communication activities, the next often revealing features can be stated as hypotheses.

1) People like to categorize the exchanged information. Typically information is categorized by content and it is defined by subject of interest. Information exchange strategies are based on these content based aggregations. The behavior of the wholeness is judged on behalf of aggregation of those content based information categorization models.

2) Social communication networks are defined by subject of interest. The name – tag – of interest guides people to form networks with such people, who express same kind of tags. Communication networks are based on similarity in content.

3) The outcome of nonlinear interacting system is emergent thus being out of individual control. This emergence is frequently attempted to tame with complicated information categorization models and precise procedures.

4) Information flow between various interactive entities is attempted to facilitate or moderate to make it controllable. The flow is controlled by content and amount. Second order effects are typically not taken account.

5) Diversity of actors in networked communication situations is wide and complex. Diversity can be organization structure, information handling role, interaction phase or information content based. Typically diversity is seen case by case without taking account the comprehensive wholeness. Universal phenomena of diversity are seldom taken account.

6) Internal models are based on existing experiences, competence and valuations of an entity and they are evolved by incoming perceptions. The evolution of internal models is relatively slow thus making novel communication situations with unseen parties somewhat challenging.

7) Because of the content based strategy of information exchange the building blocks of creating common models for releasing and receiving relevant information will be different amongst different communicative actors. This makes communication challenging, while different actors are speaking on different context.

The above statements represent typical practical level presentation about on information exchange situations between human individuals. However, this paper seeks to present some new approaches to interpret CAS at communication situation and context level instead of communication between human individuals. Aggregation will be shifted from dialogue content to dialogue situation.


## 3. Practical findings

Communication challenges could be found on the basis of CAS theory. Next, some conclusions based on practical findings that are collected during last few years on several various collaboration situations are documented. These situations are analyzed against solid theoretical basis (see literature in chapter 2.) and a suggestion to develop information exchange strategy will be argued. Analyzed situations deal with e.g.

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searching partners, launching collaboration, handling situation with collaboration, and managing emergent situation. Next conclusive text is first published in (Kuusisto 2008 a). See also an application to security culture in (Kuusisto & Kuusisto 2009).

The most important information in network foundation phase will concentrate to every actor internal facts added with values and competence information. (See appendix A.) In addition, information about all working environment features and issues was found crucial to successfully work on the area.

In tactical planning situation, information in the middle of the model comes important in addition to situation follow-up and decision information releasing. During briefings, discussions raise up mainly about available means and resources and about possibilities and alternatives to act, as well mutual restrictions for activities. In the case of small group decision-making discussion, the general information releasing profile was quite equal to the one with briefings. What comes into the discussed information categories, still the means and resources items were found to be important, but discussion about alternatives to act moved towards to anticipate the future and to evaluate the possible end-states of overall activity. Discussing about mutual future orients parties to work together more longer periods than to only deal with the emerging issues.

As a conclusion it can be argued that improvement of harmonizing the efforts on the field would need a concept that provides as good a system as possible to improve the potential of information sharing of the information of the working environment and the features and action patterns of all actors in emerging and non-lead networking communication and acting network. Information sharing system shall provide a discussion forum and it shall fulfill the demands of good practices of information and knowledge management. The forum shall contain content of areas of interest of various actors, as well.

We can postulate that different kind of usage situations require different kind of emphasis concerning the type of the information required to be exchanged. It seems that whether conducting operations or activities the sharing of certain information categories between interacting parties is beneficial. This is consistent with Habermas´s theory of communicative action (1984, 1989). He claims that to start communication, at least one common item must exist between interacting parties. Interaction and its development are based on this common item. The implication is that to conduct interaction between two or more actors, one or multiple common categories of information must be present. To gain mutual understanding, or to protect one's own information space, interacting parties require common information flows.

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Information using profiles differ in the cases of making decisions, and preliminary planning work, the decision-making itself, as well as establishing collaboration relationships, managing various collaboration situations and providing information management and other support. To re-iterate from above, at least one information category must be common between those functions. Information flows pertaining to action alternatives should be managed well, because they join planning and decision-making functions. In general this means that organizations should understand what types of information are important for the activities between organizations. Workflows should support information exchange procedures across organizational boundaries to assure the information flow priorities, and to take into account the temporal demands of information exchange. Organizations should gain understanding about information exchange requirements to be able to fulfill the challenges that they face when interacting with other organizations or actors.

Information exchange profiles for cooperation shall be determined to optimize interactivity. This interactivity may be directed to the direction of superior, subordinate or peer levels. Those organizations or parts of organizations that are working with the same kinds of issues should have common information exchange profiles. Cooperation can be enhanced when information content priorities and time frames of updating content are consistent across various, collaborating, inter-organizational actors. It can be concluded that it is essential to identify, develop and exploit inter-working information exchange profiles.

Information content is the traditional way to categorize the needs of the information system user. That is a very good approach, when building up e.g. decision support systems. When collaboration support is dealt with, the user specific information content is no longer the primary engine to drive system development. In that case the phase of collaboration will be important, as well as the role of an individual member of an organization.

Information interests of various actors vary remarkably in time, space and content. Four different classification criteria can be pointed out:
-   Information content
-   The role of information carrier inside the organization
-   The phase of collaboration
-   The level of the organization

Based on earlier research results four information exchange role profiles have been recognized. These are: situation follow-up, situation analysis, planning and decision-making. Four different situations concerning information exchange have been recognized, as well. They are: starting new activity (planning), building up a network, moving from normal "steady-state" situation to a situation, where fast decision-making is required (managing a situation, executing a task), and guidance by values, when searching collaboration parties. Those eight cases where organization will end are different by the nature of exchanging information.

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Organizations have different structures. However, organizations are formed and operated by human beings, who exchange information in a human way. That makes all organizations – despite their different structures – act among similar principles.

Collaboration relationships are building up in a complex way, where structuring principles depend on the organizational structural level, the mission of an organization, the phase of the collaboration process, and the role of the member in an organization. First two determining the relevant information content and latter two ones obey the framework of the relevant type of information. It is crucial to find out and understand also what type (not only the content) of information shall be put available for others in collaborative network. This typifying requires an internal model of entity's information exchange. This model shall be universal, i.e. equivalent despite of the parameters of the information exchanging node (actor). Parameters are here understood as the position in the organization, role in the organization, phase of activity and task-oriented information interest. One model is expressed in Appendix A. This model has been successfully used in information exchange research and it has been tested on international scientific forum. The model expresses a universal tagged aggregation to understand information flows of an active entity in a diverse and nonlinear networked environment and position entity's information exchange situation into a structured schema. This is essential, because comprehensive social system is emergent, dynamic and complex. Further on deep pondering about information strategy that can be as optimal as possible for smooth acting in that kind of working environment is required.

Research results concluded above give a steering hunch to ponder that novel idea shall be produced to rethink information exchange strategies in a new way. It is obvious that traditional ways to steer information exchange are not so optimal in emergent networked environment. Next, some evaluation about possible information sharing strategies is made.

## 4. Information sharing strategies – some new possibilities in networked environment

Creating understanding is difficult. The world outside the subject may reveal itself as digital. It is right or wrong, good or bad; I either accept it or I reject it. Acceptance is not necessarily completely related to understanding, because judgments are not related to facts, but rather feelings that are further on based on long-term subjective internal information storage. Values, competences, skills are examples of long-term internal information. To create understanding it is essential to release this kind of long-term internal information to cooperative network alongside the situation updating, aims, environment and resources information. Understanding includes potential to create acceptance. Vice versa, it includes potential for non-acceptance, as well thus helping to choose relevant cooperation partners.

Different information sharing strategies may be chosen to create this understanding, acceptance and cooperation. Next information releasing strategies can be expressed:
    1)  I share everything.

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2) I share nothing.
3) I share to suitable degree by rationing out with nominated (subjective) criteria.
4) I share to suitable degree by releasing relevant type of information content related to criteria defined by working environment and situation.

Strategies 1, 2 and 3 are more or less content based strategies that are based on fundamental assumption that right kind of content of shared information is main judgment criteria. Strategies 1 and 2 can be called simple ones and 3 complicated one. They reflect those hypotheses expressed earlier in chapter 2. Those hypotheses are revelation of traditional information sharing thinking that emphasizes subjective content of interest approach to information exchange.

Strategy 4 is framework based strategy that assumes that certain situations with certain kinds of actors form the framework that defines information exchange requirements. This strategy is network and inter-working oriented. It takes account both subjective information releasing criteria and objective collaborative parties viewpoints. It focuses to the communication situation instead of communicated content thus pursuing to create situation and context based communication forums to enhance the maturity of cooperative communication.

One example of a community that could use complex information releasing strategy could be the US Intelligence Community (IC). It is a "federation of executive branch agencies and organizations that work separately and together to conduct intelligence activities necessary for the conduct of foreign relations and the protection of the national security of the United States." It collects, refines and distributes relevant and necessary information to nominated relevant actors of US high-level decision-making. (Intelligence 2009)

An example of a supporting structure for various actors to adopt complex information sharing strategy is described in (Kuusisto 2008b) as a generic reference of collaboration support system (CSS). This kind of system was developed and demonstrated in practice on Multinational Experiment 5. This particular CSS is assumed to be an information releasing and exchange forum, as well as collaboration toolset for very various organizations that are working on the same operational area. It gives a new viewpoint to collaboration field by expanding the collaboration situation to an environment, where divergently view-pointed and oriented organizations will seek and establish collaborative relationships instead of organizing cooperative situations with relatively equally based organizations or parts of one particular organization. The users will form relevant communities of interests (COI) to perform required cooperation activities. CSS supports this COI based collaboration enabling the existence of shared information via CSS processes on CSS services, which combination is managed by CSS support. This CSS information sharing architecture is depicted in figure 1. The process level is the working space, where various information releasing and receiving practices will be conducted. So, it allows framework oriented (type 4) information sharing strategy to be used.

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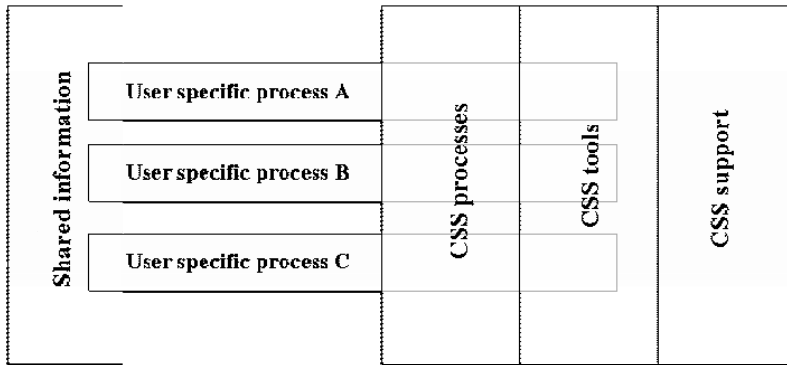Adjunct professor, FNDC

Figure 1: CSS information sharing architecture. (Kuusisto 2008b)

Strategy 4 may be called complex comprehensive information exchange strategy, or simply complex strategy. It takes account the second order aggregation, it is context tagged, and it allows nonlinearity and free evolution of divergence without need to adjust the information releasing criteria from situation to another or from actor to another. We shall remember the difference between complex and complicated. Complicated is something difficult, while complex is partly unknown systemic entity. (Applied on the basis of Merriam-Webster OnLine) Complicated is defined explicitly, but it is hard to perceive or understand as a whole, because it contains so many various parts. Complex is not known explicitly, but complexity is possible to understand, if we know some fundamental features of the complex system. That is the reason to call strategy 4 as a complex strategy and strategy 3 as complicated one. Strategy 3 obeys rules that categorize or classify the information content itself while strategy 4 relies on the understanding of the universal fundamentals of communicative situations.

Complex, comprehensive framework based information exchange strategy is based on rather simple logic of perceiving complex information exchange systems as follows. "I cannot exactly know the specified content information needs of my partners, but I can know the overall features of the working environment and the situation, where my partners are. If I know this, and I know what types of information (what kind of information exchange profile) is required to handle this kind of situation I can guide (and maybe control) my information publishing towards to release situation bound relevant kind of information and avoid to release unnecessary information." This requires that commonly accepted strategy based on common vision exists. Further on, this requires that situation understanding exists. Common operational picture (COP) is single identical display of relevant (operational) information shared by more than one command (DoD 2005). Although a common operational picture facilitates collaborative planning and assists all echelons to achieve situational awareness, it will not be enough. By using only the information that common operational picture offers, it is not possible to create comprehensive understanding about the complex situation as a whole. It requires much more information. This can be demonstrated by using the information categorization model described in Appendix A. A COP includes only few of those categories described by that model. To understand the situation and its requirements to release right kind of information requires that the existence all these information categories have been taken account.

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There are obviously challenges to move towards this kind of information exchange strategies. To understand and guide complex systems is more difficult that simple ones. This complexity is traditionally tried to control by making complicated models, where all system parts and their relations are defined. This leads to a situation where models are so difficult that their understandability suffers. Further on more and more deterministic regulations are formatted to handle these complicated models. This again, while trying to obey all regulations, leads to a situation where the viscosity of the whole system increases to a level where it becomes static compared to the requirements of the ongoing situation. At best the complicated information exchange strategy as a combination of information overflow and denial (compare to simple strategies 1 and 2) is successful in static enough situations, but at worst it produces the releasing of completely unnecessary information and at wrong moment. So, complicated information exchange strategy 3 cannot be optimal in networked environments.

Simple strategy 1 leads information receiving organization to chaos via information overflow that again leads organizations to be static while attempting to refine relevant information out of the vast mass. Simple strategy 2 leads information receiving organization either static situation or drives it out of the network. Static situation is caused by lack on information, of course. Drifting out of the network is caused by the inevitable information requirements of organization that shall be fulfilled. An organization collects its information anyway. If information is not available from the community where the organization is now, it searches a new one. So, it seems that simple information exchange strategies are not optimal in networked environment, neither.

So, let us presume that we shall move from content based simple and complicated information exchange strategies to the context and situation bound framework based complex, comprehensive information exchange strategy. However, information delivery, making it available, is only one part of information sharing strategy. Another part is receiving and use of subjectively relevant information. Information receiving strategies are simpler than releasing ones. Relevant question is filtering. Two-layer filtering is suggested, where level one (1) is situation and level two (2) is role. When we know the information type requirements of a certain situation, we can formulate relevant receiving information profile filter for that situation and if we know the role of an actor we can formulate a relevant information profile filter for that role. When complex information releasing strategy 4 is combined to this two phase receiving filtering strategy, a rather optimum information exchange strategy for emergent, dynamic and networked cooperation environment can be formatted. This supposedly requires adjustments on mind-sets both on user side and solution deliver side.

Using complex information releasing strategy and multi-filtering receiving strategy requires that the comprehensive wholeness shall be known, e.g. situation is understood, other actors are well enough known (with their roles, their activity phases and

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capabilities) and working environment is also well enough known, as well as the overall aim of activities is understood and accepted. Obviously, somewhat new kinds of technological solutions shall be developed to serve complex information sharing strategies. Finally, a new set of CAS-feature based hypotheses can be set to shift from content based thinking to framework based thinking in information sharing.

1) Aggregation shall be done on the basis of collaboration context and situation instead of communicated information content. Second order aggregation describes in that case the nature of cooperation instead of the meaning of each collaborative party.

2) Tagging is formed around the four-dimensional matrix defined by the role of information handler, phase of collaboration, level of organization and the interest of organization. Tagging supports context and situation based aggregation.

3) Nonlinearity is not tamed. Information exchange processes are meant to support various parties to deliver such information that will be effective in tagged situations.

4) Information flows are controlled by the demands of collaboration context and situation instead of one or several parties' agreements of releasable information. Each collaborating party releases such information that is relevant for tagged collaboration aggregation, not their core business. Core business information flow is meant for each party's internal use.

5) Diversity is not controlled or forced. Critical mass of various actors guarantees that all relevant acts will be done. Processes are used to encourage big enough amount of actors to involve to each tagged aggregation to guarantee critical mass.

6) Individual tacit internal models are not tried to harmonize. Tagged context and situation based aggregation's overt internal models shall be communicated in continuous dialogue. That guarantees that all individual actors involved to tagged situation have same understanding about the situation and the direction of the development of the comprehensive completeness. This means that situation understanding shall be created in continuous future oriented dialogue process amongst co-operating parties.

7) Building blocks are situations instead of organizations or other actors. The outcome of the comprehensive context will be constructed as a system of situations rather that system of actors. A shift from physical structures world towards the space of information can clearly be seen.

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**APPENDIX A**

**UNIVERSAL INFORMATION CATEGORIZATION MODEL** (Kuusisto 2008a)

Actors´ interests to information can be categorized in several ways, e.g. on time axis, based on information content, based on the role of a particular actor or based on the phase of activity. Information sharing interests differ from one situation to another and also from one actor to another. All these interest viewpoints exist during the situation where actors are involved. Information sharing situations are complex by nature. A unified structure of describing information shall be needed to structurize various information exchange situations.

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Rows describe the temporality and abstraction degree of information. Information at the upper row is relatively most abstract, future oriented and its effects are long-lasting. The lowest level contains information that updates fast, is concrete and is observable as immediate events. The column on the left contains cultural information described by Schein (1980 & 1992). The next column on the left contains actors´ internal information. Te next right contains information of expressed conclusions made by the actor. The column on the right describes information that comes from outside of an actor or is remarkably affected by the world outside the actor itself. Rough contents of the information categories are described, as well. The idea of this model is to act as a meta-model of human information handling. This model describes the information structure inside the blocks of quality and degree of individual and shared information and sense-making. With the help of this method the complex information exchange activity can be simplified and emerging phenomena of inter-working network can be found.

| *Values, Competence* | *Internal facts* | *Conclusions* | *External facts* |
|---|---|---|---|
| **Basic assumptions** Hidden assumptions that will guide the behaviour of an actor. | **Mission, vision** An end-state of the actor. | **Decision** A solution based on thinking and assessment. | **Task** Given activities or work to be performed. For example, activities originated by upper-level management or by the development of a situation. |
| **Socially true values** Assumptions that are mutually accepted in a certain group to be a basis of thinking and executing activities. | **Means** Activities or methods to reach an aim or fulfil a purpose. | **Alternatives to act** Description of possibilities or proposals to act. | **Foreseen end states** Future situations most certainly reached when activities are finished. |
| **Physically true values** Assumptions that can be accepted to be valid in a certain physical environment. | **Resources** Available material and human resources such as people, financial resources, material and office space and time. | **Possibilities to act** Describes a thing, event or development that can be taught or is expected. Possibilities to act are derived from strategies and resources. | **Anticipated futures** Describes possible paths to the goal that the actor can choose and that provide something new to the actor. For example, strategy alternatives. |
| **Social artefacts** Structure of a social system, principles of interaction and description of nodes and their mutual positions, and observable behaviour. | **Action patterns** Describes how an actor can behave. Are stored in databases or are tacit knowledge, e.g., process descriptions, manuals, instructions and action plans. | **Restrictions** Things that have to be considered before planning the use of resources and means. For example, restrictions placed on activities and conditions of information acquisition. | **Environment** Describes an area or a space that affects an actor. For example, activities of media, market trends, national trends, global trends and higher-level decisions. |
| **Physical artefacts** Results of activity, like technical results of a group, written and spoken language, symbols, art. | **Features** Describes properties of objects such as the properties of an organization or equipment. Are stored in databases or are tacit knowledge, e.g., infrastructure descriptions, properties of equipments | **Event model** A description that enables the outlining of the pattern of a situation. For example, reports, documents, analyzed conclusions such as quality reports, statistics, pictures and maps. | **Events** Describes time-limited events caused by actors. For example, meetings, accidents, hostile activity. |

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| | and competencies of people. | | |
|---|---|---|---|

Every layer of the model has a specialized task in the overall process of forming situational understanding and using information in situation follow-up, planning and decision-making process. The layer that deals with event information produces all the time an updated picture of events. On the next layer, the constraints are sorted out. This means the restrictions and possibilities that the environment and the action capabilities of actors have. Explicitly expressed information is the event picture and the information about environmental circumstances. Conclusions are abstracted analysis about restrictions and possibilities for an action.

The next two layers contain information about resources and means as input facts. These input facts as well as information about events and environment, and knowledge about the composition and the development of the situation and possible end-states are used as a basis. The possibilities to act and information about alternate ways to operate are refined. The 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. Conclusions of a neighbor layer are relatively more meaningful than information on the other layers. The whole spectrum of tacit dimension shall be available for the decision-maker. The decision-maker 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.

This ontology of human information handling structure is used to analyze various and different information sharing and information exploitation situations. Because it is universal, it can be used to analyze and develop information sharing strategies, as well.

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