

Luhmann meets the Matrix

Exchanging and sharing information in network-centric environments

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Abstract

A fast-paced process of hybridization of man and technology, organization and technology and society and technology is currently sweeping the world. This process requires a way of (scientific) thinking that takes hybrid systems as the starting point. This way of thinking gives hybrid systems an increasing need to be interlinked, which enables them to exchange and share information through these links. This development of linking (hybrid) systems to enable them to exchange and share information, can also be denoted as the realization of interoperability between (hybrid) systems. Five principles from Luhmann's systems theory can be of help to understand interoperability. Interoperability enables (hybrid) systems to join random coalitions and networks. The network centric warfare concept is currently the basis for international efforts for the development and application of interoperability that would enable armed forces to act effectively and efficiently. In this paper is demonstrated what Luhmann's system's theory can learn us.

Keywords: Hybridization, Interoperability, Systems theory, Network centric thinking

1. Introduction

This scientific research focused on the question: "can the development of interoperability between organizations in the public sector, in the preparation and fight against the consequences of disasters and crises, be promoted and made transparent with the systems theory of Luhmann". The entire research is based on the principles of postmodern, qualitative and interpretative research methodology and the argumentation of this choice is given in chapter one of my doctoral dissertation. The narrative method has been chosen for data collection. In this research we have focused on the development, use and (possible) consequences of new technologies and technological innovations.

2. Hybridization

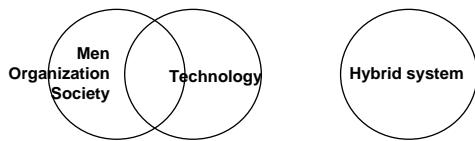
Our day-to-day existence is increasingly shaped by global techno-culture. A techno-culture created by the fast development of new technologies in areas such as the

media, ICT, robotics, but also developments in biomedicine and biotechnology, as well as the fast-moving developments in nanotechnology. The fact that technology has become a decisive factor in our postmodern society in recent years can, in our view, not be denied. Under the influence of technology, for example in the form of ICT or mobile telephony, our society has seen some fundamental changes over the past few decades. Technology and ensuing technological applications are also reducing in size and offering more and more functionality and opportunities. Technology and technological applications are also becoming ever more independent in terms of place and time. Take RFID chips, for example. These tiny chips are already being attached to, or incorporated into, products or goods to enable them to be identified and tracked at any time and anywhere. RFID chips are already being used in our passports, rail cards, in books, or in food packaging. The next step will see nanotechnology deployed on the level of atoms and molecules to create new possibilities through the production of minuscule new applications that are invisible to the human eye and can even reproduce unaided. This unstoppable and irreversible development of technology and technological applications will lead to man, as well as the organisations he is part of and the society he lives in, unwittingly merging with technology to an increasing degree. We refer to this process of fusion as the process of hybridisation, and we should, in our opinion, start taking this new combination of man or organisation and technology as the starting point for our way of thinking and acting

Technology is in a constant state of flux, partly causing an increasing influence of technology on the development of our society. Our society and its organizations and institutions are experiencing sweeping changes due to this technological development, often even without us realizing. This unnoticed change is most probably caused by the fact that technology is never stand-alone, does not develop itself, is developed in isolation, or is independent of other developments in society. The question remains what causes the irresistible influence of technology on

our working and private lives to only have a limited organizing and developing an organization? As the saying goes, 'unknown, unloved'. The development and application of technology are generally left to technicians, because people often find the complexity of technology and technological applications quite daunting. The different functional domains of organization experts and technologists are still developing separately, just like other domains.

As long as we keep our eyes shut to the way technology is developed and how this is continuously interwoven with man, organization and society, we are not consciously committed to technological development and its possible positive or negative consequences. As a result, the outcome of the process of technological development can be something we actually do not want. As argued in my dissertation the continuing hybridization between organism and technology will in daily life lead to the creation of distributed cognitive systems, which will contain human and non-human actors. These distributed hybrid cognitive systems will, in turn, be interrelated, and hence develop a kind of new 'self', in which human consciousness will be the source that delimits these hybrid systems and helps prevent these systems from getting out of hand.



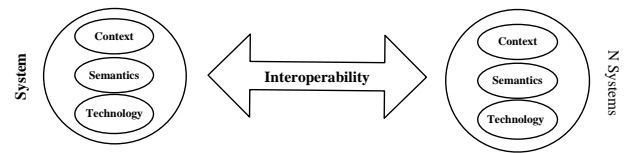
Conclusion 1. *An irreversible process of hybridization of human and technology, organization and technology and society and technology is in progress.*

3. Interoperability

That takes us to a central issue in the hybridization process, namely the way in which relations between different systems are shaped, the way in which these relations enable information exchange and sharing, and how this information can, in turn, be used for self-synchronization of the different systems in a network or temporary coalition. Establishing relations, therefore, goes beyond the technology used to exchange information, but also touches on the content of this information and the context that engenders that information or where it is used for self-synchronization of the systems involved, for example. The development of these connections is also referred to as the development and realization of interoperability between different (hybrid) systems and this is the central issue of chapter four of my dissertation. Interoperability is increasingly taking centre stage in a range of different areas within the public sector, such as defense or government at large. For instance NATO defines interoperability as the ability to set up network connections between nations, enabling real-time exchange and sharing of relevant information.

effect in terms of changing the way we think about This ability to set up connections and hence enable fast and accurate information exchange and sharing can then result in greater chances of survival, ability to act and strike power of the armed forces involved. From another perspective the European Union is also focusing great effort on the realization of interoperability, in particular as part of the 'e-Government' intentions under the Lisbon agenda.

Information interoperability basically enables the exchanging and sharing of information in any possible combination. Interoperability hence creates a basis for the development of a new form or a new system of communication between hybrid systems. In order to be able to partake in this new form or system of communication, the different participating systems will have to come to some agreement on what technology and semantics (language) to use and in what context they want to (re)use the information.



Conclusion 2. *Interoperability is the realization of mutual connections between two or more systems or entities to enable systems and entities to exchange and share information in order to further act, function or produce on the principles of that information.*

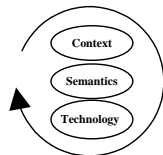
4. Interoperability and systems theory

In my opinion, the development of the interoperability referred to here, i.e. the ability of hybrid systems to exchange information within a network, share that information and act, function or produce on the basis of that information, largely resembles the way in which subjects are connected through different means of communication. Based on the latter, interoperability between different systems can acquire a theoretic base that departs from, for example, Niklas Luhmann's systems theory which is analyzed in detail and described in chapter five of my doctoral thesis.

Self-reference and Autopoiesis

Luhmann bases his systems theory on the principle of self-referential and autonomous systems. He views a system as self-referential when it is capable of forming elements that function as functional units, and when relations between these functional units and the system can be perceived as units and relations that were engendered by the system itself. The system thus continuously reproduces itself through the creation of functional units and their mutual relations. Luhmann used Maturana & Varela's concept 'autopoiesis', made up of the concepts 'auto' (self) and 'poiesis' (creation or

production), to denote this principle. Luhmann's theory states that a self-referential system is able to produce itself, i.e. reproduce, through new elements that stem from the system. Self-production of elements enables self-referential and autonomous systems to set up relations: 'with themselves and to differentiate these relations from relations with their environment'.



Conclusion 3. *The ongoing process of hybridization is also changing our perception of the definition of a system. A system is no longer just a subject or an object but also a fusion of both into a hybrid system. A hybrid system is autonomous, self-referential en based on the process of autopoiesis.*

Double contingency

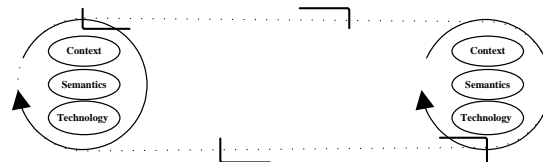
In order to be able to tackle the issue of how a self-referential, autopoietic and autonomous system can interact and communicate with one or several systems, Luhmann was forced to shift the focus of his analysis from: 'the orientation of a single given actor to the consideration of two or more interacting actors as a system'. Luhmann refers to this change using the theorem 'double contingency', which basically means that two random black boxes are connected through a random event and are looking to harmonize. Each black box assumes the other black box has the same intentions. Each black box designs its own behavior through a range of complex and self-referential operations within its limits. The relation between the systems becomes more effective as the mutual assumptions ensuing from their system/environment relation increase, and as they become willing to observe themselves on the basis of these assumptions. The black boxes attempt to influence each other on the basis of what they register, and can learn from each other on the basis of the acquired information. Luhmann refers to such a developing form and structure as a social system.



Conclusion 4. *When two or more hybrid systems want to be able to exchange and share information they have to be able to prepare, build and maintain mutual connections.*

System and Environment

According to Luhmann, the distinction between system and environment constitutes the central paradigm of systems theory. And he adds the condition that information is only really information the moment it is more than an existing distinction between system and environment: 'it is information only if it instigates a change of state in the system,' he states. And the latter is in his eyes only the case when: 'the perception of a difference creates a difference in the system. Something was not known; then information arrives, namely that these, and none other, are the facts of matter'. In other words, the difference that is referred to here comes into being when perception of information actually leads to changes in the perceiving systems. Within the theory of self-referential systems, the environment is mainly a condition for the identity of the system, because identity is only possible if there are differences. Everything that occurs is part of a system (or a range of systems) and 'always at the same time' comes under the realm of 'the environment of other systems'. Every kind of categorisation presupposes a reduction. Every perception, description and conceptualization of a certain category requires a system reference, within which something can be considered part of a system or its environment. Every change to the system is a change to the environment of other systems, every increase in complexity in one area will increase the complexity of the environment of all other areas.

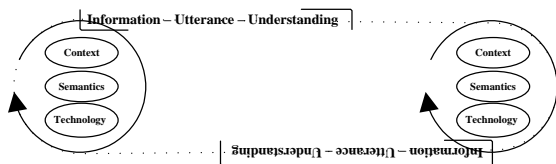


Conclusion 5. *Hybrid systems are always in the environment of other hybrid systems. The difference between system and environment jointly determines the autonomy and identity of the hybrid system.*

Communication and action

Communication therefore contains information, according to Luhmann: 'and thus is enriched which environmental meaning whenever this information comes from the environment; actions however are more easily determined as belonging to the system or not'. This means that every system has to take into consideration other systems in its environment, and every system depends on the profundity with which the environment can be perceived. If the system we depart from has the ability to understand this, this system will be able to discern another system in its environment and distinguish it from the environment they have in common. The relation with the environment has to be reproduced on a higher level of system complexity with increased possibilities and restrictions. Luhmann feels that communication is based too much on the principle of sending and receiving messages or information between

senders and recipients. In his opinion, the metaphor of sending and receiving positions the essential part of communication within the action of sending, i.e.: ‘the utterance’ or the communicated message. This focuses too much attention on, and demands skillfulness of the system that makes the utterance. Communication is more than just sending and receiving, with selective attention from both sides, but the selectivity of information is in itself part of the communication process, because this selective attention is only updated in relation to the great selection of information that is available to us. The third part of the selection process consists of the concept ‘understanding’. Luhmann ascertains that the understanding of communication contains a distinction between the informative value of the content and the reason why this content is uttered. Either side can be emphasized. The understanding process can focus more on the information itself or focus on the way the information is expressed. But this always depends on the fact that both facets are experienced as a selection, and therefore separated from each other. In other words: one needs to be able to accept that information as such is not understood, but that it requires separate decisions. Luhmann is convinced that communication transforms the distinction between information and utterance, into one between acceptance or rejection of the utterance, i.e. a transformation from and into or. In his view, communication is a fully independent, autonomous, self-referential closed way of making selections that will, however, never lose their specific characteristic as a selection.



Conclusion 6. *The exchange and sharing of information between hybrid systems takes place through a distinctive unit of information, utterance and understanding.*

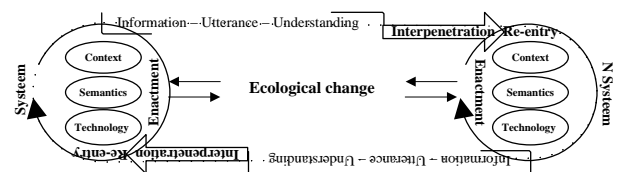
Interpenetration and sensemaking

The communicative unit can be rejected or received by the receiving system. When systems possess a reciprocal willingness and ability to accept the communicative unit, and grant communicative acts from other systems access to their system, a form of interpenetration comes about. Luhmann uses the concept of ‘interpenetration’ to pinpoint the special way in which systems contribute to the shaping of the system within the environment of the system. ‘Interpenetration’ is more than just a general relation between system and environment, but rather an inter-system relation between two systems that make up an environment for each other, and through which a system makes its own complexity available to build other systems. Interpenetration therefore only really occurs

when these processes are evenly matched. That is the case when both systems enable each other to introduce their own and existing complexity to the other side. The concept of interpenetration presupposes therefore, according to Luhmann, the ability to connect different forms of autopoiesis, such as life, consciousness and communication.

The interpenetration of a communicative element from the environment and the acceptance thereof causes the sensemaking process of the receiving system to change and evolve. At this point in the research I sought and found a connection between Luhmann’s interpenetration concept on the hand and Weick’s sensemaking concept in the other. Luhmann already stated during a lecture on the ‘Informations gesellschaft’ in 1996 that information could crystallize ‘Sinn’ or meaning in order to enable or continue further realization. Or in the words of Luhmann himself: “, the English language would be enriched with a neologism to denote this, namely ‘sensemaking’”. Weick’s concept of sensemaking starts with a system that gives meaning (grounded in identity construction). The sensemaker will give meaning on the basis of knowledge and experiences accumulated in the past (retrospective). The receiving system will take action on the basis of the allocated meaning (enactment). Meaning allocation is, according to Weick, the result of a social process based on a shared language and day-to-day social interaction. He considers the sensemaking process a continuous one, which cannot be detached from the context in which meaning is given, which he claims can be of particular importance in organisations. That Weick considers the link to technology a crucial one in the sensemaking process becomes clear from his following claim: “*Because technology is a crucial part of organisations, it is important to incorporate it into any discussions of sensemaking*”. The sensemaking process is hence a continuous process that cannot be detached from the context and environment in which sensemaking takes place.

The development of interoperability between hybrid systems on the basis of the aforementioned five basic principles, i.e. self-reference and autopoiesis, system and environment, double contingency, communication and action and interpenetration, has been caught in a diagram as follows:



Conclusion 7. *Hybrid systems have to be mutually prepared for and willing to allow units of communication to interpenetrate and include them in their own process of production and sensemaking.*

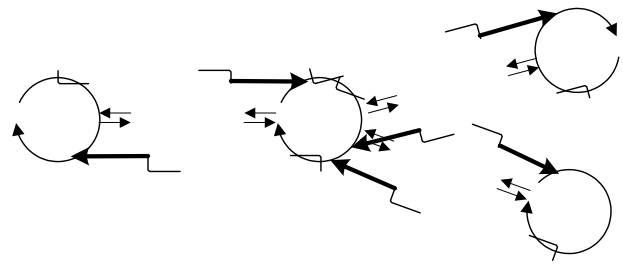
5. Case study I: Concept of Network Centric Warfare

The process of hybridization and the realization of interoperability between (hybrid) systems is reflected in modern thinking about the development of warfare and man's position in wars. This is a central element in one of the two case studies which are analyzed and described in chapter six of my dissertation. This development is based on international developments within the defense sector, which is trying to find an answer to the (im)possibilities of the information revolution regarding warfare in general, and within the fast-changing global context in particular. All these factors have led the American Department of Defense to fully focus on capitalising on the possible advantages offered by the information era. Net-Centric Warfare has been defined as a concept of operations, based on information superiority, which generates a significant increase in fighting force through the incorporation into networks of sensors, decision makers and violence platforms, in order to ensure that the armed forces involved share experiences, speed up decision making, increase operation turnaround, boost fighting force, have a greater chance of survival and degree of self-synchronisation. Net-Centric Warfare basically converts information-based superiority into increased fighting force through the effective connections of information-related entities on the battlefield. The people behind this initiative are hoping to be able to react faster and more effectively to new crises and natural disasters, or for peacekeeping missions, by hooking these information-related entities up to networks in different coalitions and under differing circumstances. Connecting different entities in networks can be seen as an innovation, as it would mean a supplementation of human capabilities instead of a replacement.

It is the term network as the crucial factor in this process, because that term implies that continuous tracking of the activities of complex subjects and the complex situation they are working in, requires more than mere network technologies and communication applications. It also requires the possibility of incorporating people and their knowledge and skills into these networks, and turning these into flexible and organisational architectures, with a constant ability to adapt to changing circumstances, and who are independent in the design of their activities. Such a net-centric way of thinking would enable a development towards a 'collection of systems'.

In a collection of systems several independent systems are linked to form a new system. An collective of systems can be an entity where: 'individual systems have equal peer to peer relationships with another but are united for a mutual benefit'. In order to have a random separate system function in a collective or meta-system with differing circumstances in terms of time, place and composition, the respective systems will have to achieve a form of 'net readiness' and necessitate a transformation of thinking in and about the armed forces.

The development towards network-centric thinking will inevitably have consequences for command and control, or management and governance structures. Traditional and vertical structures will slowly but surely have to be changed into more horizontal structures that are oriented on the exchanging and sharing of information. Network-centric working will also lead to a shift in the balance of responsibilities between man and technology. It will surely not come as a surprise that I am envisaging here that the scale will tip in favour of technology, with man losing out.



Conclusion 8. *When hybrid systems are prepared and willing to exchange and share information in this way, they can be part of any given coalition or network.*

6. Case study II: Net-centric crisis and disaster management

In the ever more globalised and insecure world we live in, potential dangers are looming larger, also for inhabitants of the Netherlands. From international terrorism to energy problems, or from pandemics to climate change. These threats are real, and can have a major impact on our society. In order for emergency services involved in disaster and crisis control to act effectively and efficiently, they need adequate information provision. The Dutch government decided in 2008 to base the further development of this required information provision structure on the network-centric method copied from the Ministry of Defence, and to roll this method out on a wider scale in the coming years, using it as a basic principle. Although I consider that a sensible move, it is still lamentable that it is not accompanied by a common and enforceable doctrine for all parties involved in contingency planning and crisis control. The merit of such a doctrine has become apparent in a defence context on both a national and international scale.

In the past few years, I have used the knowledge and experience gathered through my research to participate in a study into (the development of) ICT applications for a specific aspect within the Dutch disaster and crisis control structure, namely the registration and relief for victims of disasters and crises. In that context, there is also room for further connections between the hybrid systems involved, such as local authorities and teams of paramedics. Such connections will make these systems better able to mutually exchange and share information. That will enable them to do their jobs more effectively and efficiently, which, in turn, will result in better victim

relief. The options and connections developed for this practice have been tried out and applied in various forms during trials. These trials showed that there is still a lot left to learn and develop in this area. But that requires all parties involved, ranging from the Dutch Ministry of the Interior and Kingdom Relations to emergency services, to be on board and willing to integrate these developments and possibilities into the preparation and execution of drills and the development of policy. That is when the possibilities of network-centric working can be studied in their entirety, and used in the realisation of network-centric information provision and methods within Dutch contingency planning and crisis control.

7. In closing

You may wonder how exactly Luhmann and the movie *The Matrix* are linked. The movie was a source of inspiration for me personally. It presents a world in which people are held captive in a virtual world by intelligent and self-reproducing machines. Unaware of their situation, most people accept this virtual world as a given. As in any movie, there is, however, a heroic central figure, in this case a human being, namely computer programmer and hacker Mr Anderson, who has a vague inkling of a world beyond the one he feels trapped in. At one point at the start of the trilogy, the words 'Wake up, Neo...The Matrix has you...' slowly appear on his screen. I refer you to the movie for the continuation of this gripping and exciting story.

With this research and dissertation, we hope to make a contribution to the discussion on and raise awareness of the idea that man and technology are and will be inextricably bound up with each other. In our opinion, the development of interoperability of information that can be exchanged and shared by different hybrid systems not only offers new chances and possibilities, but can also lead to new threats when used and applied unwittingly and incompetently.

The developments we have outlined are irreversible and inevitable, but how we, as scientists, deal with this development is completely down to us.

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