Have ICT innovations turned the principle of "organizational choice" into the principle of "infinite freedom"?

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Abstract

Innovations in Information and Communication technology have created possibilities in organizations that previously were unthinkable. In the realm of military studies the so-called chaoplexic paradigm suggests that these possibilities are so path-breaking that they constitute a paradigm-shift in thinking about organizations. Inspired by criminal and jihadist networks, the chaoplexic paradigm claims that military units "in the field" can acquire far reaching autonomy as a result of a continuously updated situational awareness, which is enabled by sophisticated data-links with other units. Subsequently, the network of such military units is thought to be extremely flexible and agile because it does not need to rely on predetermined hierarchical paths of coordination. "Order" in such networks is thought to "emerge" as a result of self-organizing units that coordinate with other units. This paper discusses whether this philosophy truly constitutes a paradigm shift in thinking about organizations. The main claim is that this is not the case. Based on a discussion of a case study of a military taskforce and an analysis based on Normal Accidents Theory, it is argued that the chaoplexic paradigm overlooks the problem of "hidden" interconnections between units. All in all, it is argued that the chaoplexic paradigm underestimates the importance of hierarchy in organizations. It is furthermore argued that the ideas of the chaoplexic paradigm can only work if military units are "perfect information processors" without bounded rationality and in extremely small networks. Alternatively, a perspective is worked out which emphasizes the vulnerability of networks of organizational units in dynamically complex environments. According to this perspective operators are continuously confronted to with the need to balance the limitations of given structure with the most recent demands from the operational environment.

Have ICT innovations turned the principle of "organizational choice" into the principle of "infinite freedom"?

It is indisputable that in the last decades innovations in Information and Communication Technology (ICT) have had groundbreaking implications for organizations. Moreover, these implications are not restricted to a particular domain. ICT innovations have influenced organizations across the board. One notable development in the last two decades has been that, due to ICT innovations, organizations are better able to adopt network-forms. ICT innovations enable communications and coordination between groups and departments that are geographically widely dispersed. One particularly compelling suggestion is that such ICT innovations might be able to make "bureaucracy" and functional "silos" a thing of the past. More specifically, the suggestion is that the organizational problems associated with organizations build up on the principle of "functional concentration" (lack of control over central processes, lack of flexibility, lack of innovation potential, poor quality of working life; De Sitter, 2000) might solved by establishing direct ICT links between departments.

Sometimes this idea is more than a mere suggestion but is brought forward as a path-breaking philosophy of organizing. In the realm of military studies this philosophy points to the potential of "robustly networked systems" and is usually referred to as Network Centric Warfare (NCW) or Network Enabled Capabilities (NEC). This philosophy points out that networks are potentially extremely flexible and agile because they do not rely on predetermined hierarchical paths of coordination. According to Bousquet (2008, p.916), these ideas are inspired by criminal and jihadist networks. The idea is that units "in the field" can acquire autonomy as a result a continuously updated situational awareness, which is enabled by sophisticated data-links with other units. The whole system of military units needs to become a fully "robustly" connected network (every node is connected to every other) and is sometimes called an "edge organization" because of its radically decentralized character. The intended result is a collection of "swarming" units that "self-synchronize" and subsequently coordination between units is expected to "emerge". Bousquet (2008, p.916) observes that these ideas are currently so influential that they essentially constitute a new paradigm in thinking about military organizations and warfare, which he calls the paradigm of "chaoplexic war". Bousquet (2008, p.923) on this idea of chaoplexity: "Chaos is seen no longer as simply a threat to order which must be averted at all costs, but as the very condition of possibility of order. The key notions here are those of non-linearity, self-organization and emergence, and the pivotal technological figure is that of the network, the distributed model of information exchange perhaps best embodied by the internet." The very reason such ideas are considered valuable in this research community is that traditional organizations are considered too rigid to be able to respond to very turbulent, uncertain and dynamic environments, while the "edge organization" essentially solves this problem.

The ideas behind the chaoplexic paradigm are so radical that they make a clean

break with existing ideas within organization sciences. As such they are rightfully called a "paradigm": if they work as the paradigmatic example indicates, we are left with organizations that rely on principles that are fundamentally different compared to the ones we usually apply for understanding organizations Because the chaoplexic paradigm argues that robust networks are better able to deal with dynamic environments because they are far more agile it essentially argues in favor of a paradigm shift regarding some key ideas in organization-studies.. In essence, the chaoplexic paradigm seems to suggest that as a result of ICT innovations hierarchy can be made superfluous. Ever since the 1950's and the work of Herbert Simon hierarchy is considered to be a core feature of systems (Simon, 1962). Hierarchy refers to a nesting of subsystems within systems (Simon, 1997). Present ideas about organizations generally claim that hierarchy – or "design" – is a functional property of systems because a system without hierarchy would be overcome by "information overload". However, if every node is connected to every other node, the entire organization becomes flat and mutual adjustment is the only relevant coordination principle. If "order" emerges in such systems, it actually implies that coordination costs associated with hierarchy can be reduced to zero.

This paper focuses on the paradigm-shifting core of the chaoplexic paradigm. I will be quite skeptical of the claims of the chaoplexic paradigm. While it is certainly true that network forms are for certain organizations in some environments very valuable and can be considered an important organizational innovation made possible by developments in ICT, I will argue that it goes to far to think that hierarchy in general has become superfluous. This paper will offer a counter example against this argument and will offer a theoretical critique of NCW and NEC. Both the example and the theoretical critique originate from existing research into the organizational vulnerabilities of military taskforces. On the basis of this example and the theoretical critique the chaoplexic paradigm will be analyzed.

The chaoplexic paradigm

In the early years of the sociotechnical tradition, Eric Trist identified the principle of "organizational choice" (Trist, et.al. 1963). Core of this principle is the idea that when it comes to adopting technological innovations, organizations have a choice. The invention of the conveyor belt does not enforce a particular organizational form on the organization. Instead, the principle of organizational choice states that it is possible to adopt innovative technology by implementing it in an organizational form that fits the purposes of the organization. The chaoplexic paradigm seems to have turned this principle on its head: instead of enforcing a kind of mechanistic organizational form, technological innovations in the realm of ICT appear to offer absolute liberation: the infinite freedom to continuously change organizational forms given the particular challenges at a particular time. So just as organizational choice implies liberation from technological determinism, the chaoplexic paradigm seems to claim that ICT innovations offer liberation from the inevitably constraining effects of "choice". Also within the realm of *Science and Technology Studies*, this is a somewhat unusual position. According to

Bijker (2006) there are generally three positions in the debate of how technology influences society (i.e. also organizations). In this debate, *technological determinism* claims that technology has determining effects on society; *social voluntarism* argues that society determines technological developments and *social constructionism* argues that technology and society mutually influence each other. The chaoplexic seems to – somewhat paradoxically – claim that technological development *determines absolute freedom* in organizational forms.

Essence of the chaoplexic paradigm is the idea is that ICT can be used to create "robustly networked organizations" in which each node is connected to all other nodes. Subsequently, this ICT infrastructure enables rapid information sharing between nodes, which furthermore enable very good decentralized Situational Awareness. This idea is specifically worked out in concepts such as NCW and NEC (Alberts & Hayes, 2003). The basics of NCW & NEC are stated as follows by Cebrowski (2005, p.7):

- *"A robustly networked force improves information sharing*
- *Information sharing enhances the quality of information and shared situational awareness.*
- *Shared situational awareness enables collaboration and self-synchronization, and enhances sustainability and speed of command.*
- *These, in turn, dramatically increase mission effectiveness"*

Self-synchronization" refers to the coordination of activities between units at the decentralized positions, which implies that communication runs across the organization, rather than following hierarchical lines. In that case control is believed to *emerge* as a result of local interactions (Alberts & Hayes, 2003). Or to put it differently, control emerges as a result of massive process of mutual adjustment. Atkinson & Moffat (2005, p. 40-41) explain this philosophy as follows:

> *The nature of Network Centric Warfare for such future Information Age forces can be outlined as: within a broad intent and constraints available to all forces, the local force units self-synchronize under mission command in order to achieve overall intent. This process is enabled by the ability of the forces involved to robustly network. We can describe such a s system as* loosely coupled *to capture the local freedom available to the units to prosecute their mission within an awareness of the overall intent and constraints imposed by higher level command. (…). In this process, information is transformed in "shared awareness", which is available to all. This leads to units linking up with other units, which are either local in a psychical sense or local through an information grid or intranet (self-synchronizaton). This in turn leads to emergent behavior and effects in the battlespace".*

As will become clearer later, the key word in this quote is "loosely coupled". The idea apparently is that the ideas work if there is "loose coupling" between units: if the operations of one unit is only weakly connected to others. Proponents of the chaoplexic

paradigm argue that these ideas are supported by complexity science (Gray, 2002). The idea is that control "emerges" in robustly networked systems as a result of local interactions. This is based on the "order for free" idea from complexity science (Waldrop, 1992). The general idea is that in Complex Adaptive Systems (CAS) order does not need to be designed. Kramer & Van Bezooijen (2016) discuss this link with CAS:

> *Waldrop (1992) discusses the example of bakeries in large cities. Together these bakeries are responsible for a significant part of food supply. Taken together these bakeries handle the issue of food supply remarkably adequate. Yet, no one tells the individual bakeries how much bread to produce, nor how to organize their logistic supply. In contrast, making the food supply in cities the responsibility of a central office that issues detailed orders to bakeries would be a recipe for disaster. So in a sense, food supply in large cities is a complicated process that is "ordered for free".*

So the idea of the chaoplexic paradigm is that "order" can emerge in a military taskforce in a likewise manner. General McCrystal in his book *Team of teams* (2015) refers to elements of this philosophy in order to describe the most recent innovations in the US Army. The image that emerges from this book is that the US Army started a transformation towards this philosophy. In the foreword of the book, Walter Isaacson claims that the relevance of this book lies exactly in this realm (Isaacson, 2015, p.viii):

> *"Management models based on planning and predicting instead of resilient adaptation to changing circumstances are no longer suited to today's challenges. Organizations must be networked, not siloed, in order to succeed.*

About the developments in the US Army Isaacson states (2015, p.viii-ix):

> *"One conclusion they reached was that agility and adaptability are normally limited to small teams. (…)."The primary lesson that emerged, and is detailed in this book, is the need to scale the adaptability and cohesiveness of small teams up to the enterprise level. This involves creating a team of teams to foster cross-silo collaboration."*

Subsequently, in the book McCrystal alludes to (but not specifically mentions) the chaoplexic philosophy at different moments and concludes it has been successful. For example (2015; p.164):

> *"We knew that forging the neural network that would facilitate our emergent analysis of complex problems was vital for our long-term success, so we designed prepackaged communication bundles that our teams could take into the field, wherever they were in the world. Like NASA, we invested in bandwidth to enable us to reach every component of our force and our partners, from austere bases near*

> *the Syrian border to CIA headquarters at Langley, Virginia. Satellite dishes, from small to huge, connected the force. Secure video teleconferences, chat rooms, a Web portal, and e-mail became key arteries of our circulatory system. Technically it was complex, financially it was expensive, but we were trying to build a culture of sharing: any member of the Task Force, and any of the partners we invited, could eventually dial in to the O&I securely from their laptops and listen through their headphones."*

One of the main messages of McCrystal is that the implementation of this philosophy has integral effects. For example, it requires a different kind of leadership compared to traditional organizations and a different "culture".

To qualify the claims of the chaoplexic paradigm somewhat in advance of the actual argument of this paper, the following passage from a NATO publication is quite interesting. In a publication of the NATO defense college, El Fartasi & De Vivo (2016) start from the belief that working with sophisticated data-links in networked systems is already a reality, although the quote below suggests that it is not quite used in the way the chaoplexic paradigm suggests:

> *NATO has always maintained a technical advantage over its potential adversaries. Through its Alliance Ground Surveillance System (AGS), consisting of five Global Hawk Unmanned Vehicle (UAVs) and Ground Control Stations, the Alliance will have a 21st century system that will support the Commander's comprehensive real-time and near real-time situational awareness at strategic distance and within hours, if not minutes, of a crisis arising. AGS will gather massive amounts of data to enable situational awareness of land and maritime environments; but what use are a Global Hawk and its ground stations, without the IT infrastructure through which its data is communicated for possible use by decision-makers? NATO's IT enables surveillance and intelligence gathering, serving as NATO's eyes in the sky in light of increased airspace security breaches on its borders. Ensuring continuous situational awareness in specific areas of interest, during critical periods of heightened tension, is therefore of the utmost importance. Without the current IT architecture to support operational capability, both the Alliance and nations risk making uninformed decisions with incomplete and fragmentary data, with results that could lead to potentially serious unintended consequences.*

This quote actually suggests that data links are necessary for situational awareness of a central commander who is a key decision maker. This idea is actually the very opposite of what the chaoplexic philosophy proposes and it is also different from the spirit of McCrystal's argument. This is, however, a classical contradiction in organization studies: will sophisticated technology be used to foster self-organization, or to foster centralized control? The chaoplexic paradigm argues in favor of the former, but the latter tendency does not seem to be totally absent in its implementation. Apparently, the new technology also feeds into the old dream of perfect centralization.

The chaoplexic "image of organization"

The chaoplexic ideas are particularly interesting from the perspective of the sociotechnical tradition. They appear to be able to overcome the problems of one of the main enemies of the sociotechnical tradition: the large scale specialized bureaucratic organization built upon the ideas of functional concentration (concentrating a single specialism in a single department). Furthermore, they aim to fight traditional bureaucracy by advocating radical decentralization and self-organization, the very topics that have been embraced by the sociotechnical tradition for decades. So in a sense the ideas of the chaoplexic paradigm might appear as a validation of some core ideas from the sociotechnical tradition. At the same time, they might seem to change the nature of these sociotechnical ideas quite considerably. After all, the sociotechnical tradition has developed alternatives for traditional bureaucracies. The chaoplexic paradigm seems to suggest that merely connecting every unit to every other unit with sophisticated data links is the only design effort it takes for achieving the sociotechnical ideals. In a way therefore, it might appear that the chaoplexic paradigm is essentially an innovation that makes (sociotechnical) organizational design a topic of past times.

In essence, the chaoplexic paradigm is based upon a different "image of organization" compared to the "hierarchy paradigm". This is the image of "organizations as ant colonies" (Dekker 2011, p 157). Kramer & Moorkamp (2016) describe this image as follows:

> *"This image focuses on the complicated organized behaviour that is displayed by ant colonies, while no single ant has designed the colony, or understands it in its entire complexity. The organized behaviour of the colony is a macro-level phenomenon that emerges from the behaviour of interacting ants."*

Sidney Dekker uses this image of the ant colony to emphasize the idea of *organized complexity* (2011, p.157):

> *"It is complex because there are a large number of components, and, as a result, a dense throng of mini-programs running and interacting, cross influencing each other".*

This complexity is organized according to Dekker (2011, p.157):

> *"But what it produces is not disorganized. Rather it is organized (...) as an amazing emergent product of the complex interactions between a multitude of simpler entities".*

So the idea of emerging "organized complexity" replaces the idea of organization design. Kramer & Moorkamp (2016) emphasize furthermore:

> *"Dekker considers complex systems both resilient and vulnerable by virtue of their complexity, which he deems a paradox."*

This idea of vulnerability of complex systems is unavailable in the ideas of NCW and NEC, but Dekker offers no analysis of how resilience and vulnerability relate[1]. More specifically, Dekker states that (2011, p.157):

> *"Because they consist of complex webs of relationships, and because a lot of control is distributed rather than centralized, complex systems can adapt to a changing world".*

However,

> *"Complexity opens up a way for a particular kind of brittleness. Their openness means unpredictable behaviour" (Dekker 2011 p 153).*

So if structure can be understood by means of the idea of "organized complexity" an organization is principally seen as an "infinitely malleable" tissue that can combine and recombine elements in infinite ways in order to adapt to the newest environmental contingencies, without the burden of a previously designed hierarchical frame which severely limits the malleability of the tissue. Shedding this burden is specifically what creates the agility of the tissue. While the chaoplexic paradigm emphasizes the adaptability and resilience of "organizations as ant colonies", others adhering to this image of organization also emphasize vulnerability.

Counter-example: a military taskforce in an expeditionary mission

The counter-example that is offered here is a case study of a military taskforce. This case study was developed at the Netherlands Defense Academy by Moorkamp, and is described in detail in Moorkamp & Kramer (2014). The case description aims to express the idea that, although the conditions of the taskforce seem to be very fit for the chaoplexic paradigm, the organizing principles behind the chaoplexic paradigm could not possibly have worked.

In the last two decades, the focus of the Netherlands Armed Forces has shifted from preparing for all kinds of Cold War scenarios, to what is called "expeditionary missions". These are missions in which the Armed Forces go on "expedition" – go abroad – in the context of peacekeeping, peace enforcing missions, post conflict rebuilding missions, etc. In this time period, The Netherlands Armed forces have contributed to missions in for example Bosnia, Iraq, Afghanistan and Mali. Typical for such missions is that taskforces are deployed. Taskforces are temporary constructions that are deployed

[1] In the absence of such an analysis, this paradox is unconvincing. It rather seems like a predetermined answer to every possible question. Is there an accident? It is caused by "organized complexity". Is there no accident? It is caused by "organized complexity". Remarkably resilient behavior? It is caused by "organized complexity".

for the purposes of a single mission. Basically, a taskforce is designed by establishing what kinds of "assets" or "capabilities" are expected to be necessary in a given mission. These assets and capabilities are subsequently selected from the standing army in The Netherlands. It will be obvious that such taskforces need to find a design that works in a particular environment. As such, expeditionary taskforces are underdeveloped organizations.

On the basis of an analysis of research into such expeditionary taskforces, Kramer & Van Bezooijen (2016) identify two main organizational challenges. In the first place, typically expeditionary taskforces face environments with many unknowns. This is what Kramer (2007) refers to as "dynamic complexity". These environments constantly change under the influence of difficult to interpret dynamics. In the second place, as a consequence of these environmental conditions, taskforces continuously calibrated their internal design to fit the conditions that they found themselves in. In the case of the Dutch Uruzgan mission, Kramer et.al (2012) concluded that: "(…) previous to the deployment of the Dutch troops the Afghan province Uruzgan was basically a white spot on the map. Furthermore, during deployment the local circumstances proved to be very changeable; the force of the Taliban opposition could vary significantly. Operational units were often the first to experience changes in the environment and acted therefore in a general sense as explorers. With this in mind, it is quite impossible to design an organization in a "one-shot design effort" that can deal with all current and future – as yet unknown – contingencies."

As part of his PhD project, Moorkamp studied safety management strategies in a particular unit that operated an Unmanned Aerial Vehicle (UAV) as part of Task Force Uruzgan (TFU) (Moorkamp & Kramer, 2014; Moorkamp et al 2015). TFU was a taskforce that was deployed by the Netherlands Armed Forces, in order to start up a rebuilding process in the Afghan province of Uruzgan from 2006 to 2010. This particular unit, 107 Aerial Systems Battery (107 ASBt), was added to TFU for doing Aerial Reconnaissance and as such they contributed to the intelligence organization in TFU. 107 ASBt was a unit that, at the time, was a reconnaissance plane of the Artillery. That meant that they were trained as a part of the Artillery. One particular consequence was that they used to train in a restricted air zone, because obviously an Artillery battalion cannot train with all kinds of air-traffic flying over. A consequence was however, that they were not familiar with operating in an area with other air space users such as in Uruzgan. The consequence was that part of the self-organizing activities of 107 ASBt were focused on "discovering, establishing and refining rules and procedures for interaction, such as rules for avoiding collision in the air, or ''deconfliction"" (Moorkamp et. al. 2015, p.6). This amounted basically to learning an entire new trade during deployment ("what does a control tower mean when they say X, Y or Z"). This learning process partly was partly a trial and error affair, with some near misses, most notably a UAV nearly flying into an Apache helicopter after launch ("not a near miss, but a near hit", according to one operator). Moreover, it is very questionable if the operators of 107 ASBt eventually developed a full understanding of the whole spectrum (the exact meaning of "deconfliction", "air traffic control", Restricted Air Zone's (ROZ), etc), which was

evidenced by them contacting the control tower on how to operate in a ROZ instead of a Forward Air Controller (FAC-er). More specifically Moorkamp et. al (2015, p.6) conclude that:

> *"The majority of the self-organizing strategies of 107 ASBt's operators were aimed at trying to solve problems with regard to the amount and type of assignments and air space users within TFU were a major source of problems for 107 ASBt's operators. Within TFU, 107 ASBt was located in an extensive network of other Army and Air Force units. This organizational configuration differed substantially from the configuration in which they were training in The Netherlands. In Uruzgan, 107 ASBt was gradually included in TFU's complicated primary process that varied quickly due to the dynamic complex mission area in Uruzgan."*

Apart from a lack of knowledge of 107 ASBt on how to operate in taskforce conditions, there was a lack of understanding on the part of the rest of TFU on how to exactly use a UAV. That made integration of the UAV into TFU significantly more difficult. The control tower did not know they couldn't order the UAV to depart at a specific moment because their engine was not suited for that, and they didn't know the UAV's weren't able to deconflict on the basis of the prevailing "see and avoid" strategy (because as an UAV doesn't have a pilot and this UAV's camera was pointed to the ground). Intelligence units did not know that UAV's couldn't be deployed to search for a red car because their camera was black and white. Furthermore, the different units in the TFU-network were surprised to find out that the UAV wasn't able to contact the participants with whom their operations interconnected, because their radio was not suited for that. After all, the UAV was never meant to interconnect with the kinds of units in TFU. These are only a couple of examples. Given that personnel in TFU rotated quite frequently, different units continued to organize meetings to make clear what the specifics of the UAV are, what it can and cannot do, etc. All in all, Moorkamp et. al (2015, p.8) conclude:

> *"(…) 107 ASBt's operators developed numerous self-organizing strategies in their attempt to create safe and controlled UAV operations within TFU. In effect, they were constantly designing and redesigning structures of both their own unit and TFU in order to develop safe operations within TFU. The results section has shown that 107 ASBt and other units within TFU were differentiated substantially and, as such, 107 ASBt lacked integration into TFU's production and control structure. As a consequence, 107 ASBt's operators started improvising and pioneering within TFU in order to develop such integration. Along the way, they succeeded in tackling various problems that they encountered while operating within TFU."*

The problems in self-organizing their way out of the interactions they were part suggest that operators in 107 ASBt suffered from "information overload". The network was initially too complex to understand how their operations related to other participants in

the TFU network. Only after being some time in the mission area, and routines were worked out, the situation stabilized somewhat for 107 ASBt in TFU.

Is the expeditionary taskforce a real counter-example?

The example of the expeditionary taskforce is considered here a counter-example against the chaoplexic paradigm. It suggests why a network confronted with dynamic conditions does not work like the chaoplexic paradigm specifies. In the first place, is necessary to argue why this example is particularly suitable. It is clear that the TFU, with 107 ASBt as a part, typically faced the conditions for which the chaoplexic paradigm seems to be meant. Furthermore, their tendency to keep changing their organization design seems to refer to a need for an ability to constantly change form. TFU was essentially an underdeveloped network. Operators worked hard to develop the network into an organized system that is workable. They found out latent inputs that affected their particular node and tried to explicate these and somehow organize this latent input. By organizing the interaction with other "nodes" around them, they build structure, and in a way one can understand that as control that emerges through self-organization. As such the example seems suitable to discuss in the context of the chaoplexic paradigm.

Against this background it is clear that what was observable in the case is a far cry from what the chaoplexic paradigm formulates as ideal. What appears from this case is that "control" did not emerge as a result of interactions between nodes, and that this resulted in a super-agile taskforce. On the contrary, operators struggled to understand the system they were part of and the interconnections that influenced their work. They did not have perfect situational awareness, which would have enabled "self synchronization". All in all, TFU was not a well-organized system (as evidenced by the safety incidents). What is observable in the case is indeed self-organization, but not the kind of self-organization that is a triumph of imaginative problem solving, based on swift coordination between units. Instead, the kind of self-organization that is clear from the case resembles more a desperate attempt by operators to keep a very imperfect system afloat. The conclusions from this case are therefore the opposite of the claims made by the chaoplexic paradigm.

However, it would be too easy to stop at this conclusion. If this case is interpreted as a falsification of the chaoplexic paradigm, two quite obvious possible counter-arguments appear to be relevant. In the first place, 107 ASBt appears as an example of a quite exotic unit that was uniquely unfit to be integrated in TFU. Not only were they forced to operate in conditions that differed fundamentally from the way they were trained to operate – integrating a UAV in a mission was a first for the Netherlands Armed Forces – so it might be expected that there were some problems. In the second place, TFU was apparently not at all built up on the basis of the principles of the chaoplexic paradigm. Since units sometimes found on a trial and error basis that their operations interconnected, TFU was apparently not "robustly networked" and apparently lacked sophisticated data-links between units, which made information sharing and mutual adjustment problematic. If anything these two points appear to be in

support of the chaoplexic paradigm. Furthermore, apparently there was a process of self-organization going on in TFU that was aimed at working out an underdeveloped taskforce structure, and all in all there weren't that many incidents (although there certainly were some). So despite the fact that the way TFU operated was a far cry from the ideal of the chaoplexic paradigm, still it was self-organization and the tremendous effort of operational personnel that kept things going in TFU.

While both points are valid, they are not considered valid counterarguments against the particular point that is made here. In the first place, Moorkamp did validate the 107 ASBt case and indeed found comparable dynamics both within TFU as in other missions (Moorkamp & Kramer, 2014; Moorkamp et al, 2015), so although 107 ASBt might have been unfit, it wasn't uniquely unfit. More important is the question if "robust networking" with sophisticated ICT connections would have solved the issues of control in TFU. The vulnerability of the TFU network was not caused by a lack of "information-flow", or a botchy information flow between units (although partly they struggled with for example incompatible radios). It was a lack of understanding of the different reciprocal interdependences between "nodes" in the network. They basically found out these interdependences by trial and error. Only when the problem occurred, they found out that their activities interconnected with other units in the taskforce. Even if they had perfect means of communications, and could have contacted all other units whenever they liked, they wouldn't know what to ask them before they understood how their activities interconnected. In other words, an issue of organizing ("how do my activities influence X and how are X's activities influencing me") is of a different order than an issue of informing ("what is X doing at this moment"). Situational awareness is more than "acquiring information". Being conscious of how the operations of a particular unit might affect the operation of another requires an (sometimes deep) understanding of the other unit. This cannot be reduced to a sort general knowledge of the specifics of particular units, but it can be a matter of detail. Mere information processing does not solve the problem that a particular UAV cannot launch at predetermined specific moment because it needs to wait unit the engine is sufficiently warmed up. So the control tower learned that it needed to understand specific traits of the engine of the UAV in order to coordinate with them effectively, while the UAV-unit needed to learn that such details were important to the control tower in the first place.

The argument against the chaoplexic paradigm

The expeditionary taskforce as studied above is considered a counterexample here, because it points out a specific problem of large interconnected networks. That is the issue of "hidden" and "not-understood" interconnections between elements of the taskforce. As TFU was basically an underdeveloped network, parts of the expeditionary network were interconnected in a way operators did not realize until real interactions emerged. Subsequently operators tried to "structure" or to organize these interactions, without being aware if their local solution to the negative effects of a particular interconnection, affected other the taskforce beyond their perspective. In that way "self-organization" might be "emergent", but not every "emergent pattern" is by definition

good (Kuipers, et.al, 2010). Essentially therefore, the TFU example shows the problem of controlling (hidden) interconnections between "nodes" of the network with possible negative consequences for the operation of the networks as a whole.

The possible negative cascading effects of interconnections between "nodes" in a system has been described by Normal Accidents Theory (NAT), developed by Perrow (Perrow, 1999). NAT's essential point is that a particular kind of "cascading" accidents can be "normal" in some organizations. More specifically, such "normal accidents" can potentially occur in organizations that operate in disruptive environments because in that case elements interact in a way that cannot be fully "designed". If that is the case, a system is characterized by *complex interaction*. If there is, furthermore, a significant interdependence between elements, a disturbance has the potential to resonate throughout a system (*tight coupling*). Organizations that are characterized by complex interaction and tight coupling are therefore particularly vulnerable to cascading failures.

Van Bezooijen & Kramer (2014) and Kramer & Van Bezooijen (2016) use Perrow's NAT to criticize the chaoplexic paradigm. Their argument is that the chaoplexic paradigm is specifically focused on creating complex interaction and tight coupling. Given that military taskforces are meant to operate in turbulent conditions that create complex interactions, Van Bezooijen & Kramer (2014, p.14) conclude:

> *"(…) IT is implemented in military operations to make them more agile, enabling military units to react quicker to environmental change by removing time slack. Being quicker is a form of tighter coupling. In other words, designing for agile, emerging collaborations between networked units without direct supervision directly influences the potential for normal accidents to happen."*

So while previously Atkinson & Moffat claimed that the ideas of the chaoplexic paradigm work if there is loose coupling, Van Bezooijen & Kramer (2014) claim that in military taskforces, build up of specialized units, are tightly coupled, particularly if the attempt is to create more agile organizations: more speed means that the interrelations between units become tighter. Furthermore, the tendency in Armies to create specialized units, also creates tight coupling. In armies an element is still thought to be the basic specialized military unit: an infantry platoon, an Apache squadron, an Artillery-canon, an UAV, etc. These basic elements are called "assets" and the basic thought is that military taskforce requires a collection of assets. Basically, an "asset" consists of a crew organized around some technological system or a basic collection of soldiers. While traditional armies offer battalion and brigade structures which combine these interdependent units into larger organizational clusters, the chaoplexic paradigm aims to keep basic elements and claims that the coordinated action between interdependent elements can be established by connecting them through ICT.

What is not considered by the chaoplexic paradigm, is that by organizing around "assets" which are specialized units, it basically chooses for the principle of functional concentration (De Sitter, 2000). The effect is that if the taskforce wants to conduct a certain task it needs to assemble different units, which leads to structural complexity

(more interconnections) in the network as a whole, and tight coupling instead of loose coupling[2].

If the chaoplexic paradigm depends on "loose coupling" it should invest in creating basic "nodes" that are loosely coupled to the network they are part of. However, this point never enters the discussion. *In a sense, the chaoplexic paradigm attempts to conserve silos, with a claimed "magical" solution for the problems of coordinating between silos (control will emerge).* All in all, Kramer & Van Bezooijen (2016) conclude that:

> *"The chaoplexic paradigm is considered here as a theory that combines an opportunistic reading of complexity science with an improbable idea about designing military taskforces. This certainly is no argument against the use of IT. Instead, the analysis shows that being able to harvest the potential benefits of IT requires a sophisticated understanding of the way organizational systems work in dynamically complex environments."*

Perrow calls such discussions about network centric operations "bulleted boy scout homilies", that promise a future of super-agility, if the Armed Forces would just invest in X, Y or Z (Perrow, 2004).

Hierarchy and the chaoplexic paradigm

NAT can be seen as a theory from the existing "hierarchy-paradigm" in organization studies. It is therefore not very surprising that on the basis of such a theory it can be claimed that the new paradigm is wrong. In essence, the existing paradigm rests on the idea that "hierarchy" is an indispensible aspect of larger organizations. James Thompson (2008, p.59) claims regarding hierarchy that:

> *"It is unfortunate that this term has come to stand almost exclusively for degrees of highness and lowness, for this tends to hide the basic significance of hierarchy for complex organizations. Each level is not simply higher than the one below, but it is a more inclusive* clustering*, or combination of interdependent groups, to handle those aspects of coordination which are beyond the scope of any of its components" (emphasis in original).*

Simon (1962) argues that hierarchy simplifies systems by reducing the amount of information that needs to be processed. This is what Simon (1997) calls a "nearly decomposable system": it is a system in which the internal complexity within a node is greater than the complexity of the network of nodes. By striving for mutual adjustment within units coordination costs are minimized (Thompson, 2008, p.57). The core of this "hierarchy paradigm" is that an organization confronted with a dynamically complex

[2] If a large and complex network of units is "robustly" networked, the resulting network becomes extremely complex. More particularly, a taskforce like TFU with 49 units would on the basis of the formula n(n-1)/2 have 1176 relations between units if they would be robustly networked. However, if the taskforce would consist of just 4 units, there would only be 6 interconnections.

environment need to reduce the uncertainty of this environment by means of hierarchy, i.e. creating an organizational structure. James Thompson refers to the assumption that structure is the vehicle by which organizations achieve bounded rationality and claims that (2008, p54):

> *"By delimiting possibilities, control over resources and other matters, organizations provide their participating members with boundaries within which efficiency may be a reasonable expectation. But if structure affords numerous spheres of bounded rationality, it must also facilitate the* coordinated *action of these* interdependent *systems" (emphasis in original).*

This assumption in in line with most recent formulations in system's theory in the sense that systems need to "reduce complexity" before they can deal with a dynamically complex environment (Blom, 1997; Christis, 1998; Kramer 2007). Although the chaoplexic paradigm is based on complexity science, which is also a variation of systems theory, this particular assumption is not shared by the chaoplexic paradigm. In fact, the chaoplexic paradigm seems to suggest that systems can become as complex as their environment[3]. The assumption that systems in complex environments need to "limit possibilities" in order to "reduce complexity" might for some be counter-intuitive. Many will point to the opposite: hierarchies are actually so restricting that they limit the ability to deal with uncertainty.

This has in fact always been a main point of the sociotechnical tradition. It is no coincidence that Phil Herbst called his 1976 book about the sociotechnical tradition *Alternatives to hierarchies* (Herbst, 1976). The history of the sociotechnical tradition has been about how to overcome the restricting characteristics of "classical" bureaucratic and mechanical structures. If there is one message central to the sociotechnical tradition it is that hierarchy is often "the problem" rather than the "solution" and certainly not the solution to dealing with dynamic complexity. This might explain a lot of the allure of the ideas of the "chaoplexic paradigm": ICT-innovations might finally able to beat the archenemy of the sociotechnical tradition. However, if the "hierarchy-paradigm" claims that "limiting possibilities" is the way to deal with uncertainty, the claim is not that uncertainty can be totally transformed into certainty. Instead, the idea is that in order to be not overwhelmed by the infinite complexity of the environment, a system needs assumptions, i.e. some degree of selectivity in the way the environment is engaged. This inevitably leads to the position that there is no perfect way to deal with dynamic complexity. Selectivity is inevitable, but is also inevitably blinding and hierarchy is indeed inevitably constraining. This is a core problem of organizing according to the hierarchy paradigm that cannot be overcome by a magical ICT solution.

The essential difference between the paradigms becomes obvious. A hierarchy "limits possibilities", while previously it was argued that the chaoplexic paradigm is based on an idea that an organization is a tissue that is "infinitely malleable". One

[3] This is the reason why Kramer & Van Bezooijen (2016) claimed that the chaoplexic paradigm is based on an opportunistic reading of complexity science.

paradigm states that hierarchy is necessary as a means to be able to deal with uncertainty. According to the hierarchy-paradigm an organization would at every point be overloaded with possibilities if there were no hierarchy. The other states that hierarchy can be abolished because it in fact prohibits dealing with uncertainty. In the latter case, no "organizational choice" would be necessary: an organization can keep all possible structures open and let the "right" one emerge out of interactions between nodes. The conclusion here is that the ideas of the chaoplexic paradigm could only work if lower level units are "perfect information processors" without "bounded rationality". This seems to be a very unrealistic assumption and that is why I consider the core claims of the chaoplexic paradigm unconvincing.

The vulnerable taskforce

At the end of this paper, some ideas will be discussed that seem promising as a way to understand networked organizations such as TFU. Core of this perspective is the idea of vulnerability. The previous leads to the conclusion that organizations in certain – very turbulent – environments are by definition imperfect. On the one hand they need to "limit possibilities" because of "bounded rationality" and "information overload" while on the other hand they need openness. The very problem of organizations in dynamically complex environments is that on the one hand they have no choice but to "limit possibilities" because of "bounded rationality" and "information overload" while on the other hand they have no choice but to be open (see also Kramer, 2007). According to the perspective here, this dialectic between limitation and openness is the essential problem of organizations that creates their inherent vulnerability in very turbulent environments.

This very dilemma is clear in James Thompson's discussion of the problems of what he called the *synthetic organization*. This synthetic organization that is according to Thompson an ad hoc organization that emerges to deal with natural disasters (2008, p.52). So in fact, it is not unlike the expeditionary taskforce discussed above. Thompson claims of this synthetic organization that it is not efficient: some resources are not deployed, and some are employed at cross-purposes (2008, p.53). He claims that this is the case because (2008, p.53):

> *"Perhaps the overriding reason is that the synthetic organization must simultaneously establish its structure and carry on operations. Under conditions of great uncertainty, it must learn the nature and extent of the overall problem to be solved and the nature and location of relevant resources. At the same time is must assemble and interrelate the components, and it must do all this without the benefit of established rules or commonly know channels of communication. The synthetic organization cannot take inventory before swinging into action. (…). The synthetic organization for disaster recovery is inefficient by technological or economic standards because it must order the actions of its components in a situation of interdependence and in the face of uncertainty as to where and how that interdependence exists. It can be presumed that efficiency would be higher if the*

synthetic-organization headquarters knew in advance either the extent of the problem to be solved or the full array of resources available to it."

So the "synthetic organization" certainly is structured, but is far from ideally structured, or even "finished". It is in fact underdeveloped and works out its structure as it goes along. It is quite interesting to note that – in a publication that is generally considered to be one of the most fundamental ones in organization science – specifically discusses the very organizational issues that were observable in the expeditionary taskforce discussed above. What is discernible in this quote of Thompson is that in such organizations *structure* and *process* become directly related. Kramer & Moorkamp (2016) claim about the classical difference between structure and process:

"While structure refers to fixed – noun-like – characteristics of organizations, such as their structural design, process refers to the way activities – verbs – within systems are organized."

Synthetic organizations need to "swing into action" before they have fully worked out a structure that would work in a particular environment. That means that operators "act" (process) without fully understanding the interconnections in the organization (structure). In these cases it is local problem solving ("process") that creates fixed relations in an organization ("structure"). The idea of "the organizational skeleton" developed by Weick specifies this relation between structure and process (Weick, 2005). He uses a definition by Bate and Pye who claim that: "design is a bare bones framework on which a more organic, emergent, social structure develops as people interact, argue, fall out, come together, and otherwise manage their day to day situation" (Bate and Pye 2000, p.199). In developing local problem solving strategies (process), operators need to understand how their behavior is limited by the behavior of other units that act (structure). If you want to fly an UAV in Uruzgan, it is important to try to understand how the behavior of the UAV is related to other flying units in the same area, even though there might not be an existing structure in place that specifies your interactions with a control tower. So operators in such systems don't work "within" a structure, their everyday work (i.e. "normal work") is specifically oriented at balancing structure and process and changing each of them as you go along. Their everyday work is partly "designing". Because of the sheer complexity of this task, such systems will always be vulnerable: acts of operators in response to environmental contingencies can threaten the functional integration of the entire network. Kramer & Moorkamp (2016):

"When this perspective on organizations is used it is obvious that they are inherently vulnerable. Their design is principally outdated against the background of a dynamically complex environment. In such environments, organizations are seen as principally unsettled. Functional integration needs to be established form moment to moment, and the resulting coherence is not a sort of system-wide symphonious harmony, but one that is good enough to survive to the next moment.

> *In normal work, the conflict between on the one hand the environmental disruptions, and on the other hand the conflict with the existing structural design of an organization becomes visible. The solutions found by operators can potentially lead to vulnerability because they were unaware of certain dependencies between different processes, because they provoke a certain reaction from the environment and as such setting the stage for further environmental disruptions."*

Kramer & Moorkamp (2016) state that the best such organizations can do is to capture an ability to reflect on the possibilities and limitations of their own organizations, since any "design" is based on pre-existing ideas and in hyperturbulent conditions any "design" can become outdated very quickly. In other words, they need to be able to "organize doubt" directed at their own organizations (Kramer, 2007). Kramer & Moorkamp (2016):

> *"This outdated character of design is visible in process: operators that aim to keep a system afloat are essentially involved with this issue. For this reason, it is claimed here that systems need to organize their ability to continuously reflect on their organization: they need to "organize doubt" directed at their own organization."*

"Organizing doubt" would in the case of TFU mean that the taskforce would have understood what kinds of organizational problems they would have encountered when they deployed 49 units in a very dynamic environment. Given the acknowledgement of the inherent vulnerability of the taskforce, they could have created all kinds of structures, perhaps a "parallel learning mechanisms" (Shani & Doherty, 2003), in order to deal with organizational issues, instead of stumbling from one issue to the next.

Conclusion and discussion

The ironic side to this paper is that sociotechnical ideas are used to claim that the military organization should take hierarchy more seriously. Even more ironic perhaps is that sociotechnical ideas, which have traditionally been used to break down repressive hierarchical structures, are used here to claim that it is important for structures to limit possibilities. The conclusion of this paper is that the chaoplexic paradigm did not create a paradigm shift: our thinking about organizations does need to change radically as a result of ICT innovations. Although the ideas of complexity science are very inspiring renewing in organization studies (Morgan, 1997), a "one on one" translation into a model that describes how organizations can suddenly work as agile integrated networks without hierarchy seems a bridge too far. That might work for very loosely coupled systems such as bakeries, but is unlikely to work for very integrated networks that have no time to loose. The theory of CAS was never about that[4].

[4] Indeed, if evolution can be understood in terms of order that emerges from chaos, it should be kept in mind that not every variation survives in biological evolution. In fact, out of a mass of variations only some survive, quite unlike the image of the super network without hierarchy, which is basically a theory about trials without error.

The question is where all of this leaves us. Although the core of the ideas of the chaoplexic paradigm is rejected here, that does not mean that the sociotechnical tradition can happily ignore ICT innovations. A sociotechnical perspective will argue that there is "organizational choice". New technology does not force an organizational structure upon us. Instead, we have a "choice": we can develop smart ways of organizing to make the most of the new technology. It should be emphasized that "organizational choice" should not be understood as implying "social voluntarism" (the idea that society or the organization determines technological development). Instead, the idea that technological developments and organization mutually influence each other seems to be preferable. For the sociotechnical tradition, this means that although ICT innovations do not determine the way organizations will be structured, they create possibilities in organizational forms that previously were unthinkable. It is up to the sociotechnical tradition to theorize about how to take up these technological developments and to see how they can be used to create organizations that are both "humane" and "effective".

Regarding these possibilities, it is indisputable that ICT innovations have not only "improved" existing ways of coordinating, they also have created new possibilities beyond the scope of the traditional ways of coordinating. They have enabled mutual coordination between organizational parts in a way that would have been impossible in the past (offshore software development is just one example). That means that – technologically – they have enabled the creation of networks in a way that would have been impossible before. The chaoplexic paradigm might have argued that such new networks can be made so flexible and malleable that they can be deployed in extremely turbulent environments and find their way on their own. The implication of this paper is that – although there might be fewer and fewer technological limitation in creating such networks, there is in fact an organizational problem associated with such networks. Kramer & Moorkamp (2016) have called these networks "vulnerable" as a result of their not fully developed character and the hidden interconnections between parts of the network. This vulnerability will surface increasingly as environments become increasingly turbulent. This emphasis on the threats of interconnection in networks is gaining traction in international publications. It will be a main focus in Moorkamp's forthcoming dissertation and it is a central issue in Roe & Schulman (2016) recent publication on managing interconnections in critical infrastructures. So a broader implication of this paper is that if technology creates new organizational possibilities, the sociotechnical theorizing should focus on how to make the most of this technology, without the associated hazards. In case of ICT-technology and network-forms, that means that sociotechnical theorizing should focus on developing an understanding of the organizational dynamics of "network-forms"

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