

Information and Communication Technology (ICT) in Resilient Global Logistics (RGL)

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Abstract. The need for a special focus on the role of Information and Communication Technology (ICT) in Resilient Global Logistics (RGL) is described. A research strategy comprising theoretical development and an interpretation framework is presented. The framework distinguishes between digital infrastructure, information and knowledge, and provides the basis for looking beyond Tayloristic “common-sense” on the important issues. The paper is placed within an interpretive discourse in which the main goal is to establish sufficient management support in a globalized context, but is also based on a critical discourse concerning the role of ICT in a globalized context.

1 INTRODUCTION

As part of a larger project in Resilient Global Logistics (RGL), this paper will describe an effort to grasp and manage the role of Information and Communication Technology (ICT), both in terms of ICT as a *vulnerability factor* as well as a *source for resilience*. The paper reflects a draft scope of a PhD work on this issue.

The impact of ICT on contemporary logistics is enormous. However, this impact would probably not be achieved without the close connection between ICT capacities and prevalent management paradigms. According to Peter Drucker (1999), most of the tremendous productivity improvement over the last decades is a direct result of the scientific management principles laid down by Frederick Taylor (1911). Modern production, supply and logistics chains can be viewed as the extreme perfection of these principles, however in a scale that is unthinkable without the vast and globally connected information communication and processing capacity that modern ICT can offer. Logistics have thus utilized these capacities to the fullest, but have at the same time become increasingly vulnerable, partly due to technical dependability and “information supply chains”, but also as a victim to its own success (e.g. Just-in-Time).

From a sociotechnical perspective, ICT have caught much attention because it a technology that offers new opportunities and raise new question. Zuboff (1988) distinguishes between the *automate* and *informate* effects. The former maps directly back to the Tayloristic paradigm, the latter opens up new (indeterministic) possibilities. Zuboff pointed at some positive opportunities related to *informate*, showing how such a strategy could spark a development in skills and capabilities for workers. At the same time, she warned that in the absence of an *informating strategy*, automation would tend to be

the default (least resistance) policy, in which managers sought to maintain a (unrealistic) kind of “fail-safe” control. Other authors, like Orlikowski (1991) have focused on the reciprocally invoked dynamic between organizational controls and information technology, and asked critical question about whether the integrated information environment is a matrix of control in disguise (the paradox of empowered self-control).

Lilley & al (2004) points at the connection between ICT and Herbert Simons vision of technological substitutes for (human) bounded rationality with its direct link to the (first) artificial intelligence (AI) movement, and emphasizes ICT as an “in-forming” (that is, “giving form to”) technology which they call *representation technology*. This technology provide vast opportunities for creation of ontologies of the (real) world, as well as going beyond the “real” world and constituting powerful and fascinating “hyper-realities”. And finally, the public as well as computer professionals and managers frequently contend that ICT preserves and generates *knowledge*. **What is then left for the human actor that is expected to intervene and take responsibility** in complex logistics and supply chains? How does this fit together, what is the impact on RGL?

Moreover, as the field of *resilience engineering* is about to demarcate itself as a distinct complement and step forward in relation to the more traditional safety (and security) approaches (Hollnagel & al, 2006), new questions emerge. E.g., what are the impacts of *functional resonance* as an explanation of both success and failure, at the expense of the more retrospective and incremental (and traditional) focus on failure modes, barriers, fault trees and event trees? How can ICT make logistics resilient, and how can organizations *use and approach* ICT in a manner that facilitates (organizational) resilience in the RGL context?

Different views on ICT can guide our perceptions of its impact on RGL in different directions. We argue that it is necessary to go beyond common-sense conceptions of ICT to understand its role in relation to vulnerability and resilience in modern enterprises that are so to say “imploded into digital codes and then exploded onto the global, digital infrastructure” (Blackler, 1995).

Why do we then not turn our attention more directly to the field of information security? The reason is that this field has a too limited and narrow scope to deal with RGL. In a report from the (US) Committee on Information Systems Trustworthiness, it was stated that “...*continuing decentralization may render less and less applicable the concepts of control inherent in traditional approaches to security, reliability, and safety...*” (CIST, 1999:189). Moreover, Clarke & Drake (2003) characterize the field of information security as a representative for an extreme instrumentality (scientific functionalism) that already Immanuel Kant warned against 250 years ago, in which “*man have forgotten to think unless given rules by which to do so*”.

2 OBJECTIVES

Based on a broad understanding of possible failure modes (failure to deliver technical performance, failure to deliver proper information flows, as well as failure to facilitate

sound sensemaking and decision processes) of ICT related risk and vulnerability, we want to explore the possibilities of resilient ICT and resilient use of ICT in global logistics. Subsequently, we will synthesize different insights into models and management tools that can assist decision making related to ICT, in the RGL context.

3 RATIONALE/JUSTIFICATION

Logistics is an important part of global production networks and supply chains, as the “information shadow”, not only the goods and services, is subject to vulnerability, and may be a source of resilience.

The promises of Taylorism is more than fulfilled, now a globalized production system must face new challenges, in which resilience in general, but also more specific ICT resilience issues, must be solved.

4 RESEARCH STRATEGY

4.1 Theoretical development and interpretation framework

Our research will be conducted based on a three-part interpretation framework for ICT impact on Resilient Global Logistics (RGL). The foundation for this is a three layer-model in which the primary distinctions are between *digital infrastructure*, *information* and *knowledge* (Figure1). However, within each layer of this model, a number of critical questions can be raised, e.g:

- Should ICT be considered (only) as a digital infrastructure by conventional means, that is, a foundation underlying society, a stable structure, a common resource, and a common standard, or, should ICT be considered as a (socially constructed) highly dynamic *gateway/adapter technology* (Dahlbom, 2000) that makes common-sense metaphors like roads and electricity, obsolete?
- Should ICT be utilized to the fullest as “in-formatting” (form-giving) and *representation technology*, modeling and organizing the ontological dimension of the whole logistics and supply chain and the support processes, without objections concerning impact on sensemaking and decision making? Or, is there any reason at all to fear the emergence of hyper-realities and automatic decisions that goes beyond any reach of resilient, mindful cooperation based on human supervision? Will it be inconvenient to hypothesize that unerasable information traces will *ensnare rather than progressively enlighten* the participants in the “virtual” control room?
- How should we deal with ICT as a knowledge process mediating technology? Should we simply rule out the pragmatics of communication (Watzlawick & al, 1967) or the existence of (epistemic) communities of practice (Hislop, 2005)?

On which ground could we distinguish between knowledge as risk or resilience factor? Is knowledge a normative factor for comparative assessment, or should we “verbalize” the term (as Weick (1969) did with “organization”) and instead focus on *knowledging* in a hermeneutic spiral, and then look at the impact on cooperation and coordination of complex systems? Are we ready to look at knowledge not only in the “objective” sense, but knowledge as constructed, provisional, situated and contested (Blackler, 1995), and even relate it to human understanding, hermeneutics and phenomenology (Borland 1985, 1989)?

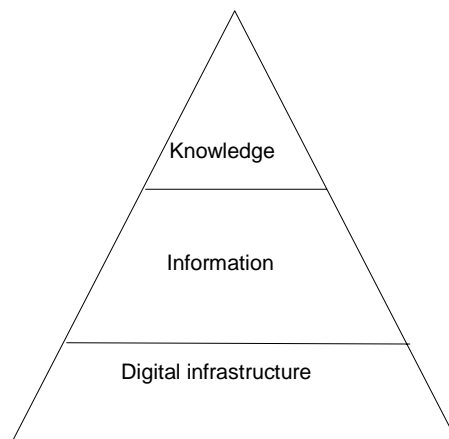


Figure 1. Interpretation Framework for Resilient Global Logistics

- Could resilience rely on some form of “social interpretation”, reflecting the dynamic and situated nature of knowledge, constituting (ICT-supported) “organizational minds”? Could this eventually lead to organizations that “*get used to their own knowledge, which then betrays them*” (Baumard 1995)? Are Lilley & al (2004) right when they claim that “*knowledge can only appear as manageable if one actively maintains ignorance of this diversity and its history*”?
- Or, can we simply attribute any epistemic differences to ethnical, national, regional and company-specific *cultures*, and align them (create shared mental models) through computer-based (objective) knowledge and models?

4.2 “Summing up” : management decision support tools

Our aim is to synthesize different aspects from the model and organize them with the ultimate aim of offering management decisions support tools. To use a popular metaphor, we intend to facilitate the “triangulation” of ICT issues in RGL. The intention is to make *managers* aware that they must look at the problem from different angles, with

a reminder that the partial answers they then get, must be seen in relation to each other, they do not simply add more precision to an earlier estimate. In using the tools, we will invite the users to go into questions like the ones in the previous section, without locking into mutually exclusive conceptions. We are aware that this metaphor may connote an expectation of a “single” truth about this issue, but we keep this metaphor because the management challenge is somewhat different from the scientific. In synthesizing the above layers of understanding, the “triangulation” metaphor indicate the managerial need: to have *sufficient* basis for *decisions* under uncertainty - not for scientific inquiry.

We will also try to transcend the subject-object dichotomy that haunts many multidisciplinary approaches - all too often technology is forced to be “pure object” and human beings correspondingly “pure subjects”. We aim to explore the use of actor-network theory (ANT) as an alternative vehicle for expressing more complex webs of actors spanning our framework of interpretation. ANT uses a principle of extended symmetry as a basis for treating social agents, objects and “texts” as entities on the same level in a heterogeneous sociotechnical network or “ensemble”. ANT is a sociology of translation, in which the four crucial “moments” are problematization, interessement, enrollment and mobilization (Hess, 1997). A critique of ANT is however that it implies a danger of underestimating the prominence of culture and power.

4.3 Case studies

We will seek to do case studies based on our interpretive framework from different sectors, in which the use of information systems may be expected to be a key to resilient operation. Integrated Operations in the oil/gas sector is expected to be an important case, in which a fundamental reorganisation due to ICT is on the way. Air transport planning systems and maritime logistics is also on our agenda. Health care could be another possibility, as access to patient information, clinical information and medical knowledge could be treated as a logistics problem. This list is not meant to be exhaustive, as we contend that our approach have a certain generic potential in the RGL context.

4.4 What kind of discourse will we then be contributing to ?

Schultze and Leidner (2002) distinguishes between four different kinds of discourse related to Knowledge Management (KM) in Information systems research. (We do believe that KM applies to RGL to a large extent).

1. The **Normative** discourse based on the assumptions of progressive enlightenment, as well as increasing rationalization, management and control.
2. The **Interpretive** discourse emphasizing the social rather than the economic view of the organization, being occupied also with aspects of organizational life that has not yet been systematized and brought under control of rationalized logics, employing methods like ethnographic and hermeneutic methods. People in organizations are seen as active sense-makers and creators of organizational life

3. The **Critical** discourse in which organizations are viewed as sites of political struggle and field of continuous conflict. The objective of the research is to unmask and critique the forms of domination and distorted communication.
4. The **Dialogic** discourse could have been labeled the *postmodern* discourse because it focuses not only on the constructed nature of reality and the role of language in the construction process, but also on the fragmented and the multi-vocal nature of this never-ending construction process.

Intuitively, it might be argued that the business of risk and safety analysis is a critical and/or dialogic discourse. But due to the criticism from the resilience engineering literature (e.g. Hollnagel, 2006), it may rather be seen as a part of a normalizing discourse, pretending to find the “last” failure mode and prepare the road to total safety. What then about resilience literature? It might be argued that due to its critique of the underlying safety focus on disciplining and domination, and (wrong) attribution to human error, they engage in a in an interpreting, but also critical discourse.

What characterizes our RGL approach then? From the outset, we deliberately mark a distance towards the normalizing discourses in security and safety discourses, as these are seen as rather myopic, ignoring important issues, being unable to grasp resilience as a concept. Our main intention is to contribute to an interpretive discourse, from which decision makers are offered a pragmatic toolbox that covers a “full” aspect of RGL, and understands the “full” implementation and organizational implications of RGL ICT.

Our main objective is thus to contribute to an interpretive discourse that produces a (sufficiently) coherent, consensual and unified representation of what RGL actually “is” or “ought” to be. In this approach, we will employ hermeneutic approaches not only as researchers in order to grasp different “parts” of reality on different premises, but we will also apply a “double-hermeneutic” in which we consider the human actors (ICT) users not only as objects, but also as (hermeneutic) subjects struggling with understanding situations on basis of information from and interaction through the ICT systems. Social science is a matter of interpreting interpretive beings (Alvesson and Sköldbberg, 2000:144). We will thus be subjects studying subjects as well as objects. We will also base our analysis on both alternative and straightforward “common-sense” views of technology and infrastructure. However, our overall (end-) goal is to synthesize a number of approaches into a common framework which is *sufficiently* “true” from a managerial viewpoint, albeit not from a philosophical one, and which contributes to the “rational” management of such complex issues.

This means that we will not contribute to a critical (and just!) discourse on the effects of globalization from RGL itself, on social inequities underlying globalizing stratifications and power relations in a globalized world, although we clearly see the possibility that ICT is contributing to a reinforcement of negative (side) effects. We must however, in order to be able to place our tool within a realistic management context, go somewhat into what the concept of globalization actually mean (from the management perspective). In order to accomplish this, we will employ perspectives on reflexive moderniza-

tion according to Beck, Giddens and others, and especially use the contribution from Jaeger & al (2001), to get a hold of the risk management issues on a “rational” basis.

Beyond this, a partly dialogic discourse is however inevitable because we introduce “opposite” foundations on each layer of the interpretive framework¹. Hence, we lend our discourse to an examination of underlying contradictions on the use of ICT. In other words, we want to offer managers some usable tools, but at the same time inject some skepticism and give them a “wakeup call” in their understanding of ICT and implications for RGL. We want to them to realize that *traditional approaches to ICT may normalize and actually hinder, rather than promote, effective responses to security threats and safety hazards*. That is, conventional use of ICT and security/safety may actually hinder, rather than provide resilience! We therefore intend to join the resilience (critical or otherwise) discourse, and use it as a vehicle for our purpose.

5 DELIVERABLES

Through our project, we will investigate how to utilize multiple philosophies of science for the sake of RGL – its theoretical foundation and grounding. We will present each frame, with opposing perspectives, searching for vulnerabilities and contributions to resilience. We will perform case studies, exercising and revising the models. We will also work out models and tools for decision support. We will also explicate the management context, with special emphasis on the premise that managers cannot rely on the Tayloristic approaches in a globalized world.

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¹ if we only put in common-sense, that is, “classical” infrastructure thinking, unreserved addiction to data modeling, and “objectivistic” view on knowledge, we would be involved in a purely interpretive dialogue

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