TECHNOLOGY ADOPTION FAILURE THROUGH THE PRISM OF ORGANIZATIONAL REGULATION MODEL

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Abstract

Experiences show that using simulation and serious games in organizations responsible for emergency management education can yield varying results. There are organizations arguing unique benefits of new technologies, while others struggle with adoption and abandon these applications after the trial period. This paper investigates potentials for benefits and hindrances for using computer simulation applications after the procurement across same-type organizations, where the use of this technology is promising to deliver significant organizational outcomes. Data comes from interviews and participant observations from a multiple case study. This data was examined through the lens of Trifecta model of IT-based organizational regulation (de Vaujany et al., 2018). The chosen model and the analysis help explore differences in knowledge between different organizational stakeholders. The findings suggest that differences in technology- and process- related knowledge between different groups and organizations lead to varying outcomes of IT adoption decisions, even in the same organization. We discuss the obtained results in order to provide suggestion on what knowledge sharing- and stakeholder- relevant factors have to be considered when making technology adoption and implementation decisions.

Keywords: IT-based organizational regulation, exploratory analysis, emergency management; training; technology adoption; simulation; serious games; gamification.

1. INTRODUCTION

Emergency services exist for decades or centuries. Akin to military organization, the training of emergency officers is a key to effective rescue work. The task of training is to enable appropriate and sought-for experiences through suitable learning scenarios. High experiences are exactly the promise of virtual reality, computer simulations, and serious games technologies (SSG). This is why many organizations see in SSG great value for improving or supporting training. There are studies arguing for using SSG, while other studies are more critical, and are pointing to careful use. What literature agrees on is the potential benefit of the new technologies hinges on the role of instructors, introductory phases after the procurement, and considering better harmonization with local educational and training goals.

Despite the aforementioned challenges related to SSG adoption, the increasing usage of the technology during the last four decades (Crookall, 2010) suggests the possible benefits of SSG must be overweighting the possible problems. Along with many positive examples found in emergency services (Jansen, 2014, Bonnechère, 2018), there are also cases when SSG was procured, but eventually not used or abandoned. Those cases generate frustration for the adopting organization and make scholars motivated to investigate causes for no use.

The motivation behind this paper is to provide a better understanding of the reasons for non-adoption of a procured, previously perceived as a useful technology. The study is based on interview and observation data from organizations responsible for emergency management training from nine different countries. The data has been collected between 2014-2018 with focus on examples of differences in how technology- and process- related knowledge between different groups and organizations leads to varying outcomes of IT adoption decisions.

"Trifecta" model of IT-based organizational regulation (de Vaujany et al. 2018) is used to obtain deeper insights on hindrances towards non-use of novel technology and to formulate suggestions how these hindrances can be overcome. We adopt Trifecta model because 1) it explicitly focuses on interactions between people, tools they use, and the organizational rules related to both the tools and the related practices, and 2) it ascribes key importance to knowledge-related processes of knowing and understanding in these rules- and tools- related practices.

The adopted model helps to understand the difficult situation in which many instructors found themselves after SSG tools have been procured by their organizations. Given their role of instructors, the knowledge-related difficulties experienced by them can lead to technology non-use. Finally, we draw implications for the procurement policies and training organization policies (and the changing role of instructors) to suggest what institutional adjustments may be needed to minimize the risk of SSG non-adoption and maximize the efficiency (and effectiveness) of training under the new virtual training paradigm.

2. TECHNOLOGY ADOPTION IN ORGANIZATIONS: THE CASE OF EMERGENCY TRAINING

Technology adoption in emergency organizations does not differ from most other organizations. Two decision points can be distinguished in the adoption process: 1) the procurement decision, and 2) the decision of how or if to use the technology for the intended purposes thereafter. If the former leads to formal adoption, which can be seen as a discrete event at a certain point of time, then the latter must be understood as a process, which eventually allows concluding the success of the adoption process.

The adoption decisions can be seen from the perspective of perceived value (Kraemer & King, 2003; Zhu & Kraemer, 2005). Willingness to adopt encompasses such determinants as perceived ease of use, attractiveness to other important user(s), status, job relevance, impact on output quality, and ability to produce a demonstrable result (as summarized by different studies, e.g., Venkatesh and Bala, 2008). For complex technologies like SSG, complementary organizational resources are often needed for its integration into organizational routines. A value generation process for different stakeholders must be understood and/or defined (Melville et al., 2004).

Studies on technology adoption can be addressing either of the two aforementioned decision points separately, or two in combination. In the latter case, the focus is on the conflict between the two decisions – e.g., the procurement decision led to the adoption of technology in organization, but the actual "adoption in practice" did not happen thus leading to non-adoption of the "adopted" technology. Such a phenomenon is usually analyzed from the perspective of different stakeholders pursuing different organizational (Markus, 1983) or state (Kwak, Lee, & Fomin, 2011) goals. In this paper, we are addressing this phenomenon from an organizational knowledge perspective.

The technology procurement decision is a discrete top-down decision made by the company management. The technology use is a bottom-up "continuum of decisions" constituted by everyday interaction with the technology at the operational level of the company.

What is in common between the top-down and the bottom-up perspectives on technology adoption, is that in both cases the decisions are made based on the specific knowledge of the relevant decision-makers. That knowledge is constituted by expectations (typical for the top-down adoption decision) and understanding (typical for bottom-up adoption decision) of how that particular technology helps attain organizational goals of that particular stakeholder group. As an example, management would typically look at technology adoption through the prism of strategic or operational management goals: technology is a "fix" to operational problems (Edwards, 2003) or "key" to strategy implementation (Ciborra et al., 2001). The users of the technology would typically look at the technology as a "tool" which helps (or creates obstacles) in attaining to operational goals (Allen, Colligan, Finnie, & Kern, 2000; Markus, 1983). In either case, it is the sense-making (Weick, 1995) of the decision makers, the knowing (or the expectations) of how the technology is related to the goals and the daily practices (Boland & Tenkasi, 1995). From the knowledge perspective, if the sense-making at the two different organizational levels (top and operational) produce conflicting understandings (Boland & Tenkasi, 1995), we are likely to see a non-adoption of technology.

2.1. The Trifecta model of IT-based organizational regulation

To better understand the nature of technology non-adoption, we focus on the training process and associated knowledge/cognitive processes of the trainees and juxtapose those to the knowledge/cognitive tasks of the instructor in designing the training scenarios.

For the analysis, we use the theoretical model developed by de Vaujany et al. (2018). The contribution of this model is in providing a comprehensive and holistic description of the binary relationships between the three organizational elements: the rules (or goals), the practices, and the tools used to support the rules and the practices (see *Figure 1*).

While the model was developed for "IT-based" organizational regulation, in this paper, we attempt to apply the model to analyze emergency training, where the tools can be both IT-based (serious games software) and non-IT (traditional physical artifacts used in emergency officers training).

The model (see *Figure 1***Error! Reference source not found.**) distinguishes three perspectives on organizational regulation when viewed as an amalgam of broad organizational practices: 1) design of (IT) artifacts, which materialize organizational rules into IT artifacts; 2) Rule creation and maintenance, which formulate rules that govern practices; and 3) IT artifact use, which focuses us on questions about individuals' use of IT artifacts as part of their practices. Over time, relationships between these three elements establish and mediate an *IT-based regulation system* which embodies deeply structured and practice-based relationships between rules, IT artifacts, and organizational practices. These relationships are called *materialization*, *elicitation*, and *sense-making* dimensions of IT-based regulation.

The *materialization* relationship defines how rules are defined in terms of content, condition, character and how they are expressed and designed as part of the artifact. I.e., how/to what extent the artifact embeds or can convey/relay the organizational rules. Larger organizations, e.g. with national responsibilities, e.g. the Swedish organization has too general rules, such as boarder educational goals, but the implementation of them relays on particular actors from parts of organization involved in education.

The use of the artifact invokes *elicitation* – an actor's effort and skill in drawing forth her regulatory response when using the artifact. During elicitation, the artifacts 'invite' practices to follow the rule. At the same time, *awareness* of the existence of the rules within the artifact shapes the actor's interactions with the artifact.

The meaning of the rule needs to be established through an actor's practical *sense-making* whereby the content of the rule becomes expressed, defined, negotiated, and enacted in local practices that define rules

and socially enforce related rule following. Here, rules and practices connect through *sense-making* which reveals the rule meaning and makes regulation effective (see also Weick, 1995).

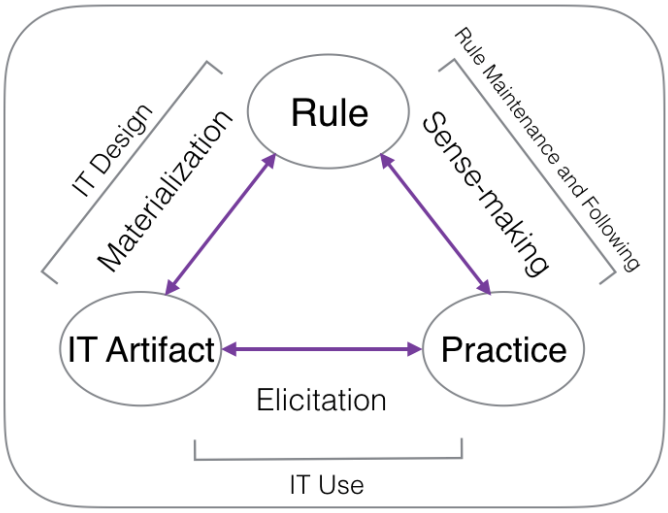

Figure 1: An IT-based regulation system (de Vaujany et al., 2018).

The model emphasizes that the three relationships *jointly mediate* as a system the meaning and effects of rules towards practices. Thus, the model can be said to be knowledge-centric – the Trifecta model sensitizes us to questions of the visibility and meaning of materialized rules to the participating actors during their (reflexive) use of the artifact.

Technology use or non-use decisions through the prism of the Trifecta model must be seen from the "Practice" corner of the model: organizational rules (goals) must align so that the practice embodies and views the use of the artifact as being related to and an expression of meaningful rule following. The authors also emphasize the importance of cognitive processes in supporting the day-to-day use of technology: rules as expressions of expected normative (future) behavior and materialized in objects need to be made both *visible and meaningful* to render the intervention effective. Defining good scenarios are basic requirements for planning effective interventions. However, the scenarios, due to limited objects on the field and more complex interventions (e.g., training rescuing for earthquake situation, harbor or forest fire) were subordinated to overall organizational goals, and have not been explicitly handled earlier, before using SSG.

To summarize on the model, in case of emergency training the three elements and the binary relationships between them can be presented as the following (see also Table 3).

Practice – the training activity. Training is an approximation of the action in the emergency situation. If one learned through practice how to act in different emergency situations, we expect this knowledge to be replicated under real-life scenario (this refers to *Sense-making* if understanding is related to *Rules* and to *Elicitation*, if the sense-making is related to the use of *Tools*).

Rules – rules for conduct under the emergency situation. The learning goals (of any particular training activity) must be designed to support those rules (this refers to *Materialization*). In a sense, learning goals are an approximation of the rules. Rules must be visible and understood to be followed in practice (this refers to *Sense-making*).

IT Artifacts – the SSG used to run the training. Include both the learning tools and the firefighting tools. Both categories can be either physical/material or virtual. Either in training or real-life emergency situations, firefighters must find the right use for their tools when facing specific situations (this refers to *Elicitation*).

3. CASE DESCRIPTION

3.1. Promises of SSG for emergency training

Emergency management has to deal with new societal changes, and consequently, the training for emergency management has to handle the new situations. There are new infrastructures, transportation possibilities, housing, and materials in the houses, communications, and living habits. There are new materials in our houses, cars, and clothes. Even the magnitude of accidents is changing. For example; an instructor can prepare to examine a hundred incident commanders in a live simulated scenario like a complicated traffic accident involving vehicles transporting hazardous goods. The scenario can involve fire, smoke, role-players and leaking gas. It is difficult to reproduce the same conditions and to conduct the examination in the same manner for all incident commanders. If the incident commanders are located in a faraway place, it is difficult to examine them. If incident commanders have to be examined, it is important to be able to follow the same situation and allow commanders to experience their role, several times as similar to a real situation as possible. They will be examined on their problem-solving skills which entail rerunning the same situation and discussing how they are thinking is the most important. This is influenced by the context considered for the learning situation. How to create a supportive and trustful context for training and examination is vital, not only for supporting user experiences but also for trusting the learning outcomes.

How to train for 'the unexpected' is far from obvious. Just planning realistic enough training situations requires extensive resources of training personnel, specialized facilities and well-planned even live fire scenarios (Chittaro et al., 2015; Williams-Bell et al., 2015). Hence, training for preparedness of emergency situations is an extremely challenging task, due to costs, all required equipment and personnel, and the need to collocate and coordinate learners for the training events. Accordingly, these events cannot be arranged as frequent as desired and run as many times as desired in an equal manner. For these reasons, SSG is often advocated as a complementary method for emergency service training.

There are studies arguing for the benefits of using SSG, for example to enhance engagement and motivation to train (Faiella and Ricciardi, 2015), for providing better context and insight into new situations (Backlund et al., 2013), by allowing high experiences via immersive technologies (Chittaro and Sioni, 2015), better supporting learning (Crookall, 2010), allowing training for many trainees (Lamb et al., 2014), or allowing accessible training with greater safety and less harmful impact on the environment (Morganti et al., 2017). Other studies are more critical, and are pointing to careful use due to e.g., the immature technology (Williams-Bell et al., 2015), unexpected effects of the actual game design (Frank, 2014), problems with technical support, or due to the fact that many instructors lack the needed technical competences (Alklind Taylor, 2014). For experiencing benefits, as commonly agreed, the role of instructors and middle management is important. The instructors are responsible due to their responsibility for defining and examining learning goals, and the middle management, for harmonizing goals for technology use and learning goals.

Historically, emergency training has been conducted in classrooms or dedicated training facilities with near-real obstacles and real tools (Heldal and Wijkmark, 2017). Traditionally, the role of the instructor has been central in designing the learning exercises and assessing the performance of the trainees. From a knowledge management perspective, learning occurs through experiences in training: "Knowledge results from the combination of grasping and transforming experience" (Kolb, 1984, p. 41). Much knowledge on tactics and use of tools had to be passed on to the trainees through the circle of experiencing, reflecting, thinking and acting. The circle is occurring over and over again. For the increased experiences of trainees, instructors may take different roles: a facilitator, an expert, an evaluator or a coach (Kolb et al., 2014).

For training to be effective, instructors have to form the learning scenarios and develop learning goals and use the best tools for these activities. To efficiently utilize technologies, they need to be familiar with it.

However, at the present stage, instructors have limited knowledge about existing technical solutions and how these can meaningfully contribute towards the fulfillment of learning goals.

3.2. Learning scenarios: train for practice

The trainees have to receive the instructor-shaped body knowledge and to learn the "mechanics" of the practice. Under the emerging paradigm, training in dedicated physical facilities often cannot be taken as a proxy for real-world emergency situations due to the increased sophistication of cases in the real-world environments. Therefore, training in the physical facilities may be experienced as ineffective or too simplistic for some situations. At the same time, people involved in technology procurement may not necessarily know what it takes to develop learning scenarios and learning goals, and thus do not understand what kind of support processes are needed for successfully implementing the technology in their organization (Adner and Snow, 2010).

SSG has been lately adopted by many emergency services to conduct the training. While the knowledge-related cognitive processes of the trainees may be argued to not to undergo substantial change under the new paradigm, the knowledge-related role of specific stakeholders – the instructor who develops the training scenarios and defines the learning goals for the training – has to undergo a substantial change (Alklind Taylor, 2014). While the trainees need to *use* technologies for their own, high user-experiences intuitively, the instructors need to *create* these experiences by designing it to suitable support learning goals.

To be able to "design" the training scenarios, the instructors must not only accumulate sufficient knowledge of the specific SSG technologies, but they also need to consider the assessment process. The nature of the learning of the "mechanics" is also changing – the trainees in the virtual world do not have the constraint of the real physical equipment and physical exercise strain. *Table* provides an overview of the knowledge-related issues in developing and undergoing training under physical (traditional) and virtual environments.

Table 1. Knowledge-related issues in developing and undergoing training in physical vs. virtual environments

	The tools used	The development of training	Pros / cons
Physical (traditional) environment	Physical objects at the training ground	High familiarity of the instructor with the tools, the assessment methods, the monitoring methods. The process of learning goal and practice development is familiar to the instructor	Pro: Easy to set-up and monitor/assess the training Con: limited number of situations, which can be created. A limited **number of rules** which can be trained.
Virtual (novel) environment	Virtual objects and environments on computers: in class-rooms, working places or at homes	Low familiarity of the instructor with the tool (SSG) and virtual tools. Unclear and/or indirect methods for assessment, which makes the task of developing learning goals complicated or impossible	Pro: Large flexibility of the virtual environment allows creating learning scenarios, which would be unfeasible or impossible in the real world Con: Development of scenarios requires from the instructor/expert user skills in virtual environments for both designing the exercises and assessing the performance of the trainees.

Successful education and training technologies require knowledge about learning scenarios. These scenarios need to be useful to achieve both old and new learning objectives. The results from the multiple case studies identified a few concrete measures for completing certain types of training in classrooms and on the fields. To examine the effects of SSGs we need to consider three possible training contexts. In the classrooms, SSGs can be used to support discussions, enhance recognition (reading or watching films about situations) and make learning more playful. On the training fields, SSGs allow more realistic representations of effects e.g. leakages of different materials. By using virtual simulations (e.g., on computer screens), the possible learning scenarios can be extended to large forest fires, earthquakes or harbor fires. Firefighters in France are trained to handle wildfires, in Portugal handling earthquake or the Netherlands harbor fire (Jansen, 2014) mainly in virtual environments.

For the UK and Estonia, the instructors had to examine a large number of firefighters in the same manner so they could not do otherwise, without computer simulations (Lamb et al., 2015). In the fields, many of these training situations can only be reproduced as overly simplified. SSG can model complex, concrete situations contributing to a common understanding of the problem and helping design learning scenarios.

The need to improve training lead to the procurement of different SSG in different countries. However, the possibility to make improvements hinges on the capability to formulate appropriate learning scenarios. Some measures were taken to define a few new learning scenarios where SSG can be useful at MSB, the Swedish authority. However, these measures never turned into concrete design ideas because the higher managers did not suggest concrete improvements, and the instructors were waiting for new concrete requirements for further improvements. During the waiting time, instructors had continued with their proven live training methods to examine training and SSG was not used. Thus, even if they missed to examine new, possible learning scenarios for the new emergencies in the society, but they could produce training results for the same type of older outcomes based on the learning scenarios they used for training without SSG.

To better understand the nature of the problem, a novel theoretical model (de Vaujany, Fomin, Haefliger, & Lyytinen, 2018) was applied in the analysis of the collected data.

3.3. Data collection

A multiple case study was initiated 2014 by a large Swedish authority, the Swedish Civil Contingencies Agency (MSB) after different types of SSG were procured for use in the education the agency is the responsible for, but prior to obtaining actual user experiences from them. The study explored the reasons for non-adoption versus successful adoption of comparable SSG across same-type organizations. Users here are managers and instructors responsible for managing SSG use and not the end-users trainees, i.e., rescue service students. Before the 2014 study, another MSB study was arguing for the possibilities with SSG in general and reporting on experiences from other organizations (Toftedahl et al., 2012). However, the perspective of handling knowledge about these simulation technologies, and transferring it to Swedish context was not investigated.

The data in the study was collected during 2014-2018 via interviews and participant observations (see Table 2). Some of the preliminary results were reported earlier, about successes in adoption (Hammar Wijkmark and Heldal, 2015, Heldal et al., 2016), and user perspectives (Heldal and Wijkmark, 2017). The results discussed the complexities of technology, how to build up necessary digital competence for instructors. This study examines the collected data with the aim to answer the question of “how differences in knowledge among different stakeholders contribute to the non-use of technology?”. The results are summative results about experiences and attitudes. Additionally, we use quotes, to illustrate underlying opinions.

Table 2. Overall experiences from organizations responsible for emergency management training in different countries (Heldal & Wijkmark, 2017)

Country	Data collection method	Key findings
Denmark	Interviews*	Non-use for firefighters, according to our present knowledge.
Estonia	Interviews and observations	Positive experiences for more than ten years. During the last few years, several scenarios were defined to better suit their environment with better understanding decision making cycles and explicit educational goals implemented in the SSG used (the XVR system). 400 Incident commanders are trained and assessed using SSG technologies every two years. The Estonian Academy of Security Sciences have explicit goals for planning and examining incident commanders.
France	Observations	Positive experiences and a number of technical staff working to develop scenarios for training. They conduct about 700 simulation-based training days per year.
Netherlands	Interviews	Positive experiences and widely used. Two major developing companies are situated in the Netherlands. From user organizations, one of the most impressive SSG based training is for the emergency response personnel at the Port of Rotterdam. 'We cannot train otherwise' states the emergency response officer in charge. Mixed reality training is considered useful at the Forensic Institute in Haag. The continuous education of the instructors is considered a key to this success.
Norway	Interviews*	Moderate use with the ambition to use. Here mainly training for the ambulance nurses was investigated.
Portugal	Observations	Positive experiences with ambitions to better exploit the possibilities of SSGs. A group with responsibility to define basic and more advanced virtual learning scenarios is defined. These new scenarios include stakeholders influencing educational and organizational goals and templates for defining scenarios aligned to interventions, educational goals, and examinations.
Singapore	Interview and observations	Positive. A great new simulator center with different simulators, from haptic-based systems to newer scenarios using SSG technology.
Sweden	Interviews and observations	Tentative use, during the last ten years but a positive attitude and plans for increased use (Toftedahl et al., 2012). There were great ambitions to use even immersive simulations (Lebram, Backlund, Engström, & Johannesson, 2009). The firefighters have possibilities to use different SSGs that can be included in their education at different centers, but the use is not coordinated.
United Kingdom	Interviews	Positive experiences of training a large number of incident commanders (K. Lamb, Boosman, & Davies, 2015).

4. CASE ANALYSIS

In this section, we analyze the nature of knowledge of different stakeholder groups in order to argue for knowledge gaps or incongruences between those of 1) the managers making SSG procurement decisions, and 2) the instructors using SSG in developing training practice. We believe that taking a knowledge perspective on different stakeholder groups can help explain non-adoption decisions and help formulate roadmaps for overcoming the non-adoption in the future.

Several plains of organizational knowledge with inherent incongruences or gaps can be identified in the development and implementation of emergency training under the new paradigm of SSG. The first plain can be identified within the adopting organization – between the knowledge of managers and instructors. Using the Trifecta model, this incongruence can be explained by exploring Practice-Tool and Practice-Rule relationships (see Table 3).

Table 1. Relationships between Rules, Tools, and Practice from top-down and bottom-up organizational perspectives

	SSG characteristics for the relationships	Top management (procurement decisions)	Operational level (daily use decisions)
Elicitation: Practice – Tool	Since SSG technologies are continuously changing, elicitation of expected use from the tool requires the provision of continuous support, updates, and training. Planning a continuous relation with the developer, or building up internal competence on handling SSGs are possible ways to facilitate elicitation process	Introduction of the Tool into training practice requires a normative base (directive/order) and **certain new skills** from the instructors, i.e. to train the instructors for handling SSG, and develop associated learning goals. **New responsibilities** and functions for handling continuous support, SSG updates, and support to design learning scenarios need to be defined and allocated.	Using the Tools requires **completely new skills**, incompatible with ones possessed by the instructor. Use of the Tool may be in conflict with existing normative base (contractual conditions, unions, training programs for instructors, etc.)
Sense-making: Practice – Rule	There are different stakeholder groups with different roles and different rule-sets on and responsibilities about local practices: instructors, responsible for different units or at USAM[1], groups responsible for coordinating education at MSB.	For managers, the sense-making on what SSG is in practice is seen from a third-person perspective, i.e., what SSG is in the eyes of instructors. Top management's own sense-making presents SSG as a tool helping attain specific organizational goals. SSG should be seen as an important element for aligning organizational goals with training and learning goals. For this to happen, clear roles and responsibilities for defining learning scenarios need to be defined.	First-person sense-making: how specific learning goals (as proxies for rules) can be 1) designed into the virtual learning environment, and 2) how attendance to those goals can be assessed
Materialization: Rules – Tool	The materialization of rules in IT artifacts in general, and in SSG, in particular, may take different forms at different organizational levels. The rules and their materialization are influencing the practical work of the instructors responsible for handling SSG. Effective use of SSG requires designing new learning scenarios – i.e., new rules for how the technology is used for training, and learning.	Given organizational goals, SSG embodies the way forward to implement those goals at procurer organizations. There are routines and processes for procurement taking into consideration the organizational goals. The rules from top management for using SSG are too general. This is the same for medium management responsible e.g., for training in general at their (sub)part of organizations, for operations or education in general.	Learning/training sessions must be developed to accommodate the new requirements and possibilities for the training. The Rules are viewed both as "rules of action in emergency situations" for acquiring familiarity with (skills for) situations in which the learning goals are developed, and used.

[1] USAM is the responsible unit at MSB: The Unit for Working with Educational Coordination.

For management in charge of the procurement decision, Practice-Tool relationship (Elicitation) is only perceived, while for the instructors it must be experienced. The same holds for the Practice-Rule (Sense-making) relationship, where the management must have an understanding of what is possible in principle, while the instructors must have an understanding of how to implement what is possible and expected. Also, while the management deals with "knowing what" type of knowledge, instructors must additionally deal with "knowing how." In this juxtaposition, the SSG as a new IT Artifact, the Practice, and the Rules for the management are black-boxed. For the instructors, while the IT Artifact – SSG – is the same, the two other elements – the Rules and the Practice – are complex "assemblies" made of many rules and practices, accordingly. Managers making a procurement decision are often unaware of those lower-order rules and practices.

The second plain of incongruent knowledge is that related to possibilities offered by software to the adopting organization. To develop learning goals and training scenarios, the instructors must have common cognitive reference points with the designers of the software (de Vaujany & Fomin, 2007). This requires an understanding of what tools can be used for, what user behavior they can elicit. The symbolic (intangible) nature of virtual artifacts presents a fertile ground for flexible (or mis-) interpretations of both Sense-making (Tools-Practice) and Elicitation (Rules-Practice) relationships. This, in turn, contributes to the third plain of incongruent knowledge – that related to the interaction between instructors and trainees mediated by the IT Artifact (SSG). Neither the instructors nor the trainees have familiarity with the tools used in the software. Instructors have limited knowledge on how specific virtual tools can be used (they do not necessarily have the same understanding of the use scenarios as the software developers had), and have limited knowledge on how to assess whether or not trainees elicit the right use of tools under given situation.

4.1. The next step: examples on knowledge gaps to close

In the following, we present some examples to support our analysis and discuss strategies for closing the knowledge gaps.

We argued for the importance of commonly accepted rules for the successful introduction of SSG. The empirical data show that at the present stage, those rules are not visible at non-adopter organizations, according to a manager responsible for SSG usage at MSB:

"...what we see so far that no one really knows who is responsible. Responsibility is pointed down on teachers from above, and from those up to different managers (Operations Manager, Unit Manager and also at USAM[1]). It's just so bad ... it shows why we have such difficulties implementing simulation... Is it not clear who is responsible for making decisions about the introduction, new course goals, using a technique or a method of training the goal nothing happens..."

Not knowing about responsibilities associated with new tools may result in continuing planning and performing education and training in the same way they are used to do before.

The task of the instructor is not only to educate on existing theories but also to "design" the Practice with the help of new learning scenarios. In order to experience training value, the design of Practice should intuitively contribute to defining training situations, superior to the existing ones. These new situations are not necessarily known by non-user organizations, according to one instructor:

"*Even if I knew the possibilities with virtual simulation, it took a long while to understand the real value with it."*

The reason for that may be the benefit to recognize the new role of the instructors for providing new, relevant and specific learning scenarios. They need to provide training:

- when the Rule must be recognized (Sense-making)
- with proper SSG deployed (Elicitation)

- trusting that the SSG deliver useful and accurate learning goals (Materialization)

Interviews from four different organizations, which successfully adopted SSG (UK, Estonia, Portugal, France) acknowledge the benefits above, by having routines for Sense-making, Elicitation, and Materialization, even if they do not use this same terminology. The organizations interviewed in this countries adopted Kathrine Lamb's introspect model (2014), a model developed to evaluate instructor competencies by using simulation-based training. This introspect model offers a simulation-based assessment tool identifying nationally determined necessary competencies for the different fire and rescue service roles. The candidates themselves need to categorize their own competencies (after a scale) due a reflective debriefing process after the situation experienced in SSG. They need to align their own decisions to decision-making situations provided by a naturalistic model. Accordingly, the learners should recognize areas needed to improve and discuss these with sector-competent instructors depending on their role. The interviews were focused on this alignment of the decisions: situations when rules need to be recognized (Sense-making), the appropriateness of context around (Elicitation), and how learners are able to connect these situations to learning goals (Materialization). When a learner (trainee) is equipped with certain tools, situations (the Rules) must be recognized (Sense-making) to be as tackle-able or un-tackle-able. At the present stage, in many countries, especially where SSG is not adopted properly, this responsibility lays almost exclusively on instructors. Since this situation (using SSG to assess competences) is new for the instructors, they would need help to know to how to define trustable learning scenarios from the organizations. They need to discuss ideas for planning new training possibilities and ways to trust these at their own organizations. As one instructor put it:

"*The knowledge behind planning exercises for live training is very different from planning virtual training. Planning virtual training needs more imagination, it is more of a top-down perspective while planning live training is more bottom-up. I couldn't plan more than the resources we have.*"

The same instructor also points to the benefit of SSG to create potentially unlimited learning scenarios. Without help from their management, instructors alone cannot define which one of the possible scenarios are most important for their organizations. Since different learning situations requires different resources, a systematic approach to handle these development situations, e.g. as in Portugal is needed.

Another instructor formulates these new possibilities of using SSG:

"*Now [for planning training scenarios in SSG] I need to think differently. For training in the field of practice [live-training], I needed to plan the training based on the limited resources we have in the field of practice: I had knowledge about the learning goals to achieve, vehicles we had, buildings and equipment, personnel etc. In SSG, I can focus on which training situation contributes most to the learning objectives for the class. Then I can focus on the situation. I need to construct a scenario illustrating it from nothing and from everything. Also, this virtual simulation is not depending on available physical resources. In a virtual environment, I can use all the resources I can imagine*."

Environments in which firefighters act, either real or virtual, is a "Rule-Tool" association's projection on Practice. Here the Sense-making must take place to recognize the situation (Rule) and Elicitation must take place to choose a proper tool for the action (Tool). The importance of sense-making activities can be seen by comparing adopters with non-adopters. The sense-making activities are important and enhanced at adopters: either a whole group is involved in defining learning goals (UK, Portugal, Estonia) or managers taking a special focus on it (Rotterdam harbor, Singapore), in contrast with having goals such as quality improvements at organizations.

5. SUMMING UP

At the present stage, for the successful continuation of technology use from the introductory phase to "daily practice" in non-adopters' organizations, the instructor must build the SSG-related Tool-Rule association (either physically, or using the virtual environment) based on learning goals. The learning goals can be seen

as knowledge, or, more precisely, a cognitive construct of the Rule-Practice-Tool association seen from the perspective of the Practice – i.e., what Tools must be used to fulfill certain Rules. Since the Rules do not refer to using SSGs, the goals not necessarily need to be addressed by SSG, and the educational results do not need to mention SSGs, the technologies may be ignored. This non-use may be prohibited by procurement policies explicitly requiring SSG contribution to results. For this, recognizing the changing role of the instructors and defining technical support to them as to organization policies may be needed.

With SSG, instructors have no prior experience and no ready-developed cognitive schema to understand whether the designed learning environments help to produce the desired learning goals. At the present stage, we can see that at non-adopter organizations the sense-making process of the instructor in developing training sessions and designing learning goals is hindered. However, strategies for the successful introduction of SSG can be formulated by analyzing Rule-Tool-Practice associations in organizations, which successfully adopted the novel technology. Additionally, the success of the development of learning goals can be assessed by analyzing the associations, reactions, etc. of the trainees towards the virtual tool.

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