Evaluating Team Resilience in Simulator-Based Crisis Management Training

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ABSTRACT

Currently, there is a lack of assessment approaches for evaluation of resilient capabilities in simulation games. This paper presents work-in-progress to create such an instrument to be used in crisis management simulation games for the fuel, food, and finance sectors. The "Team Resilience Assessment Method for Simulation" (TRAMS) is based on the Systemic Resilience Model and departs from the assumption that resilient crisis management teams will be able to develop strategies for assuring that anticipation, monitoring, response, recovery, and learning are established and maintained in their respective organizations as well as in the crisis management team. A prototype version of the TRAMS, based on the experiences of representatives from the involved sectors and firmly related to resilience theory, is presented and discussed. The TRAMS instrument will be tested in 30 planned simulations games including participants from the fuel, food, and finance sectors.

Keywords

Team resilience, assessment, simulation games, training, Systemic Resilience Model

INTRODUCTION

This paper presents work conducted in a project called Creating Collaborative Resilience Awareness, Analysis and Action for Finance, Food and Fuel Systems in INteractive Games (CCRAAAFFFTING). The goal for this project has been to develop a simulation-gaming environment (combining role-playing gaming with computer simulation) to present a context where the payment system is represented and where dependencies between different actors become evident. This system can be used to better understand how resilience is achieved and maintained during disruptions in the payment, food, fuel and finance system (Laere, et al., 2017). The purpose of developing the gaming environment is to provide team-training to decision-makers in handling crisis situations in a multi-organisational context. Gaming-simulation (Laere, Vreede, & Sol, 2006) aims at representing reality and enabling an individual actor or a group of actors to experience the dynamics of the simulated system. In this case with the purpose of increasing overall organisational resilience. The development and design of the crisis response simulation and scenario is described in detail in Laere et al. (2017). The project started in 2016 and initial data collections based on document studies, interviews and workshops with experts from the food, fuel and financial sectors reveal seven challenges for collective cross-functional critical infrastructure resilience that need to be dealt with: 1) Shortage of food, fuel, cash, medicine; 2) Limited capacity of alternative payment solutions; 3) Cities are more vulnerable than the countryside; 4) Economically vulnerable groups in society are more severely affected; 5) Need to maintain trust and prevent panic; 6) Crisis communication needs; 7) Fragmentation of responsibility for critical infrastructures across many actors (Laere et al, 2017).

Applying a systemic resilience approach to this allows for assessing and understanding the impact of the simulation-gaming upon resilience, and organizational resilience in particular. Hence, this paper presents an approach for evaluating systemic resilience in collectives of crisis responders engaging in simulator-based training sessions in the fuel, food, and finance sectors.

RESILIENCE IN THE FINANCE SYSTEM

Without transactions, or at least the potential for transactions, businesses as well as finance stops and becomes pointless. *How* transactions are made have however differed greatly through history, moving from transactions of noble metals, cash, paper documents to digital transactions and trade. All implementations of payment systems have their strengths and weaknesses. It is however fair to say that the financial system never has been so interconnected and so dependent on technical infrastructure and a multitude of actors providing various services in order to function. From a business point of view, the ability to uphold function (too keep providing goods and do transactions) is often referred to as "business contingencies" or "resilience". Literature describes the payment system as an "inverted pyramid". At the top of the inverted pyramid is the broad base of economic actors whose daily activity in the market economy gives rise to payment obligations. This base of economic actors consists of individuals who use retail payment services provided by banks, and a variety of business enterprises in the goods and service industries. The next level includes very specialized firms, such as brokers and dealers, involved in the money, capital and commodities market, which also rely on bank payment services. (Blommstein & Summers, 1998, p. 27).

Resilience is a systemic approach to understanding how systems critical to society, such as industry, infrastructure, finance, or ecology, can absorb changes or disturbances and still persist (Holling, 1973; Foster, 1993). It is a well-known fact that the financial system is surprisingly robust when considered over a longer time-period, but also that it is sensitive to local or short-term disruptions that at times have proven to cause severe cascading effects that have impact even on a global level. Improving resilience of the financial system, or parts thereof such as the payment system, is therefore of great importance to society.

A crisis event is rarely handled by a single individual (Johansson, 2005). Depending on the type of crisis there may exist prepared structures for coping with the crisis, such as professional crisis response organisations. However, other types of events may occur where there are no prepared measures for coping. In such cases, an ad-hoc team of actors usually handles the crisis event. A team is "a distinguishable set of two or more people who interact dynamically, interdependently, and adaptively toward a common and valued goal/object/mission, who have each been assigned specific roles or functions to perform, and who have a limited life span of membership" (Salas et al., 1992, p. 4). An ad-hoc team is a temporarily organized team where members are included because of their organizational background and experiences and where the team members might not have met prior to being part of the team. For the purpose of handling a crisis situation, these teams are often formed rapidly to deal with a difficult and complex situation in the short-term. In an educational context, ad hoc learning-teams develop by proceeding through stages (Fransen, Winberger, & Kirschener, 2013). To assess learning it is important to define criteria that relate to concepts important for the team task. Berlin and Carlström (2015) showed that by strengthening the collaborative components of exercises, the participants' perception of actual emergency work can be advanced.

Simulation-based crisis management training

Gaming-simulation is defined as a specific form of simulation. Simulation in general aims at designing a model of a system in a complex problem area in other to be able to experiment with the model. Deeper insight in the behavior of the system is created by evaluating various operating strategies against each other in one ore multiple scenarios. Gaming-simulation differs from other forms of simulation in that it incorporates roles to be played by participants and game administrators, implying that people and their (goal-directed) interactions become part of the simulation (Laere et al., 2006). In addition to role descriptions and interaction formats, simulation-games can also include a physical simulation model (a board game, a mock-up, a computer simulation, or any other representation of a physical reality) that the game participants need to interact with. It is important to understand that both the changes and impacts of changes to the physical simulation model in the simulation-game and the interaction between the participants (often negotiation processes about what to change and how to interpret changes in the physical simulation model) are part of the simulation-game and object of study (Mayer, 2009). Gaming-simulation is especially relevant when the "*how and why*" of the interaction processes between the participants are of interest and when these interactions cannot easily be incorporated in computer simulation models. In addition, it creates a deeper learning opportunity, as simulation-game participants literally are active participants in the simulation, rather than passive observers of a computer simulation.

Caluwe et al. (2012) and Daalen et al. (2014) discuss extensively how simulation games successfully have been used to study the interaction between stakeholder decisions in complex design problems. Simulation-games can be used for exploring the feasibility of future policy alternatives, for studying and motivating organizational change, and as research tools to study the processes or organizational change, policy-making and stakeholder interaction. Borodzicz and van Haperen, (2002; 2003) and Laere et al. (2007) discuss how crisis management simulations can be applied to generate learning at the individual, group and organisational level. Learning in crisis simulations is seen as reflecting on collaborative practice, grounded in theories like experiential learning (Kolb, 1984) and single and double loop learning (Argyris, 1977).

With respect to resilience of the payment system, a few simulation-based approaches have been reported in the literature focusing on the banking sector, and thus not incorporating interaction with the fuel and food sectors. For instance, Bedford et al. (2004) exploits a simulation framework for assessing the worst-case impact of operational incidents in large-value payment systems where a typical incident is the inability of one part to send and receive payments. In their approach, the liquidity of the banks is simulated through transaction delay factors which increase in the case of liquidity drops, making the approach similar to causal map modelling. Another related approach is presented in Galbiati and Soramäki (2011), modelling banks as agents in a multi-agent system and simulating how these banks, as artificial decision makers, minimize their own costs due to delays and liquidity acquisition resulting in game-theoretic equilibriums. However, attempts on relating the payment system to the fuel and food systems in a simulation environment is lacking.

CHALLENGES IN EVALUATING SYSTEMIC RESILIENCE

Given the variety of interpretations of resilience (Bergström, van Winsen & Henriqsen, 2015), resilience is hard to operationalize into useful strategies and measurable indicators. Lundberg and Johansson (2015) have therefore proposed the Systemic Resilience Model (SyRes) model as a way to describe process, functions and strategies on a conceptual level in an effort to synthesize different perspectives in the field of resilience research. The SyRes-model will be used to guide the simulation approach so that all core functions of a resilient system, as well as coping strategies, will be addressed in the gaming sessions.

The Systemic Resilience Model

Lundberg and Johansson (2015) made an effort to merge and compile different points of view in the field of disaster and crisis response resilience into the SyRes model. The SyRes model departs from the idea that the coping with an unwanted event can be seen as a downward spiral activating certain basic resilience functions (anticipation, monitoring, responding, recovery and learning) and their associated strategies (where the strategies are the actual manifestation of the functions, or their ‘form’, which may differ from system to system). Crises are commonly described in terms of three phases: pre-event, event, and recovery (before-during-after) (Shaluf, Ahmadyn & Said, 2003) and the SyRes model roughly follows the same logic. The SyRes model consists of four different sections: Event-based constraints, Functional Dependencies, Adjustment of capabilities and Strategy (see **Figure 1**).

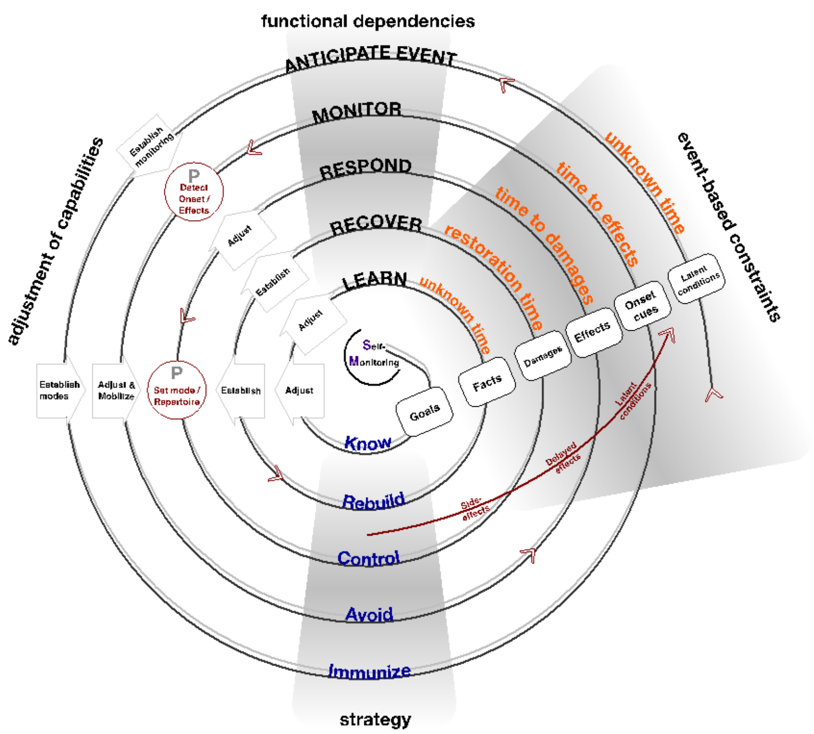

Figure 1. The systemic Resilience Model (Lundberg & Johansson, 2015, used with permission from the authors).

Functional dependencies refer to a set of functions needed to create a resilient system. The event-based constraints describe how the event to be handled put different constraints on the responding system during different phases of the event. The functional dependencies point to the core functions that must be maintained. Adjustment of capabilities refers to different approaches to shape how the functions are executed. Strategy, in turn, refers to different ways of coping with an event – in many cases these strategies are visible in terms of actions taken to keep a system out of harms way, such as constructing barriers (immunize) or creating response systems (control) (Lundberg & Johansson, 2015).

"Functional dependencies" describes a number of such "core resilience functions": *Anticipate, Monitor, Respond, Recover, Learn, and Self Monitor*. Each function can be seen as holding the potential to cope with an undesired development – for example, if a threat is anticipated, it may be mitigated or prevented from happening at all. Likewise, if monitoring is directed in such a way that threats can be detected, harm can potentially be avoided. Response takes place as a consequence of anticipation or the detection of a threat, or even as a reaction to an event that is discovered first when it is already ongoing. Response involves an effort to control the situation and minimize or avoid harm to the own, or other core, system(s). If the system takes damage in some form, recovery comes into place in order to re-construct the system after the event. Learning steps in as an essential function needed to improve the resilience of the system by adapting ways of working or creating new means to avoid similar events in the future. Finally, self-monitoring is a continuous process needed to assess if the current way of working is appropriate to maintain an acceptable level of safety and resilience in the system (Lundberg & Johansson, 2015). In the context of this study, it is the manifestation of these functions, i.e. the strategies developed by actors depending on the payment systems that are of interest. A lack of strategies corresponding to the core resilience functions indicate a potential lack of resilience, and hence capability to detect and cope with disturbance in the payment system.

What to assess?

Assessing resilient performance is challenging as there are few descriptions of what successful resilience *is*, how it manifests itself in terms of strategies and behaviours, apart from what can be found in different definitions such as to "recognize and adapt to handle unanticipated perturbations" (Hollnagel, Woods & Leveson, 2006). A well-known paradox in all contingencies planning and related activities is that what can be assessed before a critical event always has to be the *potential* for coping with an event as it by definition is impossible to say if implemented measures are going to make a difference before an undesired event actually has taken place. In real-world situations, manifested resilience can naturally be assessed post-facto, but such an assessment may not be very informative as there always will be a high degree of uncertainty in relation to how similar future events will unfold. Simulation games offer a unique opportunity in this respect as they allow us to confront participants with unusual and challenging situations without having to suffer the consequences of erroneous actions or lack of preparedness (Johansson, van Laere & Breggren, 2017).

The ability to have prepared strategies for coping with a crisis, or rapidly develop such strategies, is thus a potential assessment point. For example, if there is a lack of strategies on any of the functions in different phases of a crisis, this could be seen as a potential for improving resilience.

Another challenging aspect is to determine what “good” performance is from a resilience point of view? To successfully cope with an unwanted situation is naturally a potential indicator but avoiding the situation altogether would be an even better outcome. Success must always be related to some form of criteria. Using the SyRes-model and the concept of core values as a point of departure, we can conclude that a system can be seen as resilient if it can uphold its core value(s) by implementing successful strategies before the situation spirals out of control. This suggests that in order to assess resilient capability, even in a simulation, a thorough understanding of what a system must protect and preserve must be achieved when designing the simulation and the scenarios used in it.

The SyRes model addresses functional dependencies (Anticipate, Monitor, Respond, Recover, Learn, and Self Monitor) in terms of strategies that are suggested to be assessed. This is done using the TRAMS approach (see below).

The Team Resilient Assessment Method for Simulation (TRAMS)

In line with the SyRes model presented above, and the challenges associated with assessing resilience in teams, we have developed an assessment method for resilience in simulation games called “Team Resilient Assessment Method for Simulation” (TRAMS). This assessment approach is founded on the premises that actors from different organisations not normally working together (cf. ad-hoc teams) team up to cope with a disturbance in the payment system, as outlined in the CCRAAAFFFTING project (Laere et al., 2017) described above. In simulation-based gaming for improving team resilience scenarios must present events that *challenge the participating actors in such a way that they are forced to engage in collaborative problem-solving*. In typical training or exercise scenarios, participants are encouraged to apply known procedures or skill sets. This would not be the case when training to become more resilient. Instead, each gaming session should be divided into distinct phases based on events designed to challenge the participants’ resilience. In line with the SyRes model and crisis research, at least three phases should be used for assessment; before, during, and after a disturbance. During the *before* phase, the participants in the gaming simulation can be evaluated in terms of their ability to anticipate the development of the crisis as well as their ability to direct attention to and monitor important parameters associated with the anticipated development. In the *during* phase, the ability to avoid or cope with the disturbance can be analysed. Finally, in the *after* phase, the ability to learn from the event and adapt existing strategies in order to better cope with similar events, can be evaluated (see Figure 2. below).

The TRAMS assessment has been developed into an observation-based instrument intended to be used by researchers and training facilitators during gaming simulations. This instrument aims to support the identification of strategies developed, and used by, the participants in a gaming simulation and departs from the SyRes functions. The overarching purpose is to assess whether the participants are able to develop strategies to cope with the disturbances they encounter in the simulation and if these strategies actually lead to positive outcomes for the participants. The instrument is summarised in table 1 below, which will be explained further.

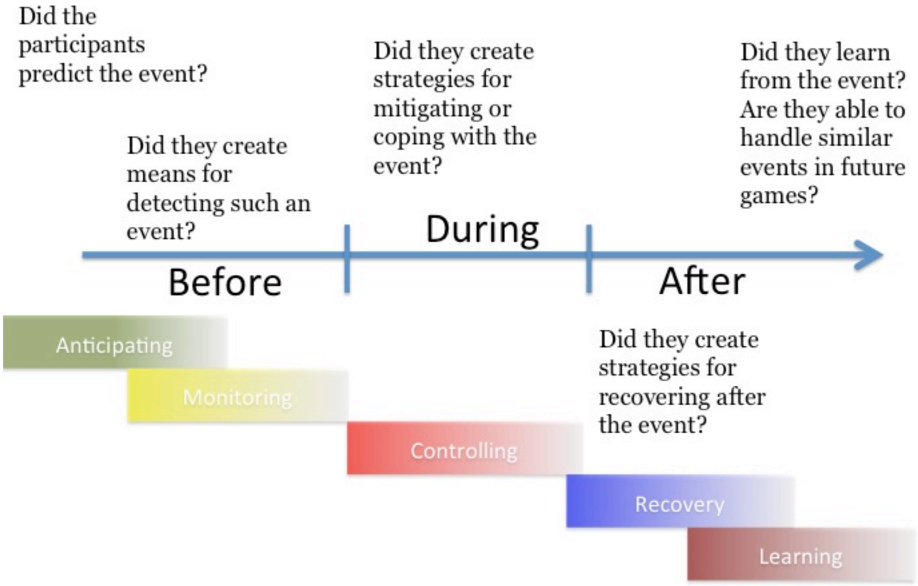

Figure 2. The SyRes functions related to the three phases of a disturbance in the gaming simulation.

Table 1. The TRAMS instrument.

SyRes core functions	Strategies in phases 1---N	Related core value	Developed by…	Involved actors	Expected effects	Implementation	Simulator outcome
Anticipating							
Monitoring							
Controlling							
Recovery							
Learning							

SyRes Core functions

In the first column, we find the SyRes core functions. These are intended to be used as guidance for identifying strategies used and developed in the various phases of the gaming simulation (see below). *Anticipating* strategies can for example take the form of prognostics used by the participants, such as brainstorming, analysis of available data, consulting experts etc. All such efforts that are possible to identify should be noted. *Monitoring* strategies are usually based on earlier experiences (such as previous gaming simulations) or anticipating strategies that direct monitoring efforts. Monitoring strategies can for example be that resources are allocated to observe certain phenomena that are deemed interesting for being prepared before a disturbance or for understanding an expected disturbance better. *Controlling* strategies concern measures for mitigating or coping with a disturbance that is expected or has occurred. *Recovery* strategies can be created based on what is anticipated, what is currently happening or after something has happened. For example, if a disturbance in the supply chain is expected, the grocery stores may stock up to avoid running out of goods to sell. Disturbances in the card payment system may be less severe if all ATMs are prepared with enough cash to support such payment etc. *Learning* strategies can for example be creating incident reporting systems, knowledge databases or assuring that experiences made during an event is incorporated in staff training.

Strategies in phases 1---N

The phase columns reflect the events in the gaming simulation. These are normally known to the researcher/training facilitator and can be described in the instrument (rather than simply providing a number). Strategies identified should be noted in the corresponding phase. Doing so makes it possible to track what strategies that where developed in the different phases. Note that several strategies may be developed in certain phases while other phases may include no strategies. This depends entirely on the participants and the outline of the scenario used in a particular gaming simulation.

Related core values

An assumption in the SyRes model is that all resilient systems are based on a set of *core values*, which may or may not be explicit (Johansson, van Laere & Berggren, 2017). A resilient system must be able to maintain core values also when situations occur that disrupt existing functions. For example, a business must be able to continue generating revenue even when payment systems fail, or at least assure that existing assets are not depleted and that readiness exists for rapid re-establishment of payment processes. Obviously, it is not always possible to infer to what core value a specific strategy relates, but if possible this should be noted in this column. For example, assuring that there are sellable goods available by stocking prior to an existing disturbance in the supply chain is an example of protecting the core value of making revenue. An organisation's core values are identified through focus group interviews with high-level managers and strategists in that organisation.

Developed by

This column should be used to describe from whom a specific strategy originates. Was it a collective decision within the team, or did an individual participant suggest it? This information can be used to assess how well collaboration between the different participants work, who (what participant) is taking initiative, and if a certain organization is more prone to pushing strategies.

Involved actors

The implementation of a strategy will normally involve several actors, both within the participating team and "external" (simulated) actors in the gaming simulation. If possible, these should be noted in this column.

Expected effects

Often, the participants express what kind of effects they believe the strategies they implement will have on the outcome of the gaming simulation. If this can be captured, it should be noted here. This information can be used to analyse what kind of understanding (mental model) the participants had of the scenario and their actions.

Implementation

This column is used to describe if a strategy actually was implemented and if so in what way? These details of the implementation can mostly be captured from simulation log files, so the description should be kept on a general level.

Simulator Outcome

This column can be used to provide a short description of the actual outcome of the implemented strategies, which can be utilized in analysis and de-briefing sessions. Extensive discussions have been held at several of our design workshops and in intermediate work group meetings considering what indicators are most relevant and appropriate to visualize performance in the various sectors of society. Currently, three major performance areas have arisen: 1) payment options, 2) good flows, and 3) security.

Available payment options are statistics on the actual use of each of the four different payment types over time, or the amount of stores (proportion of total number of stores) where they each option is available.

For goods flow the main indicators is "disappointed customers" over time (the simulation counts the number of arriving customers that cannot fulfil their purchase for any reason). Additionally, it is shown how many stores currently are closed (in %), which groups of goods currently are out of stock, how many perishable goods are destroyed over time, and how many planned deliveries that fail (due to fuel shortages).

Security related indicators are amount of cash in stores (implying increased robbery risk), number of shop lifting incidents, and the number of security guards per store.

From a collaborative resilience perspective, the challenge for simulation participants is to be resilient on all performance areas, rather than optimizing one.

Additional measures

In addition to the assessment of resilience functions, the team will be assessed regarding workload (Helton, Funke, & Knott, 2014; Funke et al., 2012), team member exchange quality (cf. Willems, 2016; Seers, Petty, & Cashman, 1995), and shared understanding (Berggren, Johansson, & Baroutsi, 2017; MacMillan et al., 2005).

Team workload has an impact on team performance (Funke et al., 2012). As the team is part of a system that, during crisis, is striving to uphold performance and as the team members are less familiar with each other (i.e., an ad-hoc team) it is important to assess team workload to be able to understand the outcomes. The same argument is true for the shared understanding in the team (Berggren et al., 2016); when team members have a lower shared understanding of the team's goals it is harder to adapt to and support each other in order to maintain performance.

Team member exchange quality (Willlems, 2016) indicate the quality of social interactions, for example high team member exchange quality suggest that the team members communicate openly, support each other, and provide constructive feedback These are traits that are seen in more mature teams (cf. Tuckman, 1965).

Humphrey and Aime (2014) suggested a multilevel, multi-theoretical, and multi-period framework can provide a better understanding of the system and team. This framework can also direct the data collection. Considering individual, team, and system level will offer a more comprehensive result. Collecting data regularly and repeatedly will ensure that a single moment in time is not a deviation vis-à-vis system outcome. This also allows for following trends over time. Using a multi-theoretical framework for interpreting results provides a richer understanding of the phenomena.

Workload, team member exchange quality, and shared understanding are all rated by the participating team members. The quickest and easiest approach is by including a questionnaire addressing these aspects. In addition, questions about how much a participant has learned and to what extent the organization has changed should be asked. All these questions (workload, team member exchange quality, shared understanding, learning, and change) provides a basis for feedback and reflection as well as possible explanation and understanding of the resilience outcomes.

DISCUSSION

The TRAMS (Team Resilience Assessment Method for Simulation) instrument has been used in a pilot study within the CCRAAAFFFTING project. The TRAMS instrument satisfies several criteria for assessment, namely: validity, reliability, theoretically grounded, useful, cost-effective, meaningful, and sound. During the pilot study the TRAMS instrument was tested and evaluated as a tool for assessing systemic resilience. The purpose was to eliminate problems and errors. After this initial iterative development, the instrument will be used during the main data collection of the CCRAAAFFFTING project lifecycle.

Utilizing a simulated environment further allows for investigating the relationship between potential resilience and manifested resilience. It can naturally be argued that simulations never will be able to reflect the intricate complexity of real-world situations (Brehmer & Dörner, 1993). However, claiming that simulated environments are useless for investigating how resilience manifests itself in different situations is also flawed. Rather, it is the model underlying the simulated environment and the participation of relevant stakeholders that decide what conclusions that can be drawn from findings from such studies (Johansson, Berggren & van Laere, 2017).

Expected added value of using TRAMS

The existing body of resilience research has not presented sufficient methodological suggestions for assessing collective resilience, especially regarding how individuals and teams contribute to the collective resilience. The literature on teamwork and collaborative practice is rich. However, the connection between collective resilience, teamwork approaches, and collaborative practice literature is still limited. The TRAMS instrument provides a structured way of assessing systemic resilience and related team concepts in socio-technical systems responsible for handling disturbances that requires collaboration between ad-hoc constellations of actors. By utilizing the instrument, actors from the fuel, food, and finance sector will potentially increase their awareness of how dependencies between them, the payment system, and how they ought to coordinate their actions with other stakeholders in the system to prevent for escalation of a disruption. Utilizing TRAMS during sessions in the gaming simulation will generate knowledge on how the large variety of actors together can develop a collaborative response that prevents escalation, rather than individual responses which might counteract each other. These insights can be used to communicate proposals for action to respective stakeholders. In this respect, TRAMS offer possibilities for organizational learning in that it creates a sound and replicable basis of indicators for both systemic resilience functions and team aspects. These can be used for feedback and reflection, a requisite for organizational learning. As the organisations develop and change they become more able to handle disturbances and be more resilient, hence are able to perform even under stressful conditions.

Future work and recommendations

The TRAMS assessment approach will be tested in the CCRAAAFFFTING project. A series of 30 simulation games with practitioners from the fuel, food and finance sectors are planned. The TRAMS assessment approach will be evaluated continuously along with the simulation game until a usable, valid and reliable version has been defined.

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REFERENCES

Argyris, C. (1977). Double-loop learning in organizations. *Harvard Business Review*, Volume 55, Number 5, pp. 115-125.

Bedford, P., Millard, S., & Yang, J. (2005). Analysing the impact of operational incidents in large-value payment systems: A simulation approach. *Liquidity, Risks and Speed in Payment and Settlement Systems–A Simulation Approach*, 247-74.

Berggren, P., Johansson, B. J. E., & Baroutsi, N. (2017). Assessing the quality of Shared Priorities in teams using content analysis in a microworld experiment. *Theoretical Issues in Ergonomics Science*, *18*(2), 128–146. http://doi.org/10.1080/1463922X.2016.1159354

Bergström, J., van Winsen, R., & Henriqson, E. (2015). On the rationale of resilience in the domain of safety: A literature review. *Reliability Engineering and System Safety*, *141*, 131–141. http://doi.org/10.1016/j.ress.2015.03.008

Berlin, J. M., & Carlström, E. D. (2015). Collaboration exercises: What do they contribute? - A study of learning and usefulness. *Journal of Contingencies and Crisis Management*, *23*(1), 11–23.

Blommstein, H.J. and Summers, B.J. (1998). Banking and the payment system. In: Summers, B.J. (Ed.), The Payment System – Design, Managmenet and Supervision,. International Monetary Fund, Washington D.C., 15-29.

Borodzicz, E. and Van Haperen, K (2003). Learning and training: a reflective account of crisis management in a major UK bank. Risk Management: an International Journal, Volume 5, Number 1, pp. 33-50.

Borodzicz, E. and Van Haperen, K. (2002). Individual and Group Learning in Crisis Simulations. *Journal of Contingencies and Crisis Management*, Volume 10. Number 3, pp. 139-147.

Brehmer, B., & Dörner, D. (1993). Experiments With Computer-Simulated Microworlds: Escaping Both the Narrow Straits of the Laboratory and the Deep Blue Sea of the Field Study. *Computers in Human Behavior*, *9*, 171–184.

Caluwé, Léon de, Jac Geurts and Wouter Kleinlugtenbelt (2012): Gaming Research in Policy and Organization. An Assessment From the Netherlands. *Simulation and Gaming, 43(5), 600-626.*

Daalen, C. E., Schaffernicht, M., & Mayer, I. (2014). System Dynamics and Serious Games. *International Conference of the System Dynamics Society*, July 20-24, 2014

Foster, H. D. (1993) Resilience Theory and System Evaluation. In (Eds.) J. A. Wise, V. D. Hopkin & P. Stager, *Verification and Validation of Complex Systems: Human Factors Issues.(pp. 35-60)* Springer Verlag: Berlin.

Fransen, J., Weinberger, A., & Kirschner, P. A. (2013). Team Effectiveness and Team Development in CSCL. *Educational Psychologist*, *48*(1), 9–24.

Funke, G. J., Knott, B. A., Salas, E., Pavlas, D., & Strang, A. J. (2012). Conceptualization and Measurement of Team Workload: A Critical Need. *Human Factors*, *54*(1), 36–51.

Galbiati, M. and Soramäki, K. (2011). An Agent-Based Model of Payment Systems. *Journal of Economic Dynamics and Control* 35(6): 859-875.

Helton, W. S., Funke, G. J., & Knott, B. A. (2014). Measuring Workload in Collaborative Contexts: Trait Versus State Perspectives. *Human Factors*, *56*(2), 322–332.

Holling, C. S. (1973). Resilience and Stability of Ecological Systems. *Annual Review of Ecology and Systematics. 4*, 1-23.

Hollnagel, E., Woods, D. D., & Leveson, N. (2006). *Resilience Engineering: Concepts and Precepts*. Aldershot: Ashgate Publishing Limited.

Humphrey, S. E., & Aime, F. (2014). Team Microdynamics: Toward an Organizing Approach to Teamwork. *The Academy of Management Annals*, *8*(1), 443–503.

Johansson, B. J. E. (2005). *Joint control in dynamic situations* (No. Dissertation No. 972). Linköping University, Linköping.

Johansson, B. J. E., Laere, J. van, & Berggren, P. (2017). Using simulation games to assess critical infrastructure resilience in case of payment disruptions. In *7th Resilience Engingeering Association (REA) International Symposium* (pp. 1–7). Liege, BE.

Kolb, D. (1984). *Experiential Learning: experience as the Source of Learning and Development*. Upper Saddle River: Prentice-Hall.

Laere, J. van, Berggren, P., Gustavsson, P., Ibrahim, O., Johansson, B. J. E., Larsson, A., … Wiberg, C. (2017). Challenges for critical infrastructure resilience: cascading effects of payment system disruptions. In *ISCRAM 2017* (Vol. 2017–May). Albi, France.

Laere, J. van, Lindblom, J. & Susi, T. (2007) Requirements for emergency management training from a 'passion for failures' perspective. ISCRAM 2007. *The 4th International Information Systems for Crisis Response and Management Conference*, Delft, The Netherlands, May 13-16, 2007.

Laere, J. van, Vreede, G.J. de., & Sol, H.G. (2006). A social simulation game to explore future coordination in knowledge networks at the Amsterdam Police Force, *Journal of Production Planning and Control*, 17(6) 558-568

Lundberg, J., & Johansson, B. J. E. (2015). Systemic resilience model. *Reliability Engineering and System Safety*, *141*, 22–32.

MacMillan, J., Paley, M. J., Entin, E. B., & Entin, E. E. (2005). Questionnaires for Distributed Assessment of Team Mutual Awareness. In N. Stanton, K. Hedge, E. Brookhuis, E. Salas, & H. Hendricks (Eds.), *Handbook of Human Factors Methods* (pp. 51–1–51–9). London: Taylor and Francis.

Mayer I. S. (2009). The gaming of policy and the politics of gaming: A review. Simulation & Gaming, 40 (6), 825-862

Salas, E., Dickinson, T. L., Converse, S. A., & Tannenbaum, S. I. (1992). Toward an understanding of team performance and training. In *Teams: Their training and performance* (pp. 3–29). Norwood, NJ: Ablex.

Seers, A., Petty, M. M., & Cashman, J. F. (1995). Team-member exchange under team and traditional management. *Group & Organization Management*, *20*(1), 18–38.

Shaluf, I. M., Ahmadun, F., & Mat Said, A. (2003). A review of disaster and crisis. *Disaster Prevention and Management: An International Journal*, *12*(1), 24–32.

Tuckman, B. W. (1965). Developmental Sequence in Small Groups. *Psychological Bulletin*, *63*(6), 384–99.

Willems, J. (2016). Building Shared Mental Models of Organizational Effectiveness in Leadership Teams Through Team Member Exchange Quality. *Nonprofit and Voluntary Sector Quarterly*, *45*(3), 468–492.