The lack of preparedness for payment disruptions in local community core businesses

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ABSTRACT

One of the most important infrastructures for society is the payment system. If this system malfunctions, it can lead to disruptions in other critical infrastructures. By developing resilience i.e. the ability to recover or resist different disruptions in complex dynamic systems, as well as analyzing and raising awareness about it, such events can hopefully be handled better. The purpose of this study is to gain an insight into the different sectors' ways of dealing with disturbances in the payment system. Six participants from the food, fuel and bank sectors were interviewed using semi-structured questions. The interviews were conducted and data was analyzed using a thematic analysis approach. The results indicate a low level of resilience maturity among these organizations when it comes to handle long-term disruptions in the payment systems. The results provide valuable input to the project and a better understanding of payment infrastructure resilience.

Keywords

Critical infrastructure, resilience, payment system, food distribution, fuel distribution

INTRODUCTION

Recent cyber attacks have shown how vulnerable many critical infrastructure systems in society are. Ansell et al. (2010) argue that our infrastructures become more and more entangled, and resilience of these systems increasingly depends on collaborative responses from actors with diverse backgrounds that may not be familiar with cascade effects into areas beyond and outside their own organisation. The payment system is no exception to this as it is increasingly dependent on digital services from a variety of providers to function. In many countries, there is a clear decline of cash payment, and in some early adopter societies, like Sweden, cash payment is virtually gone and replaced by card and/or smartphone-based payment options. Further, shopping in general is moving online, especially concerning retailer products such as clothes, electronics etc., where payment exclusively is done via card or other digital services. Businesses of central value to society, such as groceries, medicine, and fuel are still mostly procured in traditional stores or petrol stations, but payment is mainly card-based or based on other online payment methods. But to what degree are such businesses prepared for longer disruptions in the payment services?

Despite the work of identifying, analysing and understanding risks and developing routines for preventing and mitigating serious disruptions in the payment system in Sweden, there is still a lack of insight into how the proposed action plans exactly need to be executed and how numerous other actors in society (e.g. citizens, food stores, petrol stations, voluntary organizations, and so on) will act in case of a temporary or complete breakdown of the payment system. For instance, several key actors in the payment system have in earlier studies expressed that they will take a larger responsibility than their formal responsibility (MSB, 2009), but it is not clear what this means exactly and whether these organizations actually will do that when crisis hits.

This paper is part of a larger project (Creating Collaborative Resilience Awareness, Analysis and Action for Finance, Food and Fuel Systems in INteractive Games, CCRAAAFFFTING) aiming to develop a simulation gaming environment (a combination of role-playing games and computer simulation) that 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 ultimate 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 with purpose of increasing overall organisational resilience. The goal and overall design of the crisis response simulation and scenario development is described in detail in Laere et al. (2017).

The purpose of this paper is to investigate in what ways local businesses in the core sectors banking, food- and fuel distribution are prepared to handle disturbances in the payment system. This will be done by utilizing a model from resilience theory, the Systemic Resilience Model (see below), to see what strategies these businesses have in place for upholding their businesses, and thereby their societal function, in the case of a disruption in the payment system. This knowledge is needed in the CCRAAAFFFTING project in order to support simulation and scenario development to be used in the crisis response training environment. The results will be used to improve the design of the scenarios used in the interactive simulation games. It will also be utilized to modify the implementation of the computer simulation to better reflect the dependencies between actors that have been identified in the interviews. Six interviews with representatives from various businesses have been conducted and analysed. The outcome of these interviews will be presented below.

RESILIENCE AND THE PAYMENT SYSTEM

Digital services are often discussed in terms of how "secure" they are, i.e. to what extent they can continue to function during various forms of attacks. 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). The payment system is thus what the connections in the financial system that is the fundament of its very existence. Without transactions, or at least the potential for transactions, finance stops and becomes pointless. *How* transactions are made have however differed greatly during the last century, 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 fair to say that the financial system never has been so interconnected and so dependent on a multitude of actors to provide services in order to function. 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). The term has been interpreted in many different ways in different domains and may refer to: bouncing back to a previous state, or bouncing forward to a new state, or both; absorbing variety and preserve functioning, or recovering from damage, or both; and being proactive and anticipating, or being reactive (when recovering during and after events), or both (Bergström, van Winsen & Henriqson, 2015; Lundberg & Johansson, 2015). 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 (Helbing, 2012) that at times have proven to cause severe cascading effects (Pescaroli & Alexander, 2015) 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. Basole and Rouse (2008) looks at how "service value" can be created in a network context and how the structure and dynamics of the network, as well as customer expectations influence the complexity of the service eco system. Their approach aims to describe the nature, delivery and exchange of service value and direct and indirect relationships between value network actors, as in the payment system. Johansson, van Laere, and Berggren (2017) have developed a network-based approach for describing how actors in the payment system can create and consume resilience in a network based on the work of Basole and Rouse (2008).

The Systemic Resilience Model

Resilience for crisis management and response is a wide area (Williams et al., 2017). Lundberg and Johansson (2015) made an effort to merge and compile different points of view in the field of disaster and crisis response resilience (see for example Comfort, Boin & Demchak, 2010) into one systemic model, the *Systemic Resilience*

Model (SyRes). 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). The SyRes model consists of four different sections: Event-based constraints, Functional Dependencies, Adjustment of capabilities and Strategy (see **Figure 1**). 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).

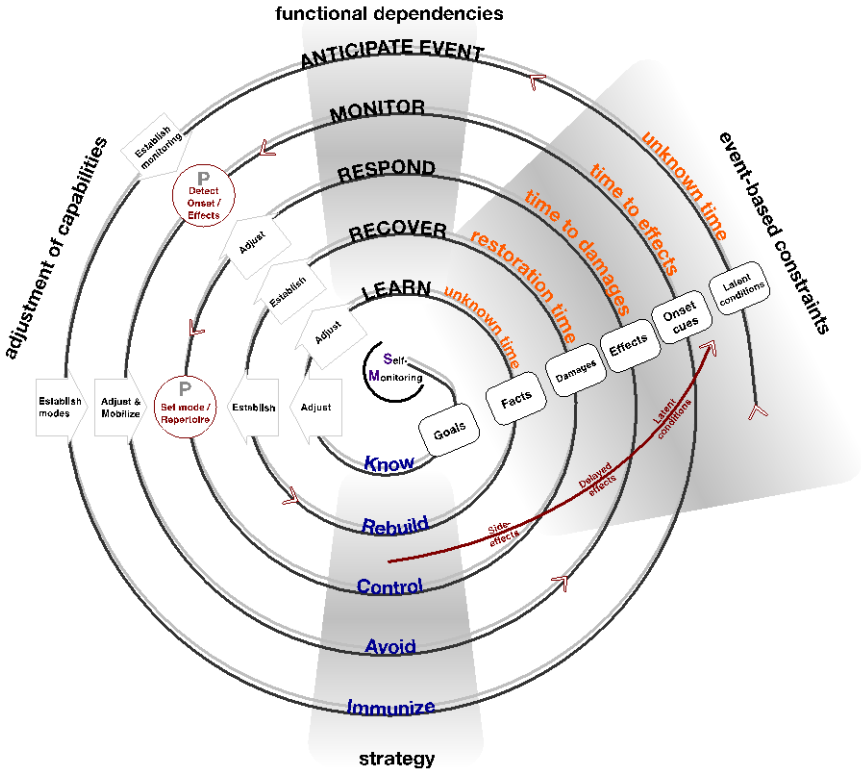

Figure 1. The systemic Resilience Model (Lundberg & Johansson, 2015. Used with permission from the authors).

"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, or suggested, by actors depending on the payment systems that are of interest. A lack of strategies corresponding to the core resilience functions (Anticipating, Monitoring, Responding, Recovery, and Learning) indicate a potential lack of resilience, and hence capability to detect and cope with disturbance in the payment system. This study aimed to identify and describe strategies used in the payment system to uphold the resilience functions described above. By identifying such strategies, or lack of such strategies, training scenarios can be designed to challenge the participants in such a way that they are forced to reflect upon how they apply anticipatory strategies, monitoring strategies, strategies for response, response strategies, and learning.

METHOD

A semi-structured interview technique was used in this study, based on the suggestions by Howitt (2010). All interviews were recorded and transcribed. The functions described in the SyRes model (Lundberg & Johansson, 2015) were used as guidance when creating the questions used in the study.

Participants

All participants were recruited from the same municipality in Sweden with the ambition of having representatives from major grocery and fuel chains/banks in the study. The municipality is a mid-sized Swedish town with strong presence of both industry and academia. Six persons from three different business types participated in the study. Two participants came from grocery stores, two from banks, and two came from fuel distribution (petrol stations).

The participants from the grocery stores both worked for supermarkets belonging to large chains that have presence in most Swedish cities. Both participants had extensive experience from this type of business having worked for 25 and 20 years. They were both in managerial positions.

One of the participants from the banks was an office manager with 20 years experience. The other was an expert on digital payment methods with 10 years of experience.

Both participants from the fuel distribution sector were petrol station managers with 8 years respective 9 years of experience from the sector.

All participants were recruited via e-mail or telephone contact. They were also provided with an information leaflet describing the project and a consent form. All interviews except for one were conducted face-to-face. The other was performed using telephone.

Material

A set of 11 overarching questions were prepared and used for guidance during the interviews. Most questions were complemented with a set of sub-questions that could be used as back-up in case the interviewee did not provided enough information. The overarching questions were:

1. Could you describe your role at your work place?
2. For how long have you been working here? What is your professional experience?
3. How many persons work here? What type of employees do you have?
4. Could you tell me about an actual event/disturbance in the payment system where you had to adapt to changes that were beyond your control?
5. Is there anyone you can contact to get support in case of major disturbances?
6. If we imagine a scenario where the payment system is disrupted for a longer period such as 6-7 days, can you describe what you would do?
7. Can you describe the measures you would follow to solve a problem in the payment system before you make a decision or take action?
8. Who is responsible for making decisions regarding payments, and how?
9. Do you have any examples of situations of what you would do if you were unable to reach other core actors such as banks, fuel distribution or others?
10. What would you describe as your most important goal in the case of a disruption in the payment system?
11. What kind of equipment do you need to be able to continue working?

Apart from the questions, the information leaflet mentioned above was used also as a consent form.

An Apple Iphone 6 was used as the recording device during the interviews.

Analysis

All interviews were transcribed according to the schemes described by Howitt (2010) and Linell (1994) prior to analysis. Transcriptions were performed on a basic level, not including for example pauses or overlapping

speech. However, orthographic transcription was applied, where the way utterances were made are reflected, i.e. accent etc (Howitt, 2010).

A thematic analysis was then performed on the transcribed material. The analysis consists of six steps that serve the purpose of moving through the process of getting acquainted with the data to identifying and describing the themes (Braun & Clarke, 2006). The steps are: 1.) Familiarise yourself with your data, 2.) Generate initial codes, 3.) Search for themes, 4.) Review themes, 5.) Define and name themes, and, 6.) Produce a report. The first stage thus consist of the process of establishing a thorough understanding of the transcribed material by generating initial codes. Such codes are more numerous than the actual themes. Once these two steps have been conducted, the actual themes usually emerge. These may have to be iterated before they are saturated and consistent. After this, they can be assigned with appropriate names and used to create a report, in this case the results section of this paper. Themes can be identified in two ways, either by empirically guided analysis or by theoretically guided analysis. Each theme should contain data that reflects essential aspects of the research questions (Braun & Clarke, 2006). In this study, a bottom-up approach to analysis was applied, meaning that the empirical material guided analysis, although the questions asked to the participants were guided by theory. The themes were thus identified based on the analysis performed on the transcribed material, although the researcher conducting the analysis to some extent was trying to identify resilience-related aspects such as "core values".

RESULTS

From the analysis described above, seven themes emerged:

- Limited payment solutions and options
- Communication with the customer
- Protect goods, customers, trust and safety
- Dependent on many actors
- Depend on others to solve the problem
- Preparations and training of staff during a crisis
- Depend on the internet and electricity

The identified themes applied in slightly different ways to the participants in the study. Naturally, there were some differences between the banks and the stores/petrol stations as they provide somewhat different services to their customers. Below, we will discuss each theme and the potential consequences for the payment system. All excerpts presented have been translated from Swedish. For original language, please refer to Jaber (2017).

Limited payment solutions and options

The participants were asked to reflect upon how they would handle a disturbance in the payment system. Something that quickly became obvious was that there are very few payment options in today's society. Neither banks, grocery stores or petrol stations would be able to maintain operations without the card payment technologies. The only realistic option mentioned were cash. However, most participants estimated that the cash available in local ATMs would run out within one hour. Cash would thus only be an option during very short disturbances in the payment system. In general, cash usage is in strong decline in Swedish society. As one participant stated (supermarket manager):

> I have checked and it is around 10-20% of my turnover that is cash

One participant had real-life experience of a short disturbance in the card payment system. In that case, the staff in the supermarket adviced their customers to go and get cash from an ATM. This was, as predicted, only a temporary solution.

> We adviced people to withdraw cash from the ATM outside the store so many went there to get money, but after a while the ATM run out of money and yes then we could not really do very much so we simply had to eh, yes the customers had to leave and walk away you could say

The participants were asked to reflect on how they would handle a disturbance in the payment system. In summary, their consideration was that there does not exit many alternatives to bank cards. Banks, grocery stores, and fuel distributors would not be able to maintain operations if ATMs, card readers etc would stop

working. If a power failure would occur, things would be even worse as pumps, freezers, and refrigerated counters would stop working as well. Smaller shops with fewer customer, such as petrol stations, may be able to cope somewhat longer than large supermarkets. One petrol station manager stated that:

> What we usually do is to write down the name and say can you come by tomorrow for example. It is a pretty small place where the petrol station is located. So that works when you have many customers nearby that you even recognize.

Communication with customers

To inform the customers is a major concern to all participating businesses. Without customers, the services would not be needed. In line with what Basole and Rouse (2008) express, it is important for the service-based system that the customers are happy. As such, the customers' attitude is of great importance to the businesses, including to have a relation with the customers and to preserve trust. The most common way to inform customers seem to be to distribute papers at the entrance to make the customers aware of what has happened. One of the store managers stated that:

> My mission as store manager is to make sure that everything works, if it does not work then I have to solve it as good as possible, then we have to write big signs by the entrance, if it would not be working for several days. Unfortunately something has happened that makes it impossible to pay by card, then we need to inform all customers that they need to bring cash in order to shop.

Protect goods, customers, trust and safety

If a disturbance does occur, the different businesses seem to prioritize differently. Banks prioritize the customers and their trust towards the bank, while grocery stores focus on the goods. However, customers are highly ranked by all participants, as well as security during a crisis. All participants mentioned that disturbances lead to insecurity for both customers and personnel. All businesses wanted to run their dealings as long as possible to maintain the customer relation, but if security is at risk and they cannot be paid then operations are closed down. One of the bank employees stated that:

> First and foremost we prioritize service, we will make profit during the journey anyway. But if something happens, then it is service to the customer, in order to solve the customer's problem or situation that is the most important issue when something occurs, that is a crisis.

An important difference between the banks and the supermarkets was that the latter also prioritized their goods. If power should fail or cash registers stop working, they still need to take care of their perishables.

> Trying to save perishable goods since it is so darn much money. In the store you go out and look what we have you will find millions on the shelves and the dates are ticking away quickly, especially on perishables.

However, service was found equally important to the supermarket managers.

> Firstly one would want to prioritize to run the business to the customer as a service. And make some money as well but firstly you want to survive this period that you may think will not last that long or at least not more than 7-10 days that you know or hope will not be much longer than that. So you can always increase speed after that. In such a case it is important to maintain a good relation with your customers. But you also need to think about your personnel and so so that they not, because it can be pretty chaotic in a situation like this, so that they do not get into a bad situation.

The managers thus express that they would like to continue operations, both in order to get rid of perishable goods and to maintain their reputation and relation to their customers. At the same time they are worried about the wellbeing of their employees as they potentially could end up in a bad position having to manage angry customers that cannot shop as expected.

Depend on many actors

The included businesses are part of large, complex networks with many dependencies to each other. If one actor in the network would stop providing their service, for example if a transport to a grocery store wouldn't show up on time this would have cascade effects in a domino like fashion. Hence, if a critical infrastructure would collapse all of society would suffer from this. Many grocery stores receive supplies daily and keep minimal stocks. This means more complex dependencies, while at the same time leading to a more effective and cost-effective production and distribution of services and goods. However, this type of on-demand supply chain also causes brittleness on the societal level. A store manager stated that:

> Today, we received 65 pallets of goods, they need to be put on the shelves and if there are no new goods then my store would be empty in a few days in case I did not get new deliverances. So there is a lot to rely upon.

The petrol stations are perhaps even more dependent on others to run their business. Communication with other suppliers is crucial as the amount of fuel available is calculated on average sales. A petrol station manager described a scenario where a lorry moving a large piece of machinery came by and filled up 2000 litres of diesel, equal to the sales of an entire day. This forced him to call the supplier and order an additional delivery.

> The guys who plan the deliveries they plan perhaps 2-3 days ahead, they always look and then I called directly you know I have a name that I can call. So I called and said now this happened, now you need to re-plan and they said great that you called. The entire thing was moved one day and he checked it out and then they turned it around so I got the delivery the next day instead of two days later as planned.

The bank employees stressed the fact that they are more or less completely dependent on other actors to run their operations. For example, the ATMs are owned and operated jointly by several banks. There are also many sub-contractors that are needed to provide basic services to customers. As one bank employee stated:

> It depends on the type of system, each system has one, we are a very complex organisation and there are many different systems involved to handle payments and the person in question has mandates for acting within ones own area or responsibility…… It is usually not just one person you have to turn to in order to make a decision about what to do, that is why we are working as a team where we have members from many different areas in the bank in order to be able to solve problems.

Depend on others to solve the problem

All participants claim that they will call a service person who will "solve" the problem. For every malfunction in the system this approach has been successful, and mostly the problem is solved quite quickly.

> We have a service desk or help desk or what you want to call it. When we have problems, no matter what it is or some IT related stuff, we call the service desk and they connect immediately. And mostly, nine out of ten times, they can resolve it like that *snap with the fingers*.

As this approach has worked, most participants hadn't even considered alternatives. A longer disturbance was hard to imagine, as it had never occurred previously (most disturbances were solved after an hour or so).

> We have a department that take handle these things, so if something doesn't work it does not take long before it is working again. It can take maybe a morning or something like that. The longest disturbance I have experienced has been for a couple of hours and then things are working.

The stores managers could not provide any input to solve a disturbance in the payment system, as these were outside of his/her control and they have to rely on others.

> I haven't thought much about this, one relies on that things will work. And at the occasions when things haven't worked someone takes care of it. And then the problem might be that you aren't prepared to

> take care of things yourself (when it happens). […] I haven't experienced anything major, during the smaller disturbances I call someone at once and things have worked out. It might be wrong at times but then you just call and they fix it.

Preparations and training of staff during a crisis

All business in the study are dependent on that other actors solves the problem. These actors do not have the competence or means to solve a disturbance in the payment system. Being part of a complex network, one of the few possible actions the involved actors can take are to inform the responsible problem solver. In addition, they can try to continue operations, even if this means degraded performance. If this is not possible shutting down is the only option. The local businesses do not have any strategies to solve the problem apart from calling someone else.

> You could say that we have trained them and they know who to contact and they can contact me if I'm not at my desk.

Among the respondents from the bank business, there is a difference in concern and approach as all personnel are trained and the banks have a plan for how to deal with a crisis situation, should it occur.

> Yes, oh yes, everyone knows that. They are trained.

> There are exact contingency plans for what to do when something unexpected occurs, who does what.

It is very clear that everyone in the study knows exactly what to do, and that there is a lot of person trained to handle unexpected events. However impressive this is, this raises some concerns. The plan is to call the help desk. How the help desk can or will handle an unexpected disturbance is not clear though. Another interesting inconsistency is in what way the very "exact contingency plan" can address unexpected events.

Depend on the internet and electricity

A disruption that blocks internet or stops electricity from running would put a halt to society. All participants say that they cannot continue operations under such circumstances. They cannot charge the customers, they do not know the price of the products, light, ventilation, heating, and cooling does not work. All information is located in systems dependent of Internet and electricity. Equipment and previously used methods are not available any more. If they were available, the younger parts of the workforce do not have the required skills, and would need training to be able to use the equipment. As more and more of the operations are digitalized and automated, requiring both electricity and the Internet to function. As the store managers put it:

> We are extremely vulnerable, we are depending on power and that technology works. Technology is fantastic but it is, if it breaks down then it is tough.

> If the electronics do not work, sure I can barter, you can trade a milk for 10 kronors[1], but that does not work. If I have two, maybe two and a half, two thousand customers a day then I cannot sell things to the customers manually. We do not know the prices of our goods either. Even if I let them in the store with flashlights to shop, we would not know the price of our stuff. Everything is in the computers. So society is incredibly vulnerable.

A petrol station manager made a similar statement:

> Yes we are depending on very many systems to maintain our system. Large heavy IT organisation, we are depending on our machines, systems and we are depending on people that can operate these systems.

CONCLUSION

Firstly, it should be noted that the sample in this study is fairly small and sampled in a single municipality.

[1] Swedish currency.

However, we still believe that the observations made are transferable to Swedish society in general as the type of stores, petrol stations and banks are very common and can be found in most Swedish cities. There is no obvious reason for thinking that this particular municipality would be a unique exception. Further, it should be taken into consideration that we have not addressed governmental organizations responsible for crisis response, such as the Swedish civil contingencies agencies or municipal crisis response teams, although we have not found any evidence in literature or in official sources indicating that a societal capability to cope with a supplying the nation, or even a part of the country, with food and fuel exist.

The conclusions that can be drawn from the results described above are that the food, fuel and bank sectors are not prepared for a longer disruption in the payment system. The actors interviewed in this study trust others (mainly IT support functions) to solve problems in the payment system for them. They also assume that the disturbances probably last as long as a few minutes or hours before the IT support solve the problem. There is little or very limited planning or strategies to deal with disturbances. Because there is no plan, the most common response of the actors is that they are likely to shut down their business if the payment system is not working for a longer duration.

The Systemic Resilience model (Lundberg & Johansson, 2015) has proven to be a valuable tool for understanding the potential resilience of the actors included in this study. If we depart from the functions described in the Systemic Resilience model, we see that no strategies related to the functions *anticipation* and *monitoring* could be found in this material. The strategies related to the *response* function mainly concerns calling other actors to solve the problem, or simply abandoning or shutting down operations entirely. The systems in operation among the actors in this study seem very robust, but the businesses in themselves are probably fragile disturbances occur in spite of this robustness. The *recovery* functions were not really discussed in the interviews, other than the fact that it is important to maintain good relations with customers in order to continue business once the problems are solved. It is hard to draw any conclusions regarding the *learning* function as no events of the kind discussed in this study have occurred. From this point of view, the crisis response training environment that is being developed in the CCRAAAFFFTING-project may prove valuable as they allow for learning in a controlled environment. *Self-monitoring* seems to be largely absent. The complexity of the actor networks also imply that even if some of the concerned actors would be able to make some degree of self-monitoring, no one has a complete overview of the entire system. This suggests that emergent effects in the network of actors could cause disturbances that could strike across the payment system, which in turn would be caught off guard. It is clear that both grocery stores and petrol stations are highly depending on logistics and that all actors are depending on functioning IT and communications to run operations. A disturbance in the card payment system would strike against all actors participating in this study, as well as society in general.

For the CCRAAAFFFTING project, this study have contributed with valuable information for the design of the simulations going to be used in the planned crisis response training as well as a better understanding of the payment system domain in general. The interviews have shown that providers of food, fuel and banking services have a need for improving their preparedness and capability for coping with payment system disturbances.

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