Coping with large disruptions in the payment system – stakeholder experience from stakeholder workshops and computer based simulation gaming exercises

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ABSTRACT

In this paper, we describe a work in progress where a mixed methods approach is used to increase insight into what kind of consequences a temporal disruption or total breakdown of the payment system creates for a large variety of societal actors and to increase insight in how their collaborative behaviour can be guided to be more resilient. This approach includes data from different types of data collections; workshop with high-level decision-makers from involved sectors, interviews with citizens, representatives from the fuel, foods, and finance sectors, as well as experiences from 15 simulation game exercises with stakeholders. The triangulated and aggregated outcomes of the different data collections resulted in a set of recommendations on how to cope with disruptions in the card payment system.

CCS Concepts

Information systems → Expert systems

Keywords

Resilience; Payment system; simulation gaming exercises

1. INTRODUCTION

Without transactions, finance stops and loses its purpose. The way transactions are made have developed rapidly during the last century, moving from transactions of noble metals, cash, paper documents to digital transactions and trade. The latter has allowed for trading and business to take place with a previously unprecedented speed [1]. However, all implementations of payment systems have their strengths and weaknesses. The payment system in Sweden is largely based on purchases made with card as more than 80% of all transactions are made this way. Cash, as a payment method is declining and many stores refuse to accept cash payments due to the administrative costs and risks associated with handling physical money. Swedish society is therefore depending on reliable systems to provide payment services. Although substantial work effort has

been put into identifying, analysing and understanding risks, as well as developing routines for preventing and mitigating serious disruptions in the payment system, there is still a lack of insight in how the numerous 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. Key actors in the payment system have stated that they will take a larger responsibility than their formal responsibility [2], but it is not clear exactly what this implies and whether these organizations actually will act, and if so, in what way?

This paper reports on findings from an ongoing project called Creating Collaborative Resilience Awareness, Analysis and Action for Finance, Food and Fuel Systems in Interactive Games, (CCRAAFFTING). The aim of this project is to increase insight into what kind of consequences a temporal disruption or total breakdown of the payment system creates for a large variety of societal actors and to increase insight in how their collaborative behaviour can be guided to be more resilient.^[1] This is done through workshops and simulation-based gaming exercises with stakeholders from businesses, organizations, and agencies that would be affected by, or responsible for handling, a major disruption in the payment system in a real-world scenario, such as the payment, food, fuel and finance sectors [3].

The results reported in this paper originate from one large workshop with high-level decision makers from the concerned sectors, interviews with citizens, representatives from the fuel, foods, and finance sectors, as well as experiences from 15 simulation game exercises with stakeholders. The results are summarised as recommendations on how to cope with disruptions in the card payment system.

2. THEORETICAL BACKGROUND

The payment system has been described as an “inverted pyramid” where 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. The base 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. [4]. Rose and Krausmann [5] uses a similar distinction when dividing the financial system into three different levels: the microeconomic (individual business or

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household), the mesoeconomic (individual industry or market), and the macroeconomic (combination of all market entities). The authors further state that resilience should be addressed at the microeconomic level as the “macroeconomy is based on building blocks of producer and consumer behaviour as underpinnings for macroeconomic considerations stemming from group interactions” [5]. From a systemic point of view, the hierarchical nature of the financial system (the inverted pyramid) suggests that the consequence of disruptions in the system potentially can propagate both up and down in the system. A disruption in the payment system will have immediate consequences for customers, but it will quickly also affect retail, food, and fuel, and eventually affect the entire financial system if the disruption is lengthy. Disruptions will also have cascading effects in the sense that suppliers, logistics, and businesses depending on the ability to purchase by card are likely to close down quickly unless alternative payment methods can be put into operation. For example, many taxi companies in Sweden purchase their fuel using cards. 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.

This leads to discussing how vulnerable these kinds of systems are. Applying resilience theory to present this allows for using a framework with a nomenclature prepared for describing disastrous events, while putting them into a theoretical context. 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 [6], [7]. 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 [8], [9]. In line with the challenges to resilience suggested by Lundberg and Johansson [9] comes the fact that societal systems, such as the payment system, depends on several different organisations to function properly. Hence, resilience must be considered from a system’s perspective. Weick and Sutcliffe [10] argue that loosely coupled systems relying on a sensemaking process generally are more resilient than tightly coupled systems based on the assumption that all system states can be predicted and safeguarded against possible threats. While this may be true, it is also true that failures in loosely coupled systems may be harder to understand and mitigate once they occur.

3. RESEARCH APPROACH

The CCRAAAFFFTING project applies a mixed methods approach utilizing both workshops, interviews, and simulation game exercises to gather knowledge on how societal resilience towards disruptions in the payment systems are/can be coped with. The research questions are:

- What are the expectations on handling disruptions in the payment system from the public (society)?
- What are the expectations on handling disruptions in the payment system from involved actors (food, finance, and fuel)?
- What are plausible responses from involved actors (food, finance, and fuel) to such disruptions captured during the simulation gaming exercises?

3.1 Overall research approach

The CCRAAAFFFTING project is a five-year research effort which started in 2016. Initially, the project conducted a number of

interviews and workshops as input to designing scenarios to be used during the simulation gaming exercises. In addition to this, interviews about customer and supplier expectations and preparations for disruptions in the payment system were conducted. After this, a series of simulation games with stakeholders (identified actors involved in coping with disruptions in the payment system) have been conducted. So far, 15 out of 30 planned simulation games have been performed.

3.2 Interviews

Six interviews were conducted in 2016 [3]. These interviews aimed at addressing issues that were not discussed in detail in the report from 2010 [2]. The interviews were rather open in nature. The starting point was “*If credit card/bank payment would not be possible during 2 days or 2 weeks, what consequences would that have for your organisation/sector?*”.

3.3 Workshops

Two workshops were conducted in 2016 [3]. In the first workshop 26 persons participated from a large variety of public and private organisations. They represented the financial sector, food stores, food production and distribution industry, transport sector, counties (responsible for hospital care and having a regional area responsibility for coordinating crisis, public transportation, and emergency management), fuel distribution sector, gas stations, and some governmental bodies responsible for paying sickness/pension allowances. The second workshop used the same material, but here there were two smaller homogeneous groups, only consisting of respectively 5 and 6 municipal crisis officers (who have a local area responsibility to coordinate cross-organisational crisis management efforts across societal actors within their geographical area).

3.4 Simulation gaming exercises

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 order to be able to experiment with the model [11]. 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 [12]. Gaming-simulation is relevant when the “*how and why*” of the interaction processes between the participants are of interest. Simulation games also create a deeper learning opportunity, as participants literally are active agents rather than passive observers of a computer simulation. de Caluwe et al. [13] and Daalen et al. [14] discuss extensively how simulation games successfully have been used to study the interaction between stakeholder decisions in complex design problems. Borodzicz and van Haperen, [15], [16] discuss how crisis management simulations can be applied to generate learning at the individual, group and organisational level. Learning, when engaging teams of participants in simulation games, can be seen as reflecting on collaborative practice, grounded in theories like experiential learning [17], [18] and single and double loop learning [19]. The project is conducting a series of simulation gaming exercises where 5-10 participants from relevant stakeholders engage in a scenario where the card payment system deteriorates for ten successive days. The task of the participants is to deal with the disruption, create alternative payment methods, and minimize the disturbance on society. Simulation gaming exercises typically last two hours and all interactions among participants, as well as the measures they take during the games, are recorded and analysed, as well as evaluated using questionnaires. Simulation-games are one method that incorporates both quantitative decision modelling as well as qualitative analysis of experts discussing what actions to implement and why.

4. RESULTS

Below the research questions will be answered. As this is a work in progress parts of the the findings have been reported earlier [20], [21], [22], [3].

4.1 What are the expectations on handling disruptions in the payment system from the citizen's (the general public/society) perspective?

The interview study with representatives from the general public (from different socioeconomic backgrounds and from both rural and urban areas) indicates that the informants have some understanding of how such a crisis affects the local community. The informants also specify, indicating some understanding, what they expect to happen. Most informants stated that they were not prepared if the debit or credit cards stopped working. Few had any cash readily available, while some had food stocked lasting for up to more than a week. Most informants said that they could last 72 hours without shopping (a time frame that citizens are expected to cope without the government providing food in the event of a crisis). Most informants expected the banks and stores to resolve the disruption problem. Others thought that cash would not be available as the ATMs would run out of money. All informants anticipated information needs on the development and escalation of the crisis. The information should be accessible through usual information channels such as radio, TV and social media, be clear and concise, should focus on facts about the situation and how to act as citizens in order to not increase the crisis escalation. The informants foresaw that durable food products would be in demand, as it is easier to store and keep. However, informants in the cities expected that food would be accessible and available through shops as they did not have large amounts of food at home.

Citizens living inside cities have expectations and preparedness that indicate a less resilient behavior, as they are less prepared with stored food and consumables with short turnover in their homes. They are used to go shopping more frequently in close proximity to their homes. Another explanation for the lack of stocked groceries can be attributed to the fact that every square meter is more expensive within the city limits than in the rural areas. Hence, to keep costs down, less money is spent on storage space where durable food can be stored. The fact that stores are available, usually within walking distance, decreases the need to stockpile food and other consumables. People in the cities are more dependent on the possibility to buy food, while people living in rural areas are more dependent on fuel in order to be able to move around [20]

Expectations from the public towards disruptions in the payment system and social trust can have a grand effect on the escalation and cascade effects initiated by a disruption in the payment system. The findings from Berggren et al. [20] suggest that people need more information about payment systems to be more resilient and to reduce concerns and social unease regarding what might happen. A disruption in the payment could lead to distrust in the payment system including the authorities and businesses responsible, even if it is just an expected responsibility. Welch et al. [23] state that "trust makes market behavior possible by allowing people to exchange money, a scarce re-source, without great levels of risk or uncertainty being incurred" (p. 466). Declining trust in government may also lead to reduced support for government action [24]. Brehm and Rahn [25] showed a correlation between social trust and civic participation. A disruption in the payment could lead to distrust in the payment system causing lower levels of trust in the

government and in lower levels of civic participation. This would decrease community resilience, the community's ability to identify, summon, and address social problems and to use resources held by the community such as knowledge, skills, and systems to handle a disturbance. Such a decrease in community resilience could become a downward spiral into social disorder. From the sociological literature we assume "that stable social relationships cannot exist for long in the absence of social order. However, it is equally apparent that trust is a requirement for both social order and social relationships" [23] (p. 467). This dependence on trust in social relations on the individual level have shown to affect and be transferred to group and community level [23].

4.2 What are the expectations on handling disruptions in the payment system from involved actors (food, finance, and fuel)?

Stakeholders from different sectors and actors involved in coping with disruptions in the payment system showed a low level of resilience maturity. Especially when it comes to handle long-term disruptions in the payment systems, the responding organizations.

These responses indicate an unawareness of the complexity and amplitude of a crisis caused by disruptions in the payment system. It also signals an unawareness of the involved organisations need to act in order to cope. There is no governmental or state actor responsible that will take control, hence the affected actors need to take action. There is little or very limited planning or strategies to deal with disruptions to the payment system. The lack of planning on behalf of stores, fuel stations etc suggest that the most common response of the actors, at least initially, would be to shut down their business if the payment system is not working for a longer duration. The actors in the food, fuel and banking sectors largely 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. The included businesses that 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. The just-on-time logistics serving most stores today imply that stores are likely to run out of goods quickly if they cannot solve the payment disruption due to decreased or non-existent liquidity. 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

4.3 What are plausible responses from involved actors (food, finance, and fuel) to such disruptions captured during the simulation gaming exercises?

Outcomes from the simulation gaming exercises illustrate how progress and the cascading effects depends on the quality of the early crisis response and less upon the initial disruption. It is conveyed how cross sectorial collaboration is required. Responses where groups focus too much on cascading effects in one area lead too poor overall performance for society at large. Groups tend to overbalance their mitigating strategies initially, until they arrive at a more balanced strategy that covers challenges in several different critical infrastructures from an integral perspective.

Participating teams considered how crisis communication could be accomplished, sets of actions that could be effective to prepare

alternative payment alternatives, to guarantee safety and security, and how to guarantee goods flows. Several of the identified issues are dependent on each other. This will lead to foreseen and unforeseen cascade effects. For example, heavy transports that cannot pay for fuel at gas stations will be queuing. These queues will slow down, even blocking, traffic on the larger highways and roads. In addition, this will lead to stores not having goods and articles on the shelves.

Participants recognize that they are aware that dependencies between different sectors exist, and while engaging in the simulation game have become more aware of how tight and critical these dependencies are as disruptions start to reproduce.

The increasing availability of smartphone-based payment options is often suggested as a solution to the disruption in card payment. However, although increased usage of mobile payment solutions is initially a promising solution, it is not a solution available for all people in society, especially elderly¹. Capacity of these payment services is a problem as they have not been designed to cope with massive amounts of purchases, and too heavy relying in this option results in a technical breakdown due to overload of the services somewhere in the chain of service providers involved. Next, the final major payment option, paying by invoice, raises the question of how to handle liquidity problems at stores and the question who will take the credit risk if not all claims are met. Simulation game participants ponder whether the credit risk can be taken by individual shops, by factoring companies or by central government.

Further, participants in the simulation game argue that it will be challenging for businesses that not already have certain payment options available to install them when a major disruption occurs. It can be hard to make arrangements with banks or other financial institutions to launch new services when everybody is contacting them, and next it can be hard to create workable routines on the fly [26].

Crisis communication to customers is deemed to be very important. By encouraging customers to avoid unnecessary purchases, the pressure on the payment system can be decreased. However, the simulation game participants are also worried that such communication could lead to hoarding as customers may want to assure that they get “their” share of what is available. Communicating the message that the problem will be solved is also risky, as pointed out by some participants, as this could result in a backlash as customers will grow increasingly disappointed as no solution appears. The simulation game participants discuss how to address such issues, for example by trying to keep up a positive atmosphere by offering free coffee or treats to citizens queuing to ATMs or in stores. Another way is to increase the presence of employees and guards at critical places, like cash points, stores and petrol stations.

5. DISCUSSION

It is evident that modern societies are vulnerable to disruptions in the payment system. This includes both actors, organizations, and agencies, as well as public citizens. This paper reports statements from different types of informants representing different levels. In addition, simulation gaming exercises has been used to understand

decisions undertaken, as well as understanding and awareness among participants.

Involved actors’ and affected citizens’ awareness and understanding is limited. There are some apparent considerations. Representatives from fuel, food, and finance sectors have mentioned several issues related to the problem. Limited payment options, communication with customers, protection of goods, customers, trust, and safety, dependencies among many actors, belief that others will solve the problem, preparations and training of staff for coping with a crisis, the dependence on the internet and electricity. All of these are complex issues, many which interact and are affected by different actors’ behaviours.

The mixed methods approach has strengthened the findings of this research paper. Triangulating results from different respondents, data collection methods, and mixing real world experiences with simulation gaming outcomes provide a more comprehensive picture. The simulation game participants acknowledge that they on a general level know that dependencies exist between their sector and other sectors, but while participating in the simulation games, they have become more and more aware how tight and critical these dependencies are when disruptions start to reproduce. A big challenge is to understand how cross-sectorial collaboration should be achieved in practice. The kind of computer based simulation games utilized in the CRRRAAFTING project is one way to approach this problem, as stakeholders are given the opportunity to experience the challenge associated with a major disruption in the card payment system.

6. CONCLUSION

Our conclusion is formulated as recommendation:

- A more holistic understanding of a disruption is needed to initiate relevant between-actor’s contacts and cross-sectorial work groups.
- These types of events require for a determined and swift response, but not too quick.
- Critical infrastructure resilience challenges demand more education and training directed at understanding overall system dynamics among decision makers responsible for coping with severe payment disruptions.
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