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Adopting Emerging Technology in Public Sector: A Case of the Contactless Payment System for Pupils in Elementary Schools

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ADOPTING EMERGING TECHNOLOGY IN PUBLIC SECTOR: A CASE OF THE CONTACTLESS PAYMENT SYSTEM FOR PUPILS IN ELEMENTARY SCHOOLS

Research paper

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Abstract

Adopting emerging technologies drive the digital transformation of public sector organisations. This is often challenging because of slow and formal public procurement process and the need to collaborate among various actors. When adopting emerging technology, the requirements of the system aren't always known in advance. The existing research has identified these barriers and presented singular solutions to them, but there is a gap in understanding what the process of adopting emerging technologies is. To fill this gap, this paper draws from the boundary spanning literature and explores the process and the boundary spanning activities between different actors in a case project of a large Finnish city, which was adopting contactless payment system for elementary schools. By examining the boundary spanning activities and actors, a framework was developed for understanding the process driving successful adoption of emerging technology in public sector organisation. The findings demonstrate the importance of iterative piloting process of the emerging technologies and the importance of the boundary spanning activities to coordinate the process. The paper contributes to the literature on the digital transformation and to the boundary spanning literature by providing a detailed understanding of the piloting process with boundary spanning activities in a specific organisational context.

Keywords: Emerging technology adoption, boundary spanning activities, boundary spanning, public sector.

1 Introduction

The emphasis of policy-making of the governments worldwide is moving increasingly to how information and communications technology (ICT from now on) can be used to increase public sector efficiency and improve internal administration and management capabilities (e.g. Andersen et al. 2009). Finland recognises ICT as an enabler to transformation (Finland, a land of solutions, 2015). Finnish municipalities are required to launch projects to increase public sector productivity. Digital transformation means using new digital technologies in order to enable major business improvements in operations and markets such as streamlining operations, enhancing customer experience or creating new business models (Horlacher and Hess, 2016). Digital transformation challenges public sector organisations to criticise existing processes and requires them to be more functional and flexible.

Emerging technologies are often new technologies which aim to change status quo; therefore, there is often only little knowledge or experience of the technologies implemented in practice. Earlier research has found that introducing emerging technologies in government context has been challenging. Managing the cultural changes is one of the most challenging tasks faced by public sector organisations (Bussen and Myers, 1997). This is because due to the emphasis on bureaucracy and hierarchy in public sector organisational culture (Parker and Bradley, 2000). This is especially true when adopting emerging technologies since defining clear objectives and formulating viable alternatives is problematic in these cases (Crawford et al., 2003). ICT governance is usually centralised and oriented towards controlling the use

of resources in public organisations, which may not provide the flexibility and responsiveness, or support for inter-organizational collaboration, required for adopting emerging technologies (Brown and Grant, 2005). Public procurement process causes lack of interaction with procuring organisations and the use of over-specified tenders as opposed to outcome-based specifications (Uyarra et al. 2014). As acquiring new technology for public sector organisation almost every time includes a formal tendering process, it is important to understand the process of finding suitable solutions before the tendering process is started. The requirements should be well understood and described to get a working solution to be able to advance digital transformation of the organisation. Based on the earlier literature, the organisational and technology related barriers for adopting emerging technology in public organisations can be rather well understood, but there is a clear gap in understanding the process of adopting emerging technology successfully in public organisation.

This paper aims to fill this gap and better understand how emerging technologies are adopted in public sector organisations. The research adopted the interpretive case study methodology (Klein and Myers, 1999) to study a case of the adoption of emerging technology in real-life environment. The research used multiple data sources to understand the phenomenon, such as interviews and project documentation. The case study examined how a public sector organisation acquired a contactless payment system for elementary school pupils and how the organisation guided the caretakers of the pupils to acquire necessary payment methods (e.g. debit cards) for underaged children. The case organisation was a big city in Finland (City from now on). The development of contactless payment system products is rapid and there is little experience of payment methods for underaged children. The activities across organisational boundaries are called boundary spanning activities. There were many parties involved in the case project so a better understanding of the collaboration process between the parties was needed. The data was first open coded based on boundary spanning activities conducted by actors over organisational boundaries, such as different departments in City. The actors were teams or individuals presenting their teams in City or in external parties like technology vendors. The study drew from the boundary spanning literature to better understand how these boundary spanning activities helped the adoption of the payment system in City. Open codes were then axial coded at the same time reflecting on the existing literature of boundary spanning and boundary spanning activities. Already in the early stage of the research it was evident that the emerging technology adoption was made possible by piloting several technologies iteratively. In each iteration stage the key factor was the collaboration between various actors and the boundary spanning activities of the actors. Finally, selective coding resulted in a process model describing boundary spanning activities and actors acquiring contactless payment system for City. This study aims to answer to the following research question: "How emerging technologies can successfully be adopted in public sector organisations?"

This paper contributes to the literature on emerging technology adoption in public organisations. The paper provides an improved understanding of emerging technology adoption in this context. This paper presents an iterative process how different units and actors in public organisation and technology vendors perform boundary spanning activities and how these activities help to overcome the barriers for the adoption of the emerging technology. The findings show the need for coordinative actions to facilitate the piloting process and importance of permeable organisational boundaries in facilitating the adoption of emerging technology. The findings contribute to the research on digital transformation by presenting a framework for understanding the iterative piloting cycle with the actors and the boundary spanning activities driving the successful adoption of emerging technology in public sector organisation. The findings also contribute to the literature on boundary spanning by providing a detailed understanding of the boundary spanning activities in the context of the adoption of the emerging technology in public sector.

Next, literature is briefly reviewed on emerging technology adoption in public organisations. After that the literature on boundary spanning is reviewed to provide the conceptual foundation to research boundary spanning activities. After that the research methodology is described. This is followed by the description of the case and finally the findings and the contributions of the paper are discussed.

2 Literature Review

2.1 Emerging technology adoption in public organisations

Public organisations are under pressure to find ways to make their operations more efficient because they need to be more cost efficient. Utilizing new technologies to reduce manual work can help achieving this goal. Public sector organisations are traditionally seen as being rigid, risk-averse and being satisfied with the status quo (Bozeman and Kingsley, 1998). They are often criticised for choosing the easy route to transformation (Holloway et al., 1999). ICT has become a major factor in the transformation (Thong et al., 2000). Still there are often problems in organisational transforms of public sector organisations, which decreases the benefits received from information technology adoption (Wiredu, 2012).

The ICT governance in public sector organisations is often centralised, which may hinder efficient adoption of emerging technologies. Centralised ICT governance allows better control of ICT resources and obtaining general economies for scale while decentralised ICT governance allows more customised solutions to respond to the needs of individual operative units (Brown and Grant, 2005). Adopting emerging technology often requires inter-organisational collaboration. Relying just on the traditional means for ICT governance might not support fully inter-organisational collaboration (Dahlberg, 2016).

In order to success in digital transformation using emerging technologies, public sector organisations need to modify their obsolete practices (Cats-Baril and Thompson, 1995). In order to enable change, consistent management and information systems changes are needed (Attaran, 2004). The attitude of the end users towards new technologies is important in the effectiveness of the new systems adoption (Skok and Kalmanovitch, 2005). Modifying the end users' beliefs, attitudes and ambitions and how they can adapt to the new experience of using ICT is a challenging issue in public sector organisations (Pan et al. 2008). The adoption of emerging technology is affected be the culture of the organisation (Schepers and Wetzels, 2007). Trust and transparency must be developed if staff are to become committed to a project (Pan et al. 2008).

Applying emerging technologies to existing administrative processes, even to a relatively small degree, can have a substantial impact (Jin and Lee, 2013). The public sector is adopting many different innovations in order to e.g. improve information sharing and interoperability (Gil-Garcia et al., 2009; Pardo et al., 2012). In practice there are problems when defining clear objectives and formulating viable alternatives is impossible such as in case of emerging technology (Crawford et al., 2003). In some cases, public organisations have adopted strategic approach of learning through experimentation in order to try new technologies before full scale deployment (e.g. Pablo et al., 2007). Also, agile methods from the field of software development have been suggested (e.g. Mergel, 2016) to overcome the problems with unclear objectives.

2.2 Boundary spanning and boundary spanning activities

Adopting emerging technology in public sector organisation requires interaction between many parties because of e.g. the issues related to following the rules of organisation. To understand this interaction the literature on boundary spanning was investigated. As Pawlowski and Robey (2004, p. 648) put it: "Boundary spanning describes activities that occur at organizational boundaries, including internal boundaries that separate organizational subunits". The goal was better understanding of the activities between the different parties. The activities across organisational boundaries are called boundary spanning activities. Moreover, boundary spanning "can be seen as the activity of making sense of peripheral information that is perceived relevant" (Lindgren et al., 2008, p. 643).

There are many types of boundaries described in literature, like technological and organisational boundaries (Rosenkopf and Nerkar, 2001). Boundaries can also be functional, geographical, hierarchical or professional boundaries (Lindgren et al., 2008). Boundaries are often connected to knowledge management literature (e.g. Levina and Vaast, 2005), but besides knowledge boundaries there can be affectively driven boundaries emerging from different organisational identities (Hinds and Mortensen, 2005). Both

can be categorised as organisational boundaries (Bechky, 2003). This study focuses on the boundaries between the internal sub-units in the organisation and the boundaries between the organisation and its external environment (Tushman, 1977; Pawlowski and Robey, 2004). The issues between occupational communities (e.g. between financial management and business) in organisations stem from their different understanding of work context (Bechky, 2003). Better understanding how to adopt emerging technology in public sector organisation can be acquired examining the boundary spanning activities between the different occupational communities.

Boundary spanning is generally enacted by people who are well positioned to reach across boundaries, such as project managers. Boundary spanners perform boundary spanning activities, such as collecting information from external sources and presenting their team to the external parties (Pawlowski and Robey, 2004). Boundary spanners enable and control information flows between the teams and the external environment and are central for diffusing ideas in organizations (Ancona and Caldwell, 1988; Pawlowski and Robey, 2004; Kellogg et al., 2006). Employees of an organisation can be assigned as boundary spanners they can emerge as boundary spanners in practice (Levina and Vaast, 2005). Boundary spanners are active and important employees for the organisation but because of their role they can experience stress, conflict, and ambiguity related to their role (Marrone, 2010).

Boundary spanners can adopt different roles. The roles identified in existing research are scout, ambassador, sentry, and guard. Scouts bring resources or information across the boundary to their group. Ambassadors communicate information to the parties external to a group and persuade them do that the group can perform their boundary spanning activities. Sentries police the boundary making sure that the group can work without distraction by controlling the information input as well as the resource input from external parties. Guards decide how to respond to the demands (in form of information or resources) of external parties made to the group. (Ancona and Caldwell, 1988)

Teams can adopt different strategies in relation to their environment like informing, parading, and probing (Ancona, 1990). Informing teams are isolated from their environment, parading teams observe their environment, and probing teams actively engage their environment. Teams perform boundary spanning activities that cross the team's own boundary. There is a stream of research that has specifically focused on these boundary spanning activities and it differs from the research focusing on internal team dynamics. Existing research (e.g. Ancona, 1990; Marrone, 2010) has found boundary spanning activities like managing requirement changes, negotiating project scopes, acquiring key resources, updating top management about team's progress, finding project related expertise or communicating with other interdependent teams. Marrone (2010) identified many boundary spanning activities from the literature and classified them into three categories: representing the team to outsiders, searching for information and coordinating task performance with other external groups.

Team boundary spanning activities can be focused on different levels. A large proportion of the team members can be involved in boundary spanning. This requires many channels for absorbing valuable information from external environment (Friedman and Podolny, 1992; Marrone et al., 2007). On the other hand, all the boundary spanning activities can be centrally controlled by certain individuals to increase communication accuracy and to reduce communication errors (Allen et al., 1979; Tushman, 1977). Boundary spanning activities can be focused on the actions taken by individual team members on behalf of the team. Marrone (2010) suggests that team boundary spanning could be represented from a social network perspective, as relational ties between actors.

Boundaries are needed, because they are a necessary element for maintaining collaboration. Sometimes effective boundary spanning is expected by both parties as a contractual obligation (Koh et al. 2004). Boundaries prevent teams from being affected too much by the other teams and maintain internal operational efficiency (Carlile, 2002). The boundaries between teams can be open (high permeability) or closed. Even different subunits of an organisation may have different permeability of boundaries. Easily penetrated boundaries are open to external influences and have many transactions with the environment (Leifer and Delbecq, 1978). More permeability is often seen when there is high uncertainty and need for information (Leifer and Delbecq, 1978).

3 Research Methodology

This research adopts the interpretive case study methodology (Klein and Myers, 1999). The case study methodology can be considered a suitable research method for this exploratory study of emerging technology adoption phenomenon in a public sector organisation. This study aims to understand a novel phenomenon in its real-life context. The case study methodology is suitable in this situation (Klein and Myers, 1999; Eisenhardt, 1989). It allows obtaining an in-depth understanding of the adoption in an organizational context. As recommended by Yin (2009), multiple data sources were used in this study: interviews, emails, and project documents.

This research studied one information system acquisition project in actual organisation. It focused on processes of the acquisition. Thus, this research has an ensemble view of technology (Orlikowski and Iacono, 2001) and studied technology as a development project (Sidorova et al., 2008). The research adopted the socio-technical perspective to research the building of an ICT artefact by a project group. The units of analysis in this research were the teams in various organisations and the individuals representing their teams, so this research uses a mixed-level unit of analysis. A mixed-level strategy preserves the macro-level concepts and grounds these concepts on individual purposes and behaviour (Markus and Robey, 1988).

In public organisations there are many rules and regulations affecting the relationship between different organisation units (Kooper et al. 2011). In the case of this study, the organisation managed to navigate the challenges related to emerging technologies and the organisational environment by piloting several of these emerging technologies. Data was conducted from December 2017 to December 2018 during the active project. This allowed the researcher to follow the progress of contactless payment system adoption in the organisation. The researcher was chief information officer of one of the municipals of City and acted in this role in the case project. The purpose was, however, not to conduct action research, but rather to observe and understand how the case project evolved. The study thus falls between the soft and hard case study approach according to Braa and Vidgen's (1999) case research framework. Participant-observation allows the researcher to gain access to events or groups that are otherwise inaccessible to a study (Yin, 2009). The participation of the researcher in the case study can be seen as a strength because it enabled richer access to data. The researcher participated in the project in his professional role and only recorded his observations for research purposes. Data were collected through semi-structured interviews. Almost all the representatives of the teams working in the case project were interviewed except one vendor and few employees that left City before the data were collected. End user representatives were interviewed also. The interviews were started with initial interviews of the most active members of the case project to get an overview of the project and teams working in it. This initial framing helped to select the theoretical lens for the study (Pan and Tan, 2011). Already in the early phases of data collection it became clear that in the case project there were many different actors across the City itself and third parties (system vendors and banks) and some problems that were caused by miscommunication or the lack of communication. It was also seen that these problems were often solved with making changes to communication practices. Data analysis was started in an early stage of the data collection and the findings were continuously compared with literature. It became soon clear that boundary spanning was the phenomenon of interest and particularly the boundary spanning activities because there were a lot of different actors and teams in organisations and problems were caused or solved by communication. After determining the theoretical lens and conducting initial analyses, all the rest interviews were conducted to get different perspectives to boundary spanning activities and to confirm the research findings. Along the data collection, it also became obviously that there was an iterative loop with similar phases in the case project. This was also confirmed with additional interviews especially near the end of the data collection.

The data consisted of 17 face-to-face or conference call interviews, project documentation, emails and on-site observations. All interviews were conducted by the researcher. The memos of the interviews were kept on a notebook. There were over 6 hours of interview recordings and 20 pages (A4) of interview memos. There were hundreds of pages of project documentation and emails which was used for understanding the case. After the transcription there were 101 pages (A4) of interview transcriptions.

After the transcription the data was open coded. Whenever a boundary spanning activity conducted over team boundaries (e.g. from a project team to a technology vendor) was observed it was coded accordingly and assigned to correct stage of the project. 299 open codes were identified of which 34 were unique. Open codes were then axial coded reflecting on the literature of boundary spanning and boundary spanning activities (e.g. Marrone, 2010). Appendix 1 presents examples of open and axial coding. Boundary spanning and boundary spanning activities theories were thus used as a lens for characterizing and analysing the project at hand. Finally, selective coding resulted in a process model describing boundary spanning activities and actors when acquiring contactless payment system for City. The selective coding was conducted based on abstraction of core concepts found in axial coding reflected on key actors within the case project and the phase of the case project.

4 Case Description

The case project of this research focuses on contactless payment system for under aged pupils in elementary schools. Providing afternoon snacks is required by the Finnish law but there can be a price for the snack. Before the case project the snacks sold in City were paid cash only. There were security issues considering the cash payment and a lot of manual work handling the cash. City decided to move to electronic contactless-based payment. Contactless electronic payment was widely used technology in Finland but there were dozens of different payment systems and they were evolving quite rapidly. Also, the payment methods (e.g. credit cards or mobile payment) were evolving fast but the products were seldom designed for under aged children because they require a bank relationship with an agreement between the client and the bank. The contactless payment system needed to fulfil financial requirements of City, such as taxless sale. Also advertising particular private bank or particular payment method for children and their caretakers was impossible for a public sector organisation.

Mapo (a pseudonym) is a municipal enterprise of City, which belongs to central administration division of City. Mapo produces various services like school meals and afternoon snacks. Koski (a pseudonym) is a division of City, which is responsible of school education. Koski orders (and pays for) the school meals and the afternoon snacks from Mapo. Kanto (a pseudonym) is part of City executive office, which is a part of central administration like Mapo. Kanto is responsible of City's economic and ICT planning. Tuikku (a pseudonym) is also a municipal enterprise of City, which belongs to central administration division of City. Tuikku is responsible of financial services (e.g. billing) of the City. There are over 100 elementary schools in City and about 45.000 pupils studying in them. Finnish children start their elementary school usually at the age of seven and end it usually at the age of fifteen.

The project was started by Mapo because Mapo was the organisation responsible of handling the cash from the snack sales. At first it was not clear who owned the project. The project was finally given to ICT department of Mapo. Mapo was interested in the project since the outcome would have reduced the manual labour of operative work and security risks. Koski was interested in teaching new payment methods to their elementary school pupils. Koski teachers also paid for their own lunches, so the project would have resulted them easier payment method as well. The payment system was supposed to be affordable since there wasn't much snack sales in schools and the sales margin was low.

Soon after the project started, the project manager contacted Kanto's ICT department and explained the project. Kanto's ICT department requested Kanto's Finance department and Tuikku to participate in the project because they were responsible of related processes. Kanto was interested whether the contactless payment system could be a City-wide acquisition. It was agreed that Mapo owned the project and could pilot the technologies, but the project still had to report to Kanto.

Mapo studied many electric payment methods to inform the caretakers of the elementary school pupils. Electric payment methods for underaged persons weren't easy to find, since Finnish banks had only few options for underaged customers. It was also considered that not every caretaker wanted to acquire electric payment methods for their dependants. The negotiations were far with one bank which promised to give free payment stickers for pupils, but Mapo had to withdraw because Kanto didn't allow the advertising of one certain bank over others. Mobile-only payment methods were impossible since a public organisation cannot assume that every pupil has a smartphone. Mapo studied also different contactless

payment systems according to initial requirements. There were many vendors and they had many products. Mapo chose one vendor for the first pilot mostly because it had low starting costs. The solution of the vendor was a plain payment terminal, not a point of sales (PoS from now on) system. Mapo had to discuss about the technology and the pilot schools with Koski, since Koski was responsible of the afternoon snacks. Ten pilot schools were selected. The selection was made based on volume of the sales of the snacks. At first communication between Mapo and Koski scattered. Sometimes it took long to get the answers and there was some misinformation in communication. To solve these problems all the Koski communication was channelled through communication manager of Mapo.

There was a lot of instruction documentation to be made to the caretakers, the pupils, the principals, and the salespersons. Mapo wrote mostly the documentation. The vendor kept two training sessions to salespersons and salespersons were given a first level support phone number for payment system problems. Mapo salespersons also gave paper announcements to pupils who still tried to use cash to buy afternoon snacks. There were some technical and process problems. The invoices of the payment system didn't reach the correct cost centres because of the communication issues with Mapo, Tuikku and the vendor. There were also problems with the invoice index numbers, the tax codes and the sale point information of the sale reports of the system and connection problems with the GSM network of the payment terminals. The issues were solved with constant communication between the vendor, Mapo system manager and Tuikku. During the first pilot Mapo conducted two questionnaires for caretakers of the pupils, principals, and Mapo salespersons. Sale reports were also analysed. Project manager reported the results to Kanto, Koski, Mapo project team, and Mapo steering group.

After one year of testing the first technology, Mapo, Koski and Kato decided to expand the pilot with new technologies and pilot schools. Mapo wanted to test PoS system instead of plain payment terminal because it wanted to know how much manual work PoS system would reduce. The two pilots were basically conducted the same way as the first pilot. Mapo seek again new technologies from vendors. The solutions of the vendors had changed during the pilot since contactless payment systems were evolving. Mapo selected a pilot system from the vendor whose PoS system it was already using in its cafeterias. The system had the integration to the financial system built in advance. Mapo also selected third pilot technology for the second pilot phase based on price of the system and updated requirements. In second pilot Mapo service manager trained the salespersons in personal trainings. One of the systems of the second pilot had also technical issues, which required a lot of manual work in the financial department of Mapo. All the sales were transferred in one bank transfer, which had to be manually divided to correct salespoints in bookkeeping.

Near the end of the second pilot, Mapo project manager discussed with Kanto's ICT, financial, and acquirement departments how final PoS system would be acquired. Kanto decided that it would be a City-wide acquisition. The project responsibility was given to acquisition department of Kanto. It conducted a public request for information to vendors with the help of Mapo's requirements definition. Nine vendors answered it. Unfortunately, City didn't receive much new information from the public request. The acquisition department of Kanto started to gather the requirements of different organisations of City. Data collection of the case study stopped at this point because the acquisition process was rather straight forward from that point. After requirement definition the City would have started the public competitive tendering process and acquired one technology solution based on the results of the process.

5 Analysis and Findings

This section presents the findings of the study. Based on interpretive analysis of the case City acquired and tested different technologies in several stages, which ended in public procurement process acquiring the final solution. The stages were repetitive. Quoting financial manager of Mapo:

> *In addition [to first pilot] we wanted to try payment solutions which had more traditional point of sales features so we can choose the right solution for us and gain information, because now we just have tried plain payment terminal. We also like to have experiences from other solutions.*

All the stages started with requirements and boundaries definition, continued to technology searching and testing and ended up in re-scoping the project, except the last one, which wasn't a pilot anymore but an acquirement of the final solution. Three distinct stages were identified namely: first experiments with emerging technology, covering a wider range of technologies and selecting appropriate technology for wider requirements. The analysis also revealed that in each stage, teams conducted different boundary spanning activities contributing to adoption of contactless payment system for elementary school pupils. The following three sections provide an analysis of teams' boundary spanning activities and their relationships with the three identified stages.

5.1 The first experiments with emerging technology

In first experiences from emerging technology stage Mapo was searching for a solution to replace the risky cash payment under of strict policies from the Finnish law and City itself. Mapo founded one system and several payment methods based on initial requirements it had and tested together it with Koski. Mapo and Koski found that there were some technical difficulties and the pupils didn't start to use the technologies as anticipated. Also, the system required a lot of manual work especially in the financial department of Mapo. The next paragraphs present the actors and boundary spanning activities performed in this stage.

Defining requirements and boundaries. Mapo started the project since there were serious security related issues with handling cash in the schools. Mapo had a discussion with ordering customer of Koski. Koski didn't want to pay for the solution. The solution couldn't be expensive since afternoon snack prices were regulated and all was funded with taxpayer's money. The ownership of the project wasn't clear, since offering the afternoon snacks to the elementary school pupils was a shared responsibility between Mapo and Koski. Mapo needed the support of Koski and Kanto to be able to pilot new technology. Mapo had to acquire official permissions from Kanto to acquire this kind of system. City had wide variety of different rules and regulations that controlled how money and payment should be handled. Mapo and Koski chose the pilot schools co-operatively. The planning was considered rather difficult since no one had previous experience from similar projects. The communication scattered as there were several employees in Mapo and several parties in other organisations, which caused misunderstandings and unnecessary delay to communication. Mapo solved this issue by channelling all the communication to the other parties through Mapo's communications manager. Communication between Mapo and Koski was mostly done with face-to-face meetings and phone calls but it changed to email-based communication which was considered more formal.

Searching information and acquiring technology. Mapo contacted several vendors searching suitable technology based on initial requirements. Vendors provided the information and presented their contactless payment systems. Also, Mapo contacted several banks in order to search for payment cards suitable for elementary school pupils since not all Finnish banks offered payment services for underaged persons. Mapo had previously chosen one payment solution with a certain bank, which was offering a solution to under aged persons. The bank was interested in the new customers segment, so it was ready to offer its solution for reduced price. Mapo developed usage instructions to the caretakers of the elementary school pupils with Koski. Kanto stopped the process noting that if public sector organisation preferred only one payment solution it would have been considered as advertising of one private sector company, which was not allowed. Mapo had to search for other possible solutions from other banks and refer them only as examples in its instructions. Mapo started to use project management methods and documentation to be able to handle the project and communication more strictly.

Testing new technology and collecting knowledge. Mapo's salespersons were trained to use new technology by Mapo project group. The training session was done in two classes by Mapo project group personnel and vendor's employee. The principals of the elementary schools were informed through Koski ordering customer. The principals were responsible for informing the caretakers of the elementary school pupils who had to acquire payment methods for their dependants. The principals communicated to the caretakers with an information system used already in schools. Mapo soon noticed that the elementary school pupils didn't have payment cards and they still tried to use cash. Mapo reacted to this

issue by creating a paper instruction handed to the pupils who tried to pay with cash. Also, some caretakers thought that there was no other way to buy afternoon snacks than with the contactless payment system but there was still an option to pay snacks with the existing voucher system. As a response, Mapo communicated directly to the principals via Mapo communications manager in order to provide information faster for the caretakers of the pupils.

Re-scoping the outcome. Mapo conducted end user survey with Koski and Kanto to salespersons, principals and caretakers of the pupils. Mapo also conducted financial analysis to examine how the sales were affected by the pilot. There were a lot of technical problems with the sales hardware, mostly caused by bad networks. Also, there were a lot of manual work in the financial department of Mapo since the selected solution wasn't integrated to City's financial system nor provided right type of sale reports. There were also some problems billing the contactless hardware. Vendor tried to solve these problems directly with Tuikku, but it didn't work since Tuikku didn't know the organisation of Mapo. This was fixed by channelling the billing discussion to between Mapo financial unit and the vendor. Mapo and other parties reacted to these issues by extending the pilot with different contactless payment systems.

5.2 Covering a wider range of technologies

In this stage, Mapo and Koski piloted two new systems based on experiences from the first pilot. They analysed the experiences and found the strengths and weaknesses of the different systems. The next paragraphs present the actors and boundary spanning activities performed in this stage.

Defining requirements and boundaries. Mapo conducted the requirements definition mostly by itself because it was suffering the most from the problems in the first pilot. There was some internal conflict because operative business unit didn't always consider the project so important (because of the cost) and administrative units wanted the system to decrease their work. The financial department of Mapo defined what kind of system features were needed. The law defines how accounting should be done including how to manage sales with or without taxes. The first pilot required a great amount of manual labour to Mapo to be able to obey this law. Also, the ICT department of Mapo defined the features to overcome the technical difficulties of the first pilot.

Searching information and acquiring technology. Based on updated requirements definitions and experiences from first pilot technology vendors were contacted again. Some already known and some new vendors provided the information and presented their contactless payment systems. It was discovered that technologies had evolved during the first pilot and there were new alternatives which weren't available in the first pilot. Two new contactless payment systems of different vendors were chosen for the second pilot. The contactless payment systems used different tele operator networks to communicate with banks. There were a lot of technical problems with the tele operator networks in the pilot schools because there were a lot of other users and the walls of the restaurants were thick. Mapo contacted different tele operators to get the appropriate data subscriptions.

Testing new technology and collecting knowledge. Again, the salespersons were trained but this time by Mapo only. Mapo updated the usage instructions and documents based on two new technologies and sent them to schools. Mapo used mostly the instruction documentation of the first pilot for the caretakers of the pupils of the new pilot schools and for the principals of the new pilot schools. Mapo and Koski had their own lists of pilot schools. The lists weren't identical, which caused problems for communication between Mapo and Koski and their customers. Mapo communicated directly to the principals of the new pilot schools. The principals published the instructions to the caretakers of the pupils with the same system they used in the first pilot. Employees of Mapo financial department used vendors' information systems to receive financial reports which they used to channel the sales to right accounts in bookkeeping. The controller of Mapo asked feedback from the salespersons during the regular inspections he conducted.

Re-scoping the outcome. After some time, piloting with three different contactless payment systems Kanto financial and acquirement departments decided that the acquirement of the system should be City wide. Mapo project and steering group considered this as a delay to the project, which was already late.

5.3 Selecting an appropriate technology for wider requirements

Selecting an appropriate technology for wider requirements stage started after Kanto decided that there should be a City-wide system. The requirements definition started again for the needs of other municipals of City. The next paragraphs present the actors and boundary spanning activities performed in this stage.

Defining requirements and boundaries. Kanto acquirement led City wide acquirement of the system. It collected the requirements from the organisations of the City which were mostly made by Mapo. The other organisations of City didn't participate much to the requirement definition. A comparison to City's other PoS systems was done and integration between the PoS and City's financial system was defined.

Searching information (for technology acquisition) and acquiring final technology. Kanto made request for information to vendors in market and got nine answers. Kanto and Mapo felt that the request for information didn't bring so much new information which was already received from three different pilots. This was the stage that the data collection ended. City planned to make the acquisition as soon as possible which would take about half a year.

6 Discussion

This study explored the boundary spanning activities and actors performing the boundary spanning activities during adopting emerging technology in public sector for elementary school pupils. Boundary spanning activities were conducted between organisational units and between organisational units and external parties (Anacona, 1990; Marrone, 2010). The case project was planned to be traditional waterfall type project (Royce, 1987) but the results show that there was a repeating cycle of boundary spanning activities between different actors. The cycle was found to be repeated in all three stages of the case study though the data collection was stopped before the last cycle was finished. The cycle was found to be iterative in nature because every pilot stage repeated the same boundary spanning activities and experiences from the previous stage were used planning the next stage. Based on the findings this study proposes a framework (Figure 1) for understanding the actors and the boundary spanning activities for emerging technology adoption for public sector organisation. The process started from upper left corner and moved clockwise.

Piloting emerging technologies has been demonstrated to yield useful information (e.g. Bartlett, 2003) because the iterative piloting cycle enables public sector organisation to test different solutions in practice. The presented framework shows that having open conversations with the vendors and with the end users enables gaining information from the piloting process. This is an opposite method for typical requirement definition and large public procurement process. As Kanto acquisition specialist notes:

> *…what it means is that then [after the tendering process is started] the talks are talked [one cannot discuss anymore with the vendors about technologies].*

This finding is in line with the research by Uyarra et al. (2014), which noted that public procurement process causes lack of interaction with procuring organisations and the use of over-specified tenders as opposed to outcome-based specifications. The findings also support the results of Pablo et al. (2007) that some public organisations have adopted strategic approach of learning through experimentation in order to try new technologies before full scale deployment.

The findings indicate that information searching and system testing activities are important if the outcome of the project isn't clear from the beginning. Every iterative stage of the acquisition project began with defining the requirements and boundaries. These were collected from various actors, existing documentation and laws. Coordinating actor was needed to gather the requirements. Since the technology in hand was emerging, there were several vendors with many different products. Technology vendors developed rapidly their products. Communication between the different parties had to be managed and synchronised to be able to handle the testing of the new solutions. There are similar findings in literature studying geographically distributed systems development (e.g. Alzoubi et al., 2016).

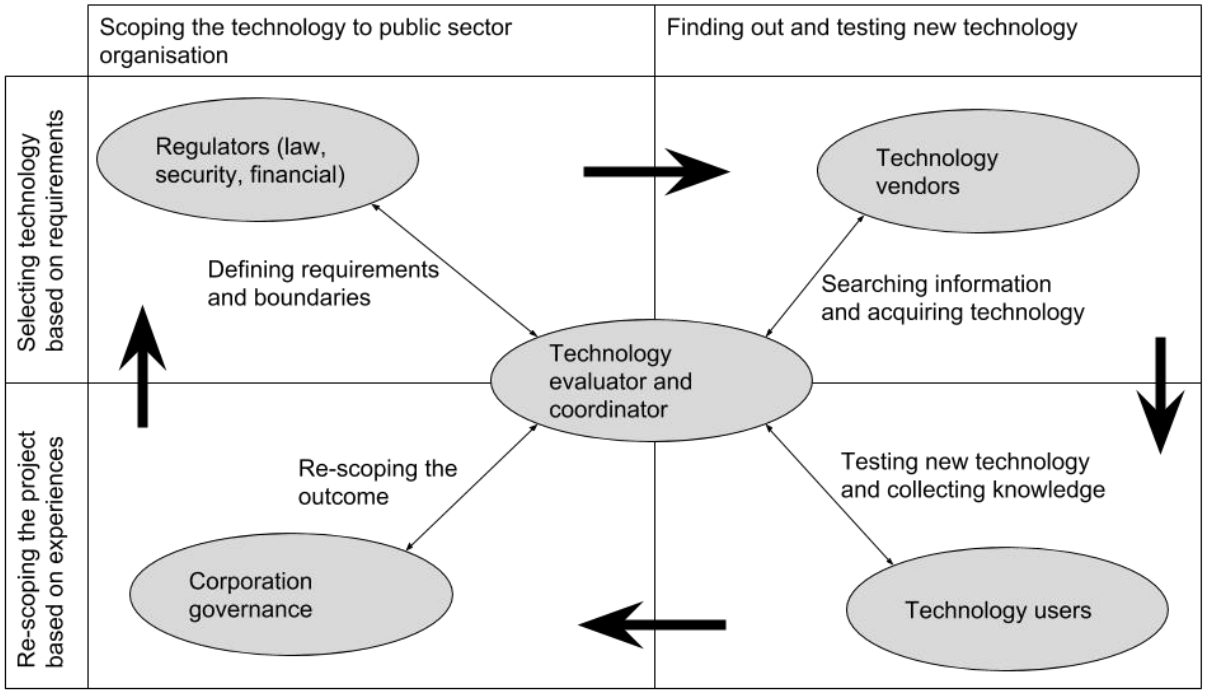

Figure 1. Actors and boundary spanning activities in iterative cycle for emerging technology adoption in public sector organisations.

The implementing organisation didn't have previous experience so information search from the vendors based on requirements was necessary in every cycle. The vendors didn't have much experience offering their services to under aged persons, so all parties were testing the emerging technologies in practice. In such a case the vendors need an environment to test their solutions in real life context. Similar findings have been found in literature considering entrepreneurial environment in public sector (e.g. Leyden, 2016). Because parties were testing an emerging technology with real end users it was necessary to keep pilot sizes rather small in order to make fast correction moves. In software development literature (e.g. Recker et al., 2017) iterative (or agile) methods have found to improve team response effectiveness which this finding indicates also. Constant information gathering from the end users was crucial. Including the end users to the project and constantly asking their opinions helped the adoption of emerging technology. This is in line with Skok's and Kamanovitch's finding (2005) that the attitude of the end users towards new technologies is important in the effectiveness of the new systems adoption. Also, as Pan et al. noted (2008): trust and transparency must be developed if staff are to become committed to a project. At the end of every cycle the outcome was evaluated based on experiences from the testing stage. Because of the large organisation, the shared responsibility, and the different goals of different organisations this was done in several levels. This was important since main goals were to reduce risks of cash payment and spent efficiently taxpayer's money. Corporate governance was needed to be able to avoid partial solutions which are not efficient when looking from the perspective of City.

The results show that one of the key boundary spanning activity was mediating technology evaluation and coordinating the project between the different stakeholders. There was a great number of rules and regulations in City. This usually makes the interaction between the ICT and the operative unit difficult (Kooper et al., 2011). Usually the ICT development in the public sector tends to be centralized to ICT units (Wiredu, 2012) but the results indicated that the most operative unit (Mapo) was best choice to pilot emerging technology in this context. Mapo was acting as probing team (Ancona, 1990) as it worked in central role acquiring emerging technology. Mapo took boundary spanner roles of scout and ambassador (Ancona and Caldwell, 1988) when it brought information across the boundaries and communicated it to the other actors. The understanding of the boundaries allows the determination of the boundary spanning activities that are essential for the communication and negotiation between different professional communities (Bechky, 2003). Boundaries between the organisations were highly permeability

because of the unclear goal and the high need for information. Leifer and Delbecq reported similar findings (1978). The case provides understanding of some of the boundary spanning activities of different actors achieving the ability needed for adopting emerging technology in public organisation. It also provides understanding how emerging technology is piloted in cycles gaining more information every round.

7 Contributions and Limitations

Information systems research has previously focused on understanding the barriers e.g. bureaucracy and inflexible ICT governance (Brown and Grant, 2005) or information management centralisation (Wiredu, 2012). This study contributes to the existing literature on technology adoption in public organizations (Dahlberg, 2016; Wiredu, 2012; Brown and Grant, 2005) by providing the iterative perspective of analysing the boundary spanning activities facilitating the emerging technology adoption in public sector organisation. Also, this study connects literature of agile software development methods (e.g. Recker et al., 2017) to studies related to acquisition of emerging technologies. Public procurement process causes lack of interaction with vendors and the use of over-specified tenders (Uyarra et al., 2014). This study contributes to the public sector innovation process literature by providing an iterative framework of piloting emerging technologies. This enables learning through experimentation in order to try new technologies before full scale deployment (Pablo et al., 2007). The findings of this study also contribute to studies related to vendors' role in testing their solutions in entrepreneurial environments in public sector (e.g. Leyden, 2016). Leifer and Delbecq suggested (1978) that boundaries are more permeable in conditions where there is high uncertainty and need for information. This study supports this by analysing the important and rather open evaluator and coordinator role between Mapo and other project parties. Lim et al. suggest (2012) that especially governmental institutions must guarantee service quality in their systems in order to make the service experience a satisfactory one for users. The findings of this study support this by highlighting the need of knowing end user's perceived service satisfactory in order to improve the service. This study also contributes to the boundary spanning and boundary spanning activities literature (e.g. Marrone, 2010) by providing a deeper understanding of boundary spanning activities performed in the case of adopting emerging technology in public sector organisation. This result emphasizes the importance of the role of the boundary spanners in the digital transformation of public sector organisation.

This study can help practitioners to understand the challenges related to emerging technology adoption in public sector organisation. This study also presents ideas how these challenges can be overcome. This research can provide guidelines how to adopt needed flexibility so that emerging technology can be piloted to under aged pupils while obeying the law and other rather strict public sector requirements. This research also has some limitations. The research was conducted by one researcher only who was an employee of one of the municipals of City. The participation of the researcher can be seen also as a strength because it enabled richer access to data. During the data coding phase of the research the researcher constantly reanalysed the existing codes and the codes were continuously reflected on and compared with the literature to be able to identify most relevant codes and categories. There are challenges that are related to the bureaucratic environment of public sector organisation and the need for collaborating between other public sector companies and third-party companies. These need to be overcome to be able to adopt emerging technology in public sector organisation. This study presents an iterative cycle of boundary spanning activities that helped to overcome these challenges. Hopefully this research can stimulate further research on the drivers of successful digital transformation initiatives.

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Appendix 1

Quote	Interpretation	Open code	Axial code
Mapo security manager: "I said we should get rid of cash because it can be stolen."	Project boundaries were collected from Mapo personnel. Security related issues were one of prime reasons for the new system.	Project boundary	Defining the owner of the project and initial requirements
Mapo financial manager: "We chose Vendor 1 because it was the cheapest option."	Vendors were examined according to project boundaries. Vendor 1 was chosen because Koski didn't want to pay for the system.	Choosing a vendor	Acquiring knowledge and selecting suitable technology
Mapo system manager: "There were some delays because we had to wait for the answers from the ordering customer."	Mapo had to test its ideas with Koski and Kanto. There were first misunderstandings who asks and who answers.	Validation round	Getting support and channelling communication
Kanto system manager: "City as a neutral actor cannot advertise one payment method over another."	Mapo had chosen previously one payment method and started negotiations with the bank offering it and writing end user instructions to caretakers. Koski lawyers forbid it being an only payment method.	Forbiddance	Rescoping the solution based on public organisation requirements
Mapo communications manager: "We made a decision to skip few steps...It is most important to get the message quickly to the children and their caretakers."	Mapo changed its communication methods and tools because it heard from surveys that the messages weren't getting through to pupils and their caretakers.	Communicating project related things	Reacting to end user needs
Mapo director: "It was about the feedback of the end users. We listened and heard what works and what doesn't."	Mapo conducted usage surveys to find out what pupils, caretakers, principals and salespersons think about the pilot system. It ends up extending the pilot.	Getting end user experiences	Optimizing the solution based on experience
Mapo financial manager: "Kanto wanted to find out if this should be extended to other municipalities also."	After three pilots Kanto decided that contactless payment system should be acquired City wide.	Decision of the scope	Pulling the brakes and re-scoping the project
Kanto acquirement specialist: "There are many parties in the City, so it is a challenging task to acquire a system which fulfils the needs of everybody."	Kanto started to collect the requirements for other municipalities of the City.	Requirements definition	Defining requirements for extended usage

Appendix 1. Examples of open and axial coding of the data.