

ITM COMMUNICATIONS 2013/1

# Modelling the Genesis and Evolution – The Case of a Prepaid Danish Cashcard

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23 September 2013

ISBN 978-87-92524-17-1



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**Abstract:**

Payment transactions through the use of physical coins, bank notes or credit cards have for centuries been the standard formats of exchanging value. Recently online and mobile digital payment platforms has entered the stage as contenders to this position and possibly could penetrate societies thoroughly and replace current physical payment standards. This paper portrays how digital payment platforms evolve in socio-technical niches and how various technological platforms aim for institutional attention in their attempt to challenge earlier platforms and standards. The paper applies a co-evolutionary multilevel perspective to model the interplay and processes between technology and institutions wherein digital payment platforms potentially will substitute other payment platforms just like the credit card negated the cheque. We present a framework for understanding the evolution and transitions of payment platforms. We demonstrate the usefulness of the framework in a in-depth single case study of a prepaid cash card. The learning of past experience with digital payment platforms is demonstrated to be the right starting point for investigations into how new solutions might succeed or fail in the future. Thus we finally discuss how possible venues and routes of transitions appear in current evolution of digital payment platforms

**Keywords:** Strategic technology evolution, digital payment cards, technology transitions

## 1. INTRODUCTION

In 1939 Luther Simijan created the “bankmatic automatic teller machine”. He asked a company, now known as Citicorp, to trial it. After six months the bank reported that there was no need or demand for such a product:

“It seems that only a small number of prostitutes and gamblers are using the innovation because they didn’t want to deal with tellers face-to-face” (In Barwise et al. 2011)

Almost thirty years later, in 1969, a second attempt to popularize the ATM was made and this time the invention caught widespread attention from banks and financial institutions. Today the inventions of Luther Simijan can still be found in ATMs, including the name “automatic teller machine”. The genesis of the ATM shows common characteristics of innovation and development stages. Many solutions are invented long before they become widespread. This is especially true for the many innovations that rely on institutional backing and widespread adoption to be firmly established.

The history of technological evolutions brings other examples (e.g. the development of railroads, water way systems and road infrastructures) of how innovations have gone through different development stages before emerging as a dominant socio-technical landscape (e.g. as a modern version of the ATM which today can be found nearly everywhere). In this paper we explore how innovations of money go through phases of transitions in order to become widespread. We build a framework to explain these transitions and we demonstrate its usefulness by applied it to the case of a prepaid cash card that like the first version of the ATM did not become widespread applied in the first attempt.

Money is any object or record that generally is accepted as payment for goods, services and repayment of debts in a given socio-economic context (Zelizer 1997) Originally money was based on commodities (such as gold) where governments or countries made guarantees that the payment objects could be exchanged into e.g. gold at any time. In modern time nearly all money systems are based on fiat money. Fiat money is without intrinsic use value as a physical commodity and derives its value by a government legal tender which defines the mediums of payments allowed by a legal system to be valid for meeting a financial obligation in a particular country or region. Several types of money can be identified such as coins, banknotes, checks etc. These physical objects currently represent the dominant pattern of payment sources for smaller transactions (Zelizer 1997).

With the widespread use of mobile phones a new type wallet for payments is also emerging (Ondrus & Pigneur 2006). The mobile phone adds a new dimension of existence in time and space. In this particular dimension both the human styles of interaction and the conceptions of time and space change in co-constructive evolutionary processes (Fortunati 2002(Ondrus & Pigneur 2006).). As a result the mobile phone among other technologies has the possibility to build upon social behaviour attached to alternative payment artefacts such as the wallet. Consequently, digital payment systems are mutual shaping’s between technology and institutions and the transitions from small innovations into widespread used platforms are complex processes filled with constraints from earlier choices and current constellations of dominant actors. In this paper we want to explain how some innovations are lifted up by societal actors who sees a potential in the innovation to support their own businesses.

This paper addresses one key research question; how do new digital payment systems grow and evolve over time? We attempt to capture and explain the shifting static yet dynamic nature of digital payment systems in socio-technical process developments. The answers are comprised into a conceptual multilevel framework for understanding and managing the evolution of digital payment platforms. With the focus on the past

trajectory and the path dependency to other technologies to show how earlier payment technologies are constantly challenged with new ones in a process of socio-technical evolution. In the paper we first in section 2 explore a theoretical background concerning the genesis and evolution of technology and derive with our framework for understanding digital payment platform evolution. In section 3 we present our methods for applying our framework to the case of a prepaid cash card. In section four we describe our empirical case. In section 5 we analyse our case based on our theoretical framework. Consequently in section 6 we discuss our findings in relation to our proposed framework and how this could be further elaborated. Section 7 summarizes and concludes the paper.

## **2. GENESIS AND EVOLUTION OF TECHNOLOGY**

In recent years the studies of the different levels and phases innovations must pass through have become a focus of attention (Geels 2002; Rip and Kemp 1996). This interest concerns how long term and large-scale innovation transforms from one socio-technological system to another and uses insights from evolutionary economics (Hodgson 1997; Aldrich et. al. 2008), sociology of technology (Latour 1987; Law and Hassard 1999; Pinch & Bijker 1984) and innovation studies (Elzen et. al. 2004). The arguments found in these contributions highlight the combinations of history, sociology and economics of technological change in order to capture the complexity in the dynamics of specific types of transitions. These major changes involve not just technological changes, but also change in markets, regulation, culture, industrial networks and infrastructure (Schot & Rip 1997; Geels 2004).

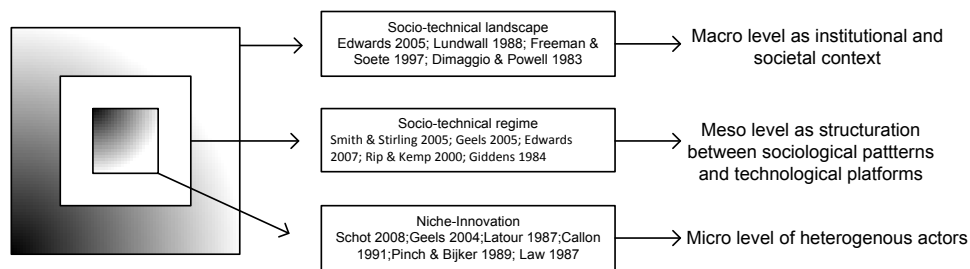
The concept of cash has long been a part of the socio-technical landscape. However many new digital payment solutions are currently evolving as niche innovations. Banking, transactions, money and payments is currently entering a new stage of online banking (Garcia-Swartz & Hahn 2006; Worthington 1995) and digital payment systems platforms are emerging as a phenomenon which possibly will penetrate societies thoroughly and substitute current payment technologies in the years to come (King 2010; Linné 2008; Bergsten 1966).

Work on transitions and system changes have been labelled under various terms, e.g. regime transformation (Van de Poel 2003), technological revolutions, technological transitions (Geels 2010) system innovation (Elzen et al. 2004) and standard wars (Shapiro and Varian 1999) and can be seen as co-evolutionary processes which involve technological changes as well as changes in other systems (Geels 2002, Edwards 2003). Perspectives from evolutionary economics emphasize the complex interdependencies and competition in transformation processes of institutions and agents from an evolutionary methodology (Aldrich et al. 2008). For David (1985) Katz and Shapiro (1986) and Arthur (1989) the evolution of technologies is path dependent. These perspectives often use detailed historical case studies (e.g. the transitions from sailing ships to steamships, the transition from horse-and-carriage to automobiles and the transition from propeller-piston engine aircraft to turbojets) to illustrate path dependent dynamics of technology transitions.

Against this backdrop this paper uses theory on technology transition and evolutions to show how digital payment platforms simultaneously shape, are shaped and co-construct the conditions of society. By linking a level of niche innovation to socio-technical regimes and socio-technical landscapes we show possible venues of IT systems over time, space and social organization as they occur form the stable foundation of contemporary payment infrastructures (Edwards 2003, Geels 2006).

We distinguish between a phase of small networks connecting in various forms seeking institutional backing to being a contender in the market seeking widespread use. This

distinction reflects three levels in the process of evolutions over time. The niche-innovation is where radical innovation is observed. Initially the novelties are unstable configurations jockeying for an institutional position and a place in the market. The socio-technical regime is the currently dominating pattern of candidates. A regime consists of scientists, policy makers, users and special interest groups contributing to the technological development (Bijker 1995). Socio-technical landscape refers to an exogenous environment beyond the direct influence of niche and regime actors (macro-economics, deep cultural pattern, macro-political developments). As a result the socio-technical landscape is not one system or platform it is the constellation and configuration of various socio- technical regimes in a specific time and context (Edwards 2003; Geels 2005). Changes at the landscape level usually take place slowly on average but occurrences at this level can push for new innovations to evolve.



**Figure 1 Levels of analysis**

## 2.1 Niche innovation

A niche innovation is an invention that is not yet picked up by institutional actors. The invention of the ATM could be considered a niche innovation for almost thirty years before key institutional actors who developed the invention into a commercial service picked it up. The niches can serve as incubation rooms where the innovations can evolve protected from mainstream market selections. The incubations rooms emerge, as innovations, at this point, are not concerned with existing customers and backwards-compatible functions. The niche innovations are also characterized by dedicated actors often outsiders of dominant actors.

Niche innovation draw primarily upon theory on heterogeneous actors in networks (Callon 1980, 1991; Latour 1988, 1991; Bijker & Law 1992; Pinch & Bijker 1984). Broadly these directions are used to conduct micro analysis of the relations between actors, networks and technologies. The niches are where the radical innovation evolves as contenders to a position in the market. Small networks of actors support novelties on the basis of expectations and visions (Damsgaard 2002). Gradually a dedicated community of engineers and producers emerges, collectively directing their activities to the improvement of the new technology of its own (Geels 2007). Learning processes, such as imitating and identifying needs in existing platforms results in attempts to link different elements in a seamless web (Damsgaard 2002). As the niche innovation not yet consists of a dominant design actors improvise, engage in experiments (e.g. a popular way to attract first time visitors is e.g. to offer gift or discounts) to work out the best design and to find out what user want (Geels 2002).

Transitions from this phase occur when the niche innovation manages to get the attention from institutional actors. When institutional actors notice an innovation that can support position and increase their power they can choose to lift the innovation up to the socio-technical regime. Thus niche innovations need to be made public and to be

shown in order to get attention from institutional actors and the inventions need to be perceived as something potentially closing a current technological gap or problem.

An example of how niche innovations can exist relatively unnoticed before institutional actors is found in the story of ATMs. As described briefly in the introduction the innovation was dormant for more than thirty years before it was eventually picked up by institutional actors to jockey for a better position in the market. As a niche innovation the technology presented by Luther Simijan in 1939 was too advanced to be perceived as a beneficial solutions to bank costumers. The solution only began to destabilize the existing socio-technical regime due to the technical technical interrelatedness of other new innovations. In 1967 the cash dispensing machine was invented, to use the machine, costumers had to buy paper vouchers from the bank tellers. They could return to the bank after hours and feed the vouchers into the cash-dispensing machine to receive cash. Soon after the paper voucher was changed to a plastic card that was kept by the machine after each use.

## 2.2 Social technical regime

The socio-technical regimes differs from the niche innovations by consisting of innovations that receives institutional support and it is offered as a service in the market often on a trial basis. Actors at the socio-technical regime level form and shape the existing and currently dominant pattern of IT platforms. At the socio-technical level the innovations and actors are constantly struggling to become the dominant actor.

The socio-technical regime serves upon the theories from niche innovation and draws in addition upon theories about structuration between technology and society (Giddens 1984; Hardy et al. 2001; Orlikowski 1996; Monterio & Hanseth 1996; Edwards 2003). A central issue at this level is the relationship between a technological innovation the rules, practices and power coalitions of dominating institutions. Socio-technical regimes are the source of dynamic stability of a technology because their rules are constantly shared and reproduced (Rip and Kemp 1996). At this level the ability to make users adopt a service is essential (Damsgaard 2002). This creates momentum and network effects and thereby chains them to the specific platform. If the platform fails in installing its proprietary service the community is left open for other platforms.

The socio-technical regimes accommodate the broader group of community of social groups and their activities. A socio-technical regime is the rule set grammar embedded in a complex engineering practices production process technologies, artefacts and personas embedded in institutions and infrastructures. Once the platform community is well established there is an on going need to nurture it.

In the socio-technical regime digital platforms fight to become the dominant actor in the market. The constellation of regime actors can be upheld for some time, but is not a stable situation. Often solutions will be in direct competition over the same users or costumers. As a contender in the socio-technical regime a position can be termed dynamically stable. *Stable* because the use of a solution is more or less settled and institutional actors has chosen to support this solution. *Dynamic* because this position cannot be sustained for longer periods of time. The solution will at this point be in constant battles with other solutions promoted by actors with other interests (Shapiro and Varian 1999). In order to become a more stable part of the infrastructure a solution has to become the preferred solution by users across a wide group of institutional actors and the preferred solution must be able to interrelate with other technologies to span across a variety of solutions and therefore other institutional actors.

## 2.3 Socio-technical landscape

The metaphor of the landscape is used because of the literal connotation of relative hardness and to include material aspects of society such as arrangements of cities, highways and electrical infrastructures. The landscape also refers to the wider environments that affect socio-technical development such as globalization, environmental problems and cultural changes. Thus the landscape resembles what elsewhere is labelled infrastructure (Hanseth 1995).

The socio-technical landscape refers to an exogenous environment beyond the direct influence of niche and regime actors (macro-economics, deep cultural pattern, macro-political developments). The landscape is not one system or platform it is the constellation and configuration of various socio technical regimes. In order to understand dynamics of the socio-technical landscape solutions our framework extends the two lower levels with more broad perspectives on societal and institutional and infrastructural development (Dimaggio & Powell 1983; Callon 1980; Calas & Smircich 1999; Freeman & Soete 1997; Tsoukas & Chia 2002).

From the perspective of the socio-technical landscape constellations of communities can be viewed when regimes become unstable and opens up because of persistent problems or landscape changes (Geels 2007). This can also be termed “overload” when a technology is use in different ways than the original design afforded. The unexpected and unintended use of current technologies creates pressure on the existing landscape. The loosening up of the existing regime stimulates actors to experiment with other technical options and as a result new possibilities for niche innovation. (Geels 2002; Edwards 2007; Rip et al. 1995).

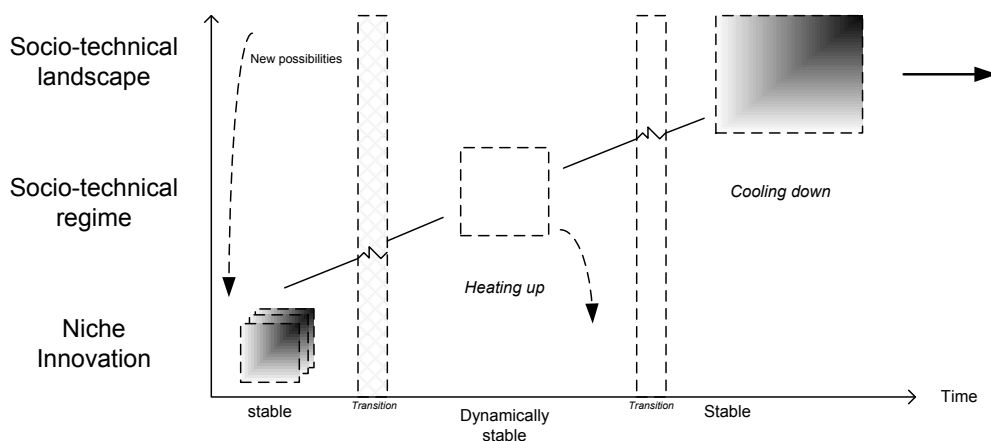


Figure 2 Digital payment platforms

Figure 2 presents our multilevel perspective. Our framework entails three phases with distinct characteristics based on diverse theoretical contributions. The transition route entails an unstable, dynamically stable and stable phase. Innovations that transform from niche-innovation all the way to becoming a part of the socio-technical landscape are rare events. Most of the time they are out-competed by more effect full technologies embedded and nurtured by a set of complementary technologies and institutions (Mokyr 1990). Only dramatic change in the environment may change the rules of the game and allow transitions routes to open in so-called “windows of opportunities”. This

view corresponds with the so-called punctuated equilibrium perspective applied to technical evolution and IS development (Tushman & Anderson 1986; Sabherwal et al. 2001; Lyytinen & Newman 2008), which argues that technological development constitutes an evolutionary process punctuated by rapid discontinuous change. For long periods of time, technological change is relatively stable, proceeding along technical trajectories in an evolutionary manner. These periods are punctuated by brief periods of rapid change, illustrated in figure as transitions. An important addition offered to the punctuated equilibrium approach recently (Schot and Rip 1997; Suarez & Olivia 2005) is the emphasis on the destabilization of the prevailing socio-technical regime before the new innovations can flourish. At the socio-technical level “heating up” from social movements and institutional actors try to delegitimize the regime by framing industry practices as “outdated”, “irresponsible” or “unacceptable” (Oliver 1997) without having settled upon as new solution the solve these problems. This phase is characterized by dynamic stability, meaning that innovation still occurs but is incremental in nature leading to technical trajectories and path dependency (Geels 2002). At this point other regime actors develop discourses that maintain or restore legitimacy when they are faced with problems or criticism. As a result stability is only dynamic as competition occurs between concrete platforms without undermining the evolution of the whole regime. When some contenders manage to transform into the socio-technical landscape they become stable. The concept of stability here emphasizes that the constellations of platforms in this phase is difficult to change and interest and discourse aiming to do that is “cooling down”. (Mokyr 1992)

The relationship between the levels is important to understand as nested hierarchies where the lowest level account for the niches of generation and development of radical innovation. The medium level refers to the dynamically stable existing technological developments picked up and made useful by important actors. The macro level is landscape of slow changing external factors, providing gradients for the trajectories (Geels 2002).

The nested character of the model means that the socio-technical regimes are embedded within the landscapes and niches are embedded within regimes. This correspondingly denotes that innovation emerge in niches in the context of existing rules, practices and problems. The new innovation are then produced on the basis and knowledge geared to the problems of the existing regimes. An example of new technologies initially developed within the old framework can be seen in the processes of providing telecommunications services in developed countries. These processes have involved a closely knit community of interest groups where many companies on the late 1980s combined postal and telecommunication under the same roof (Noam & Kraemer 1999). This meant a development from postal delivery (P) to postal and telegraph (PT), to postal, telegraph and telephone services (PTT) typically occurred controlled through governmental regulatory authorities (Noam 1992). In order to maintain the socio-technical landscape stable actors held monopoly over all postal and telecommunication service and were closely allied with domestic manufactures of equipment. For more than a century technological innovations within postal, telegraphs and telephone service occurred within institutional stability were new innovations were absorbed within the current regime and landscape. However during the early 1990s a huge turbulence and diversity of institutional arrangements occurred through deregulation.

Banking, transactions, money and payments have also been under turbulence and change over the last decades. Literature argues that we are entering a new stage of online banking (Garcia-Swartz & Hahn 2006; Worthington 1998) which potentially will shift both the payment regimes and landscapes over the coming years. In order to address the dynamics and payment platform innovation we wish to use or multilevel framework to understand the dynamics by which digital payment systems platforms



possibly may penetrate societies thoroughly and substitute current payment technologies in the decades to come ( Linné 2008; Bergsten 1966). With the mobile phone we are facing, within mobile payment solutions, niches of innovations to bring about new socio-technical regimes. At the moment solutions are developed and used by various quick-service oriented industries such as public transportation, tollbooths and fast-food restaurants (Ondrus & Pigneur 2006). It is our ambition to provide a tool for further understanding of how technological transition often occur within the nested characteristics of the tree levels presented. Thus, an important point of our framework is that processes within the niche do not only govern new payment innovation but also by developments at the level of the existing regimes and landscapes. *“It is the alignment of successful processes within the niche reinforced by changes at the regime level and the level of socio-technical landscape which determine if a regime shift will occur”* (Kemp et al. 2001 pp.277)

### **3. METHODS**

Next we demonstrate the usefulness of our framework by applying it as an explanatory vehicle to a case of a prepaid cash card developed in the 1990s. In this section we will briefly present the research setting and the context for the study. Then we will present our data sources and explain how we collected our data.

#### **3.1 Research Setting**

The empirical data stem from the case of historical accounts of a prepaid cash card in a Danish context. The prepaid cash card was launched in 1990 and followed a route of fast transition and was used in many small communities during the early 1990s. In the early 2000s the solution however came under pressure from other payment solutions and where eventually phased out and became dormant in 2005. As the prepaid cash card no longer exist in practical use the sources shedding light on this genesis and evolution has been of a historical character. We have conducted interviews with leading managers involved and witness to both the emergence and failure of the prepaid card. In addition we have studied various historical accounts of what happened to the prepaid card in documents published both by people working with the card and newspapers. Thus the research setting and object of study has been created by qualitative interviews (Hopf 2004) and document studies. We have hereby sought to re-create memories and lore of the environment which existed while the prepaid cash card was developed, was perceived initially as a success and later became known as a failure.

#### **3.2 Data sources**

Three in-depth interviews have been conducted with key actors in the process of developing the prepaid cash card. Here we used our framework to derive at open-ended questions. The first respondent (referred to as CIO) was positioned with the overall technical responsibility of the card. Respondent 2 (referred to as CMO) was the marketing director. He performed a vital role particular in the early phases of the prepaid cash where getting attention was imperative. The third respondent (referred to as CEO) was the CEO of the established company Danmønt throughout the initial and final days of our empirical example. We have used a variety of documents to shed light on the genesis and evolution of the prepaid cash card. Table 1 lists the documents used. First, five official reports from the Danmønt company has been used as a resource. Secondly a number of newspaper articles have been identified through searching in databases of Danish technical journals<sup>1</sup>

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<sup>1</sup> “Ingeniøren”, “Computerworld” and “Version2”

Reports from Danmønt A/S (R)	Newspaper articles (N)
1. <i>The open Danmønt prepaid system – Results from the trials in Næstved (1993)</i>	1 Danmønt wants to conquer the country (The engineer, 1993)
2. <i>Ideas for a new card system – Danmønt (Ubbe 1989)</i>	2 New card phones and tele cards (Press release 1997)
3. <i>Danmønt presentation (Rindorf 1990)</i>	3 Hanging up the phone card (Scenario magazine 2000)
4. <i>Danmønt overview (Rindorf 1990)</i>	4 Danmønt as a washing coin (Business magazine 1998)
5. <i>Report about prepaid cash cards – Danmønt (1989)</i>	5 Danmønt cut by Teledanmark (Mobile magazine 2000)
	6 Danmønt as dormant (Berlingske Business 2003)
	7 Banks close the failure Danmønt (Berlingske Business 2004)

**Table 1** List of documents (our translation)

### 3.3. Data collection

During our interviews we used the livescribe smartpen to record the interviews. In this process correspondingly a first round of conceptualization was taken as key concepts were written on livescribe dot paper for easy later identification. This was particularly useful as the livescribe software created a link between the sound files and the written statements, thus initially organizing the interview. After transcribing the interviews we used Atlas.ti to code the interviews for three overall categories each containing 6 characteristics (See table 2). The three overall categories were the theoretically described niche innovation, socio-technical regime and socio-technical landscape. The interviews were then coded and re-read with the focus of portraying three phases in the genesis and evolution of the prepaid cash card. Here a particular focus was held on the moments on of transitions from one phase to another. This focus naturally created a bias towards events happening around the period of what we (based on the theoretical approach) had identified as change. The constructions of categories and phases has been our way of providing a historical account and revitalizing the story of prepaid cash card. By these we wish to validate our framework actively to capture and portray dynamics of these changes.

### 3.4. Research approach

Our analysis of the different data sources has been guided by the research objective of studying the genesis and evolution of innovations and to apply our theoretically developed framework. Since our case concerns a time span took from more than ten years ago historical accounts from key participants in the development of the prepaid cash card was identified. Their statements and conceptualizations of what happened combined with written accounts have been the primary sources of the finding presented in the paper. However it should be mentioned that our aim had not been to provide a full picture of how Danmønt (the prepaid cash card) evolved, for that our data sources are not even close to an acceptable level. Instead we have aimed at the identification of tendencies in a historical development of a digital payment solution that we can learn from in contemporary attempts to create digital payment platforms. As a result our analysis has happened in four consecutive stages, and through an iterative process of working with the data material along with the theoretical resources presented in section 2. The first stage involved getting an overview of parts of the literature written about technology transitions and evolution of innovations. In the second phase we looked for connections between this theoretical perspectives and the issues we aimed at addressing. In the third phase, by continuously attempting to connect our empirical data with our theoretical constructs, we began to enable the identification of the story of a prepaid cash card in three phases. Hereafter, in the forth phase, we began to (re) construct the story and add sufficient detail to the case. Our analytical concepts and sub-

categories (presented in table 2) thus became our guiding principles for analysing our empirical case and applying our theoretical framework.

Niche innovation	Socio-technical regime	Socio-technical landscape
<ul style="list-style-type: none"> <li>- Heterogeneous actors in networks</li> <li>- Niches evolve as “incubation rooms”</li> <li>- Engagement in experiments</li> <li>- Expectations and visions described</li> <li>- Imitation of existing platforms</li> <li>- Identifying needs in existing platforms</li> </ul>	<ul style="list-style-type: none"> <li>- Rules, practices and power</li> <li>- seeking Institutional backing</li> <li>- Dominant pattern of IT platforms</li> <li>- Power coalitions</li> <li>- Complex engineering practices</li> <li>- Keep evolutions of existing platforms</li> </ul>	<ul style="list-style-type: none"> <li>- Societal and institutional development</li> <li>- Exogenous networks</li> <li>- The constellation of regimes</li> <li>- “Overload” of technologies</li> <li>- Refers to wider environment</li> <li>- Technical as well as cultural change</li> </ul>

Table 2 Analytical concepts and sub-categories

#### 4. THE EVOLUTION OF DANMØNT CASH CARD (THE EMPIRICAL CASE)

In the 1990s different companies and public sector institutions picked up a prepaid payment card with an NFC chip for small payments. The card was called “Danmønt” which referred the country wherein it was situated and to coins which it was suppose to substitute. Initially the idea gained momentum as it received attention from institutional actors. The conditions for technology transitions should be seen in the light of the dominant institutions, rules and regulations. At the time of the emergence of the prepaid cash card the key institutional actors was shared payment collaboration between all banks in the market and the Danish national bank. This collaboration will be referred to as *shared payment colloration* (SPC) in this paper. SPC had developed solutions within payment services and payment cards, which connected financial institutions, private and public businesses. SPC was as a result also the owner of both the prepaid card (Danmønt) and a shared Danish debit card (The DanKort). SPC navigated in a highly government controlled environment where comprehensive sets of legislations where made to secure that everyone could benefit from solutions made. These conditions made it difficult to launch a solution, which could be promoted as a solution for widespread use as many institutional actors, had to be in agreement. Normally political negotiations and organizational battles could take years and decades before a certain solution were lifted up and promoted in agreement for widespread use. Another vital institutional actor in the case of a prepaid cash card was the monopoly phone operator in Copenhagen (KTAS). Phone boxes had been an important way of facilitating communication for decades and coins had been an increasing cause for vandalism of the phone boxes. Thus, the phone operator had a particular good reason for backing the development of a prepaid cash card to be used in their phone boxes. The phone company was initially a private company, which delivered telecommunication to Copenhagen and the region of Sealand. However in 1992 it was merged with the partially state-governed TeleDanmark A/S. As a result one of the key institutional actors became increasingly tied to political battles and governmental legislation. A third and forth-key actors in the initial years was the public transportation company of Copenhagen and the Danish Railways. Also these huge actors saw a potential in a prepaid cash cards for small payments as machines taking coins and notes were expensive, slow and subject to expensive exchanges.

##### 4.1 The emergence of a prepaid cash card in a Danish context (1990-1993)

As huge institutional actors came together to find a solution for a payment card for small transactions a good environment for a serious solutions and contender in the market for payments were made. A company was formed (named Danmønt A/S) in 1991 where visionary people saw an opportunity to craft a solution, which could become a key part of the current payment infrastructure. The company was partly owned by SPC and the

leading phone company in Copenhagen, Denmark who each accounted for half of the share capital. In 1992 an international seminar was held where inspiration from all over Europe was shared. In September 1992 the prepaid cash card was officially announced. This happened in the average sized town Roskilde. This town formed a closed environment where the card could be tested in small scale before being launched for widespread use. Initially the card could be used in phone boxes, several cantinas, the high school, a military base, and ten newspaper vending machines and at various laundromats. Following the announcements and test in Roskilde, several similar test were made in Næstved, also an average size town in Denmark. The two cities were chosen due to their geographical location, size and political willpower and ambitions.

*“Næstved was perfect pocket for the testing. It was a town of average size, which meant that we could test on in a sufficient variety of situations. Moreover it was far way from the capital city of Copenhagen so for some time it was protected against totally free mainstream market mechanisms” (CTO)*

These experiments created a huge attention and attracted also international companies such as VISA. The small number of actors in the company Danmønt A/S had very broad frames within to act as the driving force of the prepaid cash card. This correspondingly meant that they could quickly act on new possibilities parallel to the describing the visions and expectations for the solution. In the period from 1990-1993 these actors worked intensively on identifying specific need in the exiting payment platforms and to work out the best design for the prepaid cash card.

*“It was a wonderful workplace, with only a few people to decide which directions to go, this meant that we could follow almost every opportunity. This specific type of organization made it possible to navigate quickly if we saw potential companies or actors who were interested in our project. In fact it would be fair to say that in order manage this project in these years you should not be a good manager of rules and regulations, instead you should be a salesman” (CEO)*

The card evolved and was specified as a non-rechargeable prepaid cash card with the possibility to buy 100, 200 or 500 Danish kroners (Dkr.). As the initially aim of the card was to create a solution for small payments the card was to be used for amount less than 300Dkr. This aim fitted the need for payment solutions to busses; laundromats, cantinas etc. were amount higher than this was almost never used. Throughout 1993 the prepaid cash card grew from small experiments in average size cities to more widespread use. By the end of this phase there is an agreement between the key institutional actors that the prepaid payment card is the favourable solutions as a prepaid cash card and this should subsequently be used in the whole country.

#### **4.2 Competition between prepaid cards or debit cards (1994-1998)**

The initial success of the prepaid cash card was continued in 1994. As the card was increasingly used it became an interesting object for Visa International. By 1995 Visa International purchased ten licenses to establish and use similar systems worldwide. Among the first countries to establish prepaid cash card-like systems were Australia, Canada, Hong Kong and USA. In the U.S. version of the system large-scale trials in Atlanta during the Olympic Summer Games in 1996 were conducted. At the same time the prepaid cash card was launched with a rechargeable functionality, which made it an even more prone to widespread use. The cards could be used in ATMs both to insert and redraw money. This made it easier to use the card in many situations, as the owner of the card could be sure always to have enough money on the card. At the same time plans of a multifunctional card is discussed and described within the company of Danmønt.

*“With the momentum we had in the first years, we all thought that we could do all anything, this was also reflected in plans we made. The solution we made was just as competitive in the market as anything else” (CEO)*

Around the year 1997 things however began to change. The prepaid cash card was still growing and the leading railway company changed 160 of their terminals into prepaid cash card terminals. However competition arose from different perspectives. Due to the widespread use of mobile phones the leading phone company no longer saw the use of a prepaid payment card for phone boxes. Instead the predominant phone company began to remove phone boxes as the growth of mobile phone use arose. This led to a change in the ownership of the company Danmønt A/S. The leading phone company resigned from the company and the SPC took over the entire share capital. However the prepaid cash card was still an alleged form of payment method in phone boxes. By 1998 the prepaid cash card was still a recognizable success. It was used over 7 million times and had increased 25% over the previous year.

As mobile phones emerged as an indirect competitor to prepaid cash card another even more serious competitor arose from within the company of SPC. A debit card, the Dankort, was also hosted within the same company (the SPC) and was a debit card initially meant for larger transaction over 300Dkr. However, in actual use the debit card was frequently used also for small transactions making the need for a prepaid cash card deteriorate. This meant that e.g. the leading railway company in these years had to put up two different terminal in each stations, one for the prepaid cash card and one for the debit card. This situation was not ideal neither for the railways or the SPC. The people using the cards did not consider moreover having two cards for the same use scenarios convenient. As a result pressure was rising against the prepaid cash card both from outside (mobile phones and changes use scenarios) and from within (the debit card, the Dankort, also hosted by SPC). Consequently, even though still a success on the surface, the balance within the company of the prepaid cash card had shifted. The SPC, the leading phone company and different transportation companies lifted the prepaid cash card into the market. With the resign of the leading phone company in 1996 and the unstable situation dealing with two payment cards at railways stations the company had lost its freedom to act and flexibility to consider various solutions. This was not possible anymore since the institutional actors who initially had carried the solution into a place in the market no longer seriously supported the solution.

*“Nothing of what we had planed was used anymore. We had made a plan in four phases to introduce a multi-functional card with both small and huge transactions. This would be a great way to incorporate anything from travelling to small purchases, to me this is highly problematic that we did not go in this direction” (CIO)*

### **4.3 The prepaid cash card become dormant (1999 - 2005)**

By the year 2000 the leading phone company halt their use of the prepaid cash card altogether. By this time the success of the competitor, the debit card, is so evident that the prepaid cash card is viewed as the pesky little brother within SPC. Without support from neither the transportation sector, the telecommunication sector or the financial sector the solution became dormant by SPC in 2001. However the initial starting point for the prepaid cash card, closed small environments such as cantinas and laundries kept the solution alive for some years. During these years several attempts were made to re-introduce the prepaid cash card. First a version to serve as a company card were produced following a club membership card, however none of these attempts to revoke the prepaid cash card was successful. In 2005 the Danmønt card was officially out phased and the Danmønt A/S company and its employees in brought into SPC main organization. Later reflection questioned why a combination of the prepaid cash card

and the debit card never occurred so that costumers would have both the functionality of a debit card and a prepaid cash card. Even though SPC was the owner of both solutions and the technologies would have been rather easy to merge it is clear that the institutional past of the solutions made it impossible.

*“We were meant to fill different markets, but became competitors due to changes in the use scenarios. We were always the odd and creative ones and we lived by our own rules. In the times of success people tolerated us, we came to symbolize the opposite of what SPC and other institutional actors wanted. When we came under fire we were abandoned and was left to suffer a slow death caused by our own people” (CEO)*

#### 4.4. Overview of the genesis and evolution of the prepaid cash card

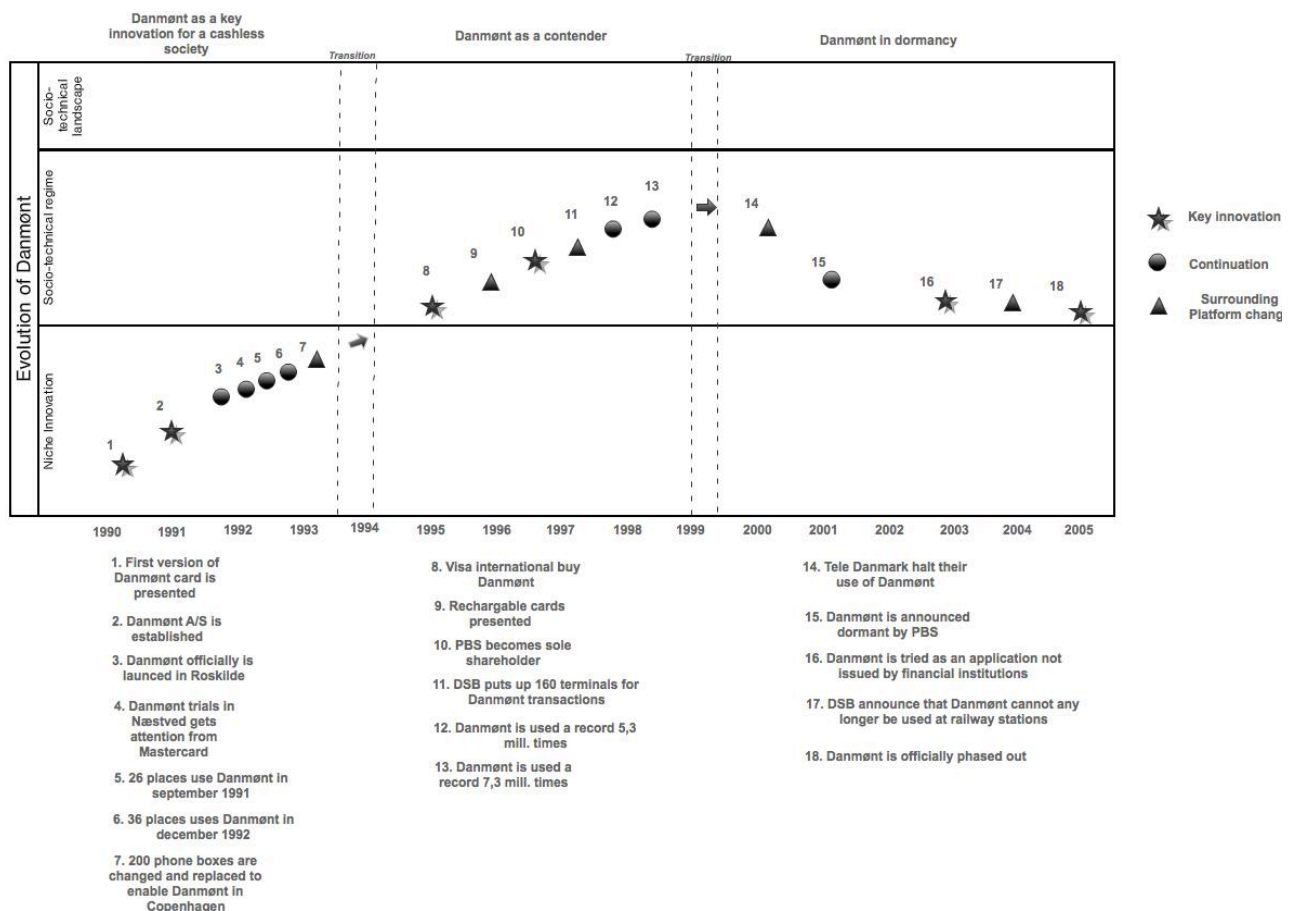


Figure 3 Events in the genesis and evolution of prepaid cash card

#### 5. ANALYSIS OF THE GENESIS AND EVOLUTION OF A PREPAID CASH CARD

Based on our theoretical constructs we aim at using the case of the prepaid payment card to show how a digital payment platform historically has evolved and transformed into a contender within the socio-technical regime. By revitalizing the story of in the light of our theoretical framework we aim at identifying important lessons to be learned in contemporary development of digital payment platforms. We particularly wish to emphasize the transition routes of new potentially widespread digital payment solutions. Based on the findings from the prepaid cash card we argue that contemporary solutions correspondingly have to evolve from initial innovation to obtain a position from where to receive institutional support. The ability to outlive strong political struggles and balance different support groups while fighting others shows, in our

findings, to be key characteristics necessary in order to finally become a dominant technical payment solution, a part of a socio-technical landscape.

### **5.1 Niche innovation of a prepaid cash card (1990-1993)**

During the late 1980s and early 1990s niche innovation of prepaid cash card emerged various places in Europe. The idea for the prepaid cash card arose around 1985 where a group of people who originally worked within SPC with the debit card (the Dankort). This group of people argued that the debit card to a large extent had succeeded in substituting the check as a preferred payment method however no substitution for smaller payments had been found. At the same time a huge interest in Europe for a shared system for small payment emerged. Many initiatives concerning a shared ECU card was taken and the prepaid cash card developed in Denmark was to be front-runner as it was the first open system of its kind in Europe. Potentially the prepaid cash card was meant to reduce the need to produce new European coins and notes.

As an increasing number of actors became aware of the need to find a solution that could substitute payment with coins and notes during small payments institutional actors aligned their interests and use scenarios. Companies, institutions and small businesses which represented closed environments saw that many of their use scenarios matches each other and therefore had a common interest in promoting a solution. Particularly closed systems such as laundromats and cantinas shared and interest but also transportation and phones companies wished to imitate that payment routines in coherency. As a result three strong institutional actors initially came together to create evolution based in their shared use scenarios. The public transportation and monopoly phone company and SPC initiated to pick up the best solution for small payments and in a shared company they started to investigate how a prepaid cash card (as already introduced by a group of people within SPC) might be the right solution to support.

### **5.2 A prepaid cash card competing in the socio-technical regime (1994-1998)**

As lifted into the socio-technical regime the prepaid cash card had ideal growth opportunities as influential institutional actors came together to find a solution for a payment card for small transactions. The institutional backing made test scenarios appear as “incubation rooms”. Political will power and support made it possible to use average sized towns to experiment and evolve shielded from mainstream market forces. From here it evolved as a contender in to a market position. As a increased number of institutional actors gained interest in the Prepaid cash card a transition from niche innovation into socio-technical regime occurred as the prepaid cash card was made available in connection to the already existing infrastructures of institutional actors. In this case e.g. in phone boxes and at railway stations. The concept of incubation rooms became important as this room for experimentation also gave the solution support from many small actors. Many newspaper shops, private cantinas and laundries were happy that they know had the opportunity to form networks around this new technology. These dedicated communities became a strong part in promoting the prepaid cash card and made bigger institutional actors see the benefits in the card as well.

*“We were welcomed like kings by many small merchants they saw themselves as part of new cutting-edge technology which would give them an advantage compared to others”*  
(R2)

In the initial years the tasks of the established company Danmønt A/S was to describe visions for the future and hereby to attract followers and supporters. In these design and formulation processes strong connections were made to both the initial institutional

actors but also small actors as the company tried to image and mirror potential use scenarios.

*“Every situation you could think of, where you normally would pull out coins or notes we would have to create that situation with a card instead. This meant that we had to make it easier to e.g. pay for phone calls with a card than with coins” (R2)*

As the idea of a prepaid cash card initially was picked up by the SPC it was no longer a niche innovation. When the experiments began it was already transforming into a contender at the socio-technical regime. In this process of transforming, learning occurred in incubation rooms where the solution was refined and adjusted.

The cash card initially entered the socio-technical regime with the institutional backing of payments business services, the leading phone company and the public transportation company. These actors lifted it up as the card filled a need in their primary use scenarios. Moreover the widespread attention the payment card got in the experiments made it initially a successful project, which actors wished to be a part of. A first sign that this solution might become a serious contender to enter the socio-technical landscape was the interest from a huge international actor (VISA). This interest established the prepaid cash card as a solution to count upon and made it easier to invest in for small merchants and companies. The legitimization of the prepaid cash card, to be a dominant player in the market, was found in a separation between small payments and high payments. When first introduced this separation matched the current use pattern of using coins and notes for small payments and then checks for higher amounts. With the introduction of payment card this logic was enforced as a prepaid cash card should substitute the coins and the notes while a debit card should substitute the checks. By this the prepaid cash card was fitted into an already existing pattern of use scenarios and supported the current logics of actors in the socio-technical regime.

*“We lived a protected life in the early years as we build upon already existing infrastructure. We filled a need for merchants and companies to get rid of all the coins and notes and therefore were often seen as the good guys” (CTO).*

The separation between the two forms of payments was so clear that the same company, the SPC, hosted both solutions believing that they could exist peacefully together.

*“Most of the employees we recruited in Danmønt A/S were the best staff we could find from SPC. Those who wanted to be creative and wanted to be a part of something new” (CEO)*

However the separation of small and large payments became increasingly difficult to maintain. First the use patterns for transactions changed, as the debit card would be used much more for small payments than initially expected. Secondly the prepaid cash card became rechargeable which meant that the customer potentially had two quite similar cards in their wallet. As the two solutions came closer to each other the prepaid cash card began to live a dangerous life. It became a direct competitor to the debit card hosted by the same company. Moreover another huge institutional support for the prepaid cash card, the leading phone companies also faced new use scenarios as the mobile phone made the phone boxes more rare. As a result during the years 1994-1998 the initial institutional support for the prepaid cash card began to fade away. The employees engaged with evolving the prepaid cash card initially had very free roles but eventually was brought back into the main company and told to just maintain the solution. This was in high contrast to what these employees initially had been recruited to do. As the institutional support for the prepaid cash card resigned it was left to having



a slow death gradually being out phased of use. The debit card took over all small amount payments and mobile phones made phones boxes obsolete.

### **5.3 The socio-technical landscape without a prepaid cash card**

At the time where the prepaid cash card attempted to enter the socio-technical landscape there was no longer a need for a card to conduct small payments. However during the struggles in the socio-technical regime the formation of a landscape without the need for at prepaid cash card did not seem straightforward. The need, initially occurring the socio-technical landscape, to remove coins and checks with a prepaid cash card was valid for over a decade. As the debit card, the Dankort, proved to enable not only to remove the checks but also to some extent to reduce the need for coins and cash. Moreover the use of mobile phone removed one of the key use scenarios initially planned for the prepaid cash card. As the slow death and exclusion of the prepaid cash card from the socio-technical regime might seem natural in the light of the current constellation of actors in the landscape this is however not necessarily a stable constellation. A payment method has been under turbulence and change over the last decades some of the issues raised from the initial aims of the prepaid cash card re-appear. As the debit card was highly successful in substituting the checks and also succeeded in becoming the preferred payment card it did not manage to substitute coins and notes in the style that the prepaid cash card initially aimed for. The prepaid cash card was designed to substitute coins from this use scenario potentially to grow. The debit card was designed for higher payments and from there also became a small payment card. From the perspective and ambition of substituting coins the best technological solution as a result did not win. As a consequence the main actor for small payments at the socio-technical landscape has its flaws. Flaws that users have learned to accept as institutional actors into almost every use scenario promoted the debit card. Consequently institutional actors constituting and supporting the socio-technical landscape opted to support a solution, which never initially was meant to be used to remove coins and notes. As a result the socio-technical landscape use a solution, which have had huge network and cable problems and failed to successfully deal with mass usage in critical times (e.g. during Christmas shopping). Moreover the dominant payment platform in the socio-technical landscape is only able operate with traceable transactions, which means that no payments can be made without two unique IDs in two bank accounts. Apart from the fact that every transaction is traceable it also prevents costumer under 18 years to have a debit card. As the prepaid cash card was build upon the concept of bearer money it was designed to be used by everyone in every situation and with no traceable functionality.

As the death of the prepaid cash card meant a limited array of functionality in the socio-technical landscape thoughts of combining the functionality from the prepaid cash card and the debit card emerged. In fact already in 1991 the shared company of the prepaid cash card made a plan in four phases for the card where phase four describes the possibility of merging the prepaid and the debit card into one. However during the struggles in the socio-technical regime actors positioned themselves in a manner that made further collaboration difficult at the socio-technical landscape. The prepaid cash card and its supporters lived a life outside the control of SPC, the leading phone company and the public transportation company in Copenhagen. As the institutional actors gradually removed their support the small company with its employees were left in a fragile position. The employees and the solution of the prepaid cash card was brought back into the main company of SPC. However as this company also hosted the debit card the key employees and supporters of the prepaid cash card where seen as contenders. When regarded as an opposition to a solution, which had huge institutional backing and highly positive business case, it became impossible to get support for any

ideas at all. As a result the merge of ideas and functionality between the prepaid cash card into the debit card was no longer considered a possibility

## 5.4 Overview of the genesis and evolution of a prepaid cash card

Niche Innovation	Socio-technical regime	Socio technical landscape
<ul style="list-style-type: none"> <li>• Actors from different sectors came together to scan the market for suitable inventions</li> <li>• A company was established in order to develop inventions into commercial use</li> <li>• visions for prepaid cash card</li> <li>• The prepaid cash card imitated use situations based in phone boxes, railway station and cantinas</li> <li>• The card primarily was meant to cover a need for small payments</li> </ul>	<ul style="list-style-type: none"> <li>• The solution initially entered the current payment practices with the backing huge institutional actors</li> <li>• The solution also sought institutional backing from the national bank of Denmark and VISA.</li> <li>• The prepaid cash card initially fitted into the current pattern of IT payment platforms as small payments were not meant for the Dankort.</li> <li>• During the mid 90s the power coalitions initially supporting the prepaid cash card no longer saw the need for at small payment card.</li> <li>• Average sized cities become small and closed environments for the earlier versions of prepaid cash card to evolve</li> <li>• Political willpower in Roskilde makes this an ideal place for experiments.</li> </ul>	<ul style="list-style-type: none"> <li>• The prepaid cash card never became a part of the socio technical landscape.</li> <li>• It became a contender over a decade but the constellation of payment regimes went in favour of the debit card system.</li> <li>• The wider environment did not see the need for at small payment card</li> <li>• The regime of mobile phones became a huge part of the socio-technical landscape, which meant a decreased need for prepaid payment cards.</li> <li>• The prepaid cash card evolved into a prepaid payment card. Paradoxically this made the card a dangerous contender to the Dankort.</li> <li>• Around 2000 the prepaid cash card is no longer was a part of further evolving existing payment platforms instead it was thought to slow existing platforms down.</li> </ul>

## 6. DISCUSSION

Next we wish to discuss the application of our framework for understanding the genesis and evolution of the prepaid cash card. We explain how our finding supports our framework in section 5.1. We discuss how our findings can be used to extend the framework for digital payment platforms in section 5.2. and in section 5.3 we discuss the contradictions and limitations of our framework. Finally in the section 5.4. we present how we be this case aim a contribution to the theory applied.

### 6.1 Value of the framework

Our framework offers guidelines to the complexity of transition routes, which can be, expected in the future genesis and evolution of digital payment platforms. It highlights how small networks of innovation have to not only focus on developing the right technological solution but just as much have to obtain institutional support to be widespread used. Our model in three phases does not have dogmatic view that all solutions pass through the same transition points and phases in the same style. However we do use the framework to argue that in order to progress into a contender

as a digital payment platform some of the dynamics presented in this analysis will be present. Moreover we highlight that a stable position at the niche or regime level cannot be maintain over long periods. The solutions will either progress into becoming a part of only the socio technical landscape or they will become dormant.

The validity of the framework is argued both from a empirical and theoretical foundation. Theoretically we build upon a growing literature on innovation of infrastructure and transition routes (Kemp et al. 2001; Geels 2002; Damsgaard and Scheepers 2000). Empirically we build on historical accounts from interviews and documents to argue for key transition points and phases. Moreover the framework has been iterated and refined during interaction with researchers, consultants and payment practitioners. We see the need to further elaborate on the framework but have found it a particular useful tool and frame for explanations and discussions when talking to practitioners. It enables a focus on key elements while still accounting for the important context in which e.g. a change occurred.

## **6.2 Extended view of digital payment platform evolution**

We argue in the light of our findings that our framework can be used to enhance the view on how digital payment platforms might evolve in the years to come. Our intention has not been to create a universal framework that can depict any digital payment platform evolution. Instead the framework should more be seen as an opportunity to reflect, understand and discuss future payment innovations for researchers and practitioners. Particular the importance of institutional backings and the complex processes of acquiring this is highlighted. Moreover when discussing new solutions with vendors, practitioners and even researchers the ambition to plan, control and evolve an innovation over a relatively short period of time is regarded as a success parameter. Our work and the application of this framework argue that a strictly planned project with good intention and relevant technology does not suffice. The complexity of niche innovations and struggles at socio-technical regimes needs to managed and navigated within from a broad perspective. We aim to provide and apply a frame which highlight the nested character of both niche, regime and landscape in order to provide a more fully understand how digital payment platforms evolve. Our framework consequently draws attention to the complex and nested character of the transformation from niche to landscape and be studying some of these processes we also wish to highlight how time and parallel innovations play and important part of transition routes. Often the success of projects is measured by how fast widespread use can occur. Particularly with new digital networks this transition has happen with incredible speed for small solution. However as seen in our findings and examples often these routes to become a part of the socio-technical landscape takes much longer time than expected and calculated due to the need for institutional actors to cooperate and technical solutions to be interrelated.

## **6.3 Limitations and contradictions**

Every framework attempts to highlight specific aspects, which makes it limited in viewing other things. Even though we find our framework useful for a broad understanding of the genesis and evolution of a prepaid cash card we have also had problems applying it. Particularly it can be difficult to determine exactly when something transforms from being an invention to becoming a service. Moreover when is a solution transcending from a regime level to becoming a part of the socio-technical landscape. In our application of the framework we have defined the transition point from niche to regime to be when institutional actors picks up a solution and actively promotes is in competition against other solutions. Following, we have the transition from regime to landscape level by how widespread used the solution has become compared to other solutions and when a solution has almost complete backing of

dominant institutional actors. For our work we find these definitions sufficient however we are aware that other studies might need different definitions of these phases and transition points.

#### **6.4 Contributions to the theory applied**

By applying the framework the empirical case of a prepaid cash card we aim a contributing to two theoretical streams. First to the literature on future digital payment solutions and infrastructure. Our contributions to this stream has iteratively been discussed and refined with researchers and practitioners during the writing of the paper. Secondly we contribute to the theoretical stream of literature dealing with evolution of innovations and technology transitions (Van den Ende and Kemp 1999). We contribute to this stream of literature by highlighting a specific case from within digital payment platforms. We argue that this specific case is of particular interest to this theoretical stream as transitions happen faster and more attached to already existing digital platforms than what mostly have been studied from these historical perspective earlier. By linking three nested levels the genesis and evolution of a prepaid cash card we have provided a specific view into the context dependent characteristics of the payment solution regime and landscape. Especially the insight that radical innovation rarely is radical but instead is a string of possibilities, need and openings at both niche, regime and landscape levels.

#### **7. CONCLUSION AND FUTURE RESEARCH**

In this paper we have introduced and applied a framework to model how digital payment systems grow and evolve over time. We have introduced the reader to literature on technology transitions and on this theoretical foundation we have presented our framework for future understanding of the transition routes of digital payment platforms. With the example of a prepaid cash card we argue to have captured aspects of stable, dynamically stable and stable phases of evolution and to show the importance of institutional attention and backing in order for transitions between levels to occur.

As various digital payment platforms currently are either niche innovations or socio-technical regimes aiming for a place in the socio-technical landscape our argument is that innovators should not endlessly seek to improve their niche innovation but instead seek the attention of institutional actors in the existing socio-technical regime. The findings in the case of Prepaid cash card will enable current actors in the digital payment market to reflect upon their own situation and consider where their current innovations are placed in relation to our levels and phases. In this sense our paper can potentially seek to show actors the importance of making their innovation compatible with the power networks and political agendas of the institutional actors. It is only through the engagement of the institutional actors that a niche innovation can be lifted up to become a real challenger. As our framework consists of three levels, future research into how particular actions, struggles and battles take place at the socio-technical level would be fruitful. The unpacking of some of the dynamics at this stage can, in the light of this research, be crucial in the understanding of future evolvement of digital payment platforms.

#### **ACKNOWLEDGMENTS**

This work was in part carried out with the support of Copenhagen Finance IT region ([www.cfir.dk](http://www.cfir.dk)) and was funded by the Danish Enterprise and Construction Authority grant number ERDFH-09-0026. Any opinions, findings, interpretations, conclusions or recommendations expressed in this paper are those of its authors and do not represent the views of the funding agencies.

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