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Drifting technologies and multi-purpose networks: the case of the Swedish cashcard

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Abstract

In this paper, we combine two theories of the dynamics of a large socio-technical system — technology drift and actor-network theory — to address how and why information technologies often need to change, relative to their initial conceptions, during implementation. We analyze the failure of the first introduction of electronic cash in Umeå, Sweden as an example of what happens when drift does not occur: the lack of drift resulted in the socio-technical system's failure to stabilize. Lack of flexibility is identified as an important reason for the card's poor public acceptance. Banks ignored the critical comments of merchants, thus refusing to negotiate about the intended role of the technology. The cards were perceived as serving only the needs of the banks, while ignoring the needs of merchants and card users. Based on the findings in this case study, we argue that in order for a socio-technical system to stabilize it must drift from a single-purpose network, reflecting the interest and agenda of its designers/originators, to a multi-purpose network that reflects the interests of all involved social actors. In addition, we argue that a network-building process can be successful only if the network is flexible enough to serve the multiple purposes of its constituent actors. © 2001 Published by Elsevier Science Ltd.

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1. Introduction

After more than a decade of relatively marginal use, smartcards are now being introduced around the world in great numbers. Smartcard technology could be on

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the verge of widespread adoption. Many applications have been developed and presented as prototypes at trade shows. However, most smartcard projects are still in their early stages and field tests, particularly in North America. In Europe, smartcards are more popular than in North America, though their application is still relatively limited. Despite its early stage of development, we can already observe what makes smartcard use a success or a failure: applications in closed environments tend to succeed better than applications in open environments. A closed environment is one in which a single authority can control all the elements of the technological infrastructure; an open environment, on the other hand, does not have a central controlling agency. Examples of relatively successful implementation in closed environments include national payphone systems, university student cards, club cards, access cards for corporate facilities, and health care cards. In open environments the use of smartcards for electronic cash products has been the most glaring failure. Mondex and VisaCash, for example, were not accepted in public trials in Europe and North America and were pulled from the market. Even where infrastructure has been installed on a national scale, as in the Netherlands, Germany, and Switzerland, the projects have failed to achieve public acceptance and are underused (Birch, 1998; Van Hove, 2000).

This situation raises challenging questions about the nature of IT development in environments that cannot be controlled by a central planning authority. While it can be argued that IT developments of significant size can never be fully controlled (Ciborra 1996a,b, 1997), this certainly holds true in open environments. Developing and stabilizing an IT infrastructure in such an environment takes time and is an open-ended process. However, there is considerable disagreement in the literature concerning the structure and character of this process.

This paper examines the process of IT development and focuses on how a technology moves from a prototype to a usable product. We analyze the introduction of the Swedish cashcard — a re-loadable, stand-alone electronic purse — that was tested in Umeå, Sweden in September 1997. (Umeå's population is 100,000 and it is located in northern Sweden.) By early 2000, it is clear that the project failed in terms of acceptance by the public. How can we understand this failure? Diffusion theory, which inspired the practice of the roll-out, provides two possible explanations. Either the social context was hostile to the technology or the technology did not possess the inherent qualities its engineers claimed it possessed, or a combination of both. This leaves us with overly simplistic explanations: the society was not ready or the technology was not working. Both of these explanations have value but they are limited because they take for granted what needs to be explained: the mutual constitution of society and the technology.

By combining the notions of technology drift theory (Claudio Ciborra) and actor-network theory (Michel Callon and Bruno Latour), we develop a different reading of the cashcard failure. A reading that analyzes what went wrong in a more complete way, and thus offers a more realistic understanding that can be used by future projects. Our main argument is that viewing technology as fixed artifacts that are to be distributed throughout society impedes understanding, and therefore managing, the often necessary process of mutual adaptation of society and technology. The result

is a hit-or-miss situation in which the technology is either adopted or it fails in its entirety. Alternatively, if we understand the development and acceptance of technology as a dynamic process shaped by a heterogeneous network that reflects all actors involved, then we can start to understand how technology can successfully move from a prototype to usable product. Understanding how and why people adapt to technology and why and how technology adapts to people — technology drift — are crucial for the successful development and implementation of technology.

In the second section, we describe the process of the introduction of the cashcard in Sweden over 3 years (1997–2000). In the third section, we analyze the failure of the cashcard as a result of the banks' simplistic application of diffusion theory. In the fourth section, we introduce alternative concepts of technology drift and actor-network theory. This allows us to understand the failure of the cashcard project more comprehensively. In the conclusion, we tie together the notion of drift with the changes in the composition of actor-networks.

2. The cashcard in Sweden: from regional trial to national roll-out

2.1. Methodological considerations

The approach adopted for this study can be broadly classified as an interpretative case study of how technology is introduced and viewed by its stakeholders (Boland & Day, 1989; Walsham, 1993, 1995). There were two distinct phases in the data collection: the trial of the cashcard technology and the nationwide roll-out of the cashcard technology. During the first data collection phase, which took place in January/February 1998, semi-structured interviews were conducted with a representative of one of the banks that was responsible for the trial introduction in Umeå. This person was interviewed twice during the first data collection phase in order for us to understand the bank's objectives for the cashcard introduction, their expectations for the technology, and their strategy behind the introduction. The first interview covered the details of the card itself and the overall plans before introducing the technology and the second interview covered the bank's assessment of the preliminary outcome of the project.

Five merchants were interviewed during the trial introduction phase about their experiences with the technology. These interviews enabled us to gain insight into the actions and interpretations of people who used the technology in their daily work. The merchants were all interviewed at their work places; this enabled us to better understand the nature of their work.

During the second data collection phase, which took place in January/February 1999, we interviewed the bank representative again. We also interviewed the same five merchants. In addition, we interviewed five card users — people who had used the cashcard. A telephone interview was conducted with a representative of Swedish Trade, an important actor representing the merchants vis à vis the banks.

The interviews in both phases of data collection lasted between 30 and 70 min. The interviewees are identified as follows: M for merchant; B for bank representative;

CU for card user; ST for Swedish Trade representative. Numbers are used to identify different persons in the same category. The distinction between the first and second interview for each numbered person is noted with "a" and "b", respectively. Thus, a quotation from M2b is a quotation from Merchant number 2 during the second interview phase.

2.2. The trial introduction of the cashcard

The cashcard was introduced in September 1997 as a joint project between three major Swedish banks — SE-banken, Nordbanken, and Föreningssparbanken (which was then called Sparbanken). In late 1997, the introduction was limited to pilot tests in a few cities, one of which was Umeå. The cashcard was launched nationwide in late 1998. The card itself is a reloadable electronic purse with the sole function of holding and distributing monetary value. The long-term goal is to replace cash in general; the short-term goal is to offer an alternative means of payment in places where cash is prevalent, for example, in small shops and on busses. Cash is popular in Sweden: today 70% of all business transactions by individuals are done with cash and 75% of the transactions involve less than 300 Swedish crowns (~US$37). For such small transactions credit and debit cards are not well suited because the transaction speed is slow and the costs are high. The process of handling cash costs stores approximately 5 billion Swedish crowns (~US$625 million) each year. The banks themselves face costs of 6 billion Swedish crowns (~US$700 million) per year for managing this process. Lowering these costs was a key motivation behind the cashcard project.

The banks thought that merchants would welcome the new technology for five reasons:

1. Saving time. Customers will be easier to deal with and the merchants will be able to serve more customers.
2. Lowering costs. Using the cashcard will cost less than dealing with real cash.
3. Speeding up cash management. Merchants generally stay at work long after having closed to deal with the cash from the registers.
4. Increasing safety. Digital cash will not attract as many robberies as real cash.
5. Improving health in the work environment. Working with cash exposes the merchants to diseases and allergies; this is reduced by the cashcard technology.

The banks thought that consumers would welcome the new technology for four reasons:

1. The cashcard is convenient. The card owner will not longer need to worry about carrying loose bills and coins.
2. The cashcard will be especially well suited for small purchases.
3. The cashcard will be especially well suited for vending machines and other non-attended points of sale.
4. The cashcard will be safe and there will be no risk of losing money.

The cashcard comes with four publicly accessible peripherals: public loaders (in ATMs), home loaders (in telephones), card readers at point of sale terminals, and personal card readers in the form of small key rings to check the card balance. The highest amount that can be stored on the cashcard is currently 1500 Swedish crowns (~US$188).

To launch the new technology, the banks placed the cashcard readers in stores cost-free. However, initial plans suggested that stores would have to pay for this service after the trial period. This, in turn, launched a controversy over its usefulness and its future development. In the following paragraphs, we present different views of the technology and reasons for its failure in the trial in Umeå.

Of the merchants interviewed, all were negative about the cashcard. They disliked having to pay for the technology because the cashcard was not integrated with other information systems in their stores. All merchants were initially persuaded by the banks to sign up and they did so because it was free. They remained open to the technology as such, but demanded that it should be more flexible and adjusted to their needs. One merchant said:

> I believe in the technology, but it has to be more reasonable. I want this as a cooperation where no one makes a profit at someone else's expense. (M1a)

Another merchant argued:

> To us, this is just an expense really; we don't benefit from it at all. We just have a new routine we have to do. (M2a)

The merchants found it impossible to communicate to the banks how the technology was used in their stores. The merchants all believed that this technology, once adjusted to their real needs, could play a useful role and be important in replacing some cash, credit card, and debit card transactions; the merchants were disappointed that the banks were not interested in hearing their feedback.

The merchants were also irritated by the banks' publicizing the cashcard as a success. As one of the merchants said:

> This is not true. In fact, many stores have rejected the technology and even among those who have agreed to try the technology, there are those who never get the technology going. (M3a)

He continued:

> The card is not used as frequently as is pictured by the banks. That's one problem. Another problem is that this card is not well suited for and connected to our other routines and practices… such as our accounting routines, for instance. (M3a)

Another source of irritation was the banks' mistaken idea that the use of small coins presented a big problem for the merchants:

> Clearly, this is more of a problem for the banks than it is for us or for our customers. While some find it annoying to use small change, others find it as annoying to have another card. As soon as the card is used, there are groans and mutterings in the queue. And this is because it does take a longer time to process a customer with a cashcard compared to anything else. (M4a)

The merchants presently pay for submitting small coins to the bank, but even if this cost disappears once they start using cashcard readers in shops, the problem seemed too insignificant to warrant the introduction of a complex new technology.

The security benefit that came with the cashcard was generally welcomed, but merchants did not see security as an urgent problem since the crime rate in Sweden is quite low. This ran contrary to the banks who believed this to be a major problem for the merchants and expected them to pay for this solution in the future.

All merchants said that they were initially unclear about what to expect from the technology. They hoped there would be more users; however, because they saw no interest from their customers in using the cashcard, they planned to discontinue using the technology once a service fee was employed.

The banks, on the other hand, saw the cashcard as a success and maintained that the only negative view they had heard from stores was that the technology was one more thing to maintain. In addition, banks had heard that some store owners would not pay for the service in the future. The media had been negative about the test and called it a large failure (Kersti & Magnusson, 1998). However, the bank representative we interviewed maintained that it was a success since there had been 40,000 card users in the test, out of which 5000 were from Umeå. The banks' main focus was on the number of cards issued, rather than on the acceptance of the issued cards.

As the banks' spokesperson argued:

> We have — potentially — three million users next year, which must be considered as a success by any standard. To be honest, the discussion in the media about cashcard being a failure is very irritating since it is not true. We feel that there have been some minor problems to begin with, but now we have a good product for our customers. (B1a)

In the banks' view, the main difficulties were in communicating the potential value of the cashcard to merchants. The stores, the spokesperson argued, were far too focused on financial issues and must broaden their vision. What this broadened vision should include, however, remained unclear.

While the media's negative assessment of the cashcard may have been premature, it raised suspicion among users about the banks' true intentions. There was even open hostility against the technology because it seemed an unwelcome intrusion into their daily work. Bus drivers, for example, mobilized their union to stop the technology from being used in their buses. They argued it would be an extra burden for bus drivers since they would have to handle the technology — carrying the cashcard reader equipment to and from the bus each morning and night and instructing card

owners on its usage. This negativity, from the media as well as the public, created the general impression that the banks were wrong and unfair. However, these attitudes did not appear to bother the banks, as their spokesperson noted:

> The critique is misguided, and the whole project must be considered as a success. The problems we've had are dealt with, and we are still right on track. There will be no problems in the near future to find stores where cashcard is accepted. So those who are critical of the card today will change their minds. (B1a)

The bank representative was untroubled by the decreasing use of the cashcard during the spring of 1998. This decrease was only natural, he claimed, since business is often a bit slow during the spring. In general, he maintained that the trial introduction had been a success and that the technology was now ready for nationwide introduction.

2.3. The nationwide roll-out of the cashcard

In late 1998, the banks felt ready to roll out the cashcard technology on the national scene. They felt that the overall experience from the trials pointed towards success. However, the response to the new technology was overwhelmingly negative. A large chain of stores, such as Hennes and Mauritz (H&M) and Åhléns, which together operate 188 stores, were unwilling to use the card. Moreover, all stores in the KF organization,[1] which includes 1400 stores throughout Sweden, also refused to use the card. H&M and Åhléns rejected the technology by arguing that it was only irritating their employees and customers; they believed that only the banks would benefit from the project. Moreover, the big chains argued that there was no customer demand for the technology. When large chains rejected the technology, other stores had even less incentive to use it. As one merchant argued:

> As long as the major chains reject this technology, there is no chance that we will embrace it. (M4b)

Furthermore, the initial consumer interest in the card waned to the point that, by late 1998, the card generated hardly any transactions. The merchants noted that their everyday experiences were different from the rhetoric of the banks:

> Well, everybody is constantly talking, "in the new economy everything is digital, and cash is out". The truth of the matter is things are not moving towards digital cash. That's sad in a way because the kind of vision I have, and I think I share this with the banks, is that cash is not really practical in business life. But people are people, and they cannot be forced to stop using cash. We cannot force them.

[1] The KF is an organization in which retailers cooperate to further their economic interests.

> And then they saw how poor the technology was; it wasn't smooth at all. I don't blame them for not accepting the cashcard technology. (M1b)

As merchants perceived the situation, cash was more practical for the purpose of low-value purchases than the cashcard. They felt that neither them nor the customers had anything to gain from the cashcard as it was presented by the banks.

> The reason I said no is because I would rather deal with cash, even if it is a pain sometimes. You try your hardest to make this [the Cashcard technology] work, but if it's not possible, you have to face facts. I want my customers to leave my store happy, and I have had too many Cashcard related incidents to be happy about the whole thing. (M5b)

Another issue the merchants were concerned with was how the cashcard technology was poorly adjusted to the existing technologies in the stores.

> I was not too keen on this to begin with, and as soon as I could see that the whole thing was useless, I just put it away. There's no chance I will use that thing. It was just not useful in relation to the other stuff — the cash register and the [credit] card reader. (M2b)

As a whole, the merchants perceived the project as a failure. Although there were aspects of the project that were of interest to them, their interests were not sufficiently considered by the banks. Even the improvements that the cashcard technology had led to — increased speed of transactions and safety in cash administration — were questioned by the merchants.

The card users were also critical about the project and were also reluctant to use the card:

> This was a big failure, of course. I knew this from the start really, but I was still a bit curious about the whole thing, so I got me a cashcard. And I did use it a bit at first. There was all this buzz about it, lots of marketing for it and stuff like that, so people talked about it. But it was unpractical and you couldn't use it everywhere. And even if you could there were problems so I feel that cash is still the best thing. For me, anyway. (CU1b)

> It was a frustrating experience, really. So I decided to stick to my credit card or real cash. They said that you would be able to buy stuff faster, but in reality the cashcard way was the slow way…. I didn't get the idea really. I mean, what was the problem, really? I got the cashcard just because I thought things would be solved in a more practical way, but I felt that things got more tricky with that thing. And I don't think the merchants were too keen on it either. (CU2b)

The banks did not conduct any systematic analysis of the trial introduction of

cashcard. Several merchants commented on this and said that they had experiences that could have been of interest to consider before the national roll-out, but the banks did not make any effort in this direction. After the national roll-out failure, the bank representative began to feel that this was a mistake.

> I feel that it all depends on what you decide on at the start of the project. I think it's important to learn to listen to the actual users — the merchants and maybe also the card owners — and to really look at the problem from the user perspective. This is not an easy task and I think it takes time to develop this skill. And you also need to commit some time to do this. I mean, I had not much time to do any actual interviews or anything. I think this could have helped the project…. To conduct some studies on actual use of the cashcard wouldn't mean that you have to do exactly what the user says. It's important to understand the business process to be able to come with improvements and suggestions. We can add to that knowledge, but I honestly feel that there is stuff that the merchants could add too. And we didn't listen to them. (B1b)

Although the bank representative initially denied that the cashcard project was a failure, he believed that after the national roll-out results were in that the project was a failure.

> Well, it's not unfair to call it a failure. I do believe that this [digital cash] is the future, and we cannot ignore that. But we didn't succeed with this project. And especially here in Umeå, things have failed big time. I mean, there's hardly any possibility today to use the cashcard here. But the project has turned out better in other cities. (B1b)

Even if the project was a failure, the bank representative remained optimistic about the future for digital cash.

> The future development looks bright, I think. The credit card readers we are handing out to the shops today includes a cash function, so that it can accept cashcards as well as credit cards. And we still have to deal with all the issues we talked about at the start of this project, issues like safety problems and the costs involved with cash administration. (B1b)

While the initial cashcard technology was a failure, the idea of digital cash, as formulated in the cashcard project, has survived. Rather than being presented as a stand-alone card, it was integrated in credit cards. In late 1998, a conventional credit card containing a cash-chip was offered to customers of the three banks offering the cashcard. The consumers received their augmented cards as part of the normal renewal of their credit card. As a result of this strategy, 10,000 new cashcard owners were added each week in 1999. However, this did not lead to a corresponding rise in usage of the cashcard. During the last week of February 1999, there were 275,000 cashcard owners, but only 75,000 purchases with cashcard. A recent survey by the

Swedish journal *Privata affärer* (in English: Private Business) found that only 6.4% of all Swedes have the cashcard. Seventy-one people out of 1100 surveyed used the cashcard, and of these only 26 used the card frequently (Anonymous, 1998).

During the national implementation, a powerful actor entered the cashcard project: Swedish Trade (ST), a trade organization representing merchants. Initially it was not expected to play any role in the project, but it gained considerable importance in the negotiations between merchants and banks during the national roll-out. At the beginning of the cashcard project, ST recommended its members to reject the technology. After renegotiating terms of use for the retailers, however, ST modified its recommendation slightly. The agreement states that there will be no charge for the cashcard technology until 2001. After 2001, card owners will be charged 50 Swedish crowns per year (~US$6) and the stores will be charged up to 0.5% of the purchase price or a minimum of 0.25 Swedish crowns. However, this agreement changed only marginally the general usefulness of the cashcard network for retailers; consequently, ST's endorsement remained very weak. The spokesperson from ST stated the position they took on the issue:

> Now that the cost per purchase has been lowered to 0.25 crowns from 0.50 crowns, we feel that the terms are acceptable and that we do not recommend our members not to join. (ST1b)

ST, however, became one of the driving forces behind the build-up of a competing network for electronic cash transactions through the introduction of their own smartcard: an "all-round card" that allows consumers to earn interest on money on the card. Unlike the cashcard network, this alternative network would promote retailers' interests. As the spokesperson for ST explained:

> The cashcard is much too limited. You can load it with money and then use it for small purchases. The technology of today allows you to have cards that are far more advanced and functional. The chip has to have more functions. For instance, it should register where the purchase is made, in order to get discounts. Also, the card should be connected to a database of customer statistics, so that the customer might get newsletters about new offers. (ST1b)

While building up a customer database clearly favors retailers, this might be a problem when enroling card users who wish to maintain their privacy. Responding to the question of whether this was a service or a nuisance to the card owner, ST's representative replied:

> Clearly, this needs to be dealt with carefully. Of course, we are representing actors on the market concerned with successful marketing and selling strategies, and this idea with connecting a card to a database would clearly be interesting for them. Now if this is not done in a way that is convenient to the card owner, the effect will be gone. It might even be the case that this idea cannot be realized fully — it's just one idea out of many concerning potential functions we would like to

> see on a card like this — and our idea with a card of our own does not depend on this function alone. The point is that we do not believe in cashcard, even if we don't work against it any more. However, we have well over 20,000 organizations tied to us, and with that in mind, we feel that we have a better chance than the banks to make a card work — a card that not only is convenient to the banks, but also takes into considerations other players in the field. (ST1b)

Plans like this, minting of cash by non-banking institutions, mobilized even more actors who were worried about the robustness of the currency system. The European Central Bank (ECB) has recommended that only deposit-taking institutions should be allowed to issue electronic money (Ljung, 1998). Should such a policy be implemented, then ST will not be able to implement its competing system.

To sum up, even as the media, retailers, and organizations like ST voiced their criticisms, the banks maintained their original position. The learning experience from the trial was minimal. More than anything else, this signifies a lack of flexibility from banks; they have resisted a drift in the technology, and have thus been unable to make changes necessary to include more actors in the network. However, the failure of the initial cash card in replacing cash has also been a learning experience for the banks, which have recently begun to intensify collaboration with third parties, such as mobile phone companies. As a result, the future development of the cashcard at the beginning of the new century is more open than it was at the end of the last.

3. The cashcard as a failure of diffusion

The most obvious way to think of the failure of the cashcard in the 3 years since its public debut is to view it as a failure of diffusion. The banks that originated the project were not able to spread the technology throughout society. Most users (merchants as well as customers) remained unimpressed by the banks' promises and continued to use traditional payment mechanisms, above all physical cash, which the card partially aimed to replace. From the point of view of the banks, the users just did not get it, they were unwilling to understand the benefits of the technology and kept insisting on doing things the old way even though the new technology would have made their lives easier. In other words, the reason for the failure of the technology was social. While bus drivers actively opposed the new technology, the merchants passively opposed it by not installing the readers, or by not encouraging their customers to use the new payment option. They also suspected that the banks would sooner or later start charging transaction fees, whereas for cash transaction there was no such fee. Furthermore, the merchants had their own technology in their shops (e.g., inventory systems, loyalty programs, etc.) and the new card did not support these systems. In other words, the new technology was more of a nuisance than a real improvement of their situation. From their point of view, the technology just did not work well enough to bother using it.

Consumers, on the other hand, did not see themselves as hostile to the new technology. Many even tried it out of curiosity but found it wanting and stopped using

it. The cards, they found, were not only slower than cash, but also there were a lot of places where they could pay with cash but not with the cashcard, but very few places where the cashcard was the only payment option.

Both ways of understanding the failure of the cashcard project —social and technical — are not necessarily wrong, but they only help us a little in understanding why and how the project failed because we are confronted with two contradictory explanations. Combining the two would be even worse because we could loose the little insight that each perspective offers by blending them into the obvious statement that the technology and existing society did not match. Diffusion theory is particularly suggestive for practitioners because its core ideas can be summarized and used with relative ease. The problem, then, seems to lie in the conceptual approach of diffusion theory that explicitly informed the banks' initial strategy.

Early work in diffusion theory can be described as dominated by a "linear model" where the key elements were science, technology, and the marketplace. This linear model is typically represented in the technology-push or market-pull approaches to diffusion. The linear model of diffusion depicts technology transfer as a process in which social actors, understood as recipients, have only two choices: wholesale adoption of the technology or its rejection. This narrow, binary choice is analyzed on three levels. On the level of individual recipients, the focus is on personal attitudes. According to these attitudes, individuals are characterized as early adopters, at one end of the scale, and technophobes, at the other end of the scale. On the level of the social environment, the focus is on the norms, values, and culture that structure a given milieu. The third level is the technology itself with assumed intrinsic properties such as complexity, flexibility, and practicality.

Although often used simplistically by practitioners, more recent diffusion theory has become much more refined. It has evolved over the years to better account for the complexities involved with the diffusion of innovations (see Levine, 1994). Moving beyond the assumption of a linear model describing the diffusion of innovation, some recent work has acknowledged the diffusion of innovation as a complex and non-linear process. Baskerville and Pries-Heje (2001) refer to these emergent approaches as ecological models and they are informed by social and organizational theories, including, for instance, actor-network theory (Knights & Noble, 1997; McMaster, Vidgren, & Wastell, 1997).

The banks, however, followed a simplistic linear model very closely in their attempt to launch the cashcard. For them, the card had a fixed set of properties that were assumed to be desirable and then concentrated their efforts on removing obstacles: attitudes of the users and the social and institutional environment in which the technology was placed. The banks offered initial free use that would allow skeptical merchants to get familiar with the card without costs. Due to the inherent qualities of the card, it was thought that once the merchants experienced it, they would be willing to pay transaction fees for continuing to use it. Similarly, the consumers where enticed by advertisement, believing that once the initial unfamiliarity was overcome, then they would understand the quality of the product. The following statement from the bank representative is typical for the banks' expectations early

in the trial that the inherent qualities of the technology would convince anyone who has an open mind.

> So those who are critical of the card today will change their minds. This is the future, and it is always the case that there are those who are negative or have fears about new technologies. But once they get familiar with the technology and realize that it is not all that difficult to use, and also that it is quite functional and convenient, they will accept the card as a part of their everyday life. (B1b)

Many of the supposedly inherent qualities of the card, such as higher security and the possibility to avoid cumbersome cash, were indeed not inherent in the card because they addressed problems that did not exist, or were at least addressed problems that were not significant enough to warrant such a major change in payment routines. The banks believed they understood users' needs better than the users understood their own needs.

Such a difference between the expectations of the designers and the experiences of the users is not uncommon in the implementation of complex technological projects. The linear notion of diffusion, however, makes it difficult to think about ways of bridging the gap between the designers and the users. Because the technology is fixed with unambiguous qualities, the reason for adoption or non-adoption must be found in the users alone. Rogers acknowledges these problems. He calls these problems the "pro-innovation bias" and "individual-blame bias" of diffusion theory but he admits that "little has been done to remedy this problem" (Rogers, 1995, p. 100). He notes that "It is ironic that the study of innovation has itself become so traditional" (p. 130).

Perhaps it is time then to address the problem head on, and to focus on the gap between technology design and technology use that is so often encountered during implementation and think of ways to conceptualize the nature of this gap in order to overcome it.

4. Understanding IT infrastructure drift

In order to fully understand the complexities involved in the development of the cashcard, we need to move beyond the linear diffusion model. A good starting point to conceptualize the problems of implementation is to examine the notion of technology drift (Ciborra, 1997). Ciborra argues that technology drifts during implementation because of numerous decisions along the way by many actors. This drift occurs because decisions are made that are sometimes different from the original plan. This argument is well in line with several studies that have found that the appropriations of technology makes the outcome of the technology implementation considerably different from that intended (see e.g., Ciborra & Hanseth, 1998; Monteiro & Hepsø, 1998; Orlikowski, 1993).

Ciborra points to an important point which is still largely missing from innovation theory, despite recent re-conceptualizations. Technologies often change as they

become incorporated into preexisting social and technological contexts. There is important feedback from the social context to the technological context through which both technology and society are subject to change while they adapt to one another. Consequently, one of the reasons why the implementation of the cashcard failed appears to be that the banks did not allow the technology to drift into the existing situation of the merchants and users and the technical infrastructure that connects them in specific ways and supports transactions.

A complex view of IT infrastructure development, then, rests on the assumption of a mutual adaptation among all aspects of the infrastructure, technological or social. Rather than unidirectional and fully controlled, technological development itself is part of a wider dynamic in which it is as much shaping as being shaped. With a proliferation of actors, the development becomes more difficult to predict. Thus, it has recently been debated whether IT infrastructure drift should be understood as "almost outside anybody's control" (Ciborra, 1997, p. 76) or whether this drift has an underlying structure (Monteiro & Hepsø, 1998).

To better understand how and why different types of changes occur, it is useful to expand the set of entities that can effect changes: in short, to include technology to the circle of actors. The idea of technological artifacts as actors has been developed to analyze the active and unpredictable role of technology in social development in a variety of settings (Callon, 1987; Callon & Law, 1997; Latour, 1996b; Phillips, 1997). The size and complexity of technologies such as groupware or smartcard-based electronic cash, and the observation that new technologies generally build upon existing technology, make it reasonable to shift the focus from IT and or isolated IT artifacts to a more complex notion of IT infrastructure (Hanseth, 1996). Other findings suggest that organizational changes due to IT deployment are rarely anticipated, well-planned phenomena. Many researchers, then, have been shifting their attention from goal to process, from IT implementation to IT infrastructure drift (Orlikowski, 1996; Orlikowski & Hofman, 1997). While it is rarely accounted for in the planning process, several case studies of IT infrastructure development indicate that most technologies change quite significantly as they are implemented (Ciborra & Hanseth, 1998; Hanseth & Monteiro, 1997; Monteiro & Hanseth, 1995; Monteiro & Hepsø, 1998). Rather than being pushed aside conceptually, such technology drift, or unplanned consequences in designing and using IT, needs to be integrated more prominently into our models.

One way to do this has been proposed by Michel Callon and Bruno Latour as actor-network theory (ANT) (Callon, 1986a, 1991; Latour, 1996a). Their approach, in which technological and social elements are understood to form a network that can only be understood as an integrated whole, has recently begun to be used successfully within IS research (see Walsham, 1997, for an overview). More conventional approaches have been criticized for lack of specificity about the interplay between IT and organization (Monteiro & Hanseth, 1995); however, ANT focuses on the relationships between technical and non-technical dimensions of designing and using IT (Hanseth, 1996, p. 5). The main reason for this claim is that ANT does not operate with a priori distinctions between the technical and the social. Latour (1993) calls this separation a purification of hybrids. Hybrids in the sense that they can only be

understood as inseparable relationships among various human and non-human actors. According to ANT, such heterogeneous actors are linked in a web of relations: an actor-network. Each actor is dependent on the entire network; different interests, or requirements, can be translated into technical and social arrangements. The requirement of an e-cash system for security, for example, is translated into hardware (tamper resistant chips), software (encryption), and social conventions (e.g., laws that criminalize any attempt to reverse engineer the chip).

At the beginning of a project, these translations do not necessarily work well, and the enrolment of heterogeneous elements into networks is fragile and contested. Actors can be unfaithful to their assigned roles. A chip can suddenly reveal its most hidden secrets when aligned in a competing network; for example, the use of an ion-beam by a hacker or consumers can drop the card after a few initial uses. Stability is thus an achievement and cannot be taken for granted; projects can, and do, fail (for networks that could not be stabilized, see Callon, 1986b; Law & Callon, 1992; Latour, 1996a).

This stability and irreversibility of translation is achieved by an alignment of interests (Callon, 1991). Irreversibility of translation derives from the impossibility of returning to a situation where the translation of the old into the new was one of several options. As these networks become irreversible, we near a situation where the technology seems autonomous (Hughes, 1994). However, stability is never absolute, even networks of the most rigid regimes, of the most solidly established artifacts, can be undone. ANT recognizes that establishing and changing a social order relies on the interplay of social and technical means. In analyzing this interplay, ANT regards humans and non-humans as equally endowed with the capability to act.

The process of building a network is referred to as heterogeneous engineering (see e.g., Law, 1992). In this process, bits and pieces from the social and the technical realms are fitted into a network. In this view, the task of design is about changing the whole actor-network into a new one — including technological artifacts. The focus of attention, therefore, is on how new technological artifacts — existing humans and non-human elements — frame one another, and how this process changes the overall composition of the actor-network.

According to ANT, an actor-network is built by negotiation among key actors. Their negotiations, which can often be open conflicts, are the driving force in this process. Different actors have different intentions and interests, and naturally try to further their own interests. To be sure, conflicts of interest are common in design processes; such conflicts are generally resolved by the ways in which some actors succeed in protecting their programs against conflicting programs (see e.g., Bijker & Law, 1992). If the translation process succeeds, it will inscribe certain relationships and properties in the technological artifacts. The technology can thus be understood as an actor that influences human actors. Technology is an actor because it has been endowed with the ability to act through its position in the network. The security of a corporate facility, for example, relies on actors controlling access to the facility. The competence to regulate access can be given to a human being, such as a clerk standing at the door and checking the badges of the people entering the building. The same competence, however, can be given to a computer system that checks the

smartcard for an encoded identity of a person wishing to enter and opens the door only to authorized personnel. In both cases, we have a complex socio-technical network, consisting of people, badges, and other technologies, doors and corporate policies. In the first case, the authority to act, that is to grant or deny entry, is provided by a human being; in the second network configuration, authority is provided by a computer system.

There is always more than one actor-network. During technology implementation, the network that supports the cashcard trial (the banks, the cards, the technology providers, etc.) comes into contact with other networks, for example, those of coins and bills, the inventory systems, and the loyalty programs of the merchants, etc. In order to succeed, the cashcard proponents must include in their network actors that already belong to other networks, most pressingly, consumers and merchants. These actors will only join the new network if they can use it to promote their interests better than the old networks. Their interests, however, may not match those of the initiators of cashcard networks. In its first configuration, retailers could not use the cashcard networks for their own interests; it seemed to serve only the interests of the banks. Thus, retailers refused to enrol.

In response to this situation, banks started to modify slightly the cashcard network. First, banks realized that very few merchants were willing to pay for the technology. Banks decided to continue providing the technology for free until it had been more widely accepted. Second, banks were starting to integrate credit cards with cashcards; banks were combining the chip technology of the cashcard with the magnetic stripe technology of a traditional credit card. The new cards were being issued to replace credit cards when they were renewed. Although the banks were convinced that these efforts — giving the market more time to accept the technology and integrating the cashcard with credit cards — would make the cashcard a success, it was more than questionable if these efforts would succeed in attracting retailers and customers to join the network. Beyond these rather superficial modifications, the banks resisted accepting feedback from the marketplace; they were trying to stabilize the technology against resistance, which was understood as a lack of knowledge or vision. The banks believed that users needed to adapt to the technology rather than the technology evolving by addressing users' needs. The banks did their best to resist technology drift. However, it did drift from the next big thing to a failure.

5. Drifting technologies: from single-purpose to multi-purpose networks

This study suggests that drift is a necessary process in the development and introduction of a complex new technology. The need for the drift arises because emerging actor-networks are so complex that their development must be regarded as open-ended. This is acerbated by the fact that each emerging network interacts with already existing networks: in an open environment, it is impossible to jump at one moment from the old network to the new (Hanseth & Monteiro, 1998). This interaction between old and new creates additional dynamics that are difficult, if not impossible, to predict. Hence, adaptive capabilities of all actors, including the technology, are

required to deal with unanticipated events. With regard to technological artifacts, the need to fit what is new to what already exists in the real world (other technologies, legislation, social customs, etc.) is what causes the drift.

So far, it has been impossible to integrate all necessary actors into the network of the cashcard project. One reason for this is that the network is badly suited to promoting multiple, divergent interests. Consequently, many actors had and still have little reason to engage in daily maintenance work. Such maintenance work, for example carrying a card reader to and from a bus, is perceived as an extra burden with no real gain. Banks have shown little flexibility and expect users to adapt to the technology. Rather than engaging with and adapting to the existing actors — for example, bus drivers and their habits, customers and their routines, merchants and their infrastructure — banks have alienated them. As a result, potential users have resisted to use and to adapt to the new technology. Such an approach is unlikely to succeed because, as Bijker and Law (1992, p. 10) argue, "technology is stabilized if and only if the heterogeneous relations in which it is implicated, and of which it forms a part, are themselves stabilized".

In the case of the cashcard, the only set of relationships taken into consideration were the interests of the banks. What has been depicted as the interests of retailers — security and more efficient cash management — has turned out to be uninteresting to them, once they could speak for themselves. Merchants have entirely different interests with regard to advanced card technologies. Merchants are interested, as reflected in the ST project, in the information-capturing capabilities of the card (although consumers might oppose this interest); merchants see the payment mechanism as something to be integrated with existing information technologies. In other words, merchants want the new and the old networks to fuse. Clearly, such interests cannot be pursued by enrolling in the cashcard project because the project has failed to consider or to integrate the users' divergent interests.

It is exactly at this intersection of diverging interests, and the need to mobilize them into a single actor-network, that the structure of drift can be found. After it turned out that neither consumers nor merchants were as the banks had assumed them to be, it would have been necessary for the banks, and their technology, to adapt to this new reality. It would have been necessary to let the technology drift so that it could accommodate multiple interests. In the initial configuration, the cashcard served, as the merchants understood it, only the interests of one set of actors: the banks. However, the banks were dependent on the voluntary cooperation of other actors. In order to motivate such cooperation the process of mutual adaptation must work in all directions. The merchants must be able and willing to adapt to the banks, for example, by learning about a new technology and adjusting their behavior accordingly. The banks must also be able to adapt to the customers and merchants by providing them with a technology that they really want, rather than a technology they simply assume they want. In this process of mutual adaptation among heterogeneous social and technical actors the entire network is shaped so that it accommodates the multiple interests of various actors. If that is successful, the various actors of the network will be willing and motivated to invest the necessary resources to maintain it because being part of the network serves their individual interests. The

structure of drift, then, is to be found in the transformation from a single-purpose to a multi-purpose network. In the drift process, the actor-network learns, by trial and error, to accommodate heterogeneity, not only in terms of actors, but also in terms of goals.

If we want to steer technological development more successfully we must find ways to account for and integrate the multiple projects and purposes so that any single technology may serve previously established configurations of humans and non-humans.

6. Postscript

Recently, after the research presented in this article was conducted, the banks were beginning to allow the cashcard to adapt under the influence of new actors. However, as of the beginning of 2001, it is still to early to know where exactly the technology will drift as electronic cash is being integrated into cell phones and, perhaps, the Internet.

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