Strategic Niche Management (SNM) beyond sustainability : an exploration of key findings of SNM through the lens of ICT and privacy

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Abstract

Recently the governance of socio-technical transitions to sustainability is gaining attention in the field of innovation studies. One particular approach is that of Strategic Niche Management (SNM), which advocates the creation of protected space to experiment with radically new sustainable socio-technical practices. This paper contributes by asking whether this approach is also useful for analysis and governance of other types of socially desirable change. This question is addressed through a review of six key-findings of Strategic Niche Management and an original case study in the field of Near Field Communication (NFC) technologies for mobile payment. The social value at stake in this case is not sustainability but privacy. We draw three main conclusions. First, we find that the key-findings and concepts in SNM for sustainability are helpful to understand and interpret

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much of the data collected for the NFC case and privacy. However, there are notable differences in each of the key-findings, i.e findings related to a) the local-global distinction in SNM, b) expectations, c) social networks, d) learning, e) protection, and f) niche-regime interactions. Second, in relation to governance, the role of sustainability values (being a promising value to pursue) and privacy values (being a bottom-line value to defend) are notably different. Third, these differences result in different roles of public bodies in niche development. The paper ends with discussing the consequences for SNM for sustainability research and future research topics.

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1.   Introduction

Understanding the nature of radical technological change in relation to major transformations in the economic and social world has long been an important theme in innovation studies [1]. Schumpeter already recognised innovation as a driving force in economic and social changes [2]. Later, innovation scholars developed a variety of theorisations of innovation in relation to major economic and social change and stability such as the Large Technical Systems approach [3], the National and Sectoral System of Innovations [4, 5] and Long-Wave theory [6]. These approaches can be characterised as a systemic turn or focus in innovation studies.

A (relatively recent) developed model for understanding system level innovation processes is the Multi Level Perspective (MLP) [7, 8, 9, 10]. The MLP conceptualises major transformative change as the product of dynamics at the three levels of niches, regimes and landscape. It has been developed on the basis of and applied to a variety of (historical) case studies covering a wide range of empirical domains including mobility, energy, agriculture, mass production, music and healthcare. Parallel to the development of the MLP there are various attempts that (partially) build upon the MLP to conceptualise governance – i.e. the process by which public and private actors collectively try to deal with social problems – and in particular regarding the governance of sustainability transitions. In this paper we focus on Strategic Niche Management (SNM) – a governance perspective that was largely developed by the same scholars who developed the MLP – which proposes experimentation with novel technologies in niches in order to mainstream socially desirable innovations [11, 12, 13]. The theory of SNM is irrespective of any specific social goal. Most of its empirical basis, however, is based on research on the developments in the field of sustainability, such as sustainable transport [12], photo-voltaic cells [14], sustainable food supply chains [15, 16], bioenergy technologies [13], biofuels [17, 18], wind turbines [19, 20], the hydrogen economy [21] and

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low-energy housing [22]. Hence, in this paper we ask the question if and how SNM might be applicable to foster other types of socially desirable change too. We do so by applying SNM to the potentially radical innovation of mobile payment using Near Field Communication technology (NFC). The social value we will be focussing on is privacy.

NFC is a technology for short range wireless communication and is developed by chip producers such as NXP and promoted by major banking incumbents such as Rabobank as well as large incumbents from the mobile phone regime, like Nokia. Next to these regime initiatives, small start-up companies target specific niche markets and experiment with functional extensions of payment, such as the inclusion of a trading stamp book and ticketing on the NFC chip. Mobile payment using NFC is a new and potentially radically new form of payment that can have major disruptive consequences for the prevailing banking regime. Namely, NFC allows newcomers with new types of business models to emerge and invade the traditional domain of the banking regime. Another possibility is that incumbents from another regime (mobile telephony) start competing with the banking regime, thereby resulting in a loss of power of traditional payment providers. Box 1 discusses some of the potential disruptions of NFC in case mobile payment becomes widespread.

Box 1. Potential disruptive qualities of mobile payment using NFC

Near Field Communication is being developed as a technology that allows access to services through the mobile phone. Niche actors aim especially at payment services to drive adoption. As a consequence of these choices, the development of NFC causes the previously separated regimes of mobile telephony and banking to overlap.

When a closely related technology was implemented in Japan, this caused several mobile network operators start offering payment and even credit services, moving into the banking domain. In the Netherlands, NFC led to similar results. Rabobank, one of the largest banks in the Netherlands, has decided to start a mobile network service as part of their strategy to explore mobile banking and mobile payment. NFC features prominently in this vision [23].

A further feature of NFC that could evoke disruptive consequences is the notion that different services converge and become integrated on one platform, the mobile phone. Payment, ticketing, access, loyalty become functionally identical and are processed in databases of similar outlay. This has provided opportunities for newcomers to the domain of payment. Firms like Payter, whose owners have a history in loyalty programmes and gift certificates, see the barriers to entry to the payment market lowered and try to capitalise on that.

A third potentially disruptive result of NFC implementation occurs in the domain of regulators and administrative authorities. Also caused by integration and convergence, NFC has potentially disruptive consequences for regulation. Currently, administrative tasks are either divided thematically (e.g. privacy, competition) or by sector (e.g. telecommunications, financial institutions). Through NFC, one technology becomes the responsibility of many different administrative authorities. If these authorities do not act upon the emergence of integrated services by creating coherent policies together, there are two possible outcomes. Either NFC services will be overregulated when authorities create their policies irrespective of others. Or services will be underregulated when authorities fail to act at all [24].

There are also major social concerns as the prospective intimate relation between service provider and user casts a new light on privacy issues and the trade in privacy-sensitive information. Governance questions arise as NFC potentially causes compatibility and portability issues where many different technological platforms, services and users interact. Box 2 discusses some of the most critical privacy concerns as raised by the Dutch Rathenau Institute for Technology Assessment [25, 24].

Box 2. Potential privacy issues related to mobile payment using NFC

Near Field Communication shares many characteristics with Radio Frequency Identification (RFID). Privacy issues relating to RFID are a much-debated topic. Googling these terms together yields millions of hits, ranging from soothing industry presentations to well-informed critical analyses to downright paranoid conspiracies.

One of the major issues revolving around privacy is a combination of two traits of RFID: the chips can be very small and scanned invisibly from a distance. This provides possibilities to inconspicuously scan items that contain RFID, for example. Critics worry that this allows that individuals to be recognised, if they carry a unique item that contains a tag (a special watch or a pacemaker, for example) [26, 27].

Another problem with RFID is its frequent use in personal documents like passports, driver's licenses, public transport cards or loyalty cards. Here, a direct link with individuals can be made, as these are individualized items.

The privacy issue lies perhaps not so much in the wanton scan by uninvited individuals (mostly, the chips contain only a unique number), but large-scale (ab)use by companies for marketing goals or by governments for law enforcement. The real culprit is often the database, not the chip itself. Every time the tag is scanned, an entry is added to the associated database. This builds up to a detailed profile on place, date and nature of the transaction [28].

Moreover, there are potential privacy issues pertaining to NFC that transcend the issues found with RFID. As we've indicated earlier, one of NFC's promises is the integration of services. When this also means that one service provider will offer a package of services (payment, loyalty, ticketing and access, for example), the user profiles in its databases will become increasingly detailed. These rich profiles could mean that service providers get to know their clients better than the clients do themselves. As such, the information can be used to exert a measure of control over clients' behaviour. These data are not only of interest to service providers, but also to the government's enforcement agencies that will undoubtedly want to check files of victims, perpetrators and possibly, bystanders [24].

This could violate the principle of information symmetry, which states that users should have as much information about the service providers as the other way around.

By applying SNM to the mobile payment case study, this paper will make three contributions. First, this paper provides a state-of-the-art summary of six key SNM findings based on SNM for sustainability research. Second, applying SNM to a potential radical innovation in the field of mobile payment and privacy, we hope to clarify if and how SNM might be applicable beyond sustainability. Third, the paper presents an original and interesting analysis of a potentially radical innovation in banking that goes to the heart of the privacy debate in the near future. The remaining part of the paper is structured as follows. Section 2 presents the

SNM approach, followed by a discussion of its key findings in section 3. Section 4 presents the case study on NFC, which is followed by a discussion of the identified key findings in relation to the case study in Section 5. The paper ends with summarising conclusions in Section 6.

2.   Strategic Niche Management for sustainability

The origins of Strategic Niche Management for sustainability can be traced back to the early 1990s [29]. SNM started with the observation that many sustainable technologies never leave the showrooms, or worse, remain on the shelves of laboratories as prototypes. Schot et al. [30] and Kemp et al. [11] performed research on early market experimentation with sustainable transport innovations to understand why. They found that 'protection' of such 'societal experiments' – explicitly using experimentation as a concept to refer to the uncertainty and learning dimensions of such activities – was crucial, because prevailing regimes would otherwise reject those innovations and prevent them from becoming mature. Hence, experimentation in *technological niches* – intentionally, but partially protected spaces with subsidies and other public (or private) supportive measures – were identified as a crucial step in maturing innovations and regime shifts towards sustainability. Adding insights from social constructivists approaches and Technology Assessment, an iterative process of articulating expectations, setting up and breaking down protection, social network building, experimentation, learning and wider diffusion as a process of branching into new market niches and eventually mainstream markets was thought to be typical and desirable for governing sustainability transitions.

Several scholars (including some of the authors originally involved in SNM research) have criticised the bottom-up, experimental focus of SNM [12]. A discussion on too much

bottom-up focus in SNM comes from Raven [13, 31]. On the basis of case-study research in the bioenergy field and building upon MLP insights, he concludes that stability in prevailing regimes is another crucial variable for understanding success and failure of niche experimentation. Another additional complexity Raven [13, 32] and Raven and Verbong [33, 34] observe is the fact that sustainability innovations tend to develop at the conjunction between multiple regimes. Smith [35] concludes that niche-regime interactions are for more complex than initially understood and, building upon actor-network theory, introduces the concept of translating sustainabilities between niches and regimes. Hommels et al. [36] position SNM against the PROTEE approach, which proposes to make radical innovations (not necessarily with a sustainability promise) vulnerable to optimise learning rather than to partially protect them from too early market rejection. Hegger et al. [37] and Monaghan [38] introduce the concept of conceptual niche management (CNM) to move away from the explicit technology focus and propose experimentation with concepts and guiding principles rather than innovative technologies. Mourik and Raven [39] and Caniëls and Romijn [40], finally, argue that while SNM carries a management promise it is still far from being usable by managers.

Welcoming the critical debates, scholars have attempted to repair some of the biases present in early SNM. Geels and Raven [41], Raven et al. [42] and Raven and Geels [43] have conceptualised how experiments and niches relate and develop over longer periods of time. They make a distinction between local experiments and a global niche level to better understand relationships between local experiments, learning, aggregation activities, global socio-cognitive structure, and path creation. Raven et al. [44] document an attempt to translate (together with practitioners) insights from literature on transition-experiments and SNM in a learning module for practitioners. In the following section we will summerize this literature on SNM for sustainability in terms of six key findings in SNM – referring to 'success criteria' for successful niche development. We will start with the local-global distinction introduced above. This is followed by three key findings from early SNM research that

focussed on three 'internal niche processes' (articulating expectations, social network building, learning). The fifth key finding relates to protection and the sixth to niche-regime interactions.[2] Those findings will form the basis for our empirical analysis of the NFC case in section 4 and 5.

## 2.1   Local and global dimensions of the niche

Key finding 1: Combining local experimentation with shaping a global niche level is crucial in sustainability experimentation. The global dimension (a proto-regime) is actively constructed out of local experimentation through a process of learning and aggregation.

Early SNM scholars expected too much of single experiments in terms of niche creation, long-term commitment of actors to sustainability and wider social embedding of sustainable technologies (see also quote in section 2). Early SNM work was also conceptually unclear about relationships between experiments and niches. Hence, building upon Hard [46] and Deuten [47] and a long-term case study on biogas development in the Netherlands, Geels and Raven [41], Raven et al. [42] and Raven and Geels [43] developed a stylized model of the niche development process as consisting both of local experiments and a global niche level. 'Local' relates to experimentation in local contexts supported by local networks and generating locally applicable lessons. The global dimension (not to be mistaken by the geographical connation of the word global) refers to an emerging field or proto-regime

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[2] The aim of discussing the key-findings is to generalise rather than to articulate specifics. Hence specific cases may deviate from the general statements in the key-findings. Moreover, SNM is an ongoing research project. Hence, there is variety in what scholars and papers stress as key findings. Hoogma et al. [12] only focus on networking and learning. Van der Laak et al. [18] do not include the assumption that expectations should be specific, but include alignment in networks as an additional variable. Geels and Schot [29] add that social networks should not only be broad, but also deep, i.e. involving actors with a large potential to mobilise others. Also not explicitly included in this list of key-findings (although implicitly present in key finding 1) is niche branching, which is suggested as a key mechanism by some scholars [45].

supported by a network of actors that is concerned with defining shared formal, cognitive and normative rules transcending their local contexts. These networks may include industry platforms, user-groups and other intermediary organisations and operate partly autonomous from local experiments. They can also partly overlap with local networks, e.g. in the case of NFC the Rabobank is active in both local and global networks.

The relations between local and global are not easily managed, but require dedicated work and aggregation activities. Lessons from local experiments need to be translated into generic, context-independent rules such as handbooks, generic models and field-level expectations and agenda's. This includes selection, comparison, framing and interpretation of local lessons and may involve struggles and power plays. Similarly, while the emerging global niche level is potentially a valuable resource for local networks and experimentation, global to local coordination is also not a linear and straightforward process and may involve (re-)negotiating expectations and social interests to translate 'global' concepts into variations that fit local contexts [42]. Figure 2 also conceptualises regime and landscape as 'indirect causations'. Their influence is mediated through the global niche level and the (re-)negotiation of global-to-local expectations.
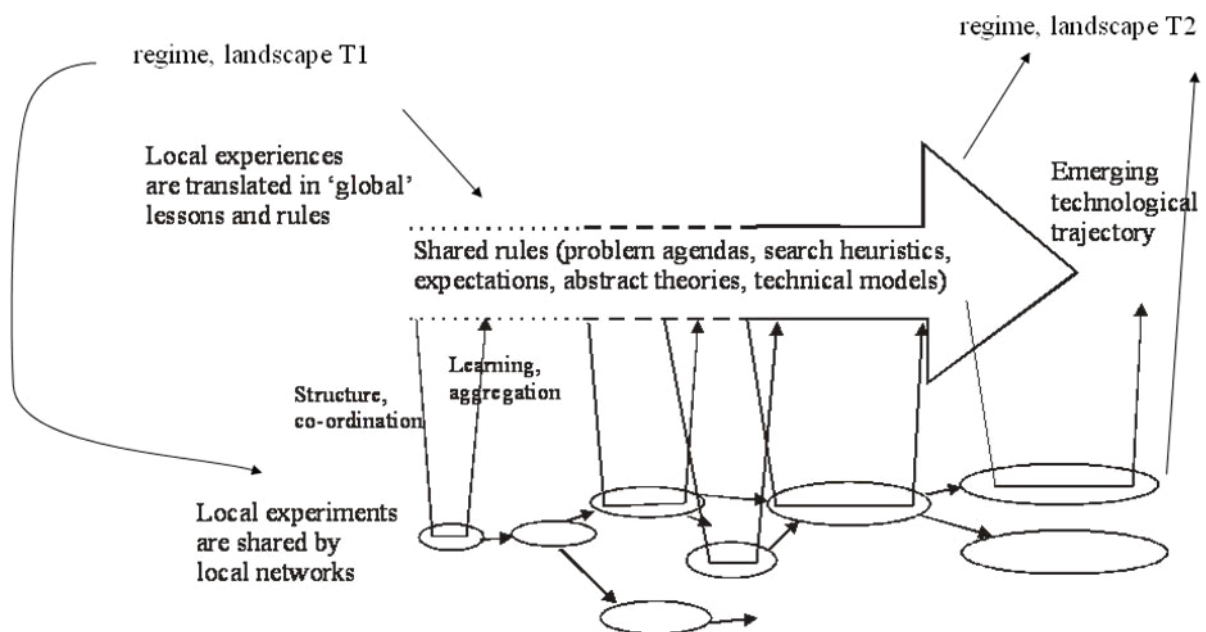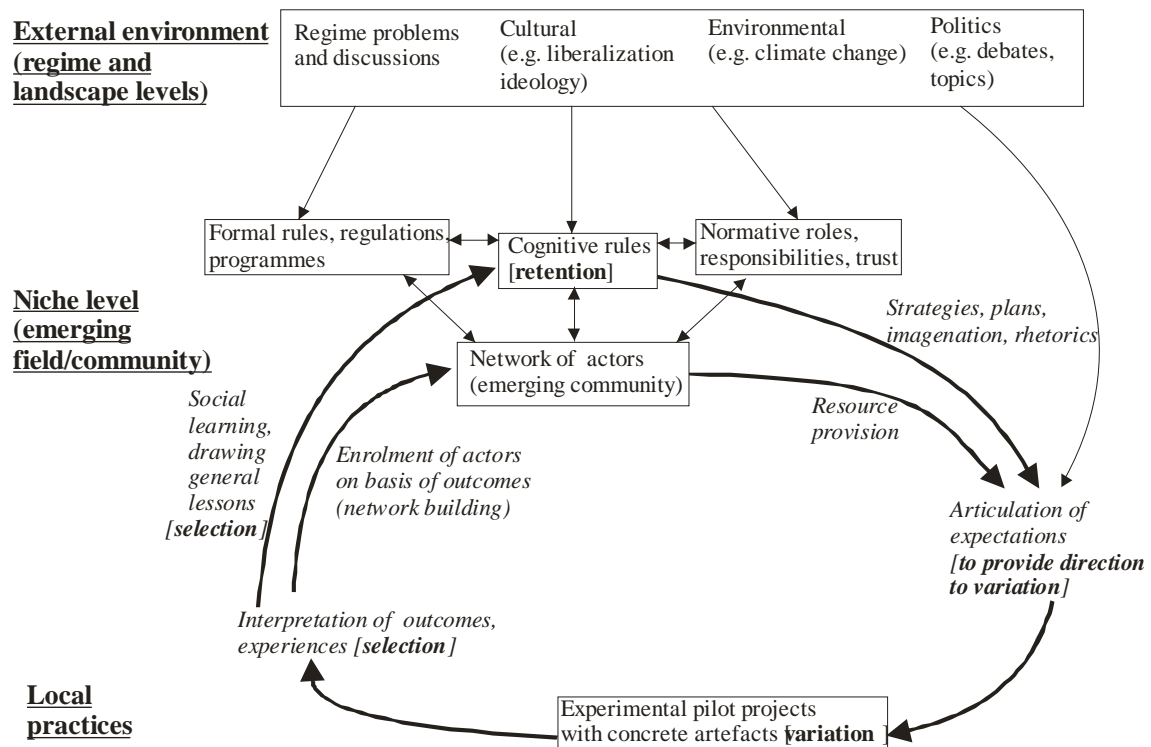
Figure 2. Relationships between local experiments, articulating expectations, learning, networks, global niche level and the external environment.

2.2   Articulating expectations

Key finding 2. Articulating expectations are an important resource in niche-experimentation. They are particularly powerful when they are shared, tangible and specific.

Building upon an emerging stream of literature SNM scholars identify the articulation of expectations as an important resource for sustainability experimentation [48, 49, 50]. Articulating expectations helps to reduce uncertainty in innovation processes, they enable

the mobilisation of resources by providing promises about future benefits and once accepted and transformed in (public or private) agenda's they act as scripts that position and influence others. SNM scholars (cf [18]) have found that expectations are especially powerful when they are shared by an increasing number of actors (guiding them into similar directions), when they are tangible (i.e. they are not just promising ideas, but realistic and backed by results from research and experimentation) and when they are specific (not just sketching utopia, but enabling falsification and the definition of next steps). Expectations are not static, but change. In early SNM research experimentation was thought to be a way to help articulate and change expectations to the benefit of sustainability. Later research showed that articulating expectations is still important, but that the effect of experimentation on changing them is limited compared to the effects of dynamics in the wider environment of prevailing regimes and the socio-technical landscape [13, 41].

2.3   Shaping social networks

Key finding 3. Shaping new social networks are crucial in experimentation for sustainability. Social networks are particularly powerful when they are heterogeneous (including both technology actors and social actors). Regime-outsiders are stressed as a particular important type of actor.

SNM emphasises the importance of shaping new social networks for sustainability experimentation. Social networks are important because they provide necessary resources, sustain development, carry expectations, articulate new requirements and demands and enable learning and diffusion of lessons and experiences between actors and locations. For sustainability innovations networks dominated by regime actors are considered not beneficial, as they might suffer from a tendency to optimise prevailing trajectories rather then

to explore new (and more sustainable) ones. Hence, regime-outsiders are considered crucial participants in social networks supporting sustainability experiments. Based on insights from Technology Assessment and empirical observations of an overly presence of technology actors in experimentation, SNM scholars also promote broad and heterogeneous networks existing not only of technology actors, such as firms and technological research organisations, but also actors representing social concerns, such as policy actors, users and non-governmental organisations, including representatives of the environmental movement. Involving users in experimentation [51] is also considered a key mechanism for stimulating second-order learning (see next key finding 4).

2.4 Learning processes

Key finding 4. Learning is crucial in experimentation for sustainability. Learning is especially powerful when a) broad, i.e. covering not only techno-economic optimisation, but also about alignment between the technical (e.g. technical design, infrastructure) and the social (e.g. user preferences, regulations, cultural meaning); and b) reflexive or second-order, i.e. there is attention for questioning underlying assumptions such as social values, and the willingness to change course if the technology does not match these assumptions.

Learning plays a key role in innovation literature and is also considered a key process in SNM. In fact, being an intellectual offspring of (Constructive) Technology Assessment, SNM can be considered a strategy to optimise social learning processes rather than a simple tool for sustainable technology diffusion. Two key findings are typical for SNM studies. First, SNM scholars have found that learning in niche market experimentation was too often characterised by a narrow focus on technical and economic dimensions. While certainly important, other dimensions were often neglected or not considered relevant. SNM proposes

to broaden traditional techno-economic learning with learning about user preferences, cultural and symbolic meaning, industry and production networks, regulations and government policy and societal and environmental effects of the new technology. Alignment between the technical and the social is crucial and can go both ways: firms and other technology developers learn about users, policies and societal preferences and adjust the technology, while users, policy makers and other social actors learn about the technological characteristics and adjust preferences, laws, routines and norms. Second, governance for sustainability and sustainability experimentation requires questioning underlying values and assumptions. Referring to concepts from organisational theory and political science [52, 53] this type of learning is conceptualised as second-order (versus first-order) or double-loop (versus single-loop) learning. First-order learning relates to asking 'are we doing things right', while second-order learning relates to asking 'are we doing the right things'.

2.5   Protection of the niche

Key finding 5. Partial and temporary protection of niche experimentation is crucial for sustainability experimentation. While protection from the private sector is conceptually not excluded in SNM, protection from the public sector is empirically stressed.

Protection has been a key concept in SNM studies. Positioning SNM against Levinthal's niche theory [53] and building upon historical examples of radical technological change, Hoogma et al. [12] argue that market niches play a critical role in transitions. Market niches can exist as 'regime anomalies', because there are some producers and users investing in and buying products that are not mainstream, e.g. because of specific locations and circumstances such as early applications of photovoltaic cells in space. However, viability of sustainable innovations might often be absent. Instead, positive expectations about future

profits or social benefits make actors invest in technologies without any direct commercial yields. Hence SNM proposes to exploit these niche dynamics by creating artificial, protected spaces, which are coined technological niches. Protection should never be completely hiding an innovation nor should it remain unnecessary long in place. Instead protection is about selective exposure to the selection environment. Ideally protection is equally broken down when learning processes increase social embedding and economic feasibility of an innovation. As of yet protection has not been an explicit research topic of SNM scholars, although there is empirical evidence of its positive role in sustainability experiments [13, 54]. Generally, there is a tendency to identify protection empirically with a particular focus on public policy measures, although measures from the private sector are conceptually not excluded.

2.6 Interactions between niche and regime

Key finding 6: Understanding stability in prevailing regimes and destabilising them are a crucial factor in sustainability experimentation. Regime actors are stressed to be defensive in sustainability experimentation rather then respond pro-actively.

Building upon the MLP, recent SNM studies have more explicitly discussed niche management in relation to stability in prevailing regimes. A key finding in this respect is that sustainability niches have minor chances on breakthrough when those regimes remain stable – even when internal niche processes are managed successfully [31]. Hence, destabilisation of prevailing regimes is another crucial element in sustainability governance. Interestingly, there is an implicit tendency in SNM studies to position regime actors as defensive or at least not pro-actively involved in sustainability experiments. While this tendency has been present in early MLP research as well (conceptualising transitions as a

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single storyline following an S-curve), Schot and Geels [7] have developed a more nuanced typology of transitions. They elaborate on four possible transition pathways distinguished by the timing of interactions between levels and the type of relationship (symbiotic or competitive) between niches and regimes. Following from their analysis as well as from the contribution of Smith et al. [55] (2005) there is no à priori reason why regime actors would under certain circumstances not develop a more pro-active stance in sustainability experimentation.

We now turn to the empirical case study on Near Field Communication (NFC). In this ICT case the central social value at stake is not sustainability but privacy. The NFC case will be briefly introduced in section 4. Section 5 will analyse to what extent the NFC case complies with SNM's key findings. That section will also provide more detailed information about the NFC case and the role privacy plays therein.

3.   Near Field Communication

In our research, we have studied two experiments in which NFC-based systems are used to provide payment services, supported by features like loyalty schemes, ticketing and value added content retrieval. These systems, called RaboMobiel and Payter, stand out in that they are the most visible NFC systems in the Netherlands and apply NFC in the most comprehensive manner. Data was collected by means of interviews and desk research. Eleven interviews were conducted, mainly with private sector actors engaged in NFC experiments, supported by interviews with actors from the public sector, like the Dutch Central Bank, and TNO, a leading public research institute. The body of literature consulted consists of policy and industry white papers, transcripts of presentations, newspaper articles

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and clippings from trade journals. After collection all data was carefully structured using the six key findings from SNM for sustainability research. We then drafted an initial discussion document, which was debated in a series of meetings with both SNM and NFC experts. The final version was published as a public report of the Rathenau Institute, the Dutch parliamentary Technology Assessment institute [24, 25].

3.1 Introduction to NFC development

In the early spring of 2004, a press release announced the establishment of a new industry forum, the Near Field Communication Forum. This forum, spearheaded by Philips Semiconductors (now NXP), Sony and Nokia was to oversee the standardisation and promote the application of this novel technology. Near Field Communication (NFC) finds its origins in a combination of wireless interconnection technology and Radio Frequency Identification (RFID). Near Field Communication tags (an NFC chip with an antenna is called a tag) create a radio field to transmit data. Another NFC tag receives the broadcasted data on its antenna, which is shaped like a coil. This shape allows the tag to respond by using the energy that is generated through the inductive coupling of the two devices.

An NFC system is based on two tags communicating. In most of the applications now advocated, one of these tags is embedded in a mobile device (phone or PDA) carried by an end-user. Many applications require this mobile device to have a connection to the Internet. Most often, the connection to internet-based online information is made through a Java application installed on the mobile phone. This application retrieves and presents the information. The other tag, depending on the kind of use, is embedded in 1) another electronic device carried by a user; 2) a passive, non-powered item or 3) an active terminal. These terminals, e.g. point of sale terminals, are then linked to the database of the service provider.

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NFC technology is designed to be integrated in mobile telephones, but expectations about application in other devices, like portable computers and camera's, also exist. NFC is envisioned to be used for services like contactless payment, ticketing, access and content retrieval. Additionally, it can be used to transfer data from one device to another, allowing users to exchange contact information, agenda items and holiday pictures. An NFC transaction of any kind is set in motion by bringing two (embedded) NFC tags close together, an action referred to as *tapping.*

3.2   NFC in The Netherlands: Payter and RaboMobiel

The activities of the NFC Forum triggered a number of pilots in different parts of the world. In this research project, we have examined two emerging NFC systems in the Netherlands. The two systems are founded by respectively Payter and RaboBank (RaboMobiel) and share an emphasis on payment extended with additional features. Both systems took off in the second half of 2007. While the systems share a similar technological base (NFC), in other respects, the two systems are very different. Payter is a start up firm, operating independently from banking regime actors, while developing novel advertising concepts. RaboMobiel, by contrast, is a daughter of the Dutch Rabobank, andthus sprouted by an incumbent. Hence, while we conceptualise both experiments to pertain to the same global niche, they represent very different local variations of the 'global' concept of NFC technology for mobile payment.

The Payter system operates in the Rotterdam city centre. Roughly 50 locations, including shops, bars, restaurants, a parking garage and a cinema, began to accept payment with Payter using NFC-equipped mobile phones. Starting with around 500 users, by October 2008 the scheme had expanded to around 1400 users, with points of sale and ticketing

increased to over 80.[3]Payter's vision focuses on customer loyalty and advertising. This vision lies at the heart of Payter's business model. This model is not aimed at skimming a percentage of payments in the way banks make money from bank card transactions, but rather at using the "mobile wallet" as a means to bring advertisers in direct contact with potential clients. It takes the form of on-demand advertising, offered in different forms. Smart posters, for example, allow users to tap a poster, downloading coupons relating to the products advertised on that poster. Coupons or loyalty schemes can also be offered online through the Payter application.

To attract advertisers, Payter needs to acquire a critical mass of users. In a bid to do so, Payter provides new users with a complimentary Nokia 6131 NFC phone, and offers participating shops subsidized infrastructure. Payter has been framed as a pilot, an image that leaves room for experimentation and that has perhaps prompted a more forgiving user response to start-up glitches and hiccups. The scheme's rollout is permanent, however, and the firm is working to expand its system to other cities in the Netherlands.

Rabobank, one of the larger Dutch banks, launched RaboMobiel in 2006 as part of a long-term innovation strategy. This semi-independent daughter company explores the possibilities of mobile payment and banking as a way to save money. In order to acquire a mass of users that could participate in piloting new systems, RaboMobiel operate as a mobile virtual network operator. RaboMobiel has developed an NFC system aimed at micropayments. In conjunction with a number of partners, the company conducted several pilots in different settings. Vending machines for drinks and hot snacks were fitted with an NFC point of sale. In another application setting, two consecutive pilots each lasting half a year experimented with NFC payment in supermarkets. In the early spring of 2008, RaboMobiel launched the first permanent NFC product: ticketing in the municipal zoo of Rotterdam. An additional

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[3] According to Brendon Carpenter, the founder of Payter, interviewed by technologyblog frankwatching.com, accessed on Februari 27, at http://www.frankwatching.com/archive/2008/10/25/app-gespot-payter (in Dutch)

feature is that NFC tags placed in front of animal displays give users extra information about the animals.

In addition to developing services based on NFC, RaboMobiel participates in negotiating the shape and role of a new actor that should facilitate mass NFC deployment, the Trusted Service Manager (TSM). The TSM should enforce interoperability amongst different kinds of hardware (types of phones, read/write devices, etc.) and software (different kinds of application software, middleware and databases). Furthermore, this new actor could act as a portal for NFC service providers to reach prospective customers and as a portal for users that experience difficulties with their NFC services. It may play a role in ensuring NFC portability when changing either phone of contract.

4.   Comparing case results with the key findings of SNM

Section 2 identified six key findings of SNM for sustainability. In this section, we evaluate the NFC case and privacy according to these key-findings.

4.1   Local and global dimensions of the niche

Our data support the emergence of both local experiments and a global NFC niche level. Experiments are carried out in specific local contexts, while knowledge aggregation and standardisation is coordinated at the global niche level. Both levels are supported by actor networks with distinct visions and agenda's. Also in line with findings from previous SNM cases is that transferring and sharing knowledge between the global and the local dimensions of the niche requires dedicated efforts [41]. Following previous findings in SNM case studies, these activities take the form of publishing white papers, hosting conferences, organising design competitions, compiling best practices, etcetera.

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There is one notable difference with the conceptualisation in SNM literature though. In the literature, the global niche level is conceptualised as an emerging socio-cognitive structure from local experiments over time. In the NFC niche, however, actors such as Philips Semi-conductors and Sony established a new actor – the NFC Forum – that pro-actively coordinated and shaped global level rules before (and only later in parallel to) local level experimentation. The forum succeeded in rapidly codifying the basics of NFC technology in international standardisation in 2004 and 2005, and later in technical specifications as blueprints for different components of an NFC system in 2006 and 2007. Participating actors made sure to comply with existing privacy regulations when developing the technical specifications for NFC, for example with respect to the design of safe encryption technology.

Local level experimentation only started in 2005 with brief and concise pilots. From 2007 onwards, the number of pilots, as well as their scope and length, increased rapidly, profiting from clear coordination from a global level predating the local level by a number of years. Despite careful preparation on the global level, however, the issue of privacy remains an issue for debate on the local level. In particular in the Payter case, the Dutch Technology Assessment Institute, the Rathenau Institute has concerns regarding the aggregation of user information that is collected through tapping. As these actions do remain within legal limits, no concrete steps are taken to adjust this situation. However, it has sparked debate within the Rathenau Institute if aggregation of user information in databases is to be a topic that warrants more attention by policy makers.

A second notable observation is that in the global-level network, many regime actors take seat, notably from the mobile telephony regime. As such, the global level, by negotiating between niche and regime interests, has become an influential institutional link in niche-regime interactions (see also key-finding 6).

4.2   Articulating expectations.

We found expectations and visions to be an important mechanism in shaping the emerging NFC and mobile payment niche. The primary actors voicing expectations are the members of the NFC Forum. Over the course of almost five years, the number of members of the NFC Forum has steadily risen to around 150 members.[4] While each actor subscribing to the NFC Forum has its own, private expectations, the rising number of Forum members indicates emerging collective expectations: the expectations advocated by the Forum. Expectations at the global level centre on the vision of NFC as a technology that provides an intuitive interface, for which the following quote is exemplary:

NFC can be used with a variety of devices, from mobile phones that enable payment or transfer information to digital cameras that send their photos to a TV set with just a touch. The possibilities are endless, and NFC is sure to take the complexities out of today's increasingly sophisticated consumer devices and make them simpler to use.[5]

This vision includes applications in other devices than mobile phones. However, more specific expectations and activities in the niche focus almost entirely on NFC integration in mobile phones.[6] In a BBC news item[7], NFC is named as one of five top technologies for 2008, indicating that the NFC Forum's vision is becoming shared in a broader circle.

In 2005, the NFC Forum launched working groups to develop the first sets of technical specifications as input for standardisation processes. In August 2006, the Forum published

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[4] For assessing the number of members, we have consulted the press release repository on the NFC Forum's website.

[5] Taken from the website of the NFC Forum (ww.nfc-forum.org/aboutnfc).

[6] The Forum has articulated its visions more elaborately in its 2007 and 2008 white papers, heavily emphasizing the role of the mobile phone.

[7] news.bbc.co.uk/2/hi/programmes/click_online/7182701.stm#top

the first set of specifications followed by additional sets in 2007 and 2008. Developing and publishing technical specifications and the subsequent codification of parts of these specifications in international (ISO and ECMA) standards is an indication for expectations turning into specific and tangible requirements. In this case, the NFC specifications allowed leading mobile phone manufacturers such as Nokia and Samsung to pilot the production of NFC phones. In 2007, Nokia was the first firm to produce an NFC enabled phone commercially. A second model followed in 2008.

In addition to technical specification, the forum also articulated the expectation that NFC will be able to comply with privacy regulations and to provide a timely answer to potentially damaging accusations of developing the next generation of "Big Brother" technologies. This led to plans, in 2006, of establishing a new actor within the NFC Forum, the Privacy Advisory council, whose task it was to prepare privacy guidelines for local experimentation with NFC technology. After a few initial mentions of this Privacy Advisory Council being established, no more mention was made of it after 2007. It seems likely that no consencus could be reached about the tasks and mandate of the Council amongst the diverse and international members of the NFC Forum. Accordingly, dealing with privacy aspects of NFC technology was delegated to local level actors.

In local experiments, too, expectations are articulated. Local expectations are typically tailored to fit the local settings for potential applications. They serve not only to motivate others to support the new technology, but also legitimate the actors' course. Surrounding the two systems analysed here, expectations centre on the vision of introducing NFC for mobile payment as the most viable way towards mass NFC deployment.[8] Currently, experience with Payter and RaboMobiel as well as previous pilots have yielded sufficient results for actors to claim that NFC systems would no longer be developed just for piloting, but rather would

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[8] Personal communication with representatives from different NFC specialists

signify emerging permanent systems,[9] indicating increasingly specific and tangible expectations.

Actors contributing to the RaboMobiel system conduct their experiments not only to test the viability of NFC applications and services, but also to facilitate a 'viable NFC ecosystem'. This concept denotes acceptance of the expectation that if NFC is to be a success, a critical mass needs to be formed not only on the demand side (end users) but also on the supply side (technology, systems and service providers). Thus, expectations regarding NFC are communicated not only to the press and the public, but first and foremost to (potentially competitive) firms to stimulate acceptance of this expectation. In the course of piloting NFC applications, RaboMobiel has consistently cooperated with multiple firms, thereby contributing to an emerging repository of knowledge on applying NFC.

In the year and a half after launch, Payter has gradually expanded. Starting with around forty participating shops, over 100 stores now accept payment via Payter [56]. The number of users has increased to 1400 in January 2009 [57]. Also on the supply side, Payter has expanded. Initially, Payter's network was very small. Payter developed the Payter point-of-sale technology in cooperation with a large supermarket chain and a payment terminal manufacturer. Later functionalities, like parking garage tickets and cinema tickets, were developed in cooperation with the associated firms.

Our findings that expectations play a crucial role in innovation not only in case of sustainability transitions is in line with observations by Van Lente [48], Brown and Micheal [49], Borup et. al, [50] and Konrad [58], for example, who report extensively on the role of expectation dynamics in development and diffusion of new technologies. We have also found some evidence that shared, tangible and specific expectations are useful notions to understand how expectations contribute to niche development processes. We found, however, limited evidence that expectations about privacy are a prominent force in the

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[9] According to industry specialists

development of the NFC niche. On the global level the Privacy Advisory council is merely concerned with remaining within the existing privacy regulations rather than privacy expectations driving innovation. In local experiments negative expectations about privacy are raised by the Rathenau Institute, but without major effect on the experiments.

4.3 Shaping social networks

The inventors of Near Field Communication technology, Philips Semiconductors and the Sony Corporation have, early in the NFC development trajectory, opted for a strategy reflecting the significance they attach to social network building. The two companies established the NFC Forum to promote standardisation and NFC deployment. Standardisation, a process relying on others to appropriate parts of a technology in order to create a critical mass on the supply side, is an approach favoured in a global setting with open markets [59]. This strategy emphasises the role of networks as an important locus of acquiring resources, carry expectations and articulate requirements. In that sense, we found social networks to be important for the same reasons as in the development of sustainable technologies in SNM.

SNM scholars found that in networks that are homogenous and dominated by regime insiders, technology will be developed along a trajectory that favours regime optimisation. The NFC Forum in our case is not a heterogeneous network. It is a network consisting of technology actors, supplemented by a small number of users in the form of firms that would potentially adopt NFC to offer services, such as banks. In this network, incumbents from the mobile telephone regime, i.e. Mobile Network Operators (MNOs), are dominant. Regime outsiders, predominantly conceptualised in SNM as actors representing social concerns, are marginally present. Most notably powerful actors concerned with privacy are lacking in these networks. There are indications that MNOs do indeed exploit their dominance to steer NFC development and standardisation along a path that would optimise along prevailing

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trajectories.[10]   On the local level, networks are smaller, but more heterogeneous. Users, in terms of service providers (banks, retailers, etc) dominate the local level. Social actors, like public policy makers or non-governmental organisations concerned with privacy, are not present. End-users are consulted extensively in long pilots, but are not part as decision makers in the social networks supporting the experiments.

A notable observation is that despite absence of outsiders articulating social values, regime actors carefully comply with the social value of privacy. Indeed, from the start they have made tried to develop specifications that remain within privacy laws through the establishment of the Privacy Advisory council, although currently with limited results (see previous section).

4.4   Learning processes

Learning processes at the global niche level and in local experiments differ considerably. Learning at the global level focuses on instrumental learning and technological optimisation through negotiating standards. While there is a clear conflict of interests between the mobile telefone regime represented by the MNOs and the banking regime, represented by the NFC service providers, there is little indication of broad learning at the global level.[10] The NFC Forum, however, has established a Privacy Advisory council preparing privacy guidelines. This points to learning processes centring on privacy issues. These guidelines, originally

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[10] This is exemplified by the behaviour of MNOs in negotiations that need to fill the largest of the existing specifications gaps. MNOs use their dominant position in the NFC Forum to back a plan that would place a vital component of the NFC tag, the secure element, on the phone's SIM card. As the SIM card is owned by MNOs, this allows them to charge a fee for using NFC. Potential NFC service providers, led by the banking regime, are vocal in opposing this plan but feel that theirs is a losing battle, according to banking representatives.

planned to be released mid 2007[11], have not been published (yet). Whether or not this advisory council will play a meaningful role in learning about privacy optimisation thus remains to be seen.

In local experiments, findings of the analyses of both the Payter and the RaboMobiel system corroborate the importance of learning. Following the dominance of technology and business actors and the absence of social actors in these systems (and the niche in general), learning focuses mostly on technical learning and learning how to successfully apply business models based on NFC. Learning aboutuser preferences, regulations and cultural meaning does occur, but is subordinate to techno-economic optimisation. To illustrate: user preferences are studied but users are consistently addressed as consumers, not as members of civil society community that represent social values. By addressing users as members of a civil society, optimising user privacy would be a specific goal for learning. In the current situation, privacy regulations serve as exogenous guidelines, monitored by an independent government agency for developments rather than as a socially desirable value to pursue.

SNM scholars found that second-order learning was crucial in sustainability experimentation. One mechanism to promote second-order learning is that pilots should be of considerable length to allow users to learn about the technology so that preferences and routines can co-evolve. Both Payter and RaboMobiel acknowledge this need for extensive piloting. Either system has conducted pilots lasting half a year or longer. However, there is little indication that second order learning is occurring. Indeed, second order learning seems, quite explicitly, not to be a goal. In designing their system for a pilot in a supermarket, RaboMobiel and their partners have chosen to remain as close as possible to the established routines of using bank cards for payment including regulations with respect to privacy. There is no articulation regarding issues such as applicability and desirability of current privacy laws

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[11] As mentioned in the NFC Forum's chairman's presentation of February 14th 2007.

from within the niche. Interestingly, they are being articulated outside the niche (see text box 1).

4.5 Protection of the niche

Previous analyses conducted with the SNM approach involved niches in which the public sector is strongly represented. With respect to measures to (partially) create emerging niches, these studies empirically emphasize the role of the public sector. Often cited measures include financial incentives like subsidies or tax exemptions or regulatory incentives like a (temporary) exemption from prohibitive legislation. In this respect, the NFC niche is markedly different. The public sector is not represented in the niche, neither at the global level nor in local experiments. Protection is provided solely by the private sector.

The protective measures employed on the global level differ from those on the local level. At the global level, protection is provided by pursuing rapid institutionalisation of technical specifications. The main mechanism used to provide protection is the process of standardisation. The goal is to rapidly establish a proto-regime, thus stabilising the niche by increasing stabilisation and structuration. This observation is in line with Raven's conclusion [13:254]: 'Stabilisation is important, because it reduces uncertainty [...]. Protection can also reduce uncertainty, but can be a source of uncertainty as well [...]. Protection is thus not a sufficient condition for the emergence of market niches. Stabilisation, on the other hand, creates a more durable and internalised form of certainty for niche actors'.

In local experiments, expectations on the value of NFC based business models provide protection that is directed at creating local spaces for experimenting with NFC systems. Payter's system is protected solely by a strategic investment by an investment agency. Payter's goal is not only to roll out a commercially viable system in Rotterdam, but also to rapidly develop this system so it can act as a showcase. One of their business models

entails licensing their concepts and technology for use abroad. RaboMobiel's experiments are protected by the actors partaking in each of the pilots. The organisation is supported by strategic resource allocations of Rabobank, the mother company in order to experiment with mobile financial services. By advocating an NFC ecosystem, the network around RaboMobiel aims at rapidly institutionalising niche characteristics, supporting the emergence of a proto-regime from the local level. While the public sector is not directly involved in the NFC niche, a protective influence is exerted. By monitoring NFC development and application, both in terms of privacy issues and in terms of monitoring new payment systems, NFC is institutionalised in practices of legislators and enforcement. To phrase differently, while in traditional SNM studies policy actors are seen as agents creating protected spaces around new social values, in the NFC case policy actors act to monitor privacy regulations so that the niche does not undermine an established social value.

Currently, with a financial sector and indeed the economy at large descended into a period of recession, allocation of resources shifts quickly. Rabobank has withdrawn support, forcing RaboMobiel to suspend their innovation trajectories, including NFC. Other firms as well have indicated that NFC activities are currently put on hold.[12]

4.6   Niche-regime interaction

In SNM literature, there is a tendency to attribute prevalent regimes a defensive role. Albeit implicitly, regimes are positioned at best as not pro-actively pursuing (sustainable radical) innovation. In order for regimes to become susceptible to change, they need to be in a phase of reduced stability [8, 13]. In the NFC case, relations between the NFC niche and the

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[12] The two industries most heavily backing NFC trials, banking and the semiconductor industry (responsible for NFC technology) are heavily disadvantaged by the current financial and economic crises

banking and mobile telephone regimes show more symbiotic tendencies. Especially mobile telefone regime actors take seat in the NFC Forum and subscribe to its vision. Banking regime actors support NFC development by supporting local level pilots and produce white papers in which integration of NFC in regime activities is proposed.[13] They actively work on making NFC technologies stay within privacy regulations as well. As regimes respond positively and pro-actively in the NFC case, a transition may occur without the need for major destabilisation at the regime level. This symbiotic transition entails niche activities being directed at hybridisation of NFC technology with regime practices [60]. Rather than the NFC proto-regime replacing prevalent regimes, it seems more likely that regimes change by reconfiguring practices to accommodate NFC.

In transition studies, niche-regime interactionsare often conceptualised as niches interacting with one regime. Pavitt [61], however, already highlighted innovative activities at sectoral boundaries, and scholars such as Raven [32], Raven en Verbong [33, 34], Konrad et al. [62] and Bai et al. [63] show how multiple regime dynamics can indeed reveal opportunities for innovation. The emergence of an NFC niche has also led to two previously separated regimes, the mobile telephony regime and the banking regime, to interact. Upon articulating their visions, the NFC niche attracted the attention of actors from both regimes. While regime actors and niche actors maintain fairly symbiotic relations with one another, interactions between the two regimes show more signs of stress. Both regimes view adoption of and adaptation to NFC as potentially beneficial, but in different ways. Their respective visions collide. The NFC Forumfunctions as a liaison or arena between the regimes.

The multi-regime setting does not seem to cause substantial innovative activities or debate related to privacy issues. The policy subdomainrelating to privacy, however, might face

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[13] See, for example, the GSM Association's or Mobey Forum's (industry platform carried by banks to support the development of mobile financial services) website, searching for NFC & white papers.

pressure. NFC potentially challenges user privacy in ways remaining outside of the scope of current regulations (see box 1).

4.7   Case conclusions

The NFC niche for mobile payment is currently being experimented with in local variations and supported by an active and stabilising global niche level. It holds the promise of reducing overhead costs for payment providers as well as new user experiences and added value such as easy ticketing and billeting. A lot of negotiating expectations and learning has occurred and is institutionalised into standards and guidelines, supported by a powerful network of actors including major representatives of both the banking and the mobile telephone regimes. Although resources are currently withdrawn from the niche due to the global economic crisis, the niche seems well on its way and may establish itself as a prominent market niche in the future.

The niche has the potential for major disruptive consequences, in particular, for the banking regime (see box 1). Currently, however, with the dominant presence of regime actors in the niche it is questionable whether this will happen. A pathway of reconfiguration in which transitions emerge from (initially) symbiotic relations between niches and regimes seems more likely (cf. [9]). Yet another uncertain variable is how the niche may disrupt established boundaries between the previously separated regimes of banking and mobile telephony. Widespread breakthrough of the NFC niche may bring both regimes in much closer relationships, either in a symbiotic, competitive or integrative way [32, 33, 34].

The issue of privacy in the niche is at least ambiguous, if not poorly addressed. Formally, niche actors have attempted to pro-actively address the issue by planning to establish a formal body to advise local level experiments on creating "privacy friendly" services. However, this Privacy Advisory Council never saw the light of day, meaning a de

facto delegation of dealing with privacy aspects to local level actors. In local experiments end-users are involved and, hence, have to opportunity to articulate social concerns. It is unclear, however, what their decisive power is or what mechanisms are in place to translate concerns back into global level rules. The fact that users are seen as consumers rather than members of a civil society does not promise serious consideration of their privacy expectations, if any. Critical observations about privacy are being raised outside the niche, but these have not had any impact on niche decision making either. The latter is not so strange as our SNM analysis has shown that currently there are limited mechanisms within the niche for learning about social values such as privacy: networks are dominated by regime players and learning is explicitly first-order. Hence, although there may be no serious threats to privacy at the moment, the niche *holds the risk* to develop in such a way that they become prominent issues in the future.

5.   Conclusions and discussion

This articleapplied SNM to the evolving niche of Near Field Communication (NFC) in the Netherlands. NFC for mobile payment is a potential radical innovation combining mobile telephony and contactless payment services. Our goal was to explore if and how Strategic Niche Management – an analytical model and governance strategy developed on the basis of sustainable technology niches – can be applied more general to foster other types of social change too. The following conclusions can now be drawn.

First, our research suggests that the key-findings and main concepts in SNM for sustainability are also relevant for the NFC case and privacy. We were able to understand and interpret much of the data collected in the NFC case using the six key findings. There

are, however, notable differences. Table 2 summarises the main differences between the key findings from SNM for sustainability research and the NFC case study.

	SNM key findings	**SNM for NFC and privacy**
Local-global distinction	Global level is actively constructed out of local experimentation	Global level was constructed before local experimentation
Expectations	Expectations are particularly powerful when they are shared, tangible and specific.	There is clear evidence for important role of expectations, but it is not clear if the concepts of shared, tangible and specificity are particularly relevant.
Social networks	Social networks are particularly powerful when they are heterogeneous and include regime-outsiders	Social networks are dominated by techno-economic actors, but a new actor is created for dealing with privacy. Regime-outsiders are present, but mainly in the form of a multi-regime setting rather than a single niche-regime setting (outsiders come from another regime rather than being innovative new players).
Learning	Learning is in particular powerful when it is broad and second-order.	Learning is mainly focussed on techno-economic optimisation

| | | and standardisation, but a new actor is created for learning about privacy.

Learning is explicitly first-order, i.e. to remain within existing privacy frameworks. |
|---|---|---|
| Protection | Partial and temporary protection from the public sector is empirically stressed | Private sector is main source of protection. |
| Niche-regime interaction | Niche-regime interactions are conceptualised as competitive. | Regimes adopt a symbiotic attitude towards niche development |

Second, our findings suggest that the social value of privacy plays a remarkably different role than the sustainability value in previous SNM studies. In the case of sustainability the social value is a promising value and driving force behind experimentation, at least from the perspective of society (entrepreneurs and users, for example, can have different reasons for participation such as economic profitability or added functionality). In an ideal-typical situation sustainability experimentation is meant to enhance sustainability in society. In the NFC case, the social value of privacy is not a promise, but rather a bottom-line value for experimentation. NFC technologies are not developed for promoting privacy, but privacy sets limits to what NFC can and cannot do. To phrase differently: the privacy value sets the boundary conditions within which techno-economic actors can manoeuvre, while the sustainability value raises the bar for them.

Third, from a governance perspective, promising versus bottom-line social values create a different stylised dynamic, which is summarised in table 2.

	SNM for sustainability	SNM for privacy
Public perspective	Sustainability as a promising value	Privacy as a bottom-line value
Problem	Regime is not sustainable	Niche developments might infringe privacy
Regimes	Regime should change with respect to sustainability, but resist change	Regime complies with privacy rules.
Niche	Niche development by regime outsiders	Niche development by regime insiders
Role of public sector	Public sector nurtures and protects the niche	Private sector protects the niche, public sector monitors
Niche (ideal)	Learning about how to achieve sustainability, challenging existing rules and institutions that are deemed unsustainable	Learning about implementing technology in a "privacy friendly" way.
Governance task	Niche aims to alter prevailing regime to become more supportive of sustainability and stronger in discourage unsustainable practices. Governance task: to support and nurture niche and stimulate learning about required regime transformations.	The niche is allowed to expand within boundaries of privacy regulations. Governance tasks: enforcing this privacy bottom line.

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In SNM for sustainability the promise of sustainability drives niche activities. Current practices, embedded in prevailing regimes, are deemed unsustainable. Therefore, a niche is constructed around this promise of sustainability, (initially) carried by actors not associated with the regimes with the purpose of developing an alternative way of fulfilling the social function now fulfilled by the prevailing regime. A promising social value, being a collective good that is worth pursuing, urges the public sector to contribute and support the niche. Prevailing regimes, however, are not fit for the new niche innovations and they require adaptation in order for niches to become successful. Hence, learning processes in niches need to be not only directed at (internal) techno-economic optimisation, but also at the required (external) regime changes. Hence, learning is also directed at challenging prevailing regimes. In the NFC case, the social value of privacy sets the boundary conditions for privacy-sensitive niches. Such a bottom-line value creates a different dynamic resulting in different constellations. Niche developments, in which regime actors take part, could infringe on this value. The public sector monitors this bottom line. Will banking and mobile telephone regimes, adopting elements from the NFC niche, continue to comply with the privacy values embedded in regulations? Hence, the governance task is to enforce privacy regulations rather than to create protected space for experimentation.

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