

Paper no. 2009/07

Public Procurement of Innovation Diffusion: Exploring the Role of Institutions and Institutional Coordination

Max Rolfstam (maxr@sam.sdu.dk)
University of Southern Denmark

Wendy Phillips
University of Bath

Elmer Bakker
University of Bath

WP 2009/07

Public Procurement of Innovation Diffusion: Exploring the Role of Institutions and Institutional Coordination

Rolfstam Max; Phillips Wendy and Bakker Elmer

Abstract

The role of the public agency as a pacer of private sector innovation has been emphasised over the recent years, especially in the context of the EU. The general ambition has been to encourage public agencies to actively stimulate private sector innovation by requesting innovation instead of procuring currently existing products. This has also triggered an increased interest among researchers and practitioners to identify examples of best practice where public agencies have successfully procured innovation. Rather than addressing this demand-oriented perspective this paper focuses on the public agency as an adopter of private-sector innovation, and how this mechanism can contribute to innovation in general. The theoretical point of departure is diffusion theory, with an emphasis on the role of institutions as identified in systemic approaches to innovation studies. A particular concern of this paper is those institutions that hinder or enable adoption of an innovation in an organisational context. The paper draws on an explorative case study looking at the introduction of a new catheter into the English National Health Service supply chain and its diffusion among NHS trusts in England. Different institutional factors are identified which have had an affect on the adoption and diffusion.

Keywords: public procurement, innovation diffusion, institutions, England.

Disclaimer: All the opinions expressed in this paper are the responsibility of the individual author or authors and do not necessarily represent the views of other CIRCLE researchers.

Public Procurement of Innovation Diffusion: Exploring the Role of Institutions and Institutional Coordination

Max Rolfstam¹, Wendy Phillips², Elmer Bakker²

Abstract

The role of the public agency as a pacer of private sector innovation has been emphasised over the recent years, especially in the context of the EU. The general ambition has been to encourage public agencies to actively stimulate private sector innovation by requesting innovation instead of procuring currently existing products. This has also triggered an increased interest among researchers and practitioners to identify examples of best practice where public agencies have successfully procured innovation. Rather than addressing this demand-oriented perspective this paper focuses on the public agency as an adopter of private-sector innovation, and how this mechanism can contribute to innovation in general. The theoretical point of departure is diffusion theory, with an emphasis on the role of institutions as identified in systemic approaches to innovation studies. A particular concern of this paper is those institutions that hinder or enable adoption of an innovation in an organisational context. The paper draws on an explorative case study looking at the introduction of a new catheter into the English National Health Service supply chain and its diffusion among NHS trusts in England. Different institutional factors are identified which have had an affect on the adoption and diffusion.

1. Introduction

The research reported in this paper ultimately aims to contribute to knowledge relating to how the public sector can stimulate or pace (Gregersen, 1992) private sector innovation. In an economy characterised by global competition, it is commonly agreed that innovation is critical for our future prosperity. In line with this perception, the role of public procurement as a means to stimulate private sector innovation has been increasingly emphasised in the last decade (Edler et al, 2006). This understanding is evident at the European level where public agencies have been described as "big market players" which "have powerful means to stimulate private

¹ Sønderborg Participatory Innovation Research Centre, University of Southern Denmark, Alsion 2, DK 6400, Sønderborg, Denmark E-mail: maxr@sam.sdu.dk

² Centre for Research in Strategic Purchasing and Supply, School of Management, University of Bath, Bath, BA2 7AY United Kingdom

investment in research and innovation” (European Commission, 2005, p. 8). In UK, initiatives are already in progress to make government “a smarter customer” where stimulating private sector innovation is a central theme (Department of Trade and Industry, 2004, p.11). It has been estimated that public procurement contributes to around 16 % of European GDP (EC, 2004). For some countries, UK for instance, and in some market areas e.g. medical equipment, the share might be even bigger. This means that the public sector constitutes a purchasing power that, if managed accordingly, could positively affect innovation.

Acknowledging the latent potential in public procurement the demand side of innovative public procurement has been emphasised (see e.g. Rolfstam, 2005, Edler & Gerghiou, 2007). The issue that relates to the general theme running through this paper is how public agencies adopt emerging private sector innovations. As a complement to the prevailing focus on developmental technology procurement (Edquist et al, 2000, p. 21) this paper tries to add to existing literature by emphasising the role of adaptive public technology procurement of goods and services. In the light of the often mentioned public purchasing power (e.g. Borg, 2003), and the perception that “without diffusion, innovation have little social or economic impact” (Hall, 2005, p. 459) the objective of this paper is to study further how a large public agency adopts private sector innovations. Following from an institutional approach on innovation studies, as will be developed below, the focus is on how institutions may affect diffusion processes within organisations. This is further justified in the perception that “[c]ompared with other aspects of diffusion research... there have been relatively few studies of how the social or communication structure affects the diffusion and adoption of innovations in a system” (Rogers, 1995, p. 25).

The empirical material included in the paper consists of an explorative case study of an attempt by the English National Health Service (NHS) to procure and diffuse a new catheter throughout its Trusts.

2. Theoretical Background

Public Procurement occurs when a public agency purchases goods and/ or services from an outside body (c.f. Arrowsmith, 2005, p. 1). The goods and services may be either regular, off the shelf-products or innovative products which have been delivered as a result of development carried out by the supplier (Edquist et al, 2000). The literature discussed in the following sub-sections reflects the interest of the latter, i.e. public procurement as a means to stimulate innovation and diffusion.

2.1 Public Procurement and Innovation

To use public procurement indirectly as a means to implement other policies what Arnould (2004) refers to as secondary policies (Arnould, 2004), is far from a new phenomenon (McCrudden, 2004). For example, recent research concerns the role of public procurement in relation to market creation (Caldwell et al, 2005) and how sustainable procurement may stimulate supplier-innovation in sustainable technologies (Walker et al, 2006). Public procurement has also been used to adopt digital technology in hearing aids in England (Phillips et al, 2006). The public sector also applies a de facto technology policy through procurement and first use of

innovations (Dalpé et al, 1991). Regarding innovation specifically, a public agency can influence demand by direct procurement, acting as a proxy customer (e.g. by creating standards) or as a linkage creator between suppliers and users (Rothwell, 1994). The demand-side approach, i.e. where “a public agency places an order for a product or system which does not exist at the time, but which could probably be developed within a reasonable period” (Edquist et al, 2000, p. 5) also suggest that public technology procurement may be a useful tool to stimulate innovation. The neglect of using public procurement in this way, and the need for resurrecting it as a means to stimulate innovation has recently been acknowledged (Edler and Georghiou, 2007).

The position taken here, as argued by Uyerra and Flanagan (2009), is that the application of public procurement as a means to stimulate innovation involves not only public technology procurement where “a public agency places an order for something which does not exist at the time” (Edquist et al, 2000, p. 5). One example of such a different situation is when private sector suppliers approach public procurers with unsolicited offers of new innovative products. This goes beyond the process of public technology procurement as defined above. In order to fund future innovations, suppliers need to secure returns of investment in research and development. In sectors dominated by the public sector, suppliers offering unsolicited innovative products or services may be dependent on public agencies ability to adopt innovation. In that sense, public sector adoption of innovation may be critical for stimulation of innovation in a long-term perspective. Thus, by emphasising this other aspect of public procurement, this paper sets out to further explore and essentially expand the understanding of public procurement in relation to innovation.

2.2 Innovation, Diffusion and Adoption

To provide a theoretical platform a discussion on the relationship between diffusion, adoption and innovation is necessary. These concepts are to some extent overlapping as they all capture aspects relevant for the purposes of this paper. An innovation may be seen as an invention that becomes commercially successful on a market, i.e. adopted and then diffused by users. An innovation may also be incrementally altered over its diffusion time, i.e. exposed to post innovation improvements (Coombs et al, 1987, p. 130), which might affect the diffusion curve. In that sense diffusion and innovation are interlinked. It may sometimes be hard to conceptually distinguish between diffusion and adoption as both these concepts to large extent try to capture how an innovation is received. One way of attaining such a distinction is to regard the former as the study on aggregate level, e.g. on a sample of firms or adopting units among which adoption would take place. Adoption studies understood in this perspective focus on the individual unit, e.g. a person and try to further understand the individual adoption behaviour (Lissoni and Metcalfe, 1996). Still both concepts capture adoption behaviour in relation to a certain innovation.

Diffusion has been at least implicitly taken into account in research on technological development and economic progress since the days of Joseph Schumpeter. The methods originally came from social sciences other than economics or innovation studies (Lissoni and Metcalfe, 1996). Typical diffusion studies conducted in the 1960s were devoted to evaluation of development programs in agriculture, family planning,

public health and nutrition in Latin America, Africa and Asia (Rogers, 1995). Up to the end of 1970s diffusion research typically dealt with single products displayed in s-curve diagrams (ibid, 1995). Modern diffusion research is less focused on diffusion curves but has taken into account that diffusion is affected by other technologies and other social or economic developments. Compatibility, interrelatedness and co-development are themes in this multi-technology perception of diffusion (Lissoni and Metcalfe, 1996). There is also a vast variety of literature dealing with diffusion issues in health service organisations (Greenhalgh et al, 2004).

When diffusion is studied, three elements are considered in the analysis. These are “the innovation which diffuses, the population of potential adopters and their process of decision making” (Coombs et al, 1987, p. 121). For the purposes of this paper, innovation is defined as “an idea, practice, or object that is perceived as new by an individual or other unit of adoption” (Rogers, 1995, p 11). Diffusion then, is this idea, practice or object “communicated through certain channels over time among the members of a social system” (Rogers, 1995, p. 5.) The ‘newness’ in this context is connected to the decision to adopt a certain innovation. An innovation might be known by adopters prior to adoption. It has to be known in order to eventually become adopted. It is also likely that the innovation has “at least some degree of benefit for its potential adopters” (Rogers, 1995, p. 13). Given the newness of an innovation, it is also accompanied by uncertainty. The decision to adopt an innovation is generally determined by how it is perceived by adopters.

Some characteristic features of diffusion and adoption processes occurring within organisations need to be further discussed. To do so, the starting point is Roger’s definition of a social system. According to this author, a social system is defined as “a set of interrelated units that are engaged in joint problem solving to accomplish a common goal” (Rogers, 1995, p. 23). Units of such a system may be individuals, informal groups, organisations, and/or subsystems (ibid, p. 23). There are some fundamental differences between, for instance, individual consumers’ adoption of an innovative end-consumer product and an innovation adopted by an organisation. Following Rogers (ibid), individuals within an organisation may sometimes not be able to adopt an innovation before the organisation, i.e. somebody with authority over the organisation, has decided to do so. Also, the decision made by an organisation to adopt a certain innovation does not by necessity mean that an individual within the organisation will do so directly. In other words, the decision whether or not to reject or adopt an innovation is not as straight-forward in an organisational context as it might be elsewhere. These special characteristics of adoption of innovations within organisations make it a “much more complex” (Rogers, 1995, p. 371-372) process.

2.3 Institutions

The focus of this paper is not so much on the decisions per se as determinants of diffusion and adoption of an innovation in a social system. Rather, as emphasised by systemic approaches to innovation studies (Dosi et al, 1988; Lundvall, 1992; Edquist and Johnson, 1997; Hollingsworth, 2000), the interest here rests on the assertion that institutions need to be taken into account. If innovation is understood as a social process characterised by interaction institutions might be understood as “the rules of the game in a society... that shape interaction” (North, 1990, p. 3) or as “sets of

habits, routines, rules, norms and laws, which regulate the relations between people and shape human interaction” (Johnson, 1992, p. 26). Institutions can also be regarded as “systems of established and prevalent social rules that structure social interactions” (Hodgson, 2006, p. 2). From an institutional perspective, the decision whether or not to adopt or reject an innovation will be treated analytically as institutionally determined. Understood in that sense, institutions may work as enablers of innovation. It may also be the case, as will be developed further below, that institutions can work as barriers to innovation.

Institutions manifest on different levels in society. Super-national law such as the EC Directives on Public Procurement, transpositions of these laws into national public procurement law, specific directives and policies for specific public agencies, endogenous institutions or rationalities (c.f. Gregersen, 1992) among potential suppliers or collaborators, individual habits and values are all examples of institutions relevant for analysis of public procurement of innovation. Probably this institutional diversity is the reason for the lack of consensus among scholars on what is meant by institutions or institutional analysis (Hollingsworth, 2000; Edquist and Johnson, 1997) and also the reason why “there is a difficult road ahead before institutions can be weaved into a coherent theory of the determinants of economic performance” (Nelson and Sampat, 2001, p. 32). Acknowledging the plethora of approaches and perspectives on institutional analysis some authors have attempted to order the institutional landscape. Some talk about institutional hierarchies (Edquist, 1997; Coriat and Weinstein, 2002) while Hollingsworth (2000) settles with attempts to order institutions based on the degree of permanence and stability. One important reflection which comes from these perspectives concerns the multifaceted way in which the institutional landscape affects innovation. A study of how institutions affect innovation or adoption “must engage in configurative analysis, recognizing that actors are not coordinated or governed by a single type of institutional arrangement” (Hollingsworth, 2000, p. 605).

An adequate starting point for an institutional analysis is the insight that the existence of institutions is fundamental for any advanced society. Institutions reduce uncertainty and release cognitive and other resources. The reason why an institution exists is that it is somehow beneficial for its endorers. Without institutions, any man-performed activity would require problem solving and decisions making about what to do and what to do next that would hinder any more advanced action from being performed. Institutions as, for example, language, technical standards, what side of the road one should drive etc. work as informational devices that “make it unnecessary to start life from scratch every day” (Johnson, 1992, p. 25). This implies in principle that a social system without institutions is not thinkable. Without institutions a social system would not be able to accumulate knowledge, or enable communication and therefore unable to sustain cumulative innovation.

This also means that endorsement of any institution and the mere existence of it can be understood from an evolutionary perspective, i.e. that institutions exist because of historical success. This refinement process is visible for instance in the development of formal institutions such as the law regulating public procurement. Since the 1970s two major revisions of the EC Public Procurement Directives have taken place, one in the early 1990s and one in 2004 (European Commission, 2008). In that sense, institutions typically evolve slowly and reactive and therefore tend to lag behind

technical change. This may lead to mismatch problems “which prevent the full realization of the productivity potentials of technical innovations, which forestall the reallocation of resources and efforts from mature to emerging technologies, and which generally favour established technological trajectories to new ones” (Edquist and Johnson, 1997, p. 55). From this follows that institutions may also sometimes act as barriers preventing diffusion of innovation. This line of thinking raises a need to also consider the institutional aspect of introducing an innovation into an organisation – i.e. what some authors refer to as institutional coordination.

One unfortunate tendency in current institutional analysis of innovation is that it typically tends to be limited to formal institutions, i.e. the legal and regulatory framework associated with a given innovation process. Although some authors acknowledge that the concept is much broader in scope (Edquist and Johnson, 1997; Hollingsworth, 2000), empirical innovation research taking into account that institutions may exist on different levels are rather scarce. For instance, within research interested in how institutions may affect possibilities for public procurement of innovation, the main focus has been on the legal frameworks as stipulated by the European Directives on Public Procurement (Edquist, Hommen and Tsipouri, 2000; Nyholm et al., 2001). The argument brought forward in this paper is that it is very problematic to make any general statements based on formal institutions only. Empirical research also suggests that in order to provide an adequate understanding, also other institutional levels need to be taken into account (Rolfstam, 2007).

Here, the work of Coriat and Weinstein is a useful starting point. These authors distinguish between Type 1 and Type 2 institutions. The former type “is based on the criteria of authority and enforcement and posed on all the agents” (ibid., p. 283). These are typically formal laws that apply to everyone and cannot be waived (ibid., p. 282), i.e. institutions that traditionally have been emphasised in the innovation literature. Type 1 institutions also include an enforcement system that punishes any violation of the institutions. Type 2 institutions are the rules that individual agents decide to give themselves; they are “‘private’ collective agreements between groups of agents” (ibid., p. 283). Furthermore, these authors take into account institutional lifetime. They distinguish between Type A and Type B institutions where the former refers to long lasting institutions regulating reproduction of the society as a whole, whereas type B institutions are fixed in time.

Also work by Jacoby, where the distinction is made between exogenous and endogenous institutions, respectively, is relevant (Jacoby, 1990). Exogenous institutions affect organisations from outside. They are imposed on organisations with little or no control from the organisation itself. Endogenous institutions typically evolve within organisations, and may also change as a result of learning within the organisation. The notion of endogenous institutions includes institutions codified in organisation specific policies or work instructions, and contracts. Understanding organisations (or sub-units within a large organisation) as developed through distinct evolutionary processes (Nelson and Winter, 1982), suggest also that organisations develop a unique set of endogenous institutions, i.e. a unique endogenous institutional set-up. One organisation may have elements in its institutional set-up that may prevent diffusion of a certain item. An innovation new to an organisation may or may not be institutionally matching with e.g. existing technology and already adopted standards, established ways of working, perceived values, strategic decisions,

rationalities, or established budgets. Thus certain endogenous institutional elements may act as barriers to diffusion of innovations into an organisation.

2.4 Institutional Coordination

Innovation theory based on institutional perspectives brings coordination and the coordinative functions of institutions at front. Research on innovation processes and systems points to “tension or mismatch between different kinds of designed institutions that often represent different levels of policy-making” (Edquist et al. 1998, p. 38). Also Lundvall and Borrás (2005, p. 627) raise a concern for “how to coordinate policies affecting innovation”. Further, systemic approaches generally recognize the importance of complementarity within systems and therefore emphasize the importance of policy coordination – for example, “the coordination of support for R&D with support for ... other kinds of learning, which operate through different mechanisms” (Edquist et al. 2001, p. 155). One of the general policy implications of systemic approaches is that it is important “to integrate and co-ordinate policy areas like R&D policies, educational policies, regional policies, and even macro-economic policies when formulating innovation policies” (Edquist, 2001, p. 230).

Metcalf (1995) has highlighted the issue of coordination in contrasting conventional or optimising approaches with evolutionary and systemic or adaptive approaches to innovation policy-making. In the optimising approach, which is informed by equilibrium economics, the “favourite metaphor ... is of the policy maker as a fully informed social planner who can identify and implement optima” for altering incentive schemes in order to change the behaviour of economic actors and thereby correct situations of market failure where “social and private welfare [are] out of step” (ibid. p. 30). In contrast, the adaptive approach, based on evolutionary economics, does not presume “that the policy-maker has a superior understanding of market circumstances or technological information; rather what s/he does enjoy is a superior coordinating ability across a diverse range of institutions” (ibid. p. 31). It follows that ‘superior coordinating ability’ must be harnessed to the cause of regenerating the diversity fundamental to economic progress by promoting and supporting ‘experimental behaviour’ on the part of economic actors. In line with this thinking comes also a preference for appreciative policy making rather than strictly scientific (Lipsy and Carlaw, 1998).

Public procurement of innovations is one of the policy instruments through which these purposes may be accomplished. In practice, however, the coordination of different actors and activities in relation to a specific policy instrument such as this is very likely to require effective coordination among different institutions. As stressed by both the Varieties of Capitalism (Hall and Soskice, 2001) and Business Systems (Whitley, 2002) approaches to the study of national differences in innovation performance, co-ordination of innovative activities is governed by the ‘institutional environment’ and achieved through reliance upon institutions as ‘co-ordination mechanisms’. Thus, understanding how the institutional set-up affects innovation processes involves detailed analysis of the interplay between different kinds of institutions conceived as coordination mechanisms or governance structures - as discussed, for example, by Hollingsworth (2000). It follows that empirical studies addressing the coordination of institutions of this kind coordination are necessary in

order to round out an institutional innovation policy perspective on the public procurement of innovations.

Public procurement can be regarded as a coordination tool in itself as it may be used to overcome institutional barriers and system failures (Edquist et al, 2000; Klein Woolthuis, Lankhuizen and Gilsing, 2005). This has for instance been applied with some success by Swedish public agencies in stimulating innovation in energy efficient technologies (Olerup, 2001) and also on the international level (IEA, 2000). On the other hand, coordination might also be necessary to sustain successful public procurement of innovation. In other words, if institutional barriers are not negotiated, projects involving public procurement of innovation may have to be terminated without rendering the intended result (Rolfstam, 2007). Institutional coordination may involve “developing, mobilizing, and coordinating competence among multiple buyers” (Hommen and Rolfstam, 2009, p. 27) in collaborative procurement projects. It may also involve institutional coordination more specifically targeting the diffusion of an innovation, which is the aspect given attention to in this paper. Central for such coordination are those institutions residing within organisations, i.e. endogenous institutions.

2.5 Summary and research question

The literature surveyed in the previous sections supports an understanding of innovation as a social process characterised by interactive learning guided by institutions. The perspective developed also underscores the linkages between innovation, diffusion and adoption necessary to take into account for understanding how innovations are diffused, for example, within organisations. In this perspective institutional coordination may be required to negotiate prevailing institutional barriers that may otherwise prevent diffusion of innovations. An institutional understanding of innovations raises a concern for institutional coordination in relation to enable innovation. In the innovation literature there is however a tendency to confine to formal or exogenous institutions such as national law and as a consequence fail to take into account other institutional levels that may also affect innovation. This narrow-minded focus on exogenous institutions may have negative consequences for institutional coordination, if coordination follows such an exogenous template, as barriers on endogenous institutional levels may be ignored.

To justify further arguments of precaution against institutional coordination based on an exogenous institutional understanding only, this paper sets out to explore the institutional interplay and how it affects innovation diffusion. The research question addressed here is formulated as follows. How may coordination (or the lack thereof) among different kinds of institutions affect performance in public procurement of innovations?

3. Method

The empirical work drawn on in this paper consists of a case study (Yin, 1994). Research design, data collection and analysis for the case study are summarised in the following subsections.

3.1 Research Design

The case discussed in this paper was identified in the context of a study conducted in England and Sweden in 2006 involving multiple cases of public procurement. The study distinguished between three categories of public procurement projects, those that lead to innovation, those that involved procurement of mainly regular or off-the-shelf goods, and a third category; public procurement projects that could have been innovative should some factors have been in place. Falling into the latter category, this case was selected through purposeful or theoretical sampling, i.e. chosen to fill a theoretical category (Eisenhardt, 1989, p. 537). One of the objectives with the study was to compare different cases in the categories and eventually try to understand what causes public procurement projects to become innovative. Three public “sub-sectors” were selected, the health sector, national level procurement and local (municipality) procurement. Other branches of the public sector were excluded, e.g. the education sector as well as the military sector. Although indeed interesting as a stimulator of innovation, the military sector was excluded partly because of a perceived access problem and partly because the military sector operates under slightly different institutional conditions than civil public procurement. One selection criteria was the judged possibility to gain access to interview persons and data. In the English case such access was secured through the rich network of practitioners connected to the research environment at the Centre for Research in Strategic Purchasing and Supply (CRISPS).

For each of the selected sectors, a centrally positioned person likely to possess the relevant knowledge of the particular public sector was identified. This person was asked to identify one case for each category in the model. In the health sector the Director of Policy and Innovation at NHS PASA played this role. The current case was identified as belonging to the third category, i.e. public procurements that ‘could have been innovative should some factors had been in place’.

3.2 Data Collection

One strength associated with case studies is that it allows the use of a variety of sources (Denscombe, 1998). Yin (1994) lists six sources of evidence that might be used in case studies, documentation, archival records, interviews, direct observations, participant observations and physical artefacts where the three first-mentioned were drawn upon here. Examples of documentation and archival records consulted were policy reports from e.g. Department of Health, or different agencies within NHS, and academic literature such as reviews of research on the effects of silver coated catheters.

In general, interviews can be carried out with different degrees of openness. They can be of an open-ended nature, i.e. where a respondent is prompted to share quite freely his or her knowledge, opinions and propositions of the matter being studied. On the other hand, interviews can also be carried out in a quite restricted and formal way in terms of the sampling procedures used and questions asked. The interviews carried out in this case study are semi-structured, belonging somewhere in between ‘open-ended’ and ‘focused’ (Yin, 1994, p. 84) on this continuum. This means that questions are prepared in advance and it is expected that each interview will generate

corresponding answers to these questions as far as they are applicable. It also means that the interviews will be carried out in an open-minded and conversational manner where it is also strongly recommended to make use also of additional information provided by the respondent that goes beyond the questions. By doing so, the interviews might provide additional information of interest to the case. As part of the preparation, a case study protocol was developed. A cover letter to be sent to interviewees was also developed.

Six persons contributed with data either through face-to-face interviews, telephone interviews or email communication. The way data was collected and informants searched for and selected resembled, once the case was identified, with conceptually-driven sequential sampling (Miles and Huberman, 1994, p. 27). This means that the selection of interviewees was purposive, rather than random. Interviewed people were procurement practitioners involved in the process to procure the new catheter, members of the Rapid Review Panel, representatives for the supplier, Bard Ltd in England and staff at the Department of Health. All interviews were recorded and transcribed.

3.3 Analysis

The analysis uses applicable parts of the four elements that determine a diffusion process, as described by Rogers (1995). What has been included in the analysis is a selection of concepts used in a sensitizing way rather than a complete application of the entire framework. For instance, one element in the diffusion process is time. It is far too early to collect data about the full diffusion process as it has not yet have had the time to happen.

Following Rogers (1995) the diffusion process is determined by the character of the innovation per se; the communication channels by which information about the innovation is communicated; time under which adopters go through a process that may lead to the decision adopt the innovation; and the social system, individuals, groups or organisations that are engaged in “joint problem-solving to accomplish a common goal” (ibid, 1995, p. 23). The characteristics that determine the diffusion of the innovation is determined by 1) *the relative advantage of the innovation*, i.e. to what degree the innovation is perceived as better than the item it supersedes; 2) *the compatibility of the innovation*, i.e. to what degree the innovation is perceived as consistent with existing values, past experiences and needs of potential adopters; 3) *complexity*, i.e. to what degree the innovation is perceived as difficult to understand and use; 4) *trialability*, i.e. to what degree it may be tested on a small scale before the decision whether or not to adopt the innovation is made; 5) *observability*, i.e. to what degree the results of the adoption are visible to others.

The criteria briefly discussed in the previous paragraph are essentially elements dealing with information and information processing, i.e. a matter of cognitive coordination (Coriat and Weinstein, 2002, p. 276). With an endogenous institutional approach on how public agencies adopt innovation comes the interesting question of how adoption may be propelled or hindered because of institutions typically prevailing within organisations. Such institutional elements may manifest as internal rules, formal power structures, work descriptions, assigned budgets, contracts,

incentive structures etc. may affect to what extent information is utilised by individuals. Therefore, as a second step, the analysis will focus on the identification and discussion of the endogenous institutions and their role in preventing or enabling diffusion of innovation.

4. Innovation Diffusion in a Large Health Organisation

This section starts with an introduction of the case, sections 4.1 and 4.2, followed by a discussion on the characteristics of the innovation to be diffused in section 4.3. In section 4.4 different procurement framework agreements are discussed. Section 4.5 describes an exogenous institution affecting the diffusion of innovation. Section 4.6 concludes with a discussion on endogenous institutions and diffusion.

4.1 Setting the Scene

The National Health Service (NHS) was established after the Second World War to provide health care for everyone resident in the UK and is today one of the largest organisations in the world employing roughly 1.3 million people (Lister, 2004). The cost of running the NHS is estimated to £100 billion and financed entirely by tax money. Although private health care exists, 92% of the population rely on NHS care (Wikipedia, 2008). NHS consists of an array of different health care providers and administrative functions. The health care providers are organised in different types of trusts; e.g. Primary Care Trusts, NHS Hospital Trusts (or Acute Trusts), or NHS Hospitals. NHS falls under the jurisdiction of the Department of Health. Under the Department of Health is the NHS Purchasing and Supply Agency (PASA). NHS PASA used to perform public procurement for the benefit of NHS health care providers. Nowadays this organisation has been given a more strategic role regarding public procurement. The purpose with this organisation is “to ensure that the NHS in England makes the most effective use of its resources by getting the best possible value for money when purchasing goods and services” (NHS PASA, 2008). Since 2006, central public procurement is managed by the NHS Supply Chain under the NHS Business Services Authority. As will be further developed below there are several channels for which suppliers can use in order to diffuse their products into the NHS organisation. These different supply routes also have different institutional characteristics that may affect diffusion within the organisation.

4.2 Public Procurement of a Solution

This case concerns the problems with Catheter Associated Urinary Tract Infections (CAUTIs) and can be seen as a special chapter of the general issue of combating infectious diseases, which has been a challenge for health care agencies globally through out history. In the last decades of the 20th century one specific area emerged as particularly problematic in UK. This was the increasing problems with health care associated infections or as it used to be called, hospital acquired infections, i.e. that infections were transmitted to patients seeking care at NHS facilities. Four major problematic areas are infections of the urinary tract, surgical-wound infections, lower-

respiratory tract and skin infections (Emmerson et al, 1996) where the most common of these are urinary infections (see also Department of Health, 2003). Thus, in 2002, health care associated infection were identified as “a major problem for the NHS” (Department of Health, 2002, p. 62) and therefore listed as one of the key areas that should be prioritised in order “to combat the present as well as the possible future threat posed by infectious diseases” (ibid, p. 22). Apart from suffering imposed on individual patients, health care associated infections are also costly for the health care system. Costs for these infections have been estimated to £930 million per annum in England, where £124 million are imposed by urinary tract infections (Plowman et al, 2001).

Many factors drive the increase of healthcare associated infections. Factors are for instance the increased number of patients with severe illnesses in the health care system as patients in worse condition become more vulnerable to infections; but it can also be therapeutic factors, i.e. that indwelling catheters need to be used to help curing patients; organisational factors, e.g. poor staff to patient ratio; or behavioural factors such as poor compliance with hygiene standards (Department of Health, 2003). Guidelines have also been developed to address these areas (Pratt et al, 2007). These guidelines are also made accessible to NHS employees through an award-winning e-learning project (Pratt and O'Malley (2007)). The interest in this paper concerns another element that may contribute in the battle against healthcare associated infections, namely adoption of new technology. In general, promoting the adoption of innovation within organisations appears to be a rather underdeveloped area and is still listed under ‘Areas for Further Research’ (Pratt, et al, 2007).

4.3 Adoption Characteristics

The implicit basic concern in diffusion studies is adoption rate. Following Rogers, adoption rates are determined by characteristics which are related to the innovation per se; its *relative advantage*; the degree of which it is *compatible* with existing structures; its *complexity*; its trialability; and *observability* (Rogers, 1995). In this section this framework is drawn upon to discuss the current case.

In order to increase adoption an innovation needs to have a *relative advantage* to the idea it is potentially about to supersede. The innovation in this case was the Bardex IC silver alloy coated hydrogel catheter, supplied in UK by Bard Ltd. This was a catheter originally developed and sold on the US market. What distinguished the Bardex catheter from conventional catheters were anti-infective properties achieved through the silver coating used (c.f. NHS PASA-CEP, 2006). The supplier had provided information about the scientific background of the product, the evidence that showed it had antibacterial properties and then the most important factor in terms of implementation in a health setting, evidence that using it in certain population groups would actually reduce the number of health care associated infections.

In this case, the relative advantage can be understood from the general problem described above, i.e. how to decrease the incidence of CAUTIs. Approximately 40% of all hospital-acquired infections are catheter associated urinary tract infections (Davenport and Keeley, 2005, p. 298). In this regard the role of medical devices “is emphasised by the 80% of urinary infections that are traced to indwelling urinary

catheters” (Department of Health, 2003, p. 8). Several attempts have been made to use certain substances on catheters to prevent bacterial colonization of internal and external surfaces of catheters (Davenport and Keeley, 2005). The relative advantage with the Bardex silver coated catheter as compared to conventional catheters comes from the silver coating which reduce the risk of infection. A literature review of studies of the effects of using silver coated catheters concluded that “[s]ilver-coated hydrogel catheters reduce CAUTIs” (ibid, 2005, p. 302).

Compatibility with existing values, past experiences and needs of potential adopters is also important for the diffusion (Rogers, 1995). Although the silver coating of the Bardex catheter differs from conventional catheters and other attempted alternative solutions, the Bardex catheter is essentially a component innovation. It is used in the same way and in the same contexts as would conventional catheters and any special training for its use is not required of medical staff. The adoption of this innovation can take place without any systematic reconfiguration or alteration of architectural knowledge in the organisation (c.f. Henderson and Clark, 1990). In principle it is designed to solve the same problem as conventional catheters. Based on these arguments the Bardex catheter appears to concur with the compatibility requirements.

Closely related to compatibility requirement is *complexity*, i.e. the degree to which an innovation is perceived as difficult to understand and use. Following Rogers (1995, p. 16) innovations which are “readily understood by most member of the system” will be adopted faster as compared to innovations of greater complexity. As far as this study goes, nothing embedded in the technology per se suggests that the degree of complexity in the Bardex catheter should reduce the adoption rate to a great extent.

Following Rogers “the essence of the diffusion process is the information exchange through which one individual communicates a new idea to one or several others” (Rogers, 1995, p. 18). Information per se is however not necessarily sufficient for attaining a high rate of adoption. One must also take into account the social system and that “[t]he structure of a social system can facilitate or impede the diffusion of innovations in a system” (Rogers, 1995, p. 25). Following Savory (2009), NHS is an organisation strongly influenced by scientific ideals where ‘scientific facts’ or ‘evidence’ are elements which have implications for trialability and observability. As discussed by this author (Savory, 2009, p. 157), “[t]he cultural propensity for scientific knowledge leads to initiatives being led by scientific method... [and the] requirement for new practices to be rigorously tested...” before adopted in practice. In spite of available clinical evidence based on research conducted in the US, local adoption decisions required local rigorous testing and verification by, for instance results published by other health care centres in the UK. This means that diffusion within the NHS is different from e.g. end-consumer products, where trialability and observability can take place as rather informal events. In this sense, the scientific rigorousness can be seen as an institutional barrier that, if nothing else, slows down the diffusion pace.

4.4 Multiple Supply Routes

Within the NHS there is no stipulated route for the supply of consumables. Any single NHS trust may utilise supply routes as they find most appropriate. In principle (for the

purposes here) there are three routes for supply of consumables to a NHS hospital. Products can be ordered through an electronic ordering system, Logistics On-Line (LOL). The products that are in this electronic catalogue are supplied from one of the six regional stores managed by the NHS Supply Chain (formerly NHS Logistics). A second option is to order directly from a supplier through a framework agreement negotiated centrally. These products are available online through the NHS E-Cat. These orders are placed directly to the suppliers with a reference to the framework contract number, and the supplier will deliver directly to the specified address and invoice the Trust directly. It is also possible to order from contracts set up through public procurement on the local level. Similar to ordering from framework agreements provided centrally (managed earlier by NHS PASA and nowadays by the NHS Supply Chain), the supplier delivers to a specified address and invoice directly the Trust.

These three supply routes differ in terms of the administrative complexity. Procurement through the NHS Supply Chain is the most straightforward as it is simply about ordering from the LOL. Buying products included in the NHS PASA framework agreements as published in the E-Cat requires awareness of the specific contracts as well as interaction with the supplier and is therefore slightly more demanding and time consuming. The third option, to manage the complete procurement process locally, is the most complex, as it requires development of contract specification, going through award procedures to find suppliers, and in the case of framework agreements ordering products.

The default supply route for catheters into a NHS ward is through the NHS supply chain which is managed in a rather operational manner. For a nurse with responsibility for replenishing the stock of catheters on a ward, to order new catheter would be a routine task accomplished through the use of an electronic system. Deliveries come once a week in appropriate packages and the invoice will typically be handled by the supplies department at the hospital. A new alternative product that is not in the LOL system may face some difficulties to compete with existing products as it may be difficult to make people switch away from an easy supply route.

To order a product that is not in the system would possibly require the submission of a (paper) requisition and also interaction with the hospital's suppliers department. This would also probably require more time, especially if the order is about something that is different. It might be the case that the wanted product is on a framework agreement administrated by the suppliers department. This is however also a longer and a more complex process than just ordering from an electronic system.

The beneficial aspects of institutions as well as the potential for mismatch problems were discussed in the theoretical background above. From an institutional perspective there are obvious advantages with centrally procured framework agreements. From the perspective of the daily operations on a hospital ward for instance, supply of catheters would preferably take place as straight rebuys. These are routine transactions requiring a minimum of new information and consideration of new alternatives (Robinson et al, 1997). On the other hand, for a new product not in the systems and therefore more difficult to access, the same routines become an institutional barrier as they may reduce both trialability and observability for an innovation. The following paragraph discusses some attempts to break this barrier.

4.5 The Rapid Review Panel for the Bardex Catheter

In August 2004 the Rapid Review Panel was set up. Run by the Health Protection Agency on behalf of the Department of Health, the purpose with the panel was to encourage industry to come with ideas that would tackle the problems related to health care associated infection. The panel's task was to "assess new and novel equipment, materials, and other products or protocols that may be of value to the NHS in improving hospital infection control and reducing hospital acquired infections" (Health Protection Agency, 2006). It is up to companies to submit evidence that they have a product that has some new properties and that it will control or reduce infection.

One of the first products submitted to the Rapid Review Panel was the Bardex catheter. The Rapid Review Panel agreed that it was a good product, it was new, it had anti bacterial activity and that there were evidence that it would reduce the number of catheter associated infections if used in patients needing catheterisation for more than 48 hours. As one of very few products, the Bardex catheter received the top mark, i.e. the judgment was that it had "shown benefits that should be [made] available to NHS" (ibid, 2006).

As a response to the result of the Rapid Review Panel, NHS PASA "fast tracked" the Bardex catheter into the NHS Supply Chain. When the Bardex catheter was introduced in England 2002, initially the only supply route available was the most complex one, i.e. it was neither available on contract and neither was it in stock. When it became available from the NHS Supply Chain, in September 2005, roughly a year after the Rapid Review Panel had published their results, the use of the product increased. In 2006, about 30 NHS hospitals were using the Bardex catheter. The estimated market share for products in its range was at the time 2-3%. In USA the same catheter had a market share around 40%.

It should be noted that from a clinical point of view, the Rapid Review Panel had a strictly indicative function. The panel makes statements based on evidence taken into account whether or not a product does what it says it does, as reported from other studies. The panel does neither recommend nor provide mandatory directives whether or not to use a certain product. In the general case, the decision to use the Bardex catheter is made by clinicians. What did happen as a result of the panel's judgement was that the Bardex catheter was brought into the NHS supply chain by NHS PASA faster than it would have without the top grading given by the Rapid Review Panel. Without it, any clinician in a hospital championing the Bardex catheter would have had to go through the procurement process as discussed in section 4.4.

From an institutional perspective, the setting up of the Rapid Review Panel can be seen as an attempt to re-design the institutional set-up created by the NHS supply chain. From the perspective of the actual potential users of the catheter, the Rapid Review Panel was an exogenous institution (Jacoby, 1990). As will be discussed in the following also other institutional levels may be important to take into account. For instance, different endogenous (ibid, 1990) institutions may also affect the diffusion process.

4.6 The Role of Endogenous Institutions

In the first years of the diffusion process of the Bardex catheter, it prevailed among NHS clinicians, infection control staff and continence advisors scepticism about the evidence base. NHS staff did not necessarily subscribe to the view that the silver coating used on the Bardex catheter would help reducing health care associated infections. Although there is no sign of studies that challenge the general view that the Bardex catheter does what the supplier claims, the critique that has arisen concerns the limitations of the referred studies. As it seems, within the time frame of this study, the Rapid Review Panel's rather encouraging statement about the Bardex catheter did not in itself lead to increased speed of the diffusion process. The organised scepticism illustrates well the double aspect of institutions discussed by Coriat and Weinstein (2002). An institution work both as a constraint or as a resource (*ibid*, 2002, p. 283). The requirement for evidence of an innovative product's claimed properties is central to any organisation providing health care. From a diffusion perspective these requirements tend to work as a barrier for diffusion.

What is often emphasised as a significant element in diffusion processes is the role of innovation champions. These are typically "powerful individuals" (Rogers, 1995, p. 398) who promote the innovation within an organisation, or implementing leaders enabling collective learning (Edmondson et al, 2001). What has been suggested a problem in the case of catheters in general relates to the way catheters are used within health care organisations. As different from e.g. wound infections which much clearer falls under the responsibility of surgical units, the problems related to catheters are not as easily connected to a specific unit. Catheters are used in operating departments, in accident emergency services, post operatively, in any medical unit or ward. This means that ownership of the problem becomes less clear and the emergence of innovation champions specifically devoted to catheters is not promoted.

As was discussed above, the need for an innovation is central to diffusion. What seems to be common among the hospitals which early adopted the Bardex catheter is that within these organisations prevailed a clear perception of the need to prevent and control health care associated infections. In these hospitals clear business cases were developed displaying the current level of catheter associated infections, their cost, and the expected benefit from introducing the Bardex catheter. What also seems to be a common theme is that the decision to introduce the Bardex catheter for a hospital was often made centrally, perhaps by the overall financial budget holder for the whole organisation. Some of the hospitals that were among the first in England to introduce the Bardex catheter did that through an authority innovation-decision (Rogers, 1995, p. 372). While introducing the order codes for the Bardex catheter in the ordering system, they excluded the possibility to order traditional catheters.

One issue related to the diffusion of the Bardex catheter was also the problem of evaluating the economic benefits of using the product. Compared with traditional catheters, the Bardex catheter was more expensive. Studies indicated, however, that although the Bardex catheter would be more expensive per unit, it would still save money in the end, as it would reduce the risk for patients to contract health care associated infections, and avoid unnecessary hospitalisation. Arguing for using a new

catheter that is more expensive than the ones currently in use also touches upon a generic problem of public health care and the nature of 'saving' by improving health care. Although the use of the Bardex catheter might mean that unnecessary hospitalisation can be avoided, the savings are not clearly visible. The reason for this is because it is hard to measure the value of what is not spent. Also, what is unavoidable for new products is that independent studies of economic benefits are not available (Williams and Bryan, 2007). One way of attaining evidence of economical benefits is through historical studies of the same care unit, where comparison between usage of conventional catheters and Bardex catheters is possible (Rupp et al, 2004). It is however in the nature of such studies that they take time.

Another problem relates to the way budgets are organised. In some cases the potential benefits of the introduction of the Bardex catheter would not be visible in the budget affected by the increased spending on a more expensive catheter. Although total cost would be lower for the hospital, the incentives for a financial manager responsible for a budget to accept a cost without gaining anything would be low. Similar experiences have been made by other companies attempting to introduce innovations to the NHS. "[T]here is a major problem in gaining acceptance into the NHS due to budget silos – where the purchasing department bears the brunt of the cost while the savings are passed onto another department" (Levinson, 2006, p. 10). These problems related to the "separation of appraisal and resource allocation functions" have also been brought up by researchers (Williams and Bryan, 2007, p. 2127). Even if it would be possible to establish the economic benefits (supported in e.g. Rupp et al, 2004) from using Bardex catheters, it would still be impossible for a procurement department which has not been provided with the means to cover the excess cost associated with the adoption of Bardex catheter. One way of removing this barrier, which has been successfully attempted in hospitals, is to internally fund the increased cost. This means that resources are put aside to cover the extra cost associated with procuring the Bardex catheter with a higher per-unit price in order to save money due to reduction in total hospitalisation time.

In one sense also existing framework agreements work as institutional barriers. This is what following Coriat and Weinstein (2002) could be called a Type 2/ Type B (i.e. endogenous, fixed-term) institutional barrier, i.e. the time delay imposed on adoption decisions as resources are tied in current contracts. Even if an adopting unit would like to change catheter, they would generally wait until current contracts are about to be re-negotiated. One interviewee highlighted that the evaluation is not only about the Bardex catheter versus traditional catheters. In an economic organisation there might also be other priorities or potentially beneficial activities to consider that would improve the health service. This issue, more generally formulated, concerns the importance of de-spending. Even in situations where there are sufficient levels of evidence verifying that a new product is beneficial, the questions remains, what other item should be removed from the budget in order to allow for the introduction of the new (Williams and Bryan, pp. 2125-2126). In that sense, diffusion has its own version of creative destruction.

The institutional barriers encountered as well as some of the measures made to negotiate them are summarised in table 1 (below).

Institutional Barrier	Description	Coordination Activity Identified in the Case
Getting into the supply chain	A product available in existing supply systems will be favoured before products not available in existing supply systems.	Rapid Review Panel set up to evaluate solutions suggested by industry and “fast-track” into the supply chain, those found to be useful.
Organised scepticism	Clinical staff requiring a high level of proof before an innovation can be adopted.	N/A
No technology champion	In comparison to other health care technologies, there appeared to be no clear champion catheters.	N/A
Decentralised decision structure	A centrally made decision to make certain technologies available may not necessarily lead to adoption in lower layers of the organisation.	Authority innovation decision. Removing existing alternative option (conventional catheter) from supply chain.
Silo budgeting	Spending and gains from spending do not affect the same budget, which removes spending incentives.	Additional funds allocated by central hospital management to cover additional cost.
Price	An innovation may be more expensive per unit (although less expensive over its lifecycle) than already existing technology.	Additional funds allocated by central hospital management to cover additional cost.
Problems with demonstrating value of innovation	Problems in showing the value of innovation (and hence justifying adoption) never tried out before in a practical setting.	Conducting long-term historical studies. Development of business case.
De-spending	Although proof supports the value of innovation the question remains what should be removed from the budget, to allow the adoption of the innovation	N/A
Existing agreements with supplier of current technology	Commitments made in current contracts prevent re-allocating of resources.	N/A

Table 1. Institutional barriers to adoption identified and corresponding co-ordination activities.

5. Concluding Remarks

This paper adds to recent literature dealing with public procurement as a means to stimulate innovation – an endeavour justifiable in the light of the current interest among policy makers on how to use public procurement as a means to stimulate innovation. The paper focuses on a relatively neglected area, namely diffusion and adoption of innovations in public procurement. Theoretically, innovation and diffusion are seen essentially as a social process, determined by institutions, which may or may not enable diffusion. Therefore, institutional coordination may at times be necessary in order to achieve diffusion. Although the perception of institutions as elements working on different societal levels is well established in the literature there is however a tendency to limit institutional analysis of innovation to include only exogenous levels. The argument brought forward here is that also endogenous

institutions need to be taken into account as they too may act as barriers for innovation and diffusion. Similarly, endogenous institutions should also be incorporated in coordination and institutional re-design.

In the paper, some structures treated as institutional barriers inhibiting the diffusion of the Bardex IC silver alloy coated hydrogel catheter into the National Health Service are discussed. One such institutional barrier manifests in the necessity for a product to get into the NHS supply chain. If a product can be accessed through ordinary supply systems, this enables diffusion to a larger extent as compared to products that require additional administrative overhead in order to become supplied. Another requirement relates to organised scepticism concerning scientific evidence verifying benefits of an innovation. One view prevailing within the NHS was that the evidence was not sufficient in order to justify adoption. Also, in comparison to other health care technologies more directly connected to a specific medical speciality catheters lack a clear champion who would be willing to promote diffusion. The decentralised organisation structure of the NHS work as a barrier in the sense that a decision to adopt or reject a certain innovation typically is made locally and cannot be controlled centrally. Although the Bardex catheter was introduced at a higher price per unit than conventional catheters currently in use, the institutional problem concerned more the way budgets are organised rather than the price difference itself. Silo budgeting created disincentives for diffusion although evidence suggested that the Bardex catheter would be more efficient in the long run.

Several examples of institutional re-design and coordination were also discussed. One such measure was the establishment of the Rapid Review Panel. The approving results of the evaluation made by the Rapid Review Panel helped to reduce the time for the Bardex catheter to get into the NHS Supply Chain. As a response to the perceived deficiencies regarding evidence, several studies generating more evidence were conducted. Other actions discussed were the effort to make the problem of CAUTIs explicit to hospital management; development of clear business cases; making authority-based innovation-decisions; and reallocating resources to enable diffusion.

One conclusion that can be made from this specific case is that co-ordination and institutional re-design should be regarded as a central activity in public procurement of innovation. This means that definitions of public procurement of innovation should, in order to be useful, go beyond just including the moment where “a public agency places an order for something which does not exist” (Edquist et al, 2002, p. 5). The case also emphasise the role of institutions as barriers for innovation and diffusion, which makes diffusion more an issue concerning institutions than just simply a matter of information and decision. This is especially important to take into account when an innovation involves adopting units where the “common goal” may vary slightly (Rogers, 1995, p. 23), as can be expected in an organisation such as the NHS. Furthermore, in principle, all the institutional barriers discussed in this case belong to the endogenous level. This in turn justifies an understanding of institutional coordination and re-design where also endogenous levels should be taken into account.

Introducing new equipment in an organisation should involve not only an assessment of the new product’s actual technical capabilities. Economical considerations and

potentially other measures that can be used to create incentives that would enable diffusion in the organisation should also be taken into account. That is also a proposition that harmonises well with initiatives made to establish a Centre for Evidence Based Purchasing within the NHS Purchasing and Supply Agency. This is an organisation that was set up to “underpin purchasing decisions by providing objective evidence to support the uptake of useful, safe, innovative products...” (NHS PASA, 2006). Sufficient information about a new product’s benefits and evidence that would justify adoption from an economical perspective may still not be sufficient for successful diffusion. As pointed out here, also different institutional barriers may need to be identified and negotiated. As was brought up in the case, this may involve coordination of research and evaluation, fast-tracking new products in to the supply-chain and also overcome institutional barriers within the organisation.

Systemic approaches to innovation studies emphasise the interaction and feedback between elements such as research, invention, innovation and production (Kline and Rosenberg, 1986). This is essentially a critique against a linear view of how innovation occurs. There is also a tendency to neglect these characteristics in the diffusion of innovations. This paper provides a basis for challenging the view “that technological diffusion proceeds in an autonomous manner, guided efficiently and effectively by the invisible hand of the market...” (Alic, 2008, p. 23). Although information of an innovation may be available, different institutional barriers may inhibit further diffusion within an organisation (c.f. Edquist and Johnson, 1997). The actions taken, the results rendered and the remaining barriers in the case studied here all point to the fact that diffusion of innovation cannot be dealt with in a linear fashion. Rather, it requires institutional coordination and design on many institutional levels in research, on the national level, within trusts, hospitals and the individual level in health care units. As demonstrated in the case discussed in this paper, also endogenous institutions need to be taken into account.

References

- Alic, John, A. (2008). A weakness in diffusion: US technology and science policy after World War II. *Technology in Society*. 30, 17-29.
- Arnould, J. (2004). Secondary Policies in Public Procurement: The Innovations of the New Directives. *Public Procurement Law Review*. 13, 4.
- Borg, Nils (Ed) (2003). *Harnessing the Power of the Public Purse*. Final report from the European PROST study on energy efficiency in the public sector. ISBN 91-631-3772-0
- Borrás, Susana (2004). System of innovation theory and the European Union. *Science and Public Policy*. 31, 6, December, 425-433.
- Caldwell, N., Walker, H., Harland, C., Knight, L., Zheng, J., Wakely, T. (2005). Promoting competitive markets: The role of public procurement. *Journal of Purchasing and Supply Management*. 11, 5-6.

- Coombs R., Saviotti P., Walsh, V. (1987). Economic and technological change. Macmillan.
- Coriat, Benjamin and Weinstein, Olivier (2002). Organizations, firms and institutions in the generation of innovation. *Research Policy*. 312, 273-290.
- Dalpé. R., DeBresson C., XXiaoping, H. (1992). The public sector as first user of innovations. *Research Policy*. 21, 251 – 263.
- Davenport K. and Keeley, F. X. (2005). Evidence for the use of the silver-alloy-coated urethral catheters. *Journal of Hospital Infection*. 60.
- Denscombe, M. (1998). *The Good Research Guide for small-scale social research projects*. Open University Press. Buckingham.
- Department of Health (2002). *Getting Ahead of the Curve. A strategy for combating infectious diseases*. <http://image.guardian.co.uk/sys-files/Society/documents/2003/12/05/idstrategy2002.pdf> (2007-02-13).
- Department of Health (2003). *Winning Ways. Working together to reduce Healthcare Associated Infection in England*. <http://www.dh.gov.uk/assetRoot/04/06/46/89/04064689.pdf> (2007-02-13)
- Department of Trade and Industry (2004). *Department of Trade and Industry five year program – Creating wealth from knowledge*. DTI/Pub 7613/0.5k/11/04/NP. URN 04/1871.
- Dodgson, M., Rothwell R. (1994). *The Handbook of Industrial Innovation*. Edward Elgar Cheltenham, UK, Brookfield, US.
- Dosi, Giovanni and Freeman, Christopher and Nelson, Richard and Silverberg, Gerald and Soete, Luc (1988). *Technical Change and Economic Theory*. Pinter Publishers, Londond and New York.
- EC (2004). *A report on the functioning of public procurement markets in the EU: benefits from the application of EU directives and challenges for the future* 03/02/2004. http://ec.europa.eu/internal_market/publicprocurement/docs/public-proc-market-final-report_en.pdf, 2007-02-16.
- Edler Jakob and Gerghiou, Luke (2007). Public procurement and innovation – Resurrecting the demand side. *Research Policy*. 36, 9, 949-963.
- Edler, J., Ruhland, S., Hafner, S., Rigby, J., Georghiou, L., Hommen, L., Rolfstam, M., Edquist, C., Tsipouri, L., Papadakou, M. (2005). *Innovation and Public Procurement. Review of Issues at Stake: Study for the European Commission*. Karlsruhe: Fraunhofer ISI.
- Edmondson, Amy C., Richard M. Bohmer, Gary P. Pisano (2001). Disrupted Routines: Team Learning and New Technology Implementation in Hospitals. *Administrative Science Quarterly*, Vol. 46, No. 4, pp. 685-716.

Edquist, Charles (2001). Innovation Policy - A Systemic Approach. In Archibugi Daniele and Lundvall, Bengt-Åke (Eds) The Globalizing Learning Economy. Oxford University Press.

Edquist, Charles (Ed) (1997). Systems of Innovation –Technologies, Institutions and Organizations. Pinter, London and Washington.

Edquist, C., Hommen, L., Tsipouri, L. (Eds.) (2000). Public Technology Procurement and Innovation. Kluwer Academic.

Edquist, Charles and Hommen, Leif and Johnson, B. and Lemola, T., Malerba F., Reiss, T. Smith K. (1998). THE ISE policy statement: The innovation policy implications of the 'Innovation Systems and European Integration' research project. Linköping, Sweden:Unitryck, University of Linköping Press.

Edquist, Charles and Johnson, Björn (1997). Institutions and Organizations in Systems of Innovation. In Edquist et al (1997)

Eisenhardt, Kathleen M. (1989). Building Theories from Case Study Research. The Academy of Management Review, 14, 4, Oct., 532-550.

Emmerson A. M., Enstone J. E., Griffin, M., Kelsey M. C., Smyth E.T.M. (2006). The Second National Prevalence Surevey of Infection in Hospitals-overview of the results. Journal of Hospital Infection, 32, 175-190.

European Commission (2008). The EU Single Market Fewer barriers, more opportunities
http://ec.europa.eu/internal_market/publicprocurement/legislation_en.htm#current
2008-02-25

European Commission (2005). Implementing the Community Lisbon Programme: More Research and Innovation – Investing for Growth and Employment: A Common Approach. COM 2005 : 488.

Fagerberg, J., Mowery, D., Nelson, R., (Eds.) (2005). The Oxford Handbook of Innovation.

Greenhalgh, Trisha and Glenn, Robert and Macfarlane, Fraser and Bate, Paul and Kyriakidou, Olivia (2004). Diffusion of Innovations in Service Organizations: Systemic Review and Recommendations. The Milbank Quarterly, 82, 4, 581-629.

Gregersen, B. (1992). The Public Sector as a Pacer in National Systems of Innovation. In Lundvall (1992).

Hall, B. (2005). Innovation and diffusion. In Fagerberg et al (2005).

Hall, Peter A. and David Soskice (2001). Varieties of Capitalism. The Institutional Foundations of Comparative Advantage. Oxford/New York: Oxford University Press.

- Health Protection Agency (2006). Rapid Review Panel
http://www.hpa.org.uk/infections/topics_az/rapid_review/default.htm (2006-10-17).
- Henderson and Clark (1990). Architectural Innovation: The Reconfiguration of Existing Product technologies and the Failure of Established Firms. *Administrative Science Quarterly*, 35, 1, 9-30.
- Hollingsworth, J. Rogers (2000). Doing Institutional analysis: implications for the study of innovations. *Review of International Political Economy*, 7:4, 595-644.
- Hommen, L. and Rolfstam M. (2009). Public Procurement and Innovation: Towards a Taxonomy. *Journal of Public Procurement*, Vol. 9, Issue 1.
- IEA (2000). Implementing Agreement on Demand-Side Management technologies and Programmes (2000): Final Management Report. Annex III: Co-operative Procurement of Innovative Technologies for Demand-Side Management EI 6:2000. International Energy Agency.
- Jacoby, Sanford M. (1990). The New Institutionalism: What Can It Learn from the Old? *Industrial Relations*, 29, 2.
- Johnson, Björn (1992). Institutional Learning. In Lundvall (1992)
- Levinson, Orde (2006). The Whiz Clean Catch The rocky road to marketing an innovative product into the NHS. *Procuring for Healthcare 2006 Investing in Innovation*, Hes Magazine June.
- Klein Woolthuis, Rosaline, Lankhuizen Maureen, and Gilsing, Victor (2005). A system failure framework for innovation policy design. *Technovation*, 25, 609 -619.
- Lipsey Richard G. and Carlaw Kenneth (1998). A structuralist assessment of technology policies – taking Schumpeter seriously on policy. Industry Canada Research Publications Program. Working Paper Number 25, October.
- Lisbon European Council (2000). Presidency Conclusions. March 23 and 24, http://www.uniovi.es/EEES/attachs/1080547066-1-PRESIDENCY_CONCLUSIONS_Lissabon.pdf (2005-01-04).
- Lissoni F., Metcalfe S. (1996). Diffusion of Innovation Ancient and Modern: A Review of the Main Themes. In Dodgson and Rothwell, 1994.
- Lister, Sam (2004). NHS is world's biggest employer after Indian rail and Chinese Army. *Timesonline* March 20.
<http://www.timesonline.co.uk/tol/news/uk/health/article1050197.ece> 2008-02-25.
- Lundvall, Bengt-Åke (Ed) (1992). *National Systems of Innovation. Towards a Theory of Innovation and Interactive Learning*. Pinter Publishers, London.
- Lundvall, Bengt-Åke and Borrás, Susana (2005). *Science, Technology and Innovation Policy in Fagerberg et.al. (2005)*.

McCrudden, C. (2004). Using public procurement to achieve social outcomes. *Natural resource forum*. 28, 257-267.

Metcalfe J. S. (1995). Technology systems and technology policy in an evolutionary framework. *Cambridge Journal of Economics*, 19, 25-46.

Miles, Matthew B. and Huberman, Michael, A. (1994). *Qualitative Data Analysis: An Expanded Sourcebook*. Second Edition. SAGE Publications. Thousand Oaks, London, New Delhi.

Nelson, Richard R. and Sampat, Bhaven, N. (2001). Making sense of institutions as a factor shaping economic performance. *Journal of Economic Behaviour and Organisation*. 44, 31-54.

Nelson R.R. & Winter S. G. (1982). *An Evolutionary Theory of Economic Change*. Harvard University Press, Cambridge.

NHS PASA (2006). Centre for Evidence-based purchasing.
<http://www.pasa.doh.gov.uk/evaluation/> (2006-10-20).

NHS PASA (2008). NHS Procurement
<http://www.pasa.nhs.uk/PASAWeb/NHSprocurement/AboutNHSPASA/LandingPage.htm> 2008-02-25.

NHS PASA-CEP (2006b). Evidence review Bardex IC Foley catheter. NHS Purchasing and Supply Agency, Centre for Evidence-based Purchasing. CEP 06001
http://www.hpa-midas.org.uk/documents/reports/Medical%20Devices/CEP_06001_Bardex.pdf.

North, Douglass, C. (1990). *Institutions, Institutional Change, and Economic Performance*. Cambridge University Press.

Olerup, Agneta (2001). Technology development in market networks. *Energy Policy*, 29, 169-178.

Phillips, W.E., Knight, L.A., Caldwell, N.D. (2006). Policy through Procurement- the introduction of Digital Signal Process (DSP) hearing aids into the English NHS *Health Policy* (Forthcoming).

Plowman R., N. Graves, M.A.S. Griffin, J.A. Roberts, A.V. Swan, B., Cookson, Taylor, L. (2001). The rate and cost of hospital-acquired infections occurring in patients admitted to selected specialities of a district general hospital in England and the national burden imposed. *Journal of Hospital Infection*, 47, 198-209.

Pratt R., J. and O'Malley, B., O. (2007). Supporting evidence-based infection prevention and control practice in the National Health Service in England. The NHS/TVU/Intuition Approach. *Journal of Hospital Infection*, 65, 52, 142-147.

Pratt R., J., C.M. Pellowe, J.A. Wilson, H. P. Loveday, P., J. Harper, S.R.L.J. Jones, C. McDougall, M.H. Wilcox (2007). epic2: National Evidence-Based Guidelines for Preventing Healthcare-Associated Infections in NHS Hospitals in England. *Journal of Hospital Infection*, 65, 52, S1-S64.

Robinson, Patrick J., Faris, Charles W., Wind, Youram (1967). *Industrial Buying and Creative Marketing*. Allyn and Bacon, Inc. Boston.

Rogers, Everett, M. (1995). *Diffusion of Innovations*. The Free Press. New York, London, Toronto, Sydney, Tokyo, Singapore Fourth Edition.

Rolfstam, M. (2007). *Organisations and Institutions in Public Procurement of Innovations: The Case of the Energy Centre in Bracknell Forest, UK* DRUID Winter Conference, Skorping, Aalborg, Denmark.

Rolfstam, M. 2005. *Public Technology as a Demand-side Innovation Policy Instrument - an Overview of Recent Literature and Events* DRUID Winter Conference Skoerping/ Aalborg, Denmark.

Rolfstam, M. (2007). *The Utilities Directive and How It Might Affect Innovation: The Case of Innovative Procurement of Maritime Radio Technology*. *Public Procurement Law Review* Issue 6, pp. 435-460.

Rothwell, R. (1994). *Issues in user-producer relations in the innovation process: the role of government*. *Int. J. Technology Management*, 9, 5/6/7.

Rupp Mark, E., Therseza Fitzgeralds, Nedra Marion, Virginia Helget, Susan Puumala, James R. Anderson, Paul, D. Fey (2004). *Effect of silver-coated urinary catheters: Efficiency, cost-effectiveness, and antimicrobial resistance*. *American Journal of Infection Control*, 32, 8.

Savory, Clive (2009). *Building knowledge translation capability into public-sector innovation processes*. *Technology Analysis & Strategic Management*. Vol. 21, No. 2, pp. 149-171.

Uyarra, Elvira and Flanagan, Kieron (2009). *Understanding the innovation impacts of public procurement*.

Walker, H.L., Bakker, E.F., Knight, L.A., Gough, S. and McBain, D. (2006). *Sustainable procurement in the English National Health Service* In: *Proceedings of 15th Annual IPSERA Conference*, San Diego, California, April 6-8.

Whitley, Richard (2002). *Developing innovative competences: the role of institutional frameworks*. *Industrial and Corporate Change*, 11, 3, 497-528.

Williams Iestyn, P. and Stirling, Bryan, (2007). *Cost-effectiveness analysis and formulary decision making in England: Findings from research*. *Social Science and Medicine* 65, 2116 – 2129.

Wikipedia (2008). National Health Service.
http://en.wikipedia.org/wiki/National_Health_Service#Organisation, 2008-02-24.

Yin, R.K. (1994). Case Study Research, Design and Methods, 2nd ed. Newbury Park, Sage Publications.

CIRCLE ELECTRONIC WORKING PAPERS SERIES (EWP)

CIRCLE (Centre for Innovation, Research and Competence in the Learning Economy) is a multidisciplinary research centre set off by several faculties at Lund University and Blekinge Institute of Technology. CIRCLE has a mandate to conduct multidisciplinary research and education on the following issues: Long-term perspectives on innovation, structural change and economic growth, Entrepreneurship and venture capital formation with a special focus on new ventures, The dynamics of R&D systems and technological systems, including their impact on entrepreneurship and growth, Regional innovation systems in different national and international contexts, International comparative analyses of national innovation systems and Policy design based on policy learning,

The CIRCLE Electronic Working Paper Series are intended to be an instrument for early dissemination of the research undertaken by CIRCLE researchers, associates and visiting scholars and stimulate discussion and critical comment.

The working papers present research results that in whole or in part are suitable for submission to a refereed journal or to the editor of a book or have already been submitted and/or accepted for publication.

CIRCLE EWPs are available on-line at: <http://www.circle.lu.se/publications>

Available papers:

2009

WP 2009/01

Building systems of innovation in less developed countries: The role of intermediate organizations.

Szogs, Astrid; Cummings, Andrew and Chaminade, Cristina

WP 2009/02

The Widening and Deepening of Innovation Policy: What Conditions Provide for Effective Governance?

Borrás, Susana

WP 2009/03

Managerial learning and development in small firms: implications based on observations of managerial work

Gabrielsson, Jonas and Tell, Joakim

WP 2009/04

University professors and research commercialization: An empirical test of the "knowledge corridor" thesis

Gabrielsson, Jonas, Politis, Diamanto and Tell, Joakim

WP 2009/05

On the concept of global innovation networks

Chaminade, Cristina

WP 2009/06

Technological Waves and Economic Growth - Sweden in an International Perspective 1850-2005

Schön, Lennart

WP 2009/07

Public Procurement of Innovation Diffusion: Exploring the Role of Institutions and Institutional Coordination

Rolfstam, Max; Phillips, Wendy and Bakker, Elmer

2008

WP 2008/01

R&D and financial systems: the determinants of R&D expenditures in the Swedish pharmaceutical industry

Malmberg, Claes

WP 2008/02

The Development of a New Swedish Innovation Policy. A Historical Institutional Approach

Persson, Bo

WP 2008/03

The Effects of R&D on Regional Invention and Innovation

Olof Ejermo and Urban Gråsjö

WP 2008/04

Clusters in Time and Space: Understanding the Growth and Transformation of Life Science in Scania

Moodysson, Jerker; Nilsson, Magnus; Svensson Henning, Martin

WP 2008/05

**Building absorptive capacity in less developed countries
The case of Tanzania**

Szogs, Astrid; Chaminade, Cristina and Azatyan, Ruzana

WP 2008/06

**Design of Innovation Policy through Diagnostic Analysis:
Identification of Systemic Problems (or Failures)**

Edquist, Charles

WP 2008/07

The Swedish Paradox arises in Fast-Growing Sectors

Ejermo, Olof; Kander, Astrid and Svensson Henning, Martin

WP 2008/08

**Policy Reforms, New University-Industry Links and
Implications for Regional Development in Japan**

Kitagawa, Fumi

WP 2008/09

The Challenges of Globalisation: Strategic Choices for Innovation Policy

Borrás, Susana; Chaminade, Cristina and Edquist, Charles

WP 2008/10

Comparing national systems of innovation in Asia and Europe: theory and comparative framework

Edquist, Charles and Hommen, Leif

WP 2008/11

Putting Constructed Regional Advantage into Swedish Practice? The case of the VINNVÄXT initiative 'Food Innovation at Interfaces'

Coenen, Lars; Moodysson, Jerker

WP 2008/12

Energy transitions in Europe: 1600-2000

Kander, Astrid; Malanima, Paolo and Warde, Paul

WP 2008/13

RIS and Developing Countries: Linking firm technological capabilities to regional systems of innovation

Padilla, Ramon; Vang, Jan and Chaminade, Cristina

WP 2008/14

The paradox of high R&D input and low innovation output: Sweden

Bitarre, Pierre; Edquist, Charles; Hommen, Leif and Ricke, Annika

WP 2008/15

Two Sides of the Same Coin? Local and Global Knowledge Flows in Medicon Valley

Moodysson, Jerker; Coenen, Lars and Asheim, Bjørn

WP 2008/16

Electrification and energy productivity

Enflo, Kerstin; Kander, Astrid and Schön, Lennart

WP 2008/17

Concluding Chapter: Globalisation and Innovation Policy

Hommen, Leif and Edquist, Charles

WP 2008/18

Regional innovation systems and the global location of innovation activities: Lessons from China

Yun-Chung, Chen; Vang, Jan and Chaminade, Cristina

WP 2008/19

The Role of mediator organisations in the making of innovation systems in least developed countries.

Evidence from Tanzania

Szogs, Astrid

WP 2008/20

Globalisation of Knowledge Production and Regional Innovation Policy: Supporting Specialized Hubs in the Bangalore Software Industry

Chaminade, Cristina and Vang, Jan

WP 2008/21

Upgrading in Asian clusters: Rethinking the importance of interactive-learning

Chaminade, Cristina and Vang, Jan

2007

WP 2007/01

Path-following or Leapfrogging in Catching-up: the Case of Chinese Telecommunication Equipment Industry

Liu, Xielin

WP 2007/02

The effects of institutional change on innovation and productivity growth in the Swedish pharmaceutical industry

Malmberg, Claes

WP 2007/03

Global-local linkages, Spillovers and Cultural Clusters: Theoretical and Empirical insights from an exploratory study of Toronto's Film Cluster

Vang, Jan; Chaminade, Cristina

WP 2007/04

Learning from the Bangalore Experience: The Role of Universities in an Emerging Regional Innovation System

Vang, Jan; Chaminade, Cristina.; Coenen, Lars.

WP 2007/05

Industrial dynamics and innovative pressure on energy -Sweden with European and Global outlooks

Schön, Lennart; Kander, Astrid.

WP 2007/06

In defence of electricity as a general purpose technology

Kander, Astrid; Enflo, Kerstin; Schön, Lennart

WP 2007/07

Swedish business research productivity – improvements against international trends

Ejermo, Olof; Kander, Astrid

WP 2007/08

Regional innovation measured by patent data – does quality matter?

Ejermo, Olof

WP 2007/09

Innovation System Policies in Less Successful Developing countries: The case of Thailand

Intarakumnerd, Patarapong; Chaminade, Cristina

2006

WP 2006/01

The Swedish Paradox

Ejermo, Olof; Kander, Astrid

WP 2006/02

Building RIS in Developing Countries: Policy Lessons from Bangalore, India

Vang, Jan; Chaminade, Cristina

WP 2006/03

Innovation Policy for Asian SMEs: Exploring cluster differences

Chaminade, Cristina; Vang, Jan.

WP 2006/04

Rationales for public intervention from a system of innovation approach: the case of VINNOVA.

Chaminade, Cristina; Edquist, Charles

WP 2006/05

Technology and Trade: an analysis of technology specialization and export flows

Andersson, Martin; Ejermo, Olof

WP 2006/06

A Knowledge-based Categorization of Research-based Spin-off Creation

Gabrielsson, Jonas; Landström, Hans; Brunsnes, E. Thomas

WP2006/07

Board control and corporate innovation: an empirical study of small technology-based firms

Gabrielsson, Jonas; Politis, Diamanto

WP2006/08

On and Off the Beaten Path:

Transferring Knowledge through Formal and Informal Networks

Rick Aalbers; Otto Koppius; Wilfred Dolfsma

WP2006/09

Trends in R&D, innovation and productivity in Sweden 1985-2002

Ejermo, Olof; Kander, Astrid

WP2006/10

Development Blocks and the Second Industrial Revolution, Sweden 1900-1974

Enflo, Kerstin; Kander, Astrid; Schön, Lennart

WP 2006/11

The uneven and selective nature of cluster knowledge networks: evidence from the wine industry

Giuliani, Elisa

WP 2006/12

Informal investors and value added: The contribution of investors' experientially acquired resources in the entrepreneurial process

Politis, Diamanto; Gabrielsson, Jonas

WP 2006/13

Informal investors and value added: What do we know and where do we go?

Politis, Diamanto; Gabrielsson, Jonas

WP 2006/14

Inventive and innovative activity over time and geographical space: the case of Sweden

Ejermo, Olof

2005

WP 2005/1

Constructing Regional Advantage at the Northern Edge

Coenen, Lars; Asheim, Bjørn

WP 2005/02

From Theory to Practice: The Use of the Systems of Innovation Approach for Innovation Policy

Chaminade, Cristina; Edquist, Charles

WP 2005/03

The Role of Regional Innovation Systems in a Globalising Economy: Comparing Knowledge Bases and Institutional Frameworks in Nordic Clusters

Asheim, Bjørn; Coenen, Lars

WP 2005/04

How does Accessibility to Knowledge Sources Affect the Innovativeness of Corporations? Evidence from Sweden

Andersson, Martin; Ejermo, Olof

WP 2005/05

Contextualizing Regional Innovation Systems in a Globalizing Learning Economy: On Knowledge Bases and Institutional Frameworks

Asheim, Bjørn; Coenen, Lars

WP 2005/06

Innovation Policies for Asian SMEs: An Innovation Systems Perspective

Chaminade, Cristina; Vang, Jan

WP 2005/07

Re-norming the Science-Society Relation

Jacob, Merle

WP 2005/08

Corporate innovation and competitive environment

Huse, Morten; Neubaum, Donald O.; Gabrielsson, Jonas

WP 2005/09

Knowledge and accountability: Outside directors' contribution in the corporate value chain

Huse, Morten, Gabrielsson, Jonas; Minichilli, Alessandro

WP 2005/10

Rethinking the Spatial Organization of Creative Industries

Vang, Jan

WP 2005/11

Interregional Inventor Networks as Studied by Patent Co-inventorships

Ejermo, Olof; Karlsson, Charlie

WP 2005/12

Knowledge Bases and Spatial Patterns of Collaboration: Comparing the Pharma and Agro-Food Bioregions Scania and Saskatoon

Coenen, Lars; Moodysson, Jerker; Ryan, Camille; Asheim, Bjørn; Phillips, Peter

WP 2005/13

Regional Innovation System Policy: a Knowledge-based Approach

Asheim, Bjørn; Coenen, Lars; Moodysson, Jerker; Vang, Jan

WP 2005/14

Face-to-Face, Buzz and Knowledge Bases: Socio-spatial implications for learning and innovation policy

Asheim, Bjørn; Coenen, Lars; Vang, Jan

WP 2005/15

The Creative Class and Regional Growth: Towards a Knowledge Based Approach

Kalsø Hansen, Høgni; Vang, Jan; Bjørn T. Asheim

WP 2005/16

Emergence and Growth of Mjärdevi Science Park in Linköping, Sweden

Hommen, Leif; Doloreux, David; Larsson, Emma

WP 2005/17

Trademark Statistics as Innovation Indicators? – A Micro Study

Malmberg, Claes