Public Procurement and the diffusion of innovations: Exploring the Role of Institutions and Institutional Coordination

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Abstract

The role of the public agency as a pacer of private sector innovation has been emphasised over recent years, especially in the context of the EU. The general ambition has been to encourage public agencies to actively stimulate private sector innovation rather than procure existing products. This has triggered an increased interest among researchers and practitioners to identify best practice examples where public agencies have successfully procured innovation. Rather than addressing this demand-oriented perspective, this paper investigates the role of public agencies as *adopters* of private-sector innovation. Employing an innovation systems perspective, the paper focuses on institutions as enablers and as barriers of innovation diffusion. The paper presents an explorative case study: the introduction of a new catheter into the English National Health Service and its diffusion among NHS trusts in England. Different institutional factors are identified which have had an affect on the catheter's adoption and diffusion.

1. Introduction

In an economy characterised by global competition, it is commonly agreed that innovation is critical for our future prosperity. Over the last decade, the role of public procurement as a means to stimulate private sector innovation has been emphasised increasingly (Edler et al, 2006). At the European level, public agencies have been described as "big market players" which "have powerful means to stimulate private investment in research and innovation" (European Commission, 2005, p. 8). In the UK, initiatives are underway to make government "a smarter customer", where stimulating private sector innovation is a central theme (Department of Trade and Industry, 2004, p.11). Public procurement contributes to around 16 % of European

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GDP (EC, 2004) and in some countries, e.g. the UK and in some market areas e.g. medical equipment, the share might be even bigger. Consequently, the public sector commands a strong purchasing power that, if managed accordingly, could promote innovation.

The demand-side influence of public agencies to shape and drive innovation has been well-researched (see e.g. Rolfstam, 2005, Edler & Gerghiou, 2007) with an emphasis on *developmental* technology procurement (Edquist et al, 2000, p. 21). The aim of this paper is to focus on the supply-side and *adaptive* public technology procurement: the role of public agencies in the adoption of emerging private sector innovations. Building on the notion that, "without diffusion, innovations have little social or economic impact" (Hall, 2005, p. 459) the paper adopts an institutional approach on innovation studies, to explore how institutions affect diffusion processes within organisations. 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.

The paper will commence with an overview of the literature, it will then present an explorative case study of an attempt by the English National Health Service (NHS) to procure and diffuse a new catheter throughout its Trusts. It will then conclude with a discussion of the role of public sector agencies in promoting the uptake of emerging innovations from the private sector.

2. Theoretical Background

2.1 Public Procurement and Innovation

Public Procurement occurs when a public agency puchases 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 indirect use of public procurement to implement other policies is far from a new phenomenon (McCrudden, 2004). With respect to innovation, 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 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 position taken here, as argued by Uyarra and Flanagan (2009), is that the application of public procurement as a means to stimulate innovation involves not only public technology procurement, there is also a need to acknowledge the supply-side, for example, when private sector suppliers approach public procurers with unsolicited offers of new innovative products. 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.

2.2 Innovation, Diffusion and Adoption

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). Building on this, diffusion 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. 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 study adoption at an aggregate level, e.g. 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.

The characteristic features of diffusion and adoption processes occurring within organisations may considered through adopting a social systems approach. Roger defines a social system 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. Thus, within an organisational context, the decision to reject or adopt an innovation is not as straight-forward as it might be elsewhere (Rogers, ibid).

2.3 The role of institutions and institutional co-ordination

The focus of this paper is not so much on the decisions per se as the determinants of diffusion and adoption of an innovation in a social system, as emphasised by systemic approaches to innovation studies (Dosi et al, 1988; Lundvall, 1992; Edquist and Johnson, 1997; Hollingsworth, 2000), which acknowledge the role that institutions play during the process of innovation. Institutions are perceived 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 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. Institutions reduce uncertainty and release cognitive and other resources. 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. Without institutions a social system would not be able to accumulate knowledge, or enable communication and therefore unable to sustain cumulative innovation.

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.

Innovation theory based on institutional perspectives brings coordination and the coordinative functions of institutions to the foret. 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 regarding the co-ordination of policies affecting innovation. Further, systemic approaches generally recognize the importance of complementarity within systems, emphasising the importance of policy coordination such as between R&D and other forms of learning, (Edquist et al. 2001).

In practice, however, the coordination of different actors and activities in relation to a specific policy instrument such as public procurement is very likely to require effective coordination among different institutions. Studies of national differences in innovation performance (Hall and Soskice, 2001; Whitley, 2002) suggest the 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 (Hollingsworth, 2000).

Public procurement can be regarded as a coordination tool as it may be used to overcome institutional barriers and system failures (Edquist et al, 2000; Klein Woolthuis, Lankhuizen and Gilsing, 2005). For instance, Swedish public agencies

have has some success in stimulating innovation in energy efficient technologies (Olerup, 2001). On the other hand, coordination might also be necessary if public procurement of innovation is to be sustained. 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.

This paper sets out to explore the interaction between organisations and its influence on innovation diffusion and addresses the following research question: How may coordination (or the lack thereof) among different kinds of institutions affect performance in public procurement of innovations?

3. Method

The research study employed a case study approach (Yin, 1994). The case discussed in this paper was identified within 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 of-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 of the study was to compare different cases in the categories and in order to understand what causes public procurement projects to become innovative. Three public sectors were selected: the health sector, national level procurement and local (municipality) procurement.

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.

Semi-structured interviews were carried out. By doing so, additional information may be provided that may be of interest and relevance to the case. As part of the preparation, a case study protocol was developed.

Data and informants were selected by means of 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. Six persons were involved; 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). The framework has been applied in a sensitised manner 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 insufficient time has progressed for this to occur.

Following Rogers (1995) 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.

4. Innovation Diffusion in a Large Health Organisation

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 word 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 deceases, 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, heath 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).

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 patents 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 marked 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 pane makes statements based on evidence taken into account whether or not a product does what is 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.

4.3 Adoption Characteristics

relative advantage;
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
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.

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.

trialability and observability
Focusing on the social system that is the NHS, the NHS is an organisation strongly influenced by scientific ideals where 'scientific facts´ or 'evidence´ are elements which have implications for. 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.

4.6 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 buy 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 my 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.

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