Public Procurement of Innovation

Rolfstam, Max

2008

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MAX ROLFSTAM

LUND
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The production of this text was made possible through financial support from the Ruben Rausing Foundation, the European Commission, VINNOVA (Swedish Governmental Agency for Innovation Systems), Sigfrid och Walborg Nordkvist Foundation, Kungl. Fysiografiska Sällskapet and Trygghetsstiftelsen (The Job Security Foundation).

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By Max Rolfstam

ISBN 978-91-977285-2-2

Appended paper 2, “The Utilities Directive and How it Might Affect Innovation: The Case of Innovative Procurement of Maritime Radio Technology” is re-printed by courtesy of Sweet & Maxwell and Public Procurement Law Review.

Printed by Media-Tryck, Lund, Sweden, April 2008

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1. Introduction

The central topic of this study is public procurement of innovation, sometimes referred to as innovative public procurement, public technology procurement or government technology procurement. This practice has been defined as something that "occurs when a public agency acts to purchase, or place an order for, a product – service, good, or system – that does not yet exist, but which could (probably) be developed within a reasonable period of time, based on additional or new innovative work by the organisation(s) undertaking to produce, supply, and sell the product being purchased" (Edquist and Hommen, 2000, p. 5). As this definition indicates, the main concern that drives research on this topic is the impact of public procurement on innovation – i.e. the extent to which public procurement generates innovations (other than process innovations within the procurement processes themselves). In other words, research in this area is concerned primarily with public procurement of innovations, rather than innovations in public procurement.

1.1 Background – Practical and Theoretical Relevance

From the definition given above, it is clear that public procurement of innovation constitutes an instrument of public policy for innovation, or what will hereafter often be referred to as "innovation policy" (see e.g. Geroski, 1990; Dalpé, 1994). Over the years, several state-of-the-art reviews of the literature on innovation policy have devoted considerable attention to this practice, which does not otherwise figure very prominently in the more general research literature on innovation (Rothwell and Zegveld, 1982; Mowery, 1995; Lundvall and Borrás, 2005; Chaminade and Edquist, 2006). Therefore, given its focus on public procurement of innovation, this thesis is to be regarded as a contribution to the literature on innovation policy.

Although public procurement of innovation has recently attracted attention in all parts of the world – e.g., in countries as widespread as India (Mani, 2003), New Zealand (Ministry of Economic Development, 2005) and Canada (Currie, 2005) – this dissertation refers primarily to, and is most relevant for, the context of the European Union (EU). Recently, EU policy makers have shown strong interest in this topic. In relation to the targets, formulated in 2000 at the Lisbon meeting of the European Council and refined at Barcelona in 2002, for the European Union to become the world's most competitive and knowledge-based economy by 2010, EU policy makers have increasingly emphasised public procurement of innovation as a key instrument for achieving this goal. Consequently, the European Council (2005, p. 6) has recently recommended that EU member states should (among other things) focus on "encouraging public procurement of innovative products and services".

Generally, available research literature on this topic reaches the conclusion that public procurement *can* be a useful policy instrument to stimulate innovation and may even be one of the most effective instruments of innovation policy (e.g. Rothwell, 1994; Geroski,

1990; Edquist, Hommen and Tsipouri). In recent history, however, innovation policy within the EU and its member states has downplayed or neglected public procurement of innovation, especially during the 1990s (Edler and Georgihou, 2007). As will be developed further in section 1.1.2 below, one reason for public procurement of innovation having fallen into disuse in past decades was that EU policies regarding public procurement were dominated at that time by the ambition to create a Single European Market. Following the passage of the EC Procurement Directives in the early 1990s, preventing protectionism and fraud became more important objectives for this policy area than promoting innovation (Edquist and Hommen, 2000, pp. 7–9). The rediscovery of public procurement of innovation as a policy instrument during the past few years is thus a remarkable about-face for EU innovation policy. It is also a very new development that is still being diffused from EU-level policy makers to their counterparts in individual EU member states. In addition to this change of policy focus, the legislative package regulating public procurement has also been reformed. New directives on public procurement were published by the European Commission in 2004 (Williams, 2004; European Commission, 2008). These mandatory directives are currently under transposition into national legislation among the individual EU member states.

To summarise, this dissertation finds practical justification in three distinct policy developments within the EU. First, there is the increased attention now paid by EU policy makers to the potential of public procurement as an innovation policy tool. Second, this first development has been accompanied by a fundamental change in how policy makers view public procurement of innovation – i.e. as more centrally important to EU economic policy. Third, and finally, there is also the fact that the legislation that regulates public procurement has been reformed at the EU level and is now being transposed into national legislation. These factors all justify the pursuit of more knowledge on this topic.

As indicated above, this thesis draws on, and intends to contribute to the literature on innovation policy. In particular, it may be regarded as a contribution to the literature on innovation policy affecting the "demand side" (Edquist and Hommen, 1999; Edler and Gerghiou, 2007) – and, even more specifically, the literature dealing with public procurement of innovation as an innovation policy instrument (Geroski, 1990; Dalpé, 1994; Edler and Georgihou, 2007). The dissertation's relevance for innovation policy theory and practice is further elaborated in the remainder of this sub-section.

Although it is not particularly large, the innovation policy literature is commonly portrayed as being divided into two main currents – one based upon standard economic theory and the other rooted in innovation theory, which is interdisciplinary in character but has a strong foundation in heterodox economics, especially evolutionary economics. Thus, Lipsey and Carlaw (1998, p. 3) distinguish between two generic policy models derived respectively from the neoclassical and the structuralist-evolutionary traditions in economic theory. Metcalfe (1995) has distinguished between innovation policy perspectives based on "equilibrium" economics, and those derived from evolutionary economics, and Edquist (2001) has drawn a similar dichotomy between "mainstream economic theory" and "systems of innovation" perspectives on innovation policy. Continuing this tradition, Lundvall and Borrás (2005) point out two main currents of

innovation policy, one based on the assumptions of standard economics and another drawing on innovation theory. The former is a non-interventionist "laissez-faire" version of innovation policy which "signals that the focus should be on 'framework conditions' rather than specific sectors or technologies". This contrasts with the second, "'systemic' version", for which a fundamental aspect becomes the "reviewing and redesigning of the linkages between the parts of the [innovation] system" (ibid., p. 611). This frequently drawn distinction between a conventional approach to innovation policy based on standard (equilibrium or "mainstream") economics and an alternative approach with its roots in theories of innovation, including evolutionary economics, also carries over into the literature on public procurement and innovation.

According to Edquist and Hommen (2000, pp. 15–20), auction theory – a sub-species of information economics ultimately derived from neoclassical economic theory – provides the main theoretical basis for current regulation of public procurement (including public procurement of innovations) in the EU. On theoretical grounds, auction theory can be criticised for a serious lack of fit between some of its main assumptions and salient characteristics of public procurement of innovations. For example, auction theory fails to recognise that users may actually be more knowledgeable than producers about innovative (previously unknown) products, and it also pays no attention to interactive learning between users and producers – a process that is, by definition, essential for product innovation (ibid., p. 19). More generally, these criticisms point to auction theory's lack of concepts appropriate to dealing with innovation. However, auction theory as it has been applied to the regulation of public procurement in the EU, along with the "neo-liberal policies" that have been used to construct the Single European Market (Cox and Furlong, 1996), can be even more convincingly criticised on purely practical grounds. So far as public procurement of innovation is concerned, this constellation of policies and the theories underlying them has proven from a comparative perspective to be ineffective and perhaps also prohibitive. For instance, a recent study commissioned by the EC, in a comparison between EU and US expenditure on "R & D procurement", found that "EU spending here is 4 times less (approximately $3,4 Bn) than the US – after the elimination of expenditures on military procurement, with the addition of which the US lead over the EU increases to a factor of 20" (National IST Research Forum, 2006, p. 10).

As noted previously, the opposing theoretical perspective is "innovation theory", which informs an alternative, "systemic" approach to innovation policy (Metcalfe, 1995; Edquist, 2001; Lundvall and Borrás, 2005). According to Edquist and Hommen (1999), three main currents in innovation theory have been especially influential in this respect – and, of these three, two have been predominant: interactive learning theory (Lundvall, 1992) and evolutionary economic theory (Nelson and Winter, 1982). Both of these theoretical traditions have strengths enabling them to compensate for some of the above-mentioned shortcomings of auction theory and standard economics more generally. However, these alternative perspectives have had little impact on innovation policy, except for having often informed critical analyses of existing innovation policies. For example, Edquist, Hommen and Tsipouri (2000) elaborated a critique of the EC Procurement Directives on this basis, but few if any of their ideas were translated into

concrete policy measures for promoting public procurement of innovation. Thus, even though conventional theories and policies may be criticised for being ineffective, policy analysis and criticism based on innovation theory may also be criticised for being ineffectual. One problem is that although mainstream economists have been fairly successful in identifying specific policy instruments, proponents of the alternative, "systemic" approach have not made similar progress in specifying instruments for innovation policy (Mytelka and Smith, 2002).

This problem with innovation theory might, however, be remedied by further development of the third current of innovation theory identified by Edquist and Hommen (1999) – namely, institutional theory. This argument may also be considered to apply with special force to public procurement as an innovation policy instrument, since policy development in this area has long been focussed on the elaboration of procedural rules, clearly anticipating what has by now become a much more widespread phenomenon – i.e. the trend in innovation policy for both "laissez faire" and "systemic" approaches "to put stronger emphasis on 'institutions' and 'organizations' than [on] science and technology policy" (Lundvall and Borrás, 2005, p. 612). Institutional theory is well suited to this emphasis, as demonstrated by its recent revival in innovation studies, where it has become essential for the comparative analysis of innovation systems and processes (Hollingsworth, 2000).

The discussion thus far has made the case for an innovation theory-based approach to policies for public procurement of innovations. For practical justification, the discussion has referred to the EU's lagging performance in this area and its recognition of the need for policy reform. For theoretical justification, the discussion has referred to the inability of standard economics to comprehend innovation and the consequent failure of conventional policy approaches based on this theoretical tradition to promote public procurement of innovation. The discussion has also noted some serious failings of innovation theory-based approaches to innovation policy – but it has also argued that an institutional perspective would provide an especially appropriate foundation for the further development of such an approach. Therefore, this thesis sets out to develop an innovation theory-based institutional perspective on public procurement of innovations by emphasising two related focal areas in recent research on innovation policy in general – and, in particular, on this specific area of innovation policy: (1) innovation policy formulation as institutional design and (2) institutional determinants of innovation performance. In the two following sub-sections these two points will be developed.

1.1.1 Institutional Design

Institutional design is a centrally important aspect of innovation policy, which is largely a matter of selecting, adapting, and in some instances creating new or abolishing old institutions, in order to promote innovation (Edquist, 2001, p. 223). This activity is thus a highly appropriate point of departure for the elaboration of an institutional perspective on policies for public procurement of innovation. From an innovation theory perspective, moreover, it is essential that "institutional design" should be based to a large extent on

the analysis of how contextual factors affect or condition innovation policy, given "the contextually specific nature of innovation processes" (Mytelka and Smith, 2002, p. 1477).

The importance of taking context into account for institutional design in innovation policy – or rather, the lack of importance accorded to it – is reflected in current policy literature on public procurement of innovations. Recently, several EC-funded projects, as well as individual national authorities, have specified principles, models, and examples of "best practice" (OGC, 2004; Edler et al., 2005; European Commission, 2005). But such guidance has been based on generic models of the procurement process and a focus on particular projects, viewed as transactions and evaluated from the standpoint of public sector organisations as buyers. This approach is unable to account for variety and change in the dynamics of user-producer interaction and longer-term processes of technological development and cannot inform broader strategies for public procurement of innovations.

An alterative and potentially more fruitful approach to institutional design in this particular area of innovation policy has been to elaborate the policy implications of particular types of contexts for public procurement of innovation. However, there have been only a few such attempts. Edquist and Hommen (2000) distinguish between "direct" and "catalytic" procurement on the one hand, and "developmental" and "adaptive" technology procurement on the other. This matrix has however never been fully tested, and also fails to recognise instances where several public buyers act in concert (e.g. Kaiserfeld, 2000). Further, the policy implications of this matrix were never fully elaborated in a systematic way. Cave and Frinking (2003) have addressed the design and implementation of public procurement projects to promote innovation in terms of four key "dimensions". However, they generate only a checklist, not a typology. Hence, there is clearly a need for a more comprehensive classification scheme capable of providing a better specification of the relations between public procurement and innovation, and indicating the implications for institutional design.

1.1.2 Institutional Determinants of Innovation Performance

Innovation policies may be more or less successful, and institutions, as designed by innovation policy makers, are often treated as causal factors accounting for either success or failure – or, alternatively, strong or weak performance – in policy areas such as public procurement of innovations. Thus, there has been continuing debate over whether or not specific institutions are responsible for the EU's under-performance in terms of innovation.

The EC Procurement Directives, first issued in the early 1970s and subsequently reformed, have been a natural focus for such a debate. In 2000, Edquist, Hommen and Tsipouri (2000, p. 308) suggested that there may be "a considerable degree of tension between the EU procurement rules and the need to accommodate informal co-operation in the form of user/producer interaction related to technical change". The International Energy Agency (IEA) (2000, p. 14) also quite early "recommended to suggest

clarifications in the existing public procurement rules, for example the EC Directives, in order to facilitate procurement efforts within innovation purpose". Other scholars have warned that "[t]he consequence of rigid procurement rules may be that procurement processes give rise to solutions that are price competitive, but do not spur innovation and the dynamic development for firms and society as a whole" (Nyholm et al., 2001, p. 264).

New revised Directives were published in 2004. This new body of legislation was produced with the objectives of modernisation, simplification, and increased flexibility (The Legislative Observatory, 2004). It is also worth noting that this legislative reform was followed by a series of initiatives aimed at demonstrating that it was both possible and desirable to pursue innovative projects within the regulatory framework defined by the Directives (Edler et al., 2005). However, it is difficult to say whether the aforementioned critiques of the EC Procurement Directives have been empirically well founded. Most criticisms of the Directives (Edquist, Hommen and Tsipouri, 2000) have been based on case study and other evidence that long predates the initial publication of the EC Procurement Directives. Thus, there is a need for contemporary empirical research that directly investigates whether the Directives are indeed a hindrance or obstacle to public procurement of innovations.

Further, whether or not formal, regulatory institutions such as the legal framework defined by the EC Procurement Directives can be shown to have hindered public procurement of innovations, an innovation theory-based institutional approach must in addition consider the possibility that other kinds of institutions could also constitute factors contributing to under-performance in this area.

Historically, the field of innovation studies has lacked a commonly agreed definition of institutions. More recently, some degree of consensus may have emerged in relation to Edquist and Johnson's (1997) proposal to adopt a Northian definition referring to institutions as "rules of the game" (North, 1990, p. 3). However, these authors have advanced a definition of institutions as "sets of common habits, routines, established practices, rules, or laws that regulate the relations and interaction between individuals and groups" (Edquist and Johnson, 1997, p. 46), and they have also pointed to the need for further taxonomic and empirical research on institutions. In particular, they have drawn attention to institutional change as an area of research where "better conceptual tools are needed", suggesting that "a distinction between designed and self-grown institutions is important in this context" (ibid., p. 61).

Progress on the research agenda suggested by Edquist and Johnson has been slow and incremental. For the most part, innovation studies has continued to focus primarily on formal, regulatory institutions – or what sociologist W.R. Scott (2001) refers to as "regulative" institutions – and to ignore other types and dimensions of institutions. However, some authors (Borrás, 2004) have begun to conceptualise the dynamics of institutional change, while others have explored the distinction between "designed" and "self-grown" institutions. Thus, Coriat and Weinstein's (2002) taxonomy of institutions distinguishes between "Type A" (exogenous) and "Type B" (endogenous) institutions, enabling analyses of institution systems and processes to take organisation-specific

aspects of the institutional set-up into account. By addressing what Scott terms the "normative" and "cognitive" dimensions of institutions, as well as the mutual embeddedness of organisations and institutions, their framework offers a much-needed alternative to the usual tendency in innovation studies – which is to adopt a purely "exogenous" view of institutions and to pursue a kind of institutional analysis in which firms and other organisations are assumed only to react passively to externally imposed constraints and incentives. Particularly where multi-organisational collaborations are involved in public procurement of innovation, an organisationally oriented analysis informed by conceptual distinctions such as those outlined by Coriat and Weinstein may be particularly important for understanding how institutional factors may determine success or failure.

Finally, an innovation theory-based institutional perspective on innovation policy should take into account issues of both coordination and the coordinative functions of institutions. Coordination is also a vital concern for the "systemic" approach to innovation policy, since much 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). Further, Systems of Innovation approaches generally recognise the importance of complementarity within systems and therefore emphasise 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). Thus, one of the general policy implications of this approach 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).

Although an emphasis on coordination can be regarded as fundamental for a systemic approach to innovation policy, this is not the case for conventional (or mainstream) approaches. Thus, Metcalfe (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). For the adaptive policy maker, moreover, the central problem is not market failure but rather the "evolutionary paradox that competitive selection consumes its own fuel, destroying the very variety which drives economic change" (ibid., p. 30). 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.

Public procurement of innovations may be 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, coordination of innovative activities is governed by the "institutional environment" and achieved through reliance upon institutions as "coordination mechanisms". This emphasis on institutions accords well with Systems of Innovation thinking, which "has emphasised the essentially context-bound nature of technological change … especially in terms of the relevance that the institutional set-up has for innovative performance" (Borrás, 2004, p. 427). 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 public procurement of innovations.

1.2 Purpose

Given the discussion in the previous sections, the purpose of this thesis is to develop an innovation theory-based approach to innovation policy regarding public procurement of innovations, by elaborating an institutional focus via research on innovation policy formulation as institutional design complemented by research on institutional determinants of innovation performance. Thus, the purpose is to explore and describe institutional aspects of policies for public procurement of innovations, with an emphasis on institutions as both outcomes of policy making and input factors affecting the success or failure of policy implementation.

1.3 Structure of the thesis

This thesis is structured as follows. Chapter 2 presents a frame of reference summarising the most important theoretical and practical concepts that are used in pursuing the purpose of the thesis. Chapter 3 discusses the methodological issues in the work. As this thesis consists of four articles, these are briefly summarised in chapter 4. This chapter also concludes with a discussion of how these four articles connect to each other. A summary of the thesis and the main conclusions are given in chapter 5. Chapter 6 provides a discussion of these results and some suggestions for further research.

2. Frame of Reference

The central topic of this thesis, the role of public procurement as an innovation policy instrument, was outlined in the introduction. The intention to draw on and contribute to innovation theory, with a particular emphasis on institutions, was also briefly outlined. From this follows a frame of reference, presented in this chapter, that comprises policy-relevant institutional aspects of the process referred to here as public procurement of innovations.

This chapter is structured as follows. First, public procurement of innovations are defined and situated as a practice in the field of innovation policy with reference to taxonomies of innovation policy instruments. Next follows a discussion on public procurement of innovations viewed as a process that is bounded and shaped by institutions. Third, through a brief outline of the history of public procurement policy and law in the EU, it will be shown how institutions defining general processes and specific procedures for public procurement of innovations have been objects of public policy, and how recent policy debates have questioned their efficacy in terms of innovation-friendliness. The fourth element of the discussion develops a critique of the approaches of mainstream economics to the institutional aspects of public procurement of innovations. Following from this, an alternative approach based on innovation theory will be presented, along with a review of the main problems with this approach. As a sixth point, the argument will be brought forward that an institutional perspective can help both to identify and to overcome some of the flaws in the innovation theory-based approach. Seventh, a number of issues that call for greater attention to institutional questions are specified. These issues concern not only matters of institutional design, but also institutions as determinants of innovation performance. With the first set of issues, there is a need to base institutional design on a systematic integration of relevant theoretical and practical dimensions. With the second, there is a need to consider a broad range of different types of institutions (rather than just formal, regulatory institutions) and, also, to address their inter-relations in order both to develop theoretical understanding and to improve efficiency in innovation policy practice. This leads to the eighth and final part of this chapter, where, on the basis of the discussion that has come before, the research problem of this thesis is formulated and the research questions appropriate to the topic and purpose of this dissertation are presented.

2.1 Public Procurement as an Instrument of Innovation Policy

Procurement "refers to the function of purchasing goods or services from an outside body" (Arrowsmith, 2005, p. 1). Public procurement occurs when this function is performed by a public agency. From a legal perspective, procurement carried out by private firms acting on behalf of a public agency also comes under the definition. Although procurement is synonymous with e.g. purchasing, buying, or sourcing, etc., and although, technically speaking, it could be referring to any actor in a market, the assumed agent, if the term is used without a qualifier (e.g. private, public), is usually a public

agency. Public procurement can take place at any level in society – in a department in a local council of a municipality, or on the regional, national or even supranational level. In fact, essentially all public functions are supported by public procurement (Thai and Grimm, 2000, p. 231). Following these definitions, goods (and services) of any kind are acquired through public procurement.

The particular interest of this thesis is the public procurement of innovations, i.e. a special sub-set of public procurement. What is needed, accordingly, is a definition of public procurement that is more specific than the one discussed in the previous paragraph. To develop this point further, there follows a discussion of definitions of innovation in general. Proceeding from that, some definitions of public procurement of innovation will be discussed.

There are many different ways to define innovation. In most cases, innovation is defined as something that is distinguishable from activities that are not innovation. Innovation can be defined in terms of required input, outcome, or the cognitive requirements of innovation, and different definitions may be more or less useful depending on context and purpose. One definition may be perfectly relevant for a given situation at the same time that it would be less useful for another purpose. For this reason, in this thesis, differing definitions of innovation are used because different aspects of innovation in relation to public procurement have been studied. The definitions used here are summarised in the following paragraphs.

One way of defining innovation is to distinguish between production and innovation, as Joseph Schumpeter did. According to him, production concerns the utilisation of "materials and forces within our reach" (Schumpeter, 1934/ 1969, p. 65). Innovations (although Schumpeter used the word development) are new combinations manifested as the introduction of a new good, a new method of production, the opening up of a new market, or the use of a new source of supply of raw materials or new ways of organising industries (ibid., p. 65). Edquist (1997, p. 1) states that "[i]nnovations are new creations of economic significance", distinguishing, at least implicitly, between innovation and invention. An invention can involve all kinds of newness but, unlike an innovation, has not yet proven its success on a market. Schumpeter also makes distinct the difference between product and process innovation, where the former is the "introduction of a new good" and the latter "the introduction of new method of production" (Schumpeter, 1934, p. 66).

The definitions discussed in the preceding paragraph treat innovation mainly as an ex post phenomenon. This is perfectly natural, as "outcomes of innovative efforts can hardly be known ex ante" (Dosi, 1988, p. 222). Still, this means that they are less effective in capturing the underlying mechanisms that actually lead to innovation, and this may sometimes be necessary. In other words, there is a need to understand not only what innovation is, but also how innovation happens. Dosi and others, as will be discussed in the following, have suggestions that satisfy the latter need as well. For instance, Dosi characterises innovation as "the search for, and the discovery, experimentation, development, imitation, and adoption of new products, new production processes and

new organizational set-ups" (ibid., p. 222). This search is also cumulative, in the sense that prior knowledge determines the possibilities to exploit new technical possibilities (ibid., pp. 222–223). In a similar way, Lundvall argues that "the most fundamental resource in the modern economy is knowledge, and, accordingly, that the most important process is learning" (Lundvall, 1992, p. 1). Edquist establishes that innovation "is a matter of producing new knowledge or combining existing knowledge in new ways" (Edquist, 1997, p. 16).

Two other concepts related to innovation are diffusion and adoption. Diffusion, adoption and innovation are to some extent overlapping concepts. Sometimes, however, it is necessary to keep them distinct. An innovation may be seen as an invention that becomes commercially successful on a market, i.e. is adopted by users, i.e. diffused. 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. One view that separates diffusion from adoption regards the former as the study on an aggregate level of 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 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 fundamental elements in the process of diffusion are the innovation which diffuses, the population of potential adopters and their process of decision making" (Coombs et al., 1987, p. 121). From that perspective, 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" (ibid., p. 5.) The "newness" in this context is connected to the decision to adopt a certain innovation, what Edquist and Hommen (2000, p. 21) refer to as "adaptive" technology procurement. An innovation might be known by adopters prior to adoption. It actually has to be known in order to become eventually 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, uncertainty follows as well. The decision to adopt an innovation is determined by how it is perceived by individual adopters.

The definitions of innovation discussed in the previous paragraphs allow for distinguishing in different ways between what is innovation and what is not. Similarly, it is possible to distinguish between regular and innovative public procurement. The former refers to the procurement of existing, off-the-shelf goods, e.g. consumables such as office stationary or fuel. The latter refers to procurement of innovations (Edquist, Hommen and Tsipouri, 2000). Following the definition referred to earlier in this section, public procurement of innovations means that the supplier needs to perform some kind of research and development work in order to be able to deliver the procured good (ibid.).

Innovative public procurement can also be understood in different ways. It can be very narrowly defined as in the definition cited in earlier in this section, where it merely

captures the act of a public agency's placing an order for something that requires innovation in order to be delivered, but there are also variations that are broader in different degrees. Hans Westling (1991, p. 43), writing about the Swedish construction sector, maintains that "'[t]echnology procurement' is a form of purchasing aimed at directly stimulating innovation". Such a definition at least implicitly includes activities other than the mere act of placing the order, such as finding the right supplier, and negotiations.

The Swedish Energy Agency uses a definition essentially similar to the one by Edquist and Hommen (2000) cited in the introduction. It does, however, provide a more elaborated interpretation of what that means in practice as well: "Technology procurement is a complete tender process with the purpose of promoting and speed up the development of new technology. The purpose of technology procurement is to develop new products, systems or processes that meet the procurer's demand" (Persson, 2003, p. 5). Apart from the formal tender procedure, this view also includes conducting pre-studies, organising procurement groups, formulating specifications, the formal tender procedure, evaluation, diffusion and, potentially, further development.

The National IST Research Directors Forum (2006, p. 14) states: "**[I]nnovative Procurement** refers to **innovative approaches in 'practice' and 'procedures' of procurement** which results in innovative contractual procurement arrangements". In its report it also presents a special type of innovative procurement, the pre-commercial procurement of innovation. This is defined as

> an R & D procurement of the type 'public service contract' because it refers to acquisition of knowledge – collected by the supplier by carrying out intellectual investigation services (R & D services) consisting of critical solution analysis, prototyping, field testing and small scale pre-product/service development – with the objective to prove the feasibility or unfeasibility to transform a technologically innovative idea into a first working batch of pre-commercial volume and quality pre-products/services according to the requirements in the tender specifications. (Ibid., p. 19)

Without providing an explicit definition of innovative public procurement, van Valkenburg and Nagelkerke (2006) report on the development of new procurement practices for large infrastructure projects in the Dutch Department of Transport and Water Management. Through the application of interweaving planning procedures, suppliers are invited to participate as early as the planning stage of a project. With such an understanding of innovative public procurement, the boundaries between the demand-side and the supply-side become indistinct. Rather, the process becomes more of a joint effort characterised by a high level of interaction between the involved stakeholders.

Another concept available in the literature is market transformation. The purpose of market transformation is "to *introduce* new products and services and to *increase* adoption of new products and services as well as existing but underutilised products and services" (Neij, 2001, p. 68). This concept concurs to some extent with a general

understanding of innovative public procurement. However, this perspective places a particular focus on the effects of procurement activities on the market. It can be seen as complementary to traditional public procurement perspectives. The concept is also broader, in the sense that it sometimes includes also private actors.

The importance of innovation for the purpose of achieving economic growth has been increasingly emphasised. By innovating, a firm can present a better product on the market, or produce it more efficiently than its competitors and thus achieve competitive advantages. With the understanding of a firm as an actor in an economic environment with factual or potential innovating rivals, innovation is far from a one-off event. A firm that wishes to stay competitive in the long run must continuously evaluate its activities to seek out possibilities for innovation. In other words, firms must handle the underlying mechanisms under which capitalist economies develop: "the perennial gales of creative destruction" (Schumpeter, 1976, p. 84).

Appreciating the firm as the central locus for innovation does not mean, however, that relying solely on innovation generated from within the market will be the most beneficiary option for economies (e.g. regions, nations or supranational entities such as e.g. the European Union). Public agencies on different levels can and may want to develop "knowledge policies" to promote e.g. scientific progress or development within a specific sector in order ultimately to stimulate innovation (Lundvall and Borrás, 2005). By using this term, these authors want to stress that innovation and competence building involve "many different sources of knowledge and that innovation itself is a learning process" (ibid., p. 625). This thesis uses the term innovation policy to denote this phenomenon. Innovation policy has been defined as "public actions that influence innovation processes: that is, the development and diffusion of (product and process) innovations" (Chaminade and Edquist, 2006, p. 142). Although there might be differences in aspects of what these two notions capture or emphasise, for the purposes here these two notions concur.

There are many instruments which e.g. national governments may include in their innovation policies. These measures can be ordered under three different headings: environmental, supply-side and demand-side measures (Rothwell, 1981). Examples of environmental measures are tax allowances for firms which engage in Research and Development (R & D). Another measure that falls into this category is intellectual property laws that give monopolistic rights to commercialise a product developed by a firm. This temporary exclusion of competition makes it possible for firms to secure return on investment in development. Supply-side measures are typically research infrastructure provided by public agencies. Examples of this category are public provision of scientific training, public laboratories and R & D grants. One measure listed on the demand side is public procurement (Braun, 1980, in Rothwell, 1981). In a similar way, Geroski (1990) put public procurement and regulations on the demand side and subsidies and infrastructure investments on the supply side. A recent taxonomy of innovation policy tools also includes public procurement as a demand-side measure alongside systemic policies (cluster policies), regulation and standardisation in order to target technical

development and support for, or articulation of, private demand (Edler and Gerghiou, 2007).

With a few exceptions, many governments have traditionally emphasised supply-side measures such as providing technical infrastructure, R & D grants or subsidies in order to stimulate innovation (Rothwell, 1981). For the European Union it has been emphasised that "the main area of neglect in recent years in R & D and innovation policy spheres has been demand-side policies. Certainly many countries have attempted to stimulate aggregate demand via the use of a variety of macroeconomic instruments, but few have actively sought to link supply and demand directly via the use of instruments such as Public Technology Procurement" (European Commission, 2003b, p. 64). Accordingly, it has been argued that now is the time when EU policy makers have to take into account both blades of the scissors of demand and supply (Georghiou, 2007, p. 4).

One general problem with implementing innovation policies has to do with the principles on which specific policies are selected. Inspired by success stories elsewhere, policy makers often attempt to copy these successes into their own domains. This "naïve borrowing of 'best-practices'" has been questioned in the context of policy making for Asian economies in transition (Lundvall, Intarakumnerd and Vang, 2006, p. 16). Similarly, authors writing about regional policies maintain that "successful borrowing or copying of a single institutional idea is quite difficult to achieve, since it is often the case that the imitated institution will not function in the same way in the context of another institutional set-up or configuration" (Eriksson, 2005, p. 53). In a similar manner, Tödtling and Trippl (2005, p. 1204) argue that "[i]t would be misleading … to conclude that innovation activities required to secure competitiveness are the same in all kinds of areas". Discussing innovation policy on the national level, Chaminade and Edquist (2006, p. 143) also indicate the importance of policies being "formulated in relation to the current situation in the country". Also, following Edquist (2001), innovation policy is largely a matter of selecting, adapting, and in some instances creating new or abolishing old institutions, in order to promote innovation. As will be developed further below, this proposition is consistent with the theoretical perspective and empirical focus that is developed in this dissertation.

2.2 Public Procurement of Innovations as an Institutionally Defined Practice

This section elaborates on public procurement from a practical point of view. It will demonstrate how the public procurement process is an activity that is highly institutionalised through policy, law, regulation, and administrative procedures and, in these respects, actually defined by institutions.

Public procurement in the EU is regulated through the EC Procurement Directives. In addition to directives, according to the EC Treaty the European Union can also issue regulations, decisions, recommendations or opinions. Like regulations, directives must be complied with, but it is laid upon the (concerned) individual member states to transpose,

i.e. implement, them according to their own choice within the time period, as specified in the directive. Directives are distinct from recommendations and opinions, which have no binding force at all. In the case of public procurement, the European Community adopts the subsidiarity principle, which reflects an ambition to avoid top-down governance from the European level (Europarl, 2004).[1]

As a consequence, national procurement law may be organised differently in different EU member states. Two countries which have incorporated the EC Procurement Directives in different ways are Denmark and Sweden. Denmark has incorporated them *telles quelles*, i.e. without further adoption of the text. In Sweden, the old Directives were embedded in the Act on Public Procurement (Lag 1992:1528). In January 2008, the Swedish procurement law was updated in compliance with the latest EC Directives on Public Procurement and (Lag 2007:1091; Lag 2007:1092; see table p. 79). Countries have also developed distinct institutional set-ups in general. For instance, it has been suggested that Denmark has a strongly centralised system for public procurement; Norway has a highly regionalised system; Sweden and Finland seem to be developing in a rather distributed fashion; whereas the UK system is best described as networked (Edler et al., 2005).

Very briefly, public procurement can be described as a process in which a need is identified, defined, and satisfied through the procurement. In its simplest form, a public procurement process consists of two categories of actors, the public procurer and preferably a number of bidders or tenderers. On a general level, the Directives stipulate some behaviour that is mandatory for any instance of public procurement. The public procurer is required to advertise new contracts Europe-wide; to hold a competition between interested firms to determine the winner of the contract; to exclude firms lacking the necessary financial or technical capacity; to respect minimum time limits to ensure that all interested firms have time to participate; to award the contract on the basis of criteria stated in advance; and to provide information on the decisions made (Arrowsmith, 2005). The public procurement process or, as it is also called, the public procurement life-cycle is commonly described as a special case of the waterfall process model (see e.g. Sommerville, 1992, p. 7), which has been summarised by Lewis (2003) (see Appendix B).

Public procurement directives currently applied in EU member states are the Works Directive 93/37, the Supply Directive 93/36, the Service Utilities Directive 92/50 and the Utilities Directive 93/38 (Williams, 2004). The most recent versions were published in 2004 (Directive 2004/18 for works, supply and service contracts, and Directive 2004/17 for utilities contracts) and are still under transposition among EU member states (see table p. 79). On a general level, the Directives specify the procedures for how public contracts should be awarded. These are the open procedure, the restricted procedure, the negotiated procedure and the design contest. As will be developed further below, the Directives published in 2004 came with a new procedure, the competitive dialogue.

[1] The typology of legal acts applicable in the EU is undergoing revision. For instance, in the new terminology the corresponding term for 'Directive' is Framework Law (see EU, 2008). For practical reasons the current terminology will be used here.

The key characteristics and differences between the procedures can be summarised as follows. Open procedures are procedures whereby any interested economic operator may submit a tender (see Article 1, § 11a, EC 2004/18). A restricted procedure is a procedure in which economic operators who have been requested and then invited by the contracting authority are allowed to submit tenders (see Article 1, § 11b, EC 2004/18). The third type of procedure defined by the Directive, the negotiated procedure, is one in which the contracting authority consults some selected economic operators, one or more of which are eventually awarded a contract (Article 1, § 11d, EC 2004/18). The final procedure, typically to be used in e.g. town planning and architecture, is the design contest. This refers to a procedure which enables a contracting authority to acquire a plan or design that has been selected as a winner by a jury in a contest (Article 1, § 11e, EC 2004/18).

Since 2004, in cases when particularly complex contracts (Article 29, § 1, EC 2004/18) are to be awarded, contract authorities may use the competitive dialogue as the procurement procedure. This procedure can be summarised as follows. Initially, the contracting authority is to publish a contract notice in which the needs and requirements for the contract are described (Article 29, § 2, EC 2004/18). The contracting authority opens up "a dialog the aim of which shall be to identify and define the means best suited to satisfying their needs" (Article 29, § 3, EC 2004/18). When dialogues have been held with different tenderers, and the contracting authority has identified a solution, it should declare the dialogue concluded (Article 29, §§ 5-6). The contracting authority should then ask tenderers to submit tenders to deliver the solution derived in the previous dialogue stage (Article 29, § 6).

The procurement procedures allow interaction between public procurer and supplier to different degrees. The most restricting procedures – the open procedure, the restricted procedure and the design contest – in principle do not allow any interaction between public procurers and suppliers. Compliance with the specifications of these procedures typically means that the public procurer posts an advertisement for a given product, receives propositions from tenderers, and awards the contract to the tenderer who offers the lowest price for the product. A procedure of this kind is very effective when the procurement consists of regular off-the-shelf products. Following Edquist, Hommen and Tsipouri (2000), problems emerge, however, when the procured good involves innovation, i.e. when some (or all) features of the product are not established at the time of the initial advertisement, since the more restricted procedures do not allow the interactive processes associated with innovation to take place and the possibilities for innovation are obstructed. There are procedures, however, which are more allowing in this regard. These are the negotiated procedure and the recently published competitive dialogue. If public procurement takes place according to these procedures, innovation-friendly interaction is allowed. The problem is that these procedures are applicable only in exceptional cases.

The effects of the Directives outlined above are far from incidental but are results of deliberate policies. In fact, the institutional framework governing public procurement of innovations has long been an object of public policy – either implicitly or explicitly. With

a few exceptions (see Edquist and Hommen, 2000, pp. 8–9), the central aim of the EU policy on public procurement has until recently been to create "free markets" where trade barriers have been eliminated and differences in regulations between the countries in the EU evened out: i.e. objectives consistent with the overall project of creating a common European framework for economic activity (e.g. Europarl, 2000). The current Directives were designed to counteract governments' protectionist procurement policies, preferential public procurement which had led to inefficiencies, and instead to promote a competitive EC-wide single market (Uttley and Hartley, 1994; Arrowsmith, 2005, pp. 120–125). This policy is most clearly manifested in the application of the open procedure as described above. The side effect, however, has been neglect of the interactive aspects (see Edquist and Hommen, 2000).

Recent voices acknowledge, however, that "the main area of neglect in recent years in R & D and innovation policy spheres has been demand-side policies. Certainly many countries have attempted to stimulate aggregate demand via the use of a variety of macroeconomic instruments, but few have actively sought to link supply and demand directly via the use of instruments such as Public Technology Procurement" (European Commission, 2003, p. 64). And also the latest legislative package had as its purpose to "simplify and clarify the existing Directives … and to adapt them to modern administrative needs in economic environment that is changing" (Williams, 2004, p. 154). The following section attempts to elaborate further on this development.

2.3 Changes in Public Procurement Policy and Law in the EU

This section attempts to show, by referring to the history of public procurement policy and law, how institutions defining general processes and specific procedures for public procurement of innovations have been objects of public policy, and how recent policy debates have questioned their efficacy. The main argument that is developed is that only in the post-Lisbon period (from 2000 onwards) have the EU policy makers devoted any serious attention to the use of public procurement as a tool or instrument for promoting innovation. The theories and concepts underpinning the EC Directives on public procurement have been less effective, so far as their grasp of innovation is concerned.

It should be noted that the idea of using public procurement as a policy tool is not new. Over the years, public procurement has been used to accomplish a variety of policy objectives: to increase overall demand, stimulate economic activity and create employment; to protect domestic firms from foreign competition; to improve competitiveness among domestic firms by enticing "national champions" to perform R & D activities; to remedy regional disparities; and to create jobs for marginal sections of the labour force (Martin, 1996).

McCrudden (2004) discusses procurement initiatives addressing social goals that took place in the 19th century. For example, in 1840, US President Martin Van Buren issued an executive order that established the ten-hour workday for those working under certain government contracts. Similar initiatives were also made in Europe, in particular France

and the UK. The same author even states that "[i]t is not too much of an exaggeration to say that modern procurement systems evolved alongside the development of the welfare State, and it is hardly surprising that the former was used in part to underpin the goals of the latter" (ibid., p. 258).

It has also been shown how public procurement public agencies can stimulate innovation and help in maintaining or even increasing competitive advantage for a country. Scandinavian cases supporting this point are e.g. the formation of a development pair with the Royal Board of Waterfalls (Vattenfall, the Swedish Power Corporation) and ASEA (later ABB) in the 20th century. The public agency provided the necessary willingness to take risks associated with the development of innovative technology as well as pressure to do so in situations when the private supplier hesitated (Fridlund, 1999). The important role played by public telecom operators in the 1980s to stimulate innovation in telecom in a similar way, in both Sweden and Finland, has also been brought up in the literature (Palmberg, 2002; Bergren and Laestadius, 2003).

In the 1980s, studies were carried out to explore the phenomenon of technology procurement and to assess its potential as an industrial policy instrument in the telecom sector in four countries (Denmark, Finland, Norway and Sweden). On a general level it was concluded that "although there are several indications that private and public technology procurement is an efficient means of generating economically viable innovations, it does not follow that government policies to stimulate public and/ or private technology procurement are easily implemented" (Granstrand and Sigurdsson, 1985, p. 202). Ove Granstrand (1984) also produced a paper providing a general framework for describing and analysing patterns of buyer-seller interaction with special reference to technology procurement. Cases collected from the areas of telecommunications and power transmission were provided.

If one makes the jump from history to recent history, it is also possible to find cases of public procurement and, in particular, cases of innovative public procurement. Swedish examples can be found in Westling (1991); Swedish and European examples in Edquist, Hommen and Tsipouri (2000); examples of projects carried out by the Swedish National Board for Industrial and Technical Development (NUTEK) in Suvilehto and Öfverholm (1998, cited in Neij, 2001); and from Europe in Edler et al. (2005).

In the last decades of the 20th century, however, the general perception of the relation between the market and public sector changed. The free market approach which stressed market mechanisms rather than public sector management as the way forward was promoted e.g. by world leaders such as US President Reagan and UK Prime Minister Thatcher. In many countries this trend typically led to the contracting out of non-core activities in the public sector or to sales of government business enterprises (Callender and Matthews, 2002). Also in Sweden in the 1990s the policy discourse was "characterized by more generally oriented policies than before, at least within the area of industrial policy. Instruments of a more selective character; implying stronger intervention in the market economy [e.g. public technology procurement], were not in fashion" (Persson, 2008, p. 22).

There are examples of reports that discuss the implications of deregulation on public procurement of innovation. The final report of a research project funded by the European Commission argues that "liberalisation of the telecommunications sector have severely diminished not only the possibilities for telecom operators to carry out public procurement but also their capability to do this in an innovative manner. In other words, both their opportunities and abilities to carry out innovative public procurement have been greatly reduced" (Gavras et al., 2006, p. 72).

Another report produced by the Royal Swedish Academy of Engineering Sciences deals explicitly with the telecom sector, the energy sector, the railway sector and the defence sector in Sweden and how deregulation came to make the traditional Swedish model impossible (for a description of the traditional model, see e.g. Fridlund, 1999). The ambition of the authors was to "add nuance to the discussion on the future of technical development in the sectors, and if we can learn things from the past that can be applied in future scenarios, then we should be satisfied" (IVA, 2003).

This development was also brought up in a Swedish innovation strategy produced by the Swedish Ministry of Enterprise, Energy and Communications and the Ministry of Education and Research (Näringsdepartementet/ Utbildningsdepartementet, 2004). The report discusses the liberalised state in the Swedish economy and the changing or unclear roles the liberalisation has generated. Typically, such uncertain sectors are railroad, telecom, and energy – i.e. sectors that have traditionally been important loci for innovation driven by public demand. These sectors are served today by many operators, and it is unclear who should take responsibility for developing new technology.

These – as Cox and Furlong (1996) describe them – neo-liberal policies were also visible in the way public procurement legislation was designed: to prevent nationalistic, protected and (therefore) inefficient procurement and instead promote the creation of a common European market. Other references elaborating on this development are the European Commission (1998) and Martin, Hartley and Cox (1997). Similarly, Gavras et al. (2006, pp. 70–71) argue that the EC Directives were stressing regulation rather than strategy, the free market rather than interventionist orientation, European rather than national competitiveness, competition rather than protectionism, equal opportunity rather than collaboration and learning, and competitive markets rather than public sector monopolies.

The International Energy Agency (IEA), the organiser of an array of procurement projects involving the development of new energy-saving technology, called quite early for "clarifications in the existing public procurement rules, for example the EC directives, in order to facilitate procurement efforts within innovation purpose" (IEA, 2000, p. 14). Academics analysing the EC Directives concluded that there is "a considerable degree of tension between the EU procurement rules and the need to accommodate informal co-operation in the form of user/producer interaction related to technical change" (Edquist, Hommen and Tsipouri, 2000, p. 284).

Since then, it seems, the pendulum has changed direction, and the emphasis on market forces has lost ground in favour of the public sector. “Government is suddenly seen as a fundamental provider rather than an adjunct to the business of running the economy” (Callender and Matthews, 2002, p. 230). Although these authors discuss the US perspective, the way public procurement policies have developed in the recent past shows a similar pattern in the European Union. Since the Lisbon European Council meeting in 2000, public procurement has increasingly been mentioned as one important policy tool that can help realise the goal of making Europe the most advanced knowledge economy in the world by 2010. In the following, an overview is given of the development of public procurement as an innovation policy that has taken place in recent years.

Prior to the year 2000, public procurement secondary policies (Arnould, 2004) mainly addressed issues related to the basic foundations of the European Community and the common European market. Typically, the focus was on e.g. assuring competition, avoiding corruption and national discrimination through increasing transparency, and policies designed to overcome inefficient public spending (Martin, Hartley and Cox, 1997; European Commission, 1998).

At the Lisbon European Council meeting in 2000, a process was initiated in which public procurement as a means to stimulate innovation would become increasingly emphasised. At the meeting it was established that the European Union, although in a fairly good state in terms of inflation levels, interest rates, public sector deficits and education level of the workforce, still had to address the challenges imposed by global competition and the shift towards a knowledge-driven economy. As a response to the perceived situation, the goal was set for the European Union “to become the most competitive and dynamic knowledge-based economy in the world” by 2010 (Lisbon European Council, 2000). One of the ways forward to achieve this goal was to form “better policies for the information society and R & D, as well as stepping up the process of structural reform for competitiveness and innovation” (ibid.).

Two years later, the European Commission (2002, p. 23) concluded that “a stronger European impulse is needed” to achieve the Lisbon goal. At the Barcelona European Council that year it was also agreed that R & D investments needed to increase from the level of 1.9 per cent of GDP in 2000 to 3 per cent of GDP in 2010. A second issue concerned the level of business funding of R & D. The goal was set that the current levels of 56 per cent should be increased to two-thirds of total R & D investment (European Commission, 2002b).

In the general effort to develop research and innovation-friendly regulations, public procurement started to gain attention as a potentially useful funding source for public infrastructure. The tendency of governments to buy established rather than new technologies was acknowledged, however, and also that “[c]hanges in these areas could have a substantial impact on increasing private R & D” (ibid., p. 14).

In 2003, research carried out for the European Commission based on the perception that the targets initiated at the Lisbon Council will not be met without support from

governments and the European Commission, emphasised (among other things) the importance of a right mix of different policies adapted to a given context. Among the measures listed was public technology procurement. It was also concluded that

> [p]olicy instruments which attempt to link supply with demand have been relatively neglected … despite the fact that public technology procurement entailing a measure of R & D is the largest potential source of the financial resources needed to meet the Barcelona target. Public authorities should be encouraged to be less risk-averse and take steps to increase the amounts of R & D associated with procurement decisions. (European Commission, 2003)

The same year, the European Commission concluded that public procurement "is a leading or major component of demand in a number of sectors … where the public sector can act as a launching customer" (European Commission, 2003b, p. 20) and noted that "[a]n important objective is to raise public buyers' awareness of the possibilities offered to them by the legislative framework, and to support the development and diffusion of information enabling them to make full and correct use of these possibilities" (ibid., p. 20).

In 2005, public authorities were described as "big market players" which "have powerful means to stimulate private investment in research and innovation" (European Commission, 2005, p. 8) for the purpose of assuring economic growth in the face of global competition. In the same year, the Council of the European Union recommended that member states should (among other things) focus on "encouraging public procurement of innovative products and services" (European Council, 2005, p. 6). A report from the European Commission published in 2006 emphasises the role of the public sector and the use of "public procurement to drive demand for innovative goods, while at the same time improving the level of public services" (European Commission, 2006, p. 6).

One way of implementing this ambition is described in the National IST Research Forum report (2006), referred to above, on pre-commercial procurement of innovation. This process describes a series of tenders through the life cycle of a product, beginning in the earliest explorative stages, through prototype development, the production of test batches and eventually to what the report refers to as regular procurement. For each of the stages, contracts are awarded through competition. Pre-commercial procurement of innovation takes advantage of the exception in the procurement rules that exclude public procurement of research and development (R & D) services. This exception in the rules makes it possible for public procurers of R & D contracts to discriminate non-European tenders. Since 2007, the European Commission also recognises technical innovation as a market failure eligible for state aid.

In 2007, the European Council published a guide on dealing with innovative public procurement, drawing on cases collected in a study by the Fraunhofer Institute (Edler et al., 2005). In addition to providing a list of ten "elements for decision makers who want to develop and implement a public procurement policy that promotes innovation"

(European Commission, 2007, p. 5), the guide explicitly emphasised the role of public procurement as a tool for innovation:

> To have the greatest impact, then, public procurement for innovation needs to be a part of a general innovation policy. What is needed is a system providing for education, for research, for finance, for knowledge transfer and support for small business, for intellectual property management and for high regularity environment. (Ibid., p. 4)

2.4 Mainstream Economics and Auction Theory

According to Edquist and Hommen (2000), a useful point of departure in mainstream economics in the analysis of public procurement, including public procurement of innovation, is auction theory. In such a perspective, public procurement is treated as a game in which the buyer and the supplier each try to take advantage of the other's weaknesses. The supplier's supposedly superior knowledge stands against the buyer's advantage in being in control of the actual design of the auction rules. Applying this perspective to a regular procurement process would, regardless of procurer (public or private), be a quite straightforward analysis: The lowest bid to meet the specifications should automatically be awarded the contract.

However, in the case of non-regular public procurement, i.e. public procurement of innovation, the conditions are not the same as in regular procurement. One central point, for instance, is that the buyer probably holds crucially important knowledge about the product to be developed that needs to be shared with the supplier. In contrast to mainstream economics, innovation theory treats public procurement of innovation as a special case of user-producer interaction. This means that the process is regarded not as the result of an anonymous market process, as a mainstream economics perspective would suggest, but as the result of user-producer cooperation and information sharing (von Hippel, 1988; Lundvall, 1988). This is rather different from the auction theory-based understanding of public procurement of innovation as the acquisition of information.

The understanding of public procurement of innovation as essentially a social and interactive process is also emphasised in the systems of innovation literature. Rather than understanding public procurement of innovation as the acquisition of information, as the auction theory-based perspective suggests, a systemic approach regards innovation as a complex and interactive process influenced by many factors (Edquist, 1997), where the central activity within the system is learning and "which involves interaction between people" (Lundvall, 1992, p. 2). Following Edquist and Hommen (2000), this means that auction theory is not well equipped to deal with the case of innovation, since it addresses itself primarily to market failures brought about by asymmetries of information. To further develop this point, approaches based on innovation theory are discussed in the next section.

2.5 Innovation Theory-Based Approaches – Evolution and Interactive Learning

The previous section suggested that innovation theory would provide an alternative way to deal with public procurement of innovation. To develop this point further, this section provides a general overview of innovation theory, which informs the systemic approach to innovation policy.

According to Edquist and Hommen (1999), three main currents in innovation theory have been especially influential in building a theory of innovation. Of these three, two have been predominant: interactive learning theory as developed by Lundvall (1992) and evolutionary economic theory as developed by Nelson and Winter (1982). Both of these theoretical traditions have strengths enabling them to compensate for some of the above-mentioned shortcomings of approaches originating in mainstream economics and, as discussed in the previous section, auction theory.

One contribution to a systemic understanding of innovation has been made by Kline and Rosenberg, who proposed a model consisting of four elements: research, invention, innovation and production, and the feedback between these elements. According to this chain-linked model, a "perceived market need will be filled only if the technical problems can be solved, and a perceived performance gain will be put into use only if there is a realizable market use" (Kline and Rosenberg, 1986, p. 289). In a similar way, Lipsey and Carlaw (1998, p. 7) acknowledge that a "change in any one element of the complex technological structure … creates incentives that induce further changes in technology through the system". What follows from a systemic understanding of the innovation process is the acknowledgement of demand-side policies such as public procurement of innovation (Edquist and Hommen, 1999).

Edquist and Hommen (1999) summarise the evolutionary perspective as follows. The point of departure is the existence of a certain set-up of technology. In the system, there are mechanisms which create diversity, i.e. novel developments from the initial technological set-up. Then there is a selection mechanism that reduces the diversity, i.e. some of the novel developments become more emphasised while others diminish in importance. "The selection environment influences the path of productivity growth any given innovation, and also it feeds back the influence strongly on the kinds of R & D that firms and industry will find profitable to undertake" (Nelson and Winter, 1977, p. 61), thus connecting to a systemic perspective as described in the previous paragraph.

Taking into account that innovation is essentially a social process characterised by interactive learning among actors also brings an interest in institutions to the fore. Institutions have been defined as the "sets of habits, routines, rules, norms and laws, which regulate the relations between people and shape human interaction" (Johnson, 1992, p. 26). From the point of view of an innovation researcher, institutions may either constrain or facilitate innovation (Hollingsworth, 2000).

With institutions as a central analytical pillar (Edquist, 1997), Edquist, Hommen and Tsipouri (2000) summed up the state of the art in research on public procurement and innovation. Their volume, since its publication, has inspired and provided arguments for public agencies and supranational organisations around the world to address and place on the policy agenda the issue of public procurement as a means to stimulate innovation. *Public Technology Procurement and Innovation* analysed public procurement in the light of innovation theory and also included a number of case studies of public technology procurement in Sweden, as well as case studies of public technology procurement projects in the telecom sector in several European countries. The findings of a comparative analysis of these cases stressed the importance of user competence and user-producer interaction for successful technology procurement projects. These were also central points of argument in the analysis of the EC Directives on Public Procurement. Edquist, Hommen and Tsipouri (2000, p. 308) concluded that there is "a considerable degree of tension between the EU procurement rules and the need to accommodate informal co-operation in the form of user/producer interaction related to technical change". They also argued that the EU policy development related to the EC Directives on Public Procurement was "almost exclusively concerned with the regulatory aspects" of policy, while they, in contrast, emphasised another policy dimension, "the *strategic* aspect – i.e. the use of public technology procurement as an instrument of innovation policy by the EU or by national government agencies" (ibid., p. 7).

However, Edquist, Hommen and Tsipouri (2000) did not manage to analyse the institutional set-up for public procurement of innovation in a fully integrated manner, and their discussion therefore falls far short of being fully comprehensive. Further, the empirical aspects of their work – and also of the other chapters collected in the same volume – predates the introduction of the current Public Procurement Directives. Consequently, the findings and conclusions of these authors cannot be directly applied to the current empirical and policy context. In order to develop this analysis further, the next section will discuss in more detail the role of institutions for innovation.

2.6 Towards an Institutional Perspective

The above-mentioned problems with applying innovation theory to public procurement of innovations might be remedied by further development of the third current of innovation theory identified by Hommen and Edquist (1999) – namely, institutional theory. The current trend in theoretical and practical discussions of innovation policy is towards "stronger emphasis on 'institutions' and 'organizations'" (Lundvall and Borrás, 2005, p. 612). Institutional theory is well suited to this emphasis, as demonstrated by its recent revival in innovation studies, especially in comparative analyses of innovation systems and processes (Hollingsworth, 2000). In light of these developments, and also in view of the fact that innovation policy is fundamentally concerned with institutions (Edquist, 2001), it can be argued that an institutional perspective would be an especially appropriate basis for the further development of an innovation theory-based approach to policies for public procurement of innovations.

2.7 Institutional Issues

The aim of this section is to specify a number of issues that call for greater attention to institutional questions. These issues concern not only matters of institutional design, but also institutions as determinants of innovation performance. Thus, the ambition here is to develop an innovation theory-based institutional perspective on the public procurement of innovations. This will be achieved by focussing on these two related areas in recent research on innovation policy in general – and on this specific area of innovation policy, in particular. The two focal areas, which will be addressed in the following sub-sections, are: (1) innovation policy formulation as institutional design, and (2) institutional determinants of innovation performance.

With the first set of issues, there is a need to base institutional design on a systematic integration of relevant theoretical and practical dimensions. With the second set of issues, there is a need to consider a broad range of different types of institutions (rather than just formal, regulatory institutions). There is also a need to address the inter-relations of these two dimensions.

2.7.1 Innovation Policy Formulation as Institutional Design

Following Edquist (2001), the formulation of innovation policy can be regarded as being fundamentally concerned with institutional design. It has also been argued that institutional design should be based to a large extent on the analysis of how contextual factors affect or condition innovation policy, given "the contextually specific nature of innovation processes" (Mytelka and Smith, 2002, p. 1477). Therefore, as suggested – but not fully implemented – in Edquist and Hommen (2000), the institutional design of policies for public procurement of innovations should be based on a systematic integration of evolutionary and interactive learning approaches. These approaches are the main frameworks that innovation theory has developed for relating innovation to its social and economic contexts.

The importance of context for institutional design in innovation policy is reflected in current policy literature on public procurement of innovations. Recently, several EC-funded projects, as well as individual national authorities, have specified principles, models and examples of "best practice" (OGC, 2004; Edler et al., 2005; Georghiou and Cave, 2005). But this empirically based approach is unable to account for variety and change in the dynamics of user-producer interaction and longer-term processes of technological development and cannot inform broader strategies for public procurement of innovations.

2.7.2 Institutional Determinants of Innovation Performance

Innovation policies may be more or less successful, and institutions are often treated as causal factors accounting for either success or failure – or, alternatively, strong or weak

performance – in policy areas such as public procurement of innovations. Thus, there has been continuing debate over whether or not specific institutions are responsible for the EU's continuing under-performance in this area.

It is difficult to say whether the aforementioned critiques of the EC Procurement Directives have been empirically well founded. With the exception of the National IST Directors Forum, which is still pursuing its own research, most criticisms of the EC Directives have been based on case studies and other evidence that long predates the initial publication of the EC Procurement Directives. Thus, there is a need for contemporary empirical research that directly investigates whether the Directives are indeed a hindrance or obstacle to the public procurement of innovations.

Further, whether or not formal, regulatory institutions such as the legal framework defined by the EC Procurement Directives can be shown to have hindered public procurement of innovations is not the only relevant institutional question. An innovation theory-based institutional approach must in addition consider the possibility that other kinds of institutions could also contribute to under-performance in this area.

Historically, the field of innovation studies has lacked a commonly agreed definition of institutions. More recently, some degree of consensus may have emerged in relation to Edquist and Johnson's (1997) proposal to adopt a Northian definition referring to institutions as "rules of the game" (North, 1990, p. 3). However, these authors have advanced a definition of institutions as "sets of common habits, routines, established practices, rules, or laws that regulate the relations and interaction between individuals and groups" (Edquist and Johnson, 1997, p. 46), and they have also pointed to the need for further taxonomic and empirical research on institutions. In particular, they suggest that "a distinction between designed and self-grown institutions is important" for understanding institutional change (ibid., p. 61).

For the most part, innovation studies has continued to focus primarily on formal, regulatory institutions – or what sociologist W.R. Scott (2001) refers to as "regulative" institutions – and to ignore other types and dimensions of institutions. However, some authors (Borrás, 2004) have begun to conceptualise the dynamics of institutional change, while others have explored the distinction between designed and self-grown institutions. Thus, Coriat and Weinstein's (2002) taxonomy of institutions distinguishes between "Type A" (exogenous) and "Type B" (endogenous) institutions, enabling analyses of institution systems and processes to take organisation-specific aspects of the institutional set-up into account. By addressing what Scott terms the "normative" and "cognitive" dimensions of institutions, as well as the mutual embeddedness of organisations and institutions, their framework offers a much-needed alternative to the usual tendency in innovation studies. Particularly where multi-organisational collaborations are involved in the public procurement of innovations, Coriat and Weinstein's framework may be particularly important for understanding how institutional factors may determine success or failure.

Coordination is also a vital concern for the systemic approach to innovation policy, since much 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). Further, systemic approaches generally recognise 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 general policy implication of this approach 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).

Metcalfe (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).

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. Systems of Innovation thinking "has emphasised the essentially context-bound nature of technological change … especially in terms of the relevance that the institutional set-up has for innovative performance" (Borrás, 2004, p. 427). 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 would also be useful in order to round out an institutional innovation policy perspective on public procurement of innovations.

2.8 The Research Problem

An institutional perspective, which provides an especially appropriate foundation for the further development of an innovation theory-based approach to policies for public procurement of innovations, can be elaborated fruitfully by focussing on two key areas: innovation policy formulation as institutional design, and institutional determinants of innovation performance.

In the first of these two key areas, it is necessary to link institutional design to evolutionary and interactive learning approaches, which are innovation theory's two main frameworks for relating innovation to its social and economic contexts. Institutions should be linked to evolution and interactive learning in a comprehensive and systematic way. In the second key area, it is not sufficient to focus only on externally defined rules of the game. Instead, it is necessary to consider a broad range of different types of institutions rather than just formal, regulatory institutions, and also to address their inter-relations.

By developing an institutional perspective on public procurement of innovations, it would be possible to advance an innovation theory-based approach to this particular sub-field of innovation policy, and innovation policy more generally. By relating this perspective to both the design of policy and its impact on innovation performance, it would become possible to describe and analyse processes involving public procurement of innovations in a better way, and thereby to derive implications for both researchers and practitioners.

In response to the purpose of the thesis and the topics highlighted in this section, the following research questions are proposed.

1. What implications for the institutional design of public procurement of innovations can be drawn from a systematic integration of evolutionary and interactive learning dynamics related to the social and economic context?

2. How do various kinds of institutions affect innovation performance outcomes in public procurement of innovations?

2a. How do formal, regulatory institutions help or hinder public procurement of innovations?

2b. How may endogenous institutions affect possibilities for public procurement of innovation?

2c. How does coordination (or the lack thereof) among different kinds of institutional governance mechanisms affect performance in public procurement of innovations?

3. Methodology and Research Setting

The contents of this chapter can be outlined as follows. Section 3.1 starts out with a discussion on methodology in a broad sense. From this follows a narrower and more specific discussion of the research process carried out in the preparation of this thesis. Section 3.2 summarises more practical aspects of the research setting, section 3.3 discusses delimitations, and the concluding section 3.4 discusses the extent to which the result of the research reported here is valid, reliable and generalisable.

3.1 Methodology

This section starts with a broad discussion on what qualifies as science (section 3.1.1). This includes a discussion of what a paradigm is and some characteristics of scientific knowledge. A brief account of a critical realist approach to science is also included. Relying heavily on a model developed by Christensen (2006), section 3.1.2 outlines the research strategy applied. Section 3.1.3 concludes with a description in some detail of the research design and methods used.

3.1.1 Scientific Inquiry: A Critical Realist Perspective

This study is intended as a contribution to scientific knowledge. The following discussion considers what implications that intention might have, as "questions concerning the distinctiveness of scientific knowledge, as opposed to other kinds of knowledge, and the exact identification of the scientific method are seen as fundamentally important and consequential" (Chalmers, 1999, p. xx).

Following Chalmers (1999), science is derived from facts as statements, rather than personal opinion. Chalmers illustrates this by referring to the discoveries of novel plants and animals made by Darwin. "It was only when [Darwin] had formulated *statements* describing the novelties and made them available to other scientists that he had made a significant contribution to biology" (ibid., p. 10, italics added). Similarly, although it might be argued that the events and developments associated with the journey devoted to exploring public procurement of innovations were necessary, the fact per se, that the journey was undertaken, is not sufficient. Science is obtained from the *formulated* statements that have come out of it, i.e. the present text.

It should be noted, however, that the formulation of such statements, what Chalmers calls "observation statements", does not happen solely by facts entering the brain through the senses. Chalmers (ibid., p. 13) maintains that "the formulation of observation statements presupposes significant knowledge, and that the search for relevant observable facts in science is guided by that knowledge". This means that scientific knowledge cannot be derived from *any* fact but is the result of a knowledge-dependent (ibid., p. 14) selection mechanism. Views of how this selection mechanism works, which have "reverberated in

the philosophy of science ever since" (ibid., p. 107) they were originally published by Thomas S. Kuhn, will be discussed briefly in the next paragraph.

Kuhn (1996) sees scientific progress as a cyclic process involving two states: normal science and scientific revolution. In the normal state, practitioners follow the paradigm which specifies what is legitimate within the discipline. A paradigm typically rests on "one or more past scientific achievements" … "that was sufficiently unprecedented to attract an enduring group of adherents away from competing modes of scientific activity", at the same time that it is "sufficiently open-ended to leave all sorts of problems for the redefined group of practitioners to resolve" (ibid., p. 10). Eventually the paradigm encounters problems or anomalies which the paradigm cannot deal with. Such development leads to a crisis, a revolution and the formation of a new paradigm.

Although Kuhn used natural science to illustrate his ideas, it is possible also within social science to distinguish between different paradigms devoted to understanding technical change and innovation (Coombs, Saviotti and Walsh, 1987). This thesis has followed some paradigmatic rules that have affected what and how facts have been collected, observed and analysed. In fact, the topic for this thesis would perhaps never have been "conceived and none would have [carried out further research on it] without a paradigm theory to define the problem and to guarantee the existence of a stable solution" (Kuhn, 1996, p. 28). The paradigmatic governance for this thesis is provided in the book edited by Edquist, Hommen and Tsipouri (2000). Understanding public procurement of innovation as they do, these authors provide a direction towards specific concepts which affect what knowledge has been collected for the studies in this thesis. For example, following naturally from Edquist, Hommen and Tsipouri (2000) is the interest in the procurement legislation and how it might affect possibilities for the public procurement of innovation.

To further develop this, the difference between intransitive knowledge and transitive knowledge is useful (Bhaskar, 1975, cited in Sayer, 2000). These two knowledge dimensions central to a critical realist ontology can be contrasted as follows. The objects under study form the intransitive dimension. This might be certain properties of particles that interest the physicist, or a social phenomenon that interests the social scientist. The theories and paradigms governing the search process belong to the transitive knowledge dimension. These might change as the result of a scientific revolution, while the objects in the real world, the particles or the social phenomenon, will remain the same (Sayer, 2000, pp. 10–11).

The distinction between the transitive and intransitive knowledge dimensions is central to a critical realist understanding of what is science. Critical realists distinguish between the real, the actual and the empirical. The real is what exists regardless of whether it is perceived as an empirical object. Specimens of animals may exist in the deep oceans although they have never been observed by humans. Structures and powers or capacities that the object might exercise are also part of the real. A creature living in the deep oceans might swim or feed in a particular way. It is also possible that although this creature has these powers, it might not employ them. The actual, which is the second

component in this critical realist ontology, refers to what happens when these potential structures are employed. In the case of the deep-sea fish, the actual can be the fish eating, or its motoric system. The empirical, then, is the domain of experience. The empirical is either the real or the actual. What a scientist sees in the deep sea may be what exists, i.e. something real and/ or something actual. The experience may also depend on structures which are not observable to the scientist. A critical realist view of observability is central here. Observability may create confidence, but is not a guarantee of fully complete claims about reality in relation to what is real.

Critical realist philosophy is applicable to institutional theory for understanding innovation in the following sense. For example, formal laws are perfectly observable and thus potentially run the risk of creating false confidence. This has often been the case, in fact, in innovation studies. What is maintained here is that one should take into account that "[l]aws can be obscure in their meaning and contested in their interpretation" (Scott, 2003, p. 886). If the law is treated not as originating from the real but from the empirical, the analysis can take into account that the significance of the law "is often negotiated by various actors in the field – ranging from legislators and judges to policy administrators and managers" (ibid., p. 886). Applying critical realist ontology to the study of formal institutions such as the EC Procurement Directives would prompt the researcher to go out to study the actual effects of the Directives when they are employed, rather than attempting an analysis of the literal law, understood as something real.

There is yet a further restriction of scientific knowledge that needs to be discussed. Following Chalmers (1999, p. 24), "[a]n observation statement" becomes scientific "if it is such that it can be straightforwardly tested … and withstands those tests". This restriction is perhaps the most critical determinant of scientific knowledge. It also presupposes a narrow definition of the concept of scientific method. A narrow definition of method would refer to the more concrete tools used to collect data, whereas a broader definition would take into account also epistemological aspects of how the world is perceived and what is knowledge, etc.

With regard to method considered in a narrow sense, scientific methods can be mapped according to a polarity consisting of two extremes, where one is the universally rigorous type of (often quantitative) methods, and the other is context dependent (and often qualitative) and sometimes more practically oriented. According to the former, the purest form of scientific endeavour is the experiment, where the scientist can isolate everything but the dependent variable under study, and through manipulation of the independent variable in the experiment, make universally valid conclusions about their relationships. Most social phenomena, however, do not allow studies based on an experimental set-up. Neither do the relevant questions about these phenomena always provoke researchers to pursue research of a kind that leads to universally applicable conclusions. Further, in this kind of research, "rigorous" variable-oriented approaches may fail to capture useful information embedded in context (Ragin, 1987). The researcher thus has to deal with a dilemma: "Shall he remain on the high ground where he can solve relatively unimportant problems according to his standards of rigor, or shall he [try to solve] important problems where he cannot be rigorous in any way he knows how to describe" (Schon, 1995)? In

this project, as will be discussed in the following sub-section, the methodological endeavour has been towards the latter end of this polarity.

Another polarity in which a work of science is typically to be positioned is induction–deduction. Induction is viewed as "inferring propositions about general regularities or universal laws from a limited set of observations" (Wuisman, 2005, p. 367). Deduction can be described as an "attempt to explain and predict particular empirical phenomena by deducing them from a set of propositions about general regularities or universal laws and precisely specified initial conditions" (ibid., p. 367). In brief, this thesis emphasises induction more than deduction. This is consistent with a critical realist approach which maintains that "the search for regularities and universal laws in empirical reality is in vain" (ibid., p. 368). Further,

> critical realist ontology implies that social reality is neither equal to nor explainable exclusively in terms of the empirical. Instead, scientific explanation of social phenomenon necessitates a search in the underlying layers for specific mechanisms that generate the particular events actually taking place and which, in turn, to a greater or smaller extent, may be experienced through the senses. (Ibid., p. 369)

Such understanding is consistent with relying on qualitative methods. This will be further elaborated below.

3.1.2 Research Strategy

The case studies of the type conducted here do not employ theoretical propositions as such. Instead, theory is used to provide sensitising concepts which in turn are used to identify elements that may be studied further. The kind of analytical framework that results from this use of concepts has been referred to as "sensitising schemes, which are more loosely assembled congeries of concepts intended only to sensitize and orient researchers and theorists to certain critical processes" (Turner, 1991, p. 10). The essential motivation for such an approach comes from the general view of the social world the social scientist sets out to study. "[C]oncepts and their linkages must always be provisional and sensitizing because the nature of human activity is to change those very arrangements denoted by the organization of concepts into theoretical statements" (ibid., p. 12). In that sense, the assumptions made here about the social phenomena under study differ from a more naturalistic view commonly and typically seen in natural sciences. Hence, except for very general conceptual categories, the scheme must be kept flexible and capable of being revised as circumstances in the empirical world change. "At best, explanation is simply an interpretation of events by seeing them as an instance or example of the provisional and sensitising concepts in the scheme" (ibid., p. 12). This position also affects how gathered data are used in the thesis. Through a matching exercise where an attempt is made to link data and theoretical concepts, further development of concepts may take place.

It was stated in section 3.1.1 that this dissertation emphasises qualitative methods and inductive analysis. This is an oversimplification, however, as not all of the articles collected here are primarily empirical in character. As for those articles that are empirically based, not all of them are purely inductive in character. To further develop a description of the approach, a model of the research process described by Christensen (2006) will be used.

Christensen describes the research process essentially as the attempt to go from descriptive theory to normative theory (ibid.). In order to reach the former, the researcher goes through three steps: observation, classification and the final stage in which relationships are defined. The output of this process is referred to as models and can be seen as generated from an inductive research process. The next step, then, becomes improving the theory by "cycling from the top down to the bottom of this pyramid in the deductive portion of the cycle" (ibid., p. 41); in others words, testing the hypotheses derived in the first stage. These tests may verify what was predicted, which may of course be a good thing. The even better result, according to Christensen, is if anomalies are found, which then can stimulate work that will eventually contribute to improved theory.

Each of the papers included in this thesis is situated on a different stage in this process. Paper 1 can be characterised as an extended exercise in classification, ultimately aimed at proceeding to the final stage of defining relationships and normative theory. Paper 2 can be considered to be partly deductive (addressing the proposition that there is some sort of tension between the EC Procurement Directives and public procurement of innovations), and partly inductive (in describing and analysing how the Directives help or hinder public procurement of innovations). Papers 3 and 4 are perhaps more purely inductive in character, and closer to Christensen's initial inductive stage of observation. Since the three empirically based papers appended to this dissertation take the form of partly or wholly inductive case studies, a discussion of this research strategy is in order

As was stated above, the overall methodological approach in this project has been exploratory or theory-building case study research (Eisenhardt, 1989). This is also primarily an inductive approach to research, where analysis actually begins with the definition of research questions and the selection of cases, which proceeds according to theoretical or purposeful sampling. This means that the cases were chosen not through the application of statistical methods but because of their perceived information richness.

> The logic and power of purposeful sampling derive from the emphasis on in-depth understanding. This leads to selecting *information-rich cases* for study in depth. Information-rich cases are those from which one can learn a great deal about issues of central importance to the purpose of the research, thus the term purposeful sampling. (Patton, 2002, p. 46)

In the later stages, the research becomes more analytical in character. Analysis begins with the generation and checking of explanatory hypotheses through within- and cross-case analysis in a rather dialectic fashion. Findings in one case will suggest where to look

in the other for correspondences or deviations that would then potentially generate new questions. Subsequently, hypotheses are refined and matched with supporting data. Eventually, more abstract second-level generalisation is achieved by comparison with conflicting and similar formulations drawn from the theoretical and research literature, carried out in order to build internal validity, refine concepts, and raise the level of theorisation.

The way the dialectic process described in the previous paragraph was applied here can be described as a process in which the institutional scope was widened and refined as a result of the knowledge gained. The early empirical work (paper 2) suggested that legislation was not the only institutional factor determining the possibilities for innovation in the context of public procurement projects. Consequently, in addition to legislation, institutions other than formal law, institutions with a shorter life span or less scope (Coriat and Weinstein, 2002), were also taken into account in the subsequent work. The second empirical paper (paper 3) focussed less on the effects of formal law and more on endogenous institutions as manifested in the rationalities of different organisations (van De Donk and Snellen, 1989; Gregersen, 1992). A signed public procurement contract of innovation was theoretically treated as the result of institutional match between collaborating actors. Paper 4 focussed even more on endogenous institutions by looking more specifically at the institutional interplay within a particular organisation.

It should be noted, then, that this project consists not of one case study, but of multiple cases. The advantages of multiple case studies are that the evidence collected is usually considered more compelling than the evidence from a single case. One disadvantage, however, is that multiple case studies can require extensive resources and time "beyond the means of a single student or independent research investigator" (Yin, 1994, p. 45).

An additional justification of the selected method relates to the availability of quantitative data. In contrast to other sub-disciplines within innovation research, quantitative data on public procurement in general are quite scarce. Relevant data for a student interested in innovative public procurement are practically non-existent. Even so, the problem – to refer to the previous discussion – is that if such data were available, their use would be rather limited for the purposes addressed here.

Concerning the use of case study results to build more general theory, it is important to note that the results come from analytic rather than statistical generalisation (ibid., p. 30). In statistical generalisation "an inference is made about a population (or a universe) on the basis of empirical data collected about a sample" (ibid., p. 30). Further, the confidence in such generalisations is determined on the basis of formulas weighting the size and variation within the universe and the sample. In this thesis, however, the cases have not been treated as sampling units. Rather, the multiple cases can be regarded as multiple experiments, where each case supports a theory.

3.1.3 Research Design and Methods Overview

Three central concepts which come from systemic approaches to innovation are evolution, learning and institutions (Edquist and Hommen, 1999). Following this dichotomy paper 1 deals with evolution and learning. The third concept, institutions, is emphasised in the next three papers. This division is also discernable in the way the research questions have been formulated (section 2.8).

The first research question addressed in this thesis was formulated as follows: What implications for the institutional design of public procurement of innovations can be drawn from a systematic integration of evolutionary and interactive learning dynamics related to its social and economic context? The main response to this research question is given in paper 1. Paper 1 should be seen essentially as a response to a perceived lack of taxonomies for the public procurement of innovations. The purpose of the paper is to develop a taxonomy that will contribute to better understanding the multifaceted character of the public procurement of innovations. A fundamental point of departure is the understanding of public procurement as an activity taking place in a variety of different procurement contexts and as an act of innovation, which up to this point, current literature has failed to take into account. Through the combination of two dimensions, interactive learning and evolutionary perspectives on innovation, the model developed in the paper distinguishes between different modes of interaction.

The second research question was formulated as follows. How do various kinds of institutions affect innovation performance outcomes in public procurement of innovations? In order to make this research question practically manageable, it was broken down into three parts. Research question 2a was formulated as follows. How do formal, regulatory institutions help or hinder public procurement of innovations? This was a question mainly pursued in paper 2. Research question 2b was formulated as follows. How do formal, regulatory institutions help or hinder public procurement of innovations? This research question was mainly addressed in paper 3. Research question 2c was formulated as follows. How does coordination (or the lack thereof) among different kinds of institutional governance mechanisms affect performance in public procurement of innovations? The research questions dealt with in papers 2, 3 and 4 were all pursued through case studies.

Paper 2 reported on a procurement project aimed at building a new digital maritime radio system in Norway. The public procurers' ambition was to comply with the European Directives of public procurement and the project was successful in terms of ability to deliver the new system in time, within budget and according to specification. The case study, somewhat unexpectedly, failed to demonstrate that the procurement law did not significantly inhibit public procurement of innovations. On the contrary, an earlier failed attempt to procure a new radio system which was an attempt with less ambition to comply with the Directives, reinforced the paper's conclusions that the Directives might sometimes actually promote innovation. This result provokes several questions that

prompt a further development of the institutional analysis. Essentially, it stresses the need to take into account other institutions than formal laws.

	Paper 1	Paper 2	Paper 3	Paper 4
Research objectives	To propose a taxonomy for public procurement of innovations.	To study how the EC Directives affected the possibilities for this public agency to procure innovation.	To study a public procurement project through an analysis of the interaction between the organisations and institutions at play.	To study how a large public agency adopts private sector innovations.
Unit of analysis	Theoretical dimensions and sub-dimensions derived from the literature.	The procurement project carried out by Telenor to procure innovative maritime radio technology.	The attempt formally led by Bracknell Forest Borough Council to procure a renewable energy centre.	The diffusion of a catheter in the NHS supply chain.
Sampling	Comprehensive survey of literature.	A successful case of public procurement of innovation under the EC Directives.	A case of public procurement involving multiple organisations where the project had to be terminated.	A case of adaptive innovative public procurement in a large complex organisation.
Data Collection	Literature survey and case studies.	Case study, interviews, documents.	Case study, interviews, documents.	Case study, interviews, documents.
Research Questions	1. What implications for the institutional design of public procurement of innovations can be drawn from a systematic integration of evolutionary and interactive learning dynamics related to its social and economic context?	2. How do various kinds of institutions affect innovation performance outcomes in public procurement of innovations?		
		2a. How do formal, regulatory institutions help or hinder public procurement of innovations?	2b. How may endogenous institutions affect possibilities for public procurement of innovation?	2c. How does coordination (or the lack thereof) among different kinds of institutional governance mechanisms affect performance in public procurement of innovations?

Table 1: Overview of methods used in papers 1–4

Paper 3 was an effort to develop this line of inquiry further. Instead of looking specifically at formal institutions, the paper was concerned with endogenous institutions typically emerging within an organisational context. This case study dealt with an attempt formally administrated by the Bracknell Forest Borough Council to procure a new energy

centre. The project included an array of other organisations in addition to the Borough Council, all with different rationalities. The attempt was terminated before any contract could be signed. The reasons for this outcome could be explained in terms of prevailing endogenous institutions within the organisations which participated in the pre-procurement phase.

The most intriguing aspect of paper 4 is that it offers a case consisting of purely institutional factors determining the diffusion of innovation into a public organisation. The case also underlines the necessity of taking into account not only exogenous institutional barriers but also endogenous. This case study deals with the diffusion, or rather the inhibited diffusion, of an innovative catheter that was claimed to have properties which would reduce hospital-acquired infections in the National Health Service in the UK. An interesting, noteworthy side effect of this case is that it expands the role of public procurement as an innovation instrument by incorporating unsolicited bids and diffusion also as important elements, which is not typically the case (Edquist, Hommen and Tsipouri, 2000).

3.2 Research Setting

The empirical basis or context of the thesis, i.e. the context to which its conclusions should be generalisable, is the public sector procurement of innovations occurring within the jurisdictional context of the EU.

As public procurement of innovations can be studied only within a public sector context, the choice has been to study public procurement projects empirically. More specifically, public procurement projects that were selected were chosen because they included innovation. The intention was thus to capture innovation and to illuminate various aspects of this phenomenon. Examples of such aspects are e.g. development or diffusion. Also, different institutional aspects of this process such as formal or informal institutions, or exogenous or endogenous institutions, were taken into account.

As was pointed out in section 2.2, for all EU member states, public procurement is governed by the EC Directives on public procurement. Although EU member states may transpose this legislative package into their national legislation in the way they find most appropriate, they all have to comply with these rules. This means that public procurement in any EU member state is essentially regulated by one and the same formal institution, the EC Directives on Public Procurement. Although national variations may exist, such as specific rules on public procurement under certain threshold values, or exactly how the EC Directives are implemented in the national legislation in this regard, any public procurement project taking place under this institutional set-up would allow inclusion in this thesis. In addition, other non-EU members may have chosen to comply with the EC Directives through membership of the European Free Trade Association (EFTA) and the European Economic Area (EEA).

The case study in paper 2 reports on a case collected from Norway. The cases in papers 3 and 4 occurred in the UK. Since this is a dissertation written in a Swedish university, some comments should perhaps be made on this apparent peculiarity. The reason for the inclusion of a Norwegian case was that this was the only case that came up after an extended search process in the Tenders Electronic Daily Database that was carried out early in this project. The case qualified, as Norway has agreed indirectly to comply with the EC Directives on Public Procurement, through its acceptance of the EFTA and EEA agreements. Justification for inclusion of the UK cases in this thesis is based mainly on the findings that the UK was found to be a leading country in developing innovation policies for public procurement (Edler et al., 2005). It should be noted that this does not mean that Sweden lacks recent examples of public procurement of innovation. Rather, it merely verifies the judgement of the Swedish set-up for public procurement as scattered (ibid, 2005) and therefore perhaps not as easily accessible to researchers. A final remark on this issue concerns the institutional focus here, which is specifically about the EC Procurement Directives. Such a focus does not specifically require a Swedish case per se, but rather cases occurring under the institutional set-up as defined by the Directives, a requirement with which all the included cases comply.

3.3 Delimitations

This dissertation is confined to studying public procurement of innovation as defined by the EC Procurement Directives. Omitted from scrutiny is the belief in public procurement as a means to achieve the Lisbon target that R & D spending should account for 3 per cent of EU GDP in 2010 – as well as the extent to which such a target is adequate. Also, the underlying assumptions about the importance of growth and that innovation is critical for achieving it, have not been tested.

Due to limited time, research on public-private partnerships (PPP), i.e. partnerships between a public agency and one or several private firms, was excluded. Military procurement has also been omitted, mainly because military procurement contrasts with civic public procurement e.g. in terms of organisations or incentives for innovation (Walker, 1994). Further, although military procurers may choose to follow civic procurement laws, such a decision is optional. Typically, military procurement is exempted from these laws.

The empirical material discussed and analysed here may have global relevance on a general level. Still, it should be noted that the main focus has been on the EU context – in particular as defined by the EC Procurement Directives. Although procurement law implemented elsewhere in the world may share characteristics with European legislation, a comparison of the individual legislative packages would be required in order to determine the relevance of this thesis for non-EU contexts. Such comparison, although interesting, fell outside the scope of this thesis. (For a further discussion on generalisability, see section 3.4.)

3.4 Validity, Reliability and Generalisability

Two central notions in determining and judging the quality of science are reliability and validity. Kirk and Miller (1986, p. 19) illustrate the difference between them as follows:

> A thermometer that shows the same reading of 82 degrees each time it is plunged into boiling water gives a reliable measurement. A second thermometer might give readings over a series of measurements that vary from around 100 degrees. The second thermometer would be unreliable but relatively valid, whereas the first would be invalid but perfectly reliable.

Following this general dichotomy, there are some typical questions that could be posed to establish validity. For instance, one could ask to what extent the collected measures are valid, i.e. in what sense they actually measure what is intended. What is maintained here is that a case study of a case of innovative public procurement may be relevant for the purpose of understanding innovative public procurement in general. On this general level, then, validity can be claimed on the basis of the fact that the observation statements originate from the same empirical realm that was intended for study. Cases of innovative public procurement have been studied in order to learn more about innovative public procurement.

The reliability criteria essentially involve scrutinising the application of the tools that have been used to collect data. According to Yin (1994, p. 36), reliability means that "if a later investigator followed exactly the same procedures as described by an earlier investigator and conducted the same case study all over again, the later investigator should arrive at the same findings and conclusions". One way of making it possible to repeat an earlier study is to document the procedures applied in a case study protocol. The case study protocols used in the case studies included in this thesis are attached as Appendix A.

Yin provides a list of much more complex notions adopted for case studies in social science, however, as will be briefly discussed in the following. Construct validity has been achieved when correct operational measures for the concepts studied have been established. To meet the test of construct validity the researcher needs to specify significant operational events and make sure that the measures used are valid. One way to increase construct validity is to use multiple sources of evidence, e.g. documentation, archival records, interviews, direct observation, participant observation, and physical artefacts, but the list could be extended further (ibid, 1994). To meet the test of construct validity, multiple sources have been used in the papers appended to this thesis. These are documentation available, for instance, online; archival records, e.g. the archived part of the Tender Electronic Daily Database; and interviews with people with special insights on the cases that were studied or on public procurement in general.

External validity has to do with establishing the domain to which a study's findings can be generalised "beyond the immediate case study" (ibid., p. 35). According to Yin, in order to examine to what extent a case study is externally valid, one must realise that

what is at stake here is analytic generalisation rather than statistical (as was mentioned in section 3.1.2). In analytic generalisation this means that "the investigator is striving to generalise a particular set of results to some broader theory" (ibid., p. 36). This has been done by relating the case studies to different accounts of theoretical framework as discussed in chapter 2.

According to Yin (ibid.), external validity also means that the researcher establishes to what extent the derived results are applicable elsewhere. As will be discussed in the following, for this thesis, the external validity varies somewhat according to what specific aspect of the findings of the thesis is considered.

One immediate limitation of the external validity is the institutional framework that has been a central element in the empirical papers, the EC Procurement Directives. The results derived here are generally valid in those contexts where the EC Procurement Directives or some other legislative package with the same effect is at force. This may not be much of a problem, however, as it is these very rules that were the starting point for this project. In that sense, the external validity can be claimed as sufficient for the problem domain under scrutiny. There are also elements of this thesis which are not entirely and strictly connected to the procurement law. For instance, the taxonomy developed in paper 1 does not rely on procurement law per se. This theoretical paper draws on concepts capturing phenomena occurring in capitalist economies in general. In that sense, the external validity of the results of paper 1 can be extended to conditions beyond the domains regulated by public procurement rules. Further, some of the more practical findings in paper 2, e.g. the requirement of certain project management skills in order to secure successful completions of development projects in general, seem at least intuitively to be valid for development projects in general. In that sense, some of the results are valid more universally than only for public procurement activities regulated by the EC Procurement Directives.

Paper 2 is interesting because it deals with a case collected from Norway, a country that is not an EU member. What could be questioned is how a case collected from a country outside EU may be valid for countries within EU. The justification for including the case here relies on the fact that Norway has in practice agreed to comply with the Directives through other collaboration treaties. Being a member of the European Economic Area, Norway has agreed to adapt EU legislation and also the "four freedoms" of the European Community (see Wikipedia, 2008).

It is also worth discussing the finding that the EC Directives did not prevent innovation in the case of public procurement of a maritime radio system in Norway, as discussed in paper 2, as well as the extent to which this may be regarded as externally valid for public procurement taking place elsewhere under the same rules and with similar organisational and managerial set-ups. It would not be adequate to draw the general conclusion that the EC Procurement Directives do not prevent innovation. Paper 2 does, however, lead to two important externally valid claims. Firstly, by demonstrating that public procurement of innovation is possible within the Directives, it falsifies a general proposition that these rules prevent innovation. Secondly, from the first claim follows the necessity to criticise

statements based on analysis of the law alone, about whether or not the Directives prevent innovation. To reflect from a critical realist perspective, relying on analysis of the formal law alone would be very problematic, as such analysis relates neither to the empirical nor to the actual, and therefore may be very distant from the real.

As regards the focus of papers 3 and 4, which are on other than formal institutions, the specificity of the particular organisations that were studied means that the findings are probably of limited external validity. The main reason for this is, as might be conjectured, that these institutions are organisation-specific. A straightforward, direct application of the findings here would therefore probably be problematic. However, a domain that could be claimed to have relatively high external validity concerns the institutional interplay per se on a more abstract level. For instance, an institutional mismatch, as was seen in the attempt to procure an energy centre in Bracknell Forest Borough discussed in paper 3, can most likely happen elsewhere. While the specific reasons for such an institutional clash to take place elsewhere might be different, it can be claimed that the principle problem, and also the suggestions for overcoming it, has rather high external validity. Similarly, the same class of problems as the institutional coordination mechanisms that were not sufficiently harmonised to enable adaptive public procurement of innovation as discussed in paper 4 probably exist elsewhere. The specificities, however, are most probably different.

Yin (1994) also discusses internal validity, which deals with the consideration of spurious effects that might affect conclusions. This is a concern mostly for causal and explanatory case studies, "in which an investigator is trying to determine whether event x led to event y" (ibid., p. 35). This pertains, for example, when effects of e.g. study programs or treatments of any kind are being evaluated (Research Methods Knowledge Base, 2008). In this thesis, although the EC Procurement Directives are to some extent regarded as an independent variable (potentially) affecting the ability of public agencies to procure innovation, the research designs developed here were not constructed in a way that makes internal validity a particular concern.

There is a certain ontological connection between the concept of internal validity and a critical realist perspective. To take into account that a particular empirical entity may be either from the real or from the actual – i.e. associated with uncertainty regarding what a certain observation actually captures – further suggests that internal validity in the literal sense may be very problematic to achieve. What is applicable as regards internal validity in this case, however, is the procedure in which respondents are asked to give comments on e.g. transcriptions of interviews and early versions of papers. In this way, at least, the results are triangulated against respondents' perceptions. This was applied to all the empirically focussed papers (papers 2, 3 and 4). Some comments from respondents helped to improve and verify conclusions arrived at in the final versions of the papers. The experience of applying this procedure yielded two reflections worth mentioning. Firstly, sending out interview transcripts of complete recordings proved to be less valuable, as these documents tend to be less accessible to the respondents. Preliminary versions of the papers were more efficient vehicles for such feedback. Secondly, there is a risk that commentators might attempt to take this second chance to improve their

statements and to present themselves in a much more positive way. This was a tendency experienced in one of the cases, and it has been experienced also in other studies (Eriksson, 2005, p. 127).

4. Summary of Appended Papers

The four appended papers are summarised in the following sections (see also table on p. 80). The presentation of each paper includes four elements: research objective, methods, results and implications. This discussion is summarised in Table 2. The chapter ends with an attempt to link the four papers together. This discussion generates the topics for Chapter 5, Discussion and Conclusions.

4.1 Paper 1

The objective of paper 1 is to propose a taxonomy for public procurement of innovations. This is justified in the current development of public procurement as an innovation policy tool intended eventually to help realise the Lisbon and Barcelona goals of increased private sector R & D investment in the EU. Current models of public procurement of innovations are inefficient for this purpose as they lack strategic perspective and attention to context. The discourse within this area of research has been focussed up to this point on the level of individual procurement projects viewed as a relatively linear project. The conclusions reached have generally not taken into account one of the fundamental problems raised in this dissertation, that public procurement of innovations takes place in different modes of interaction.

Although this is mainly a conceptual paper, it relies on twelve case studies covering cases from EU and Norway, where four were analysed in the light of the taxonomy which was developed in the paper.

The taxonomy of public procurement and innovation proposed in the paper combines interactive learning and evolutionary perspectives on innovation processes as a way to account for the broad range of different interaction environments or resource interfaces in which government or public sector organisations may act as lead users of innovations. Based on these assumptions, the paper attempts to place public procurement projects in the intersection between these two dimensions: modes of interaction and phases of evolution. In the model, public procurement projects are direct, cooperative, or catalytic. The evolutionary dimension in the model draws on the product life-cycle model which specifies three evolutionary phases: early (fluid), middle (transitory), and late (specific) (Utterback, 1994). The taxonomy presented includes nine separate kinds of public procurement of innovation.

The case studies referred to in the paper suggest that the different interaction modes have distinct characteristics and different issues to which attention needs to be given. Cooperative technology procurement is especially problematic, compared to other types, in terms of external governance, management of technological risk, and articulation of demand. Insufficient competence to define appropriate specifications, and/ or insufficient power to influence other actors, may potentially inhibit the success of catalytic technology procurement projects where multiple buyers are involved. Consequently, in

multiple-buyer projects, special attention should be paid to the involved stakeholders, the structure and operation of project teams in relation to risk and knowledge management, and the definition of product specifications.

One fundamental implication of the paper is the necessary exercise of caution in approaching public procurement of innovations that takes place as a series of procurement projects and involves more than one mode of interaction. It should not be assumed that the same set-up that works in direct procurement projects will also work in cooperative and catalytic procurement projects. This point will be discussed further.

4.2 Paper 2

Paper 2 was provoked by a perceived tension between the strategic use of public procurement as a means to stimulate innovation and regulatory aspects of the policies aimed at creating a common European market, suggesting that the EC Procurement Directives were not innovation friendly (Edquist, Hommen and Tsipouri, 2000). The purpose of paper 2 was originally to verify these perceived tensions. The conclusions reached, however, were based on a set of cases most of which had occurred before the mid 1980s, i.e. under a completely different legislative set-up. Also, the analysis by these authors of the Procurement Directives published in 1993 was based on the legal text rather then on actual cases conducted according to these rules. Paper 2 essentially attempts to overcome and go beyond some of these shortcomings.

The method applied in paper 2 is case study research. The case selected was a procurement project aimed at building a new digital maritime radio system in Norway. The ambition of the public procurers was to comply with the EC Procurement Directives, and the project was successful in terms of being able to deliver the new system in time, within budget and according to specification. Interviews were held with people who had been involved in the project, and available documents were studied.

The case study, somewhat unexpectedly, failed to demonstrate that the procurement law significantly inhibits public procurement of innovations. On the contrary, the case generally suggests that complying with the Directives may not significantly inhibit innovation. It can actually enable innovation. One reason for this is that the Directives, at least implicitly, encourage the procurer to search for suppliers. In this particular case, it meant finding a supplier not earlier known to the procuring entity.

The paper also lists three critical areas significant for success in public procurement of innovations. These are expertise on public procurement procedures as specified by the Directives; the technical competence to be able to produce a specification, i.e. knowing what the intended outcome of the project is; and general management skills, i.e. keeping to established plans.

4.3 Paper 3

It should be noted that the results of paper 2 do not suggest that institutions in general do not inhibit public procurement of innovation. Rather, it gives reason to doubt the extent to which an analysis based on formal institutions alone is sufficient. The results also give reasons for questioning the asserted tension between the formal institutions regulating public procurement, i.e. the EC Procurement Directives, and the possibilities for innovation. In other words, the results of paper 2 prompt an analysis based on a wider institutional perspective than what is typically common in systems of innovation approaches. This means that attention should also be given to the role of endogenous institutions, i.e. institutions other than formal laws. This widening of an institutional approach for innovation studies is essentially what paper 3 sets out to achieve. The paper develops a theoretical framework that specifies types and aspects of institutions relevant for such an analysis.

The paper includes a case study of an attempt by an English borough council, in collaboration with a number of other organisations, to procure a wood-chip-fuelled power plant intended to deliver sustainable energy to a renewed part of the town centre. At the end of the procurement process, there were no suppliers interested in obtaining the contract and the project was terminated. People representing the most important participating organisations were interviewed. Various kinds of documents were studied as well, e.g. information leaflets and strategic documents formulated by the borough council.

The empirical result achieved in paper 3 is an analysis of how innovative public procurement projects may take place in collaboration among multiple public and private actors or innovation networks. In regard to theory, the paper attempts to develop a discussion inspired by Coriat and Weinstein (2002) in which the role also of endogenous institutions is taken into account. In that sense, the paper sets out to overcome the tendency of systemic approaches to neglect the variety of organisational models and strategies among individual firms and other organisations (ibid.).

The main policy implication of these results relates to the scope of public procurement as an innovation policy tool. The paper suggests that innovation policies related to public procurement may not be sufficient if they do not take endogenous as well as exogenous institutions into account. Especially in situations where stakeholders come from different realms of society, and when these stakeholders are driven by different rationalities, public contracts leading to innovation may be, as in the case studied, very hard to achieve. This means that in order to be effective, innovation policies must be directed not only towards public procurers exclusively. Further, harmonisation of endogenous institutions may be necessary for the institutional match that is required if contracts are to be signed. Preferably, policies directed at increasing the possibilities for contracts involving public procurement of innovation should also take e.g. private sector suppliers and not-for-profit organisations into account, and should also address endogenous institutions.

4.4 Paper 4

The purpose of paper 4 is to contribute to knowledge relevant for how the public sector can stimulate or pace (Gregersen, 1992) private sector innovation. In paper 2 and paper 3, the cases coincide to a large extent with public procurement as a demand-side policy instrument (see e.g. Edler et al., 2006), something that has recently been emphasised. The issue related to this general theme that paper 4 brings up is the role of public agencies adopting emerging private sector innovations. As a complement to the prevailing focus on developmental technology procurement (Edquist, Hommen and Tsipouri, 2000, p. 21), the paper emphasises the role of adaptive public technology procurement of goods and services. In light of the often-mentioned public purchasing power, and the perception that "without diffusion, innovation have little social or economic impact" (Hall, 2005, p. 459), the objective in paper 4 is to study further how a large public agency adopts private sector innovations.

The paper includes a case study of an attempt by the National Health Service (NHS) in the UK to procure and diffuse a new catheter claimed to have properties that reduce the risk of hospital-acquired urinary-tract infections. Different persons within the NHS as well as representatives of the supplier were interviewed. Various documents providing information on the case were also studied.

The paper yields two main results. First, it stresses the importance of taking adaptive public procurement into account as a means to stimulate innovation. In sectors dominated by the public sector, suppliers offering unsolicited innovative products or services may be dependent on the ability of public agencies to adopt innovation. In that sense, public sector adoption of innovation may also be critical for stimulating innovation in a long-term perspective. Second, the paper underscores the sometimes neglected role that diffusion plays in innovation (Alic, 2008). Even if a new product is known by members of a social system, this condition per se may not be sufficient for diffusion to happen. Within an organisation, different institutional barriers may prevent or hinder diffusion. In such situations, it may be necessary to alter the institutional set-up in order to enable diffusion. Some institutional barriers found in the case, and one example of an attempt to change the institutional set-up, were discussed in the paper.

One important implication of these results presented in paper 4 concerns the role of public procurement as an innovation policy tool. The institutional dimension of diffusion applied in the paper put in focus the importance of identifying institutional barriers and the fact that, sometimes, redesigning the institutional set-up may be required in order to enable the diffusion of innovation. Viewed in this light, public procurement of innovation becomes an activity that needs to be considered not only in purchasing departments; it becomes a strategic issue, of central importance to an organisation.

The four articles and their main findings are summarised in Table 2, below.

	Paper title • Main message of papers
Paper 1	Public procurement and innovation – towards a taxonomy • Public procurement of innovation takes place in different modes of interaction. • According to the taxonomy developed in the paper, public procurement can be direct, cooperative, or catalytic and can take place in the early (fluid), middle (transitory), and late (specific) phase in a product's life cycle. • Different interaction modes have distinct characteristics and different issues to which attention needs to be paid.
Paper 2	The Utilities Directive and how it might affect innovation: the case of innovative procurement of maritime radio technology • The EC Procurement Directives did not prevent innovation from taking place. • Three areas of expertise were identified as critical for a successful project: expertise on the Directives; technical competence to provide specification; and general project management skills.
Paper 3	Public procurement of innovations and the role of endogenous institutions • Institutional analysis of innovation should also include other institutions than the formal. • Endogenous institutions are important determinants for public procurement of innovation.
Paper 4	Public Procurement of Innovation Diffusion: Exploring the Role of Institutions and Institutional Coordination • Adaptive innovative public procurement may also be important in the context of innovation, in particular to promote diffusion of innovation. • Adaptive innovative public procurement may require endogenous institutional change.

Table 2: Summary of the main messages of the four appended papers

4.5 Linking the Four Papers

The summaries of the appended papers in sections 4.1–4.4 revealed to some extent how each paper inspired the next, and thereby indicated how they are connected. In this section, the connections or the linkage between the articles are further developed.

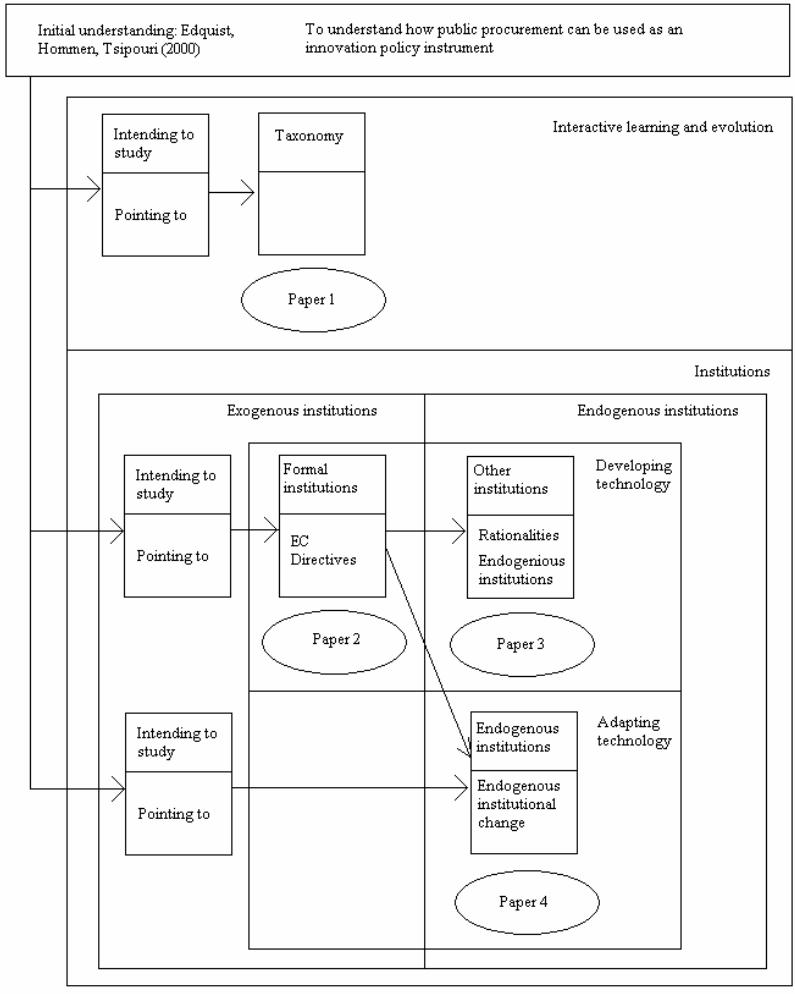

Figure 1: Linking the four papers

The fundamental point of departure common to the four papers is the volume on public procurement edited by Edquist, Hommen and Tsipouri (2000). When this project started, this volume was an exception to the general perception that not much literature had recently been published on the topic. From these authors came the general point of departure for this project, which was to pursue further knowledge in order to understand better how public procurement can be used as an innovation policy tool.

As was discussed in Chapter 1, systemic approaches highlight interactive learning, evolution and institutions (Edquist and Hommen, 1999). These three pillars have been taken into account in the four papers as follows. Paper 1 essentially departs from interactive learning and evolutionary perspectives, whereas the remaining papers 2–4 set out to study further institutions. Paper 1 and papers 2–4 are also complementary in the sense that paper 1 to greater extent takes an ex post perspective on evolution and innovation. While paper 1 stresses a Schumpeterian definition of innovation, the investigations of innovation in papers 2–4 rely more on a Dosian definition of innovation.

Paper 1 can be seen as building on and extending the work of Edquist and Hommen (2000), who suggest a taxonomy consisting of two dimensions. The direct versus catalytic dimension distinguishes between direct procurement, i.e. when a public agency procures something based on intrinsic need, and catalytic procurement, i.e. where the procurer acts as an organiser of demand. The other dimension captures the degree of innovation. Public procurement can be developmental, i.e. leading to "completely new products, processes or systems", or adaptive, i.e. concerned with products that may be new to the procurer's country rather than universally new, and as such requiring adaptation to local circumstances (ibid., p. 21).

A central institution dealt with in Edquist, Hommen and Tsipouri (2000) was the role of the procurement law. This was an interest that was picked up in paper 2, where the formal law was studied. The case study in paper 2 failed however to verify the propositions stated about the role of the EC Procurement Directives in Edquist, Hommen and Tsipouri (2000). Also, informal conversation with public procurers gave a somewhat ambiguous view of the extent to which the Directives actually prevent public procurement of innovation. A natural decision to make at this point was to study institutions further. More specifically, this meant studying institutions other than the formal, i.e. endogenous.

Thus, having established in paper 2 that the EC Procurement Directives may not always prevent innovation, momentum was created for seeking to understand what other institutions may play a role. The Bracknell Forest Borough Council's attempt to procure a new energy centre offered such an opportunity and was studied in paper 3. In the paper, the formal institution, i.e. the Directives, was essentially treated as an endogenous institution prevailing among the public procurers, i.e. one of the participants in the project among other participants. The focus was on endogenous institutions understood as organisation-specific rationalities.

Paper 4 connects to the others in two ways. First, Edquist and Hommen (2000) distinguish between two types of demand-side public procurement policy instruments.

These are developmental and adaptive public procurement of innovation. Paper 4 deals with the latter category. In that sense, this thesis includes both accounts of these authors' conception of innovative public procurement. The second connection manifests in the fact that the focus is primarily on endogenous institutions, which follows from the results arrived at in paper 2; that is, in order to fully understand institutional effects on public procurement of innovation, endogenous institutions need to be taken into account.

In summarising the work underlying this dissertation, the importance of an innovation-enabling institutional set-up for public procurement of innovation becomes clear. In addition, acknowledging the importance of an institutional approach is not sufficient if a certain degree of specificity is not considered regarding what institutions are referred to. Attention to formal exogenous institutions – in this case, the EC Procurement Directives – may not be sufficient, neither from the perspective of the researcher, nor from the perspective of the policy maker. Instead, what this thesis maintains is that endogenous institutions also need to be taken into account. The implications of this are further discussed in chapter 5.

5. Discussion and Conclusions

Current debates and deliberations on how to make public procurement of innovation a more effective instrument for innovation policy illustrate the opposition between the perspectives of mainstream economics and innovation theory on innovation policy. Although it may develop a more comprehensive and insightful account of public procurement of innovation as a special case of user-producer interaction involving interactive learning, innovation theory has had relatively little impact on policy in this area – perhaps due to its general lack of facility for identifying policy instruments. However, this defect of innovation theory can be remedied through the further development of an institutional perspective.

5.1 Mainstream Economics versus Innovation Theory

In the introduction of the thesis it was established that the development of regulation of public procurement in the EU has rested on neoclassical economic theory (e.g. Cox and Furlong, 1996). Some of the main assumptions which follow from neoclassical economics are problematic, however, when the innovative aspects of public procurement are analysed. By applying auction theory, this perspective neglects the possibility that public procurers may actually be more knowledgeable than producers about innovative (previously unknown) products. A second problem concerns the failure to take into account interactive learning between users and producers – which is essential for product innovation (Edquist and Hommen, 2000). Indeed, the practical effects of these policies are also visible. Public procurement of innovation (R & D procurement) is today significantly lower in the EU than in the US. It is also a general problem that "no attention is given to any of the characteristics of structure and institutions which experience [and systemic approaches to innovation suggest] are important" (Lipsey and Carlaw, 1998, p. 5).

Innovation theory and mainstream economics differ further in the assumptions on which these two approaches base the justification for innovation policies in the first place. In general, both approaches concur with the position that innovation takes place mainly among private firms acting on a market and that public intervention is looked upon as an exception; intervention should take place only when the market is incapable of producing innovation. The significant difference between innovation theory and mainstream economics is how this incapability should be understood. Following Edquist (2001, p. 220), the concept brought forward by mainstream economics – market failure – is not applicable, as this concept implies "a comparison between conditions in the real world (empirical facts) and an ideal or optimal system" which does not exist. Instead, innovation theory distinguishes between different types of systemic failures, where institutional failures constitute a central sub-type (Woolthuis, Lankhuizen and Gilsing, 2005).

One key difference between innovation theory and mainstream economics is how technology and technological development are taken into account. Following Freeman (1988, p. 3), "[t]he main weakness of [mainstream economics] has been inadequate attention to social learning processes, particularly technological accumulation and the institutions affecting these processes". An understanding of technological development and innovation informed by innovation theory emphasises the role of knowledge and learning in innovation. For instance, Lundvall (1992, p. 2) states that a "system of innovation is constituted by elements and relationships which interact in the production, diffusion and use of new, and economically useful, knowledge". The same author also acknowledges that an innovation system is a social system and that a central feature in this system is learning and interaction between people (ibid., p. 2).

As distinct from mainstream economics, innovation theory does not consider knowledge to be "free". Rather, technology "involves specific, often idiosyncratic, partly appropriable knowledge which is accumulated over time through equally specific learning processes, whose directions partly depend on firm-specific knowledge and on the technologies in use" (Dosi and Orsenigo, 1988, p. 16). This perspective harmonises well with the chain-linked model, where it is taken into account that "perceived market need will be filled only if the technical problems can be solved, and a perceived performance gain will be put into use only if there is a realizable market use" (Kline and Rosenberg, 1986, p. 289). Dosi emphasises also that "technological change cannot be described as simple and flexible reactions to changes in market conditions"; instead, "it is the nature of technologies themselves that determines the range within which products and processes can adjust to changing economic conditions" (Dosi, 1988, p. 233). Through such a structural-evolutionary understanding, which differs from that of mainstream economics, technological change and innovation become endogenous (Lipsey and Carlaw, 1998).

The approach applied in this thesis concurs with the view that "the institutional set-up of an economy consists of many different kinds of institutions which more or less hang together and are related to one another. They form a complex system, which taken as a whole fulfils some functions in relation to both the cohesion and change of the economy" (Johnson, 1997, pp. 55–56). In contrast to mainstream economics orthodoxy, this view maintains that public procurement of innovations neither follows from perfect market mechanisms nor is based solely on information on price and quantity. The difference between regular public procurement and public procurement of innovation made explicit here is essential. An institutional approach highlights the importance of an adequate institutional set-up for public procurement of innovations as distinct from regular public procurement (Edquist and Hommen, 2000).

The appended papers generally position themselves in the framework informed by innovation theory. Paper 1 attempts to account for variety and change in the dynamics of user-producer interaction and longer-term processes of technological development. This will be further discussed in section 5.2. The more empirically focussed papers appended to this thesis (papers 2–4) all illustrate the significance of an institutional approach to further understanding innovation in general and, more specifically, innovation induced by

public procurement. Concepts drawn from institutional theory applied in the papers capture the developments and identify problems discussed, and also provide means of explanations and suggestions for how to overcome these problems. Paper 2 addresses the role of formal institutions, i.e. the EC Procurement Directives and to what extent they inhibit or enable innovation. The latter two papers (paper 3, paper 4) study further the effects of endogenous institutions on public procurement of innovation. These papers are discussed in section 5.3.

5.2 Implications from Evolutionary and Interactive Perspectives

It is maintained here that the assertion that formulation of innovation policies in general is concerned with institutional design (Edquist, 2001). Also, institutional design should be based mainly on the analysis of how contextual factors affect or condition innovation policy (Mytelka and Smith, 2002). Therefore, as suggested – but not fully implemented – in Edquist and Hommen (2000), the institutional design of policies for public procurement of innovations should be based on a systematic integration of evolutionary and interactive learning approaches. Therefore, this section discusses further what implications for the institutional design of public procurement of innovations can be drawn from a systematic integration of evolutionary and interactive learning dynamics related to its social and economic context.

Paper 1 in this thesis endeavours to contribute a starting point for a discussion on public procurement of innovation emphasising evolutionary and interactive perspectives. Although neither the idea nor the application of public procurement as a policy tool is new, as was discussed in section 2.3, the interest in public procurement in the EU context as a means to stimulate innovation has developed fairly recently from rather a modest level at the turn of the millennium. This may explain why few recent attempts to classify the relations between public procurement and innovation have been made. One attempt was made by Edquist and Hommen (2000). Their classification distinguishes between direct and catalytic procurement as well as developmental and adaptive technology procurement. This model fails however to recognise instances where several public buyers act in concert (e.g. Kaiserfeld, 2000). Cave and Frinking (2003) have addressed the design and implementation of public procurement projects to promote innovation in terms of four key “dimensions” – relations between public and private demand, reasons for innovative procurement, the type of innovation involved, and the modalities available.

As was discussed in section 5.1, following from innovation theory, public procurement of innovations cannot be seen as transactions occurring on perfect markets determined by information on price and quantity. Paper 1 underscores the consequences of taking the actual context for each specific public procurement project into account.

5.3 Institutional Determinants of Innovative Performance

This thesis has investigated institutions as determinants for innovation in the context of public procurement. The central formal institution that naturally becomes an issue when

an institutional approach is applied is the EC Procurement Directives. In principle, the point of departure for this thesis project was the comment by Edquist, Hommen and Tsipouri (2000, p. 308) that there is "a considerable degree of tension between" the design of this legislative package and the possibilities for user-producer interaction and interactive learning, which are processes strongly associated with innovation. The results in this thesis concur with the general view of these authors on the role of institutions as determining innovative public procurement. According to the results reported in paper 2, the Directives clearly affect public procurement of innovation, the way public procurers manage procurement processes, and how potential suppliers act.

In general, institutions may enable, stimulate, inhibit or reduce possibilities for public procurement of innovation. Pursuing answers to the question whether or not the EC Procurement Directives can be shown to hinder public procurement of innovations is not sufficient, however, for understanding institutional effects on the possibilities for public procurement of innovation. An innovation theory-based institutional approach must include other institutional levels than formal law. In such a discussion the distinction between exogenous and endogenous institutions is useful, as was discussed in section 1.1.2. To make universal statements on how a specific institutional level affects innovation in the context of public procurement is problematic, however. A more promising approach following from the papers appended to this thesis is to regard exogenous and endogenous institutions as interlinked. The outcome of this interplay may render either the enabling or the prevention of innovation.

The following sub-sections discuss how the scope of institutional analysis should be broadened to address several different kinds of institutions, as well as interactions among them. At a minimum, an institutional analysis of public procurement of innovations should include the following types of institutions:

- Formal regulatory institutions imposed by the state (Paper 2)
- Endogenous institutions specific to organisations (Paper 3)
- Institutions as coordination or governance mechanisms (Paper 4)

5.3.1 Formal Regulatory Institutions Imposed by the State

Under this category comes the EC Procurement Directives as transposed into national legislation by EU member states. These institutions coincide with the definition of a "type 1" institution given by Coriat and Weinstein (2002). One significant attribute of this institutional type is that there is an enforcement mechanism or sanctioning system associated with it. In the case of the EC Procurement Directives, there are Remedies Directives which regulate procedures to follow when the rules are violated. On the national level, there are also typically organisations which are monitoring public procurement activities and may take actions in cases of legal violation. What further characterises these kinds of institutions is that they apply for all agents, i.e. any public agency setting up a public procurement project, or any potential or actual supplier that wishes to participate needs to comply with these rules.

Altogether, these characteristics offer some good reasons for a student of institutions to take formal regulatory institutions into account. The role of formal institutions is also the main issue addressed in paper 2. The case study reported on in paper 2 failed to show that the formal procurement laws prevented innovation. On the contrary, as reported by the respondents in the study, compliance with the law actually spurred innovation. This result, however, does not by necessity justify a general conclusion that the procurement law in a universal sense is innovation-friendly. Rather, these results were treated as an implication that maybe some other institutional interplay was going on as well, underneath the formal institutional level, so to speak. Although cases in which formal procurement law had hindered innovation were not included in this thesis, anecdotal evidence and perceptions reported by public procurers also suggested that the "tension" discussed by Edquist, Hommen and Tsipouri (2000) actually exists.

Another interesting pattern, initially appearing mostly as anecdotal evidence through the interaction with procurement professionals over the duration of this thesis project, but also later confirmed by scholars (Carlsson and Waara, 2006, p. 30), revealed two distinct views which provided another lead. It seems as of it is possible to distinguish between two types of public procurers as defined by their attitudes towards the procurement law. Very roughly, one type of public procurers finds the law to be problematic, bureaucratic and not particularly well suited for innovative public procurement. The other type would be the more entrepreneurial type. These public procurers in general think there are possibilities within the restrictions of the law to successfully procure innovation.

Available literature raises awareness of the limitations of basing institutional analysis on formal law only. Coriat and Weinstein (2002), for instance, discuss institutions with less endurance and scope than formal laws. Scott (2003, p. 886) emphasises the importance of taking interpretative aspects of formal laws into account, thus at least implying that other institutions than formal ones may determine behaviour. The multilevel approach to institutions is emphasised even further by Hollingsworth (2000, p. 600), who is explicit about the point that "we must be sensitive to multiple levels of reality".

5.3.2 Endogenous Institutions Specific to Organisations

The results of paper 2 came to imply what some authors had already noted, that institutional analysis in innovation studies has a tendency to emphasise exogenous institutions (Jacoby, 1990, p. 139). Typically, institutions are viewed mainly as constraints on human behaviour (Nelson and Nelson, 2002, p. 269), or as incentives or obstacles to innovation (Edquist and Johnson, 1997). What follows from this view is that firms and other organisations are seen as rather passive agents and their actions as essentially reactive. The institutional analysis is typically limited to the formal institutions, i.e. the procurement law in this instance. This was the case in the analysis in Edquist, Hommen and Tsipouri (2000). In general, these approaches fail to consider the possibility that organisations are distinct and that any organisation essentially is a locus for the evolution of distinct organisation-specific institutions (see Coriat and Weinstein, 2002).

Paper 3 can thus be seen as reflecting an ambition to contribute to going beyond these shortcomings by specifically addressing the role of endogenous institutions in public procurement of innovation. Following Edquist (2001), two conditions must be true to justify public intervention. There must be a problem which is not solved by market mechanisms, and the public agency should have the ability to solve the problem. As innovation per definition includes uncertainty, which makes this latter criterion problematic, public intervention sometimes, therefore, goes wrong. Although the position in paper 3 to large extent stresses the endogenous institutions within the specific organisations, the general recipe for errors applies in the case; i.e. when a public agency lacks the required ability, a "detailed analysis of the problems and their causes may … be necessary means of acquiring this ability" (ibid., p. 220). The findings in paper 3 provide interesting empirical material that fuels a discussion on this point. In this case, the results provide no basis for pinpointing what organisation lacked the "ability". Essentially, all the participating organisations acted according to their endogenous institutions or rationalities. Rather, it was the institutional mismatch revealed in the attempt to unite the different underlying rationalities that emerged as the central problem. The public procurers failed to award a contract to any supplier because of this institutional mismatch. In this case, the lack of "ability" did not exist within the public agency or the other participating organisations but manifested in the interaction between them and in the conflict between organisations' rationalities. This in turn clearly highlights the importance of institutional coordination and coordination of innovation policy, and it indeed supports the point that policy "is very much a matter of creating, changing, or getting rid of institutions" (ibid., p. 221).

5.3.3 Coordination of Institutional Governance Mechanisms

The starting point for paper 4 was the impression that beyond the potential benefits in using public procurement as a demand-side policy instrument as emphasised by e.g. Edquist, Hommen and Tsipouri (2000) and Edler et al. (2006), there are also other ways in which public procurement can be used to stimulate innovation which do not strictly belong to the demand-side category. More specifically, paper 4 attempts to study further and contribute to existing literature by emphasising the role of adaptive public technology procurement of goods and services. In 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 the paper is to study further how a large public agency adopts private sector innovations.

The analysis in the paper drew on the four elements affecting the diffusion process as developed by Rogers (1995), but with less focus on the availability of information as determinant for the adoption rate. Instead, similarly to paper 3, a strong emphasis was placed upon institutional effects on the diffusion process. Following from a systemic approach on innovation studies, the focus was on how institutions may affect diffusion processes within organisations. This was 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" (ibid., p. 25).

Understood from an evolutionary perspective, institutions exist because they are beneficial for their endorsers. Institutions like, for example, language, technical standards, what side of the road one should drive on, etc., work as informational devices that "make it unnecessary to start life from scratch every day" (Johnson, 1992, p. 25). What also comes from the evolutionary mechanism shaping institutions is that they evolve slowly, and therefore may create tensions in organisations when new technology is introduced. 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).

Institutional coordination and redesign may be required to overcome such institutional barriers to innovation. In paper 4, discussing the case of the attempt to introduce a new catheter into the National Health Service (NHS) in England, a set of institutional barriers was identified. A number of coordinative actions made on different levels within the NHS were also identified. Based on the case, two important conclusions can be made. First, in addition to price and technical capability, diffusion of innovation is also affected by institutional barriers within organisations. And second, the actions taken, the results rendered, and the remaining barriers in the case 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, and within an organisation.

6. Summary and Implications

This section summarises the main conclusions of this thesis and some implications for research and policy makers. The chapter concludes with some ideas for future research.

6.1 Research Implications

This thesis deals with public procurement of innovation as a means to stimulate innovation. Theoretically, the thesis draws on innovation theory, which in turn means that particular emphasis is placed on evolution, interactive learning and institutions. The application of this approach calls attention to certain characteristics of public procurement of innovation. Rather than presenting public procurement as a process determined by information about price and quantity, central importance is given to the perception that public procurement of innovation takes place in interaction environments which may vary considerably, depending on the market characteristics and the demand structure in a specific case.

What follows from an interest in interaction and interactive learning is an interest in institutions which work as governance mechanisms for innovation in general as well as public procurement of innovation. In the past, one institution that has been studied as a determinant for public procurement of innovation is the legislative package regulating public procurement, in the case of the EU, the EC Procurement Directives. In earlier work, the standpoint has been communicated that these laws may have a negative impact on the possibilities for public procurement of innovation, as the interaction between the procuring public agency and potential suppliers would be restricted by these directives. The results arrived at in this thesis diverge to some extent from this earlier perception.

The empirical studies appended to this thesis demonstrate that institutions matter, i.e. that the behaviour and outcome of public procurement of innovations are affected by institutions. However, the studies fail to support the proposition that the EC Procurement Directives in general inhibit public procurement of innovation. Instead, the results arrived at in the thesis indicate that to fully understand the institutional effects on public procurement of innovation, other institutions on other institutional levels also need to be taken into account. Examples of such institutions are endogenous institutions, i.e. those institutions that exist within organisations. These organisation-specific institutions may affect how an organisation interacts with exogenous institutions such as the procurement law. Following from an evolutionary line of thinking, the endogenous institutional set-up is organisation-specific. From this follows that institutional set-up of some organisations may be better disposed for public procurement of innovation than others.

Thus, the general argument brought forward here is that the EC Procurement Directives may appear to restrict or inhibit innovation if one or some organisations taking part in public procurement project are institutionally set up in a way that creates an institutional interaction which leads to the inhibiting of innovation. This also means that the question

whether the EC Directives per se inhibit or stimulate innovation is not adequate. To pursue the answer to such a question would require isolation of the effects that comes from endogenous institutions. This would be impossible in practice.

6.2 Policy Implications

With the recent increase of interest in the use of public procurement as a means to stimulate innovation, if it is to become a successful and widely used tool for this purpose, some knowledge will presumably have to be diffused to public agencies. The most important implications emerging from the work carried out in the preparation of this thesis, and which may be a contribution to such diffusion of knowledge, can be summarised as follows.

One significant property of innovative public procurement which makes it distinct from regular public procurement is the resources required by the former. Buying innovation requires more information and perhaps also more consideration of alternatives (Robinson et al., 1967). Public procurement of regular products may simply be a matter of ordering from a framework agreement available through some kind of electronic system. One reason for failure in public procurement of innovations is related to underestimating the additional resources required for innovative public procurement. Therefore, an essential requirement in order to create favourable conditions for innovative public procurement projects is to acknowledge the importance of providing the resources required.

There is great variety in innovative public procurement projects in terms of what is required from the involved public procurers, something that should be a concern when public procurement teams are set up. Direct procurement, where the needs addressed are intrinsic to the procuring organisation and there might be only one buyer on the market, may require skill profiles quite different from those required by cooperative or catalytic procurement. Typically, direct procurement addressing intrinsic needs to a large extent requires technical skills, whereas priorities in the latter cases would be directed more towards coordinative and interactive capabilities. In collaborative procurement projects, the ability to communicate and reach consensus among the collaborating partners becomes more important than it is in situations where there is only a single buyer.

One area of expertise that needs to be included in any innovative public procurement project is expertise on public procurement law. Such legal experts should possess knowledge not only of procurement law but of how to apply it in the context of innovation. The need for expertise in public procurement law in public agencies might not be a very controversial statement. It is also important to point out that the role of legal expertise on the supply side should not be neglected. A supplier with a profound understanding of the underlying rationale of the EC Procurement Directives and the recent developments concerning the role of public procurement as an innovation policy tool would presumably create favourable conditions for successful responses to tender calls for innovations.

A remark should be made regarding the complementary relationship between public procurement of innovation and institutional coordination. Very little suggests that success in innovative public procurement should be regarded as an isolated event. On the contrary, as partly indicated in the previous paragraphs, public procurement of innovation requires coordination of various kinds. For instance, there may be coordination activities connected to individual public procurement projects, examples of which are allocating the right competencies to a project, coordinating demand among multiple buyers, tight monitoring of the project, and identifying and removing institutional barriers that could potentially undermine diffusion of the procured product. Further, innovative public procurement may be seen as one instrument to be used in concert with other innovation-promoting measures such as research, tax incentives, or standardisation. There may also be a need for cross-sector coordination to increase the feasibility of innovative public procurement projects.

This all implies that if public procurement as a means to stimulate innovation is to be increasingly applied, it should not remain an issue only for public procurers. Managers in public agencies, policy makers, suppliers and other not-for-profit organisations that may play a part in public procurement projects should be exposed to the potential of public procurement as a means to stimulate innovation. If such information were more generally diffused, this might create possibilities for the institutional redesign that may sometimes be necessary in order to use public procurement as a means to stimulate innovation.

6.3 Suggestions for Future Research

Several topics emerged in the work with this thesis that could not be included in the thesis itself but may still be of some importance and therefore worth additional research efforts. Some of these topics are outlined in the following sections.

6.3.1 Public Procurement as a Demand-Side Policy Instrument

The role of public procurement as an innovation instrument as well as its position in relation to other innovation policy tools was discussed in section 2.1. Section 2.3 gave a brief account of the historical development of public procurement as an innovation tool. Viewing innovative public procurement as a demand-side policy instrument has some bearing on the general debate about what is driving innovation and therefore has implications for innovation policy as well.

Different views have developed since the emergence of innovation studies as a field of research. The prevailing view of the 1950s regarded innovation as a process that began with research which led to development followed by production and was concluded by marketing. The fundamental problem with this linear innovation model was later described as follows:

> In the linear model, there are no feedback paths within the ongoing work of development processes. Nor are there feedbacks from sales figures or from individual users. But all these forms of feedback are essential to evaluation of performance, to formulation of the next steps forward, and to assessment of competitive position. Feedbacks are an inherent part of development processes… (Kline and Rosenberg, 1986, p. 276)

In the mid 1960s perspectives were developed in which market pull was seen as the engine for innovation. Instead of stimulating developments and advances within universities and government laboratories in expectation that this would eventually lead to the emergence of new products on the market, it was perceived that R & D was directed by demand (Rothwell, 1994). Interestingly, Rothwell associates public procurement of innovations with this way of thinking. In a similar way, Lundvall and Borrás (2005) connect public procurement to technology policy rather than innovation policy. Although they are clear on the point that "[i]t would be misleading to argue that we pass from science policy to technology policy and then to innovation policy as we pass from one historical stage to another" (ibid., p. 602), by connecting public procurement with technology policy as they do, they do not rule out the perception of public procurement as a policy tool out of vogue.

On the science push versus demand pull debate, the following has been stated: "[T]he uncritical appeal to market demand as the governing influence in the innovation process simply does not yield useful insights into the complexities of that process" (Mowery and Rosenberg, 1979, p. 139). Another view is that "[i]n reality, this relationship is more complex than the mere pulls of the various demand segments of innovation. In a more articulated way, this relationship is a dynamic and a two-way one. On one hand, there are the effects of demand structure on technical change … On the other hand, technological change may create new structures of demand by opening up completely new types of demand" (Malerba, 1985, p. 293).

Later, Kline and Rosenberg (1986) proposed an alternative innovation model. Their model consists of four elements: research, invention, innovation and production, and the relationships between them. This chain-linked model emphasised the feedback between the elements. Instead of viewing the innovation process as linear flow from research to market, the model takes into account that, for instance, a "perceived market need will be filled only if the technical problems can be solved, and a perceived performance gain will be put into use only if there is a realizable market use" (ibid., p. 289). This "modern" understanding of innovation as an interactive process is a central theme in e.g. systems of innovation literature. By applying this perspective, innovation becomes a continuous process, and "it is characterized by complicated feedback mechanisms and interactive relations involving science, technology, learning, production, policy, and demand" (Edquist, 1997, p. 1).

A definition of innovative public procurement as something that happens when a "public agency acts to purchase or place and order" (Edquist and Hommen, 2000, p. 5) clearly connects to the demand pull or technology policy understanding discussed above. The

more recent definitions, in particular the one developed in the National IST Research Directors Forum (2006), has less resemblance to such thinking. Instead, this is a way of using public procurement in line with current understanding of how innovation works. The Royal Swedish Academy of Engineering Sciences (IVA) points to

> the need for building new networks and the fact that networking per se is a crucial success factor for different players (government, industry, academia, etc.), and perhaps for areas other than R & D as well. If it is not clear whether players in the system have found their roles yet, then networking is certainly a prerequisite for the flexibility that will apparently be necessary in the future. The way in which research will be organised in the future has not yet been determined either. The question is essentially: What sort of cooperation can we expect to see? (IVA, 2003, p. 8)

It is possible to see such flexibility emerging in the new forms of innovative public procurement discussed above (National IST Research Directors Forum, 2006; van Valkenburg and Nagelkerke, 2006). There are also examples of innovative public procurement projects where the role of public demand was at least unclear. A recent attempt by the National Health Service in England to introduce a new catheter that was claimed to reduce the risk of urinary-tract infection among patients provides such an example. The initiative essentially came from the market, promoted by other public agencies, and struggled against internal institutional problems (paper 4). In another procurement project in England involving the development of an energy centre, the initiative essentially came from the major property owners in the area but was executed as a public procurement project (paper 3). This means that Rothwell (1994) and Borrás and Lundvall (2005) rightfully regard public procurement as a policy tool from the past, if they are referring to the older incarnation of the concept.

When suppliers become involved early in the process, not only through suggesting solutions but also by defining the problems, the perception of public procurement as a demand-side policy tool becomes pointless at best, if not misleading. Instead, much more emphasis should be placed on the interactive characteristics of public procurement of innovations and what implications this might have for public procurement organisations. Viewed in this way, innovative public procurement becomes a versatile innovation policy instrument for the future. It will also have major implications for procurement departments.

However, it is possible to see a potential problem emerging if this development goes too far. A recurring reflection in the discussion of public procurement in relation to other supply-side measures that might stimulate innovation is that public procurement is not a state aid. On the contrary, public procurement conducted in compliance with the EC Procurement Directives is a competitive and non-discriminating process. Pre-commercial procurement (National IST Research Forum, 2006) is an arrangement that seems to have features which comes close to state aid. This model is based on the legal possibility to make exemptions from the competitive requirement if the procurement involves research and development. Thus, in pre-commercial procurement there is a risk that contracts will

be awarded to national champions rather than to suppliers that offers the most efficient and innovative solution. Close monitoring of the outcome of such projects carried out in the future seems to be a sensible thing to do.

6.3.2 Public Procurement of What Kind of Innovation?

As was outlined in section 2.3, public procurement has become established as an innovation policy tool. As this document elaborates throughout, it is clear that there are several complementary views of how innovative public procurement is defined and also how it is applied in practice. What has not been discussed very much in the literature is what kind of innovation is associated with the procurement activities. This section therefore endeavours to introduce such a discussion.

As was discussed in chapter 2, there are many different ways to define innovation. Schumpeter included in the notion of innovation the introduction of a new good, a new method of production, the opening up of a new market, the use of a new source of supply of raw materials or new ways of organising industries (Schumpeter, 1934/ 1969, p. 65). A more recent definition states that "[i]nnovations are new creations of economic significance" (Edquist, 1997, p. 1). There are also definitions that, rather than referring to the outcome of the innovation process, instead underline the underlying mechanisms. Dosi (1988, p. 222), for instance, maintains that innovation is the "search for, and the discovery, experimentation, development, imitation, and adoption of new products, new production processes and new organizational set-ups". Innovation has also been defined as "an idea, practice, or object that is perceived as new by an individual or other unit of adoption" (Rogers, 1995, p. 11).

If one wants to evaluate public procurement of innovation, or policies dealing with public procurement of innovation in general, the results of such evaluations will depend on what definition of innovation is used. A few examples to illustrate this follow.

Some examples of public procurement projects that did not yield the intended result can be found in the literature. One such example is the attempt to procure a school computer in Sweden (Kaiserfeld, 2000), while another concerns procurement activities during an attempt to create a technical innovation system in bio fuels in the Netherlands (Suurs and Heckert, 2007). A third example is an attempt to procure a maritime radio system for coastal radio in Norway (paper 2).

The first case was an attempt initiated in the early 1980s by the Swedish Board for Technical Development to procure a computer to be used in the Swedish schools. The project failed essentially because companies elsewhere were able to produce MS-DOS-compatible computers at lower cost. In this case, however, the most important outcome was the knowledge it generated among the engineers who had worked in the project. From a strict Schumpeterian/ Edquistian interpretation of innovation, this project was a failure. However, the project did help to diffuse knowledge and definitely offered opportunities for search and discovery according to the Dosi definition of innovation.

The study from the Netherlands reports on the build-up of systemic functions over time in bio fuels. The article includes a story about an engine running on bio fuels that was procured and successfully developed as part of an ambition to create a bio fuel system. The problem with this specific engine, however, was that no measures had been taken to establish a market for the product. Although the technology had been developed, the product never really became diffused. In this case, the innovation complied to some extent with many of the Schumpeterian criteria, and also with the Dosi definition, but not with the requirement for success on the market.

The case from Norway was about a public procurement project to upgrade radio technology for maritime radio communication. This project led to success in many ways, though not immediately. One factor contributing to the success was that the procurers had made an attempt to procure a system a few years earlier, which had failed. A significant success factor for the new system seems to have been the experiences from the first attempt; the lessons learned in the first attempt were significant for the success of the second. Thus, this project initially included the Dosi type of innovation without reaching the Schumpeter/Edquist definition, as the first attempt was never finished. When the second attempt eventually led to innovation as defined by Schumpeter and Edquist, this happened to some extent due to knowledge gained in the earlier "failure". What was never achieved was diffusion. Although successful for the public procurers in Norway, the specific system was never sold anywhere else.

These are only a few perspectives from which public procurement projects can be discussed. It seems reasonable to suggest that exercises like the one above, based on these definitions or on others, may be fruitful. The issues discussed above are relevant both at the stage of formulation and also in the evaluation of innovative public procurement policies – as they may increase awareness of what is to be achieved and accordingly how this should be measured.

6.3.3 Innovative Private Procurement

Buyer demands for an item not available on a market are not reserved exclusively for public agencies. They can and do take place as relationships between private firms. Exploring and making comparisons between these private collaborations and "traditional" public procurement projects may be a very interesting thing to do (see Edquist and Hommen, 2000). Moreover, private sector purchasing departments seem to be facing similar challenges when it comes to the need for going from an administrative department that is supposed to cut costs to acting like a competent partner that influences demand (Wolf, 2005). It might even be the case that interesting experiences gained from the public sector in the transition to more innovation-friendly procurement practices might be useful for the private sector, e.g. in large multinational companies.

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Laws and Directives

Swedish Public Procurement Law	
Depreciated	Lag (1992:1528) om offentlig upphandling.
Current	Lag (2007:1092) om upphandling inom områdena vatten, energi, transporter och posttjänster.
	Lag (2007:1091) om offentlig upphandling.
EC Directives on Public Procurement	
Depreciated	Council Directive 93/36/EEC coordinating procedures for the award of public supply contracts.
	Council Directive 93/37/EEC concerning the coordination of procedures for the award of public works contracts.
	Council Directive 93/38/EEC coordinating the procurement procedures of entities operating in the water, energy, transport and telecommunications sectors.
	Council Directive 92/50/EEC relating to the coordination of procedures for the award of public service contracts.
Current	Directive 2004/17/EC coordinating the procurement procedures of entities operating in the water, energy, transport and postal services sectors.
	Directive 2004/18/EC on the coordination of procedures for the award of public works contracts, public supply contracts and public service contracts.

Appended Articles

Publication Status	Authors/Title	Division of Labour
Accepted for publication in Journal of Public Procurement.	Hommen, Leif and Rolfstam, Max. Public Procurement and Innovation – Towards a Taxonomy.	Rolfstam contributed with empirical and practical aspects of the article by finding cases to be used. Rolfstam also participated in discussions that led to the development of the model that is elaborated on in the article.
Published in Public Procurement Law Review, 2007, Issue 6, pp. 435-460.	Rolfstam, Max. The Utilities Directive and How It Might Affect Innovation: The Case of Innovative Procurement of Maritime Radio Technology.	Rolfstam selected the case, collected the data and wrote the article.
Abbreviated version submitted for peer review and publication. Preliminary version presented at DRUID Winter PhD Conference, 2007, Skörping, Denmark.	Rolfstam, Max. Public Procurement of Innovations and the Role of Endogenous Institutions.	Rolfstam selected the case, collected the data and wrote the article.
To be submitted for peer review and publication. Preliminary version presented at the IPSERA 2007 Conference in Bath, UK.	Rolfstam, Max, Phillips, Wendy and Bakker, Elmer. Public Procurement of Innovation Diffusion: Exploring the Role of Institutions and Institutional Coordination.	Rolfstam selected the case with assistance from Phillips who also reflected on the results. Bakker worked with adjusting the questionnaire to fit the context, as well as reflecting on the results and the way the article was written. Rolfstam collected the data and wrote the article.

Appendix

Appendix A

Three different case study protocols were developed for this thesis. The first one was used for paper 1 and paper 2. The second case study protocol was used for paper 3 and the third for paper 4. For practical reasons, the case study questions were separated from the case study protocol.

Case Study Protocol for Papers 1 and 2

This case study protocol has been developed for the case studies carried out in the INNO-UTILITIES project (Stage Two in the updated work plan). The overall purpose of this document is to provide a guide for the researcher who will carry out the individual case studies. In this case especially, as the study consists of a series of cases, the development of, as well as the compliance with the protocol is required in order to increase reliability (Yin, 1994).

This document is organised as follows. Below are an overall statement of purpose for the project and a short description of its components and the contexts in which the case studies are carried out. Section 1 briefly covers some procedural aspects of the case studies. In section 2 the questionnaire (see document "Case Study Questions") is discussed. The concluding section 3 briefly covers how the collected data will be analysed and how a case study report should be structured.

Purpose

Essential resources like telecommunications, electricity, water and gas that are taken for granted in 21st-century Europe are provided by utilities. In order to provide these life-goods continuously, utilities as well as other publicly administrated functions must innovate relentlessly. However, in order to innovate, these public administrations must follow strict procurement procedures that have their origin in public procurement provisions. At the same time, new procurement models, e.g. electronic procurement and electronic auctions, are introducing a further complexity parameter into the already complex procurement environment.

In addition, the public agencies must innovate not only to meet demand for better services but also increasingly to protect their infrastructure from malign attacks that become more and more frequent due to the omnipresence of information technology. There are two challenges:

> How to make public procurement procedures more innovation friendly, and
>
> How to protect utilities from modern technology attacks against their infrastructure.

The project is focussed on telecommunications utilities, which are on the forefront of both challenges. However, other utilities can benefit from the project results as well.

The main objective of the work carried out within the research part in which these case studies are included is to develop policy recommendations for the creation of an innovation-friendly public procurement framework in Europe. The goal is to develop public procurement of innovation as an innovation policy instrument.

This objective will be realised by conducting a study of the procurement framework(s) and procedures that are used by telecom operators in carrying out innovative projects. The findings of this investigation will provide a basis for developing recommendations on how other public utilities can make their procurement procedures more innovation friendly – i.e. conducive to innovation. The study will also generate suggestions concerning adaptations of the overall public procurement procedures for the public sector in general.

From the objectives and aims described above, the following broad research question has been derived:

> What lessons can be learned from the procurement framework of telecom operators and other public utilities that excel in innovation?

The objective of research at this stage is to examine how the practices and procedures that telecom operators and other public utilities have employed in innovative procurement have interacted with broader institutional frameworks governing public procurement – such as, for example, the EC Procurement Directives. On this basis, it will be possible to determine whether, to what extent, and how these broader institutional frameworks have either facilitated or obstructed innovative public procurement. It should also be possible to identify more and less successful cases of innovative procurement, and on this basis to elaborate and explain models of good practice.

This case study protocol will be used in the research part of the project. The comparative analysis of cases of innovative public procurement occurring in the telecom and health care sectors will result in the identification of good practice and an assessment of the extent to which existing regulations either help or hinder innovative public procurement.

1. Procedures

The case studies will examine how the practices and procedures that telecom operators and actors in the health sector have employed in innovative procurement have interacted with broader institutional frameworks governing public procurement. There will be a series of several case studies. In this section some practical matters related to the procedure of the field work are emphasised.

1.1 Determination of Cases and Persons to Be Interviewed

The cases selected for this study should involve innovative public procurement, which occurs when a public agency acts to purchase, or place an order for, a product – service, good, or system – that does not yet exist but which could probably be developed within a reasonable period of time based on additional or new innovative work by the organisation(s) undertaking to produce, supply, and sell the product being purchased.

Interviews will be carried out with key actors for each procurement case that is studied. These persons should have contributed to or affected the procurement process in some way. Examples of key actors are buyers, suppliers, users, consultants, etc.

1.2 Initial Arrangements

When a case has been selected, arrangements should be made to set up interviews with relevant persons (as specified in section 1.1). Sometimes an initial contact will provide information that leads to the identification of another person who is relevant for the case and can be asked to participate in the interviews. The application of this snowball procedure is encouraged.

On every occasion where a person is asked to participate in the interviews, background information about the project should be provided in which the context and purpose of the research project are outlined.

1.3 Procedures for Data Collection

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 about 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 these case studies belong somewhere in between “open-ended” and “focused” (Yin, 1994, p. 84) on this continuum. This means that questions have been 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 strongly recommended to make use of additional information provided by the respondent that goes beyond the questions. Through this, the interviews might provide additional information of interest to the case, and eventually to the cross-case analysis.

It is strongly recommended that a recording device be used in the interviews. The use of other complementary sources of information is also strongly recommended. Examples of these are news archives, web pages, newspaper articles, policy documents, etc. Ideally,

relevant additional available sources should be retrieved before the actual interview is carried out.

One point, emphasised by Yin (1994), concerns the material collected during the field work of the study: It is strongly recommended that the material, including documents and other written material, be stored for later retrieval, should the need arise for further studies.

2. Case Study Protocol and Questions

The case study questions are specified below. The questions are organised under the following headings: Background Information, Questions Related to Innovation, Questions on How Public Procurement Was Organised…, Questions on Interactive Learning, and Questions Related to Regulation.

Analytically, these questions can be divided into three categories: context, actors and events. The questions under the heading "Background Information" correspond mainly to the context category, but questions are also listed here that are related to the actor category. The main purpose of the questions under the heading "Questions Related to Innovation" is to establish the character of the procurement process, e.g. to verify that the procurement actually involved innovation (i.e. as distinct from regular procurement). In that sense, the questions under this heading can be put in the context category. The questions under the headings "Questions on How Public Procurement Was Organised" and "Questions on Interactive Learning" correspond to all three categories. The last category of questions mainly captures reflections by actors on institutional aspects of the procurement process, i.e. the perception of how the formal laws governing public procurement affected the procurement process.

3. Analysis Plan and Case Study Reports

The analysis that will be conducted will try to determine whether, to what extent, and how the institutional frameworks governing innovative procurement in each case have either facilitated or obstructed innovative public procurement. It will also seek to identify more and less successful cases of innovative procurement, in order to identify models of good practice.

These two purposes are not mutually exclusive: rather, they can be considered to be complementary insofar as they will together contribute to an account of how telecom operators and actors in the health sector have successfully adapted their procurement procedures to the "new model" of public procurement represented by the EC Procurement Directives.

In order to carry out a cross-case analysis of this kind it is important that the reports from each case be written in a similar way. A standard format for case study reports that will be used here is presented below.

3.1 Format of the Case Study Reports

Yin (1994, p. 137) indicates several alternative structures for written case study reports. Of these several alternative structures, a "chronological" structure seems especially appropriate for the purposes of a descriptive study documenting a complex process occurring over a fairly lengthy span of time. Therefore, the case study report will adopt a chronological structure.

The report will begin with an introduction that addresses the scope and purpose of the case study. Parts of this introduction may be drawn from the present research plan.

In the second section, the context of the case will be addressed. The historical background of the procurement project will be discussed, focussing on the conditions that eventually gave rise to the project – i.e., the needs that the project eventually came to address.

The third section of the report will provide an account of the "pre-procurement" phase. The discussion will focus on how the needs referred to above eventually led to an articulation of demand on the part of certain organisations, and how these organisations interacted with other organisations on both the supply and demand sides to define and structure a process of innovative public procurement. In the course of this discussion, the main actors involved in the project will be introduced, and profiled.

The fourth section will describe the procurement phase, focussing on the continuing interaction between suppliers and buyers. The discussion will concentrate on the clarification and refinement of functional requirements and technical specifications. It will also address the evolving division of labour and organisation of work within the project, and examine the progress of the project towards realising its objectives.

A fifth and final section will provide a summary discussion of the project as a process of interactive learning. It will focus on how learning is reflected in the acquisition, deployment and further development of capabilities by actors on both the supply and demand sides. In doing so, it will systematically relate the empirical evidence of the case to the aforementioned theory of interactive learning.

References

Yin, R.K. (1994). Case Study Research, Design and Methods. Newbury Park, Thousand Oaks / London / New Delhi: Sage Publications. 2nd ed.

Case Study Questions for Papers 1 and 2

This document specifies interview questions to be used in the case studies of the INNO-UTILITIES project. The fundamental rationale for its application is to achieve systematic data collection and thereby increase reliability (Yin, 1994), and it should therefore be used where applicable. It should be pointed out here that this list of subsidiary questions is by no means exhaustive. It may be added to or modified as a result of dialogue amongst partners. For instance, some of the answers to the questions listed here may be followed up with clarifying or elaborating questions such as "How?" or "In what way?" The questions have been organised in five sections. Each section starts with a brief description of its specific purpose (in italics).

Background Information

The purpose of the questions here is to provide background information.

Name of Interviewee

Affiliation

Profile of organisation (main line of business activity, special competence(s), historical background, market share, international activities, R & D spending, etc.)

Contact Data

Position/ Role of Interviewee in the organisation

Role of the organisation in the procurement process (buyer, supplier, user, other)

Duration of procurement process (pre-procurement to decision – decision to delivery, total time.

Procured good/ service

Price of the good/ service

Number of competing bids in the procurement process

Number of contracts of the same product/ service delivered to other customers as well

Questions Related to Innovation

It is important to establish that the procurement process involves innovative as distinct from regular procurement. The purpose of the questions in this section is to establish that this criterion is met.

Has the procured product or service been used before?

By the organisation?

Elsewhere?

Has the procured product or service been used elsewhere after the procurement process was finished?

What kind of development (if any) did the product or service undergo in the procurement process?

Did the new product/ service require changes in the organisation or the environment in which it is used?

Did the new product/ service replace existing technology or routines in the organisation?

Did the new product/ service require user training?

Did the new product/ service lead to productivity gain/ cost reduction?

Did the new product/ service have any other effect on the organisation?

Was the procurement of the new product or service successful (or not)?

Questions on How Public Procurement Was Organised, and How It Proceeded

Here, the ambition is to cover the "story" of the procurement from the occurrence of a need, leading to an eventual articulation of demand and the further communication of this need to prospective supplier(s). Ideally, included parts would be as follows: the ongoing interaction between prospective buyer(s) and supplier(s), entailing: clarification of functional requirements and technical specifications acquisition, deployment and further development of capabilities by both prospective buyer(s) and supplier(s).

Who were the main actors in the procurement process, and what are their significant attributes (for example, their roles and competencies as buyers, suppliers, regulators, etc.)?

What was the rationale for the procurement to take place?

Where (what category: user, producer, customer, other) was the need for the procurement first identified?

When was the need for the procurement first identified?

What was the institutional framework within which this process occurred?

> In what ways did laws and regulations affect the procurement?
>
> Did other routines or traditions affect the development of the procurement process?

What were the organisational requirements of the procurement process, including the division of labour among actors?

Through what identifiable stages did the process proceed, what were the most significant events that characterised each stage, and how can their most significant features be described? (For example, how were needs first translated into functional requirements and then into technical specifications?)

Patterns of interaction – Did the way that different actors interacted with one another change over time through the project, if so, how?

How did the organisation of the procurement process change over time?

Questions on Interactive Learning

Central to this study is the understanding of the interaction between the actors who have been involved in the procurement process. The purpose of the following questions is to capture this interaction and how it has evolved over time.

What knowledge and skills (e.g. technical and organisational) were provided by the different actors in the procurement process?

In what way did the different actors' contributions of knowledge and skills affect the outcome of the procurement process?

Why did the procurement constitute a case of public rather than private procurement, i.e. why had private firms failed to develop the product/ service?

Would the procurement project have been possible to execute unless public means were involved? (How?)

What changes occurred over time in terms of the organisation of the process and the attributes of the actors involved (for example, changes in competence or capability) and what conditions accounted for these changes?

What were the (financial, other) risks associated with the procurement process? How were the risks (if any) addressed?

Can the procurement process best be described as a “cooperative” or “network” model of interaction characterised by lots of informal meetings and information sharing, rather than a “market” model, as in regular public procurement, where the supplier responded to a relatively anonymous call for tender.

Could the procurement process be seen as an example of “catalytic procurement”, i.e. that the public agency has acted on behalf of eventual users?

Questions Related to Regulation

The questions in this section aim at gaining information about perceptions of how the legislation might have affected the procurement process.

What bidding principle (open bid, restricted, negotiated, other) was used in the procurement process?

What is the general view of the legislation regulating public procurement?

In what way did the legislation affect public procurement process?

Did the legislation (in any way) obstruct public procurement of new technology and new services?

Did the legislation (in any way) obstruct interaction between users, buyers, suppliers and other actors in procurement processes concerning new technology and new services?

If any problems arose from public procurement regulations, what were they and how were they solved?

Notes

It is strongly recommended that a recording device be used in the interviews. The use of other complementary sources of information is also strongly recommended. Examples of these are news archives, web pages, newspaper articles, policy documents, etc.

References

Yin, R.K. (1994). Case Study Research: Design and Methods. Thousand Oaks / London / New Delhi: Sage Publications.

Case Study Protocol for Paper 3

This case study protocol has been developed for the case study carried out in the project called Public Procurement and Innovation. The overall purpose of this document is thus to provide a guide for the researcher who will carry out the case study and to increase reliability (Yin, 1994).

This document is organised as follows. Below are an overall statement of purpose for the project and a short description of its components and the context in which the case study is carried out. Section 1 briefly covers some procedural aspects of the case study. In section 2 the questionnaire is discussed. The concluding section 3 briefly covers how the collected data will be analysed and how a case study report should be structured.

Purpose

Since 2000, the role of public procurement as a means to spur innovation has been increasingly emphasised by the European Commission. By procuring innovations, public agencies will help reach the targeted R & D share of GDP of 3% in 2010, and thus contribute to the goal of making Europe the most advanced knowledge economy in the world (Lisbon European Council, 2000).

One reason for emphasising public procurement as an innovation tool lies in the perception of its significant contributions to most national economies in Europe. It has been argued that "with public procurement accounting for 16% of EU GDP, public authorities are big market players", and that public agencies "have powerful means to stimulate private investment in research and innovation" (European Commission, 2005).

The increasing interest in innovation policies in relation to public procurement obviously raises demands for knowledge about how public sector procurement activities are carried out within the member states of the EU. In this connection, the identification and adoption of "best practice" models for public procurement of innovations has been assigned a high level of priority (Edler et al., 2005; European Commission, 2006). Sometimes, however, innovative public procurement projects that have yielded a result that is less than expected can also provide a source of useful knowledge (see Kaiserfeld, 2000). This study demonstrates this latter perception, as it constitutes an effort to contribute to knowledge of public procurement practices by analysing innovative public procurement where the initial innovative ambitions were not accomplished.

The importance of institutions as determinants of the interaction taking place in innovation is well established in innovation research (Nelson and Winter, 1982; Lundvall, 1992; Edquist, 1997; Hollingsworth, 2000; Whitley 2002). The application of institutional analysis in innovation studies sometimes tends to assume an exogenous view (Jakoby, 1990, p. 139), where institutions are viewed mainly as constraints on human behaviour (Nelson and Nelson, 2002, p. 269), or as incentives or obstacles to innovation

(Edquist and Johnson, 1997). What follows from this view is that firms' actions are seen as rather passive responses triggered by the institutional set-up. In this connection, the institutional set-up typically means formal national law. Yet another limitation in this approach is the tendency to neglect individual variety among firms or organisations (Coriat and Weinstein, 2002).

The overall purpose of this study is thus to develop an argument for the importance of taking the variety of organisational institutional set-ups into account in order to understand multi-organisational collaboration in public procurement of innovation. With regard to theory, the ambition is to treat the case as an example of how interacting endogenous institutions may inhibit the possibilities of collaborating organisations to innovate through public procurement. In order to do this, a theoretical model is developed that structures types of institutions that are relevant for such an analysis. The research question is formulated as follows:

> How may endogenous institutions affect possibilities for public procurement of innovation?

1. Procedures

The study reports on a case in which an English local council in collaboration with a number of other organisations tried to procure a wood-chip-fuelled power plant intended to deliver sustainable energy to a renewed part of the town centre. In the end, there were no suppliers interested in getting the contract and the project was terminated. The report will endeavour to discuss this outcome through an analysis of the interaction between the organisations involved in the project and the relevant institutions at play

1.1 Determination of Cases and Persons to Be Interviewed

This project was carried out in collaboration with the Centre for Research in Strategic Purchasing and Supply (CRISPS) at the School of Management, University of Bath, UK. This is a research unit which possesses (among other virtues) a very strong interface towards practice. This case was eventually identified through CRISPS' network of practitioners. To be able to deal with this rather extensive project with the resources available, some limitations had to be made. One such limitation follows from the choice of the unit of analysis, which is the *attempt* to procure a renewable energy centre in Bracknell Forest. This choice stipulates a concern for aspects of two separate but still related processes. One process was the formal public procurement process carried out by the Bracknell Forest Borough Council leading to the tender call in January 2005 (TED, 2005). The other process was the Concerto initiative which was funded by the European Commission, where information on renewable technologies was developed and shared among the participants. These two processes involved an array of organisations from different countries which may have little to do with the immediate developments of

relevance for the present analysis. The organisational emphasis here was on the Bracknell Forest Borough Council, the Bracknell Regeneration Partnership, TV Energy and the Concerto initiative.

1.2 Initial Arrangements

When a person or a case has been selected, arrangements should be made to set up interviews with the relevant persons (as specified in section 1.1). Sometimes an initial contact will provide information that leads to the identification of another person who is relevant for the case and can be asked to participate in the interviews. The application of this snowball procedure is encouraged, though with some restriction due to the time available.

On every occasion where a person is asked to participate in the interviews, background information about the project should be provided in which the context and purpose of the research project are outlined. To this end, a one-page leaflet should be developed which is recommended to be distributed to the respondents when the project is introduced.

1.3 Procedures for Data Collection: Interviews

In general, interviews can be carried out with different degree 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 about 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 that will be carried out belong somewhere in between “open-ended” and “focused” (Yin, 1994, p. 84) on this continuum. This means that questions have been 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 strongly recommended to make use of additional information provided by the respondent that goes beyond the questions. Through this, the interviews might provide additional information of interest to the case, and eventually to the cross-case analysis. In addition to face-to-interviews it may also be necessary to conduct telephone interviews. The principles applied in the face-to-face interviews should apply as far as possible for telephone interviews as well.

It is strongly recommended that a recording device be used in the interviews. The use of other complementary sources of information is also strongly recommended. Examples of these are news archives, web pages, newspaper articles, policy documents, etc. Ideally, relevant additional available sources should be retrieved before the actual interview is carried out.

One point, emphasised by Yin (1994), concerns the material collected during the field work of the study: It is strongly recommended that the material, including documents and other written material, be stored for later retrieval, should the need arise for further studies.

1.4 Other Sources of Information

In addition to interviews, other sources of information should be used, where such sources are available. Examples of other sources are documentation e.g. related to the tender call, web sites and perhaps newspapers (see Yin, 1994, p. 80). If possible, the sources relevant for a given case should be studied prior to the corresponding interview session. Another important use of these sources is to corroborate and augment evidence (ibid., p. 81), such as that collected in the interviews, for instance. These sources can also be used to verify spelling or names of organisations mentioned in the interviews.

1.5 The Review of Draft Case Study

After each interview, the written draft version of the case report should be submitted to the informant(s) as a way of corroborating essential facts and evidence.

Similarly, the finished case study report should also be submitted to informants. Although informants may disagree with conclusions made, the final version should not include any disagreements about facts and evidence (ibid., pp. 144–145).

2. Case Study Protocol and Questions

The case study questions are specified in one specific document. The questions are organised under the following headings: Background Information, Questions Relating to a Specific Case of Public Procurement, Questions Relating to the Procurement Decision, Questions Relating to the Context of the Procurement, and Questions Relating to the Outcome of the Procurement.

Analytically, these questions can be divided into three categories: context, actors and events. The questions under the headings “Background Information” and “Questions Relating to a Specific Case of Public Procurement” correspond mainly to the context category, but questions are also listed here that are related to the actor category. One purpose of the questions under the heading “Questions Relating to a Specific Case of Public Procurement” is also to establish the character of the procurement process, e.g. to verify that the procurement actually involved innovation (i.e. as distinct from regular procurement). In that sense, the questions under this heading can be put in the context category. The questions under the heading “Questions Relating to the Procurement Decision” and “Questions Relating to the Outcome of the Procurement” to large extent correspond to the events category.

3. Analysis Plan and Case Study Reports

The analysis that is developed in section 3.1 attempts to contribute to a more profound understanding of the institutional requirements necessary for innovative public procurement to take place. Section 3.1 briefly discusses the structure of the case study report.

3.1 Analysis

Following Yin, it is important for anyone doing case study research to have an analytical strategy in order to know what to do with the collected data. Also, any description of a case involves a selection of facts (De Vaus, 2001, p. 251). Such a selection can follow from the theoretical propositions on which a study relies, if such theoretical propositions have been developed. Based on the theoretical propositions made here, the analysis of the empirical material that was gathered comes close to explanation-building analysis (Trochim, 1989; Yin, 1994). Explanation-building analysis as a special case of pattern-matching is iterative in nature. It starts out from an initial theoretical statement or proposition which is compared with an initial case. This is followed by revision of the initial propositions, which are in turn compared with other details in the case, followed by further revisions of the propositions. What has not been possible with the current study is to proceed with the last step in the iteration, which is comparison with other cases (Yin, 1994, p. 111).

Coriat and Weinstein (2002) have developed a taxonomy based on two institutional dimensions of relevance for the purpose of understand innovation processes. This will be adopted for analysis of the case. A brief summary can be made as follows.

Coriat and Weinstein distinguish between Type 1 and Type 2 institutions. The former "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). Type 1 institutions also include an enforcement system that punishes any violation of the institutions. In real life such institutions are maintained, for instance, by the police or the justice system. 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). Here, these two types will be labelled exogenous and endogenous respectively. Such a labelling is understood from the perspective of an organisation. Although both of these types influence an organisation's learning, the ways they do it are different. Exogenous institutions affect organisations from outside. They are imposed on organisations with little or no control from the organisation itself. Endogenous institutions are those originating and evolving from within the organisation. They may also change as a result of learning within the organisation. What may change within an organisation in relation to exogenous institutions is e.g. the perception of them or the response that might be triggered. This change is then an example of an endogenous institutional change.

Coriat and Weinstein's second institutional dimension essentially concerns the duration of the institution. Type A institutions rule the reproduction of the society as a whole, considered in the long run, whereas Type B institutions are fixed in time. These two types will be labelled long term and fixed term respectively. These two dimensions of institutional types, if put together, form a taxonomy consisting of four distinct categories as follows. Type 1–Type A are universally regulated institutions that are not fixed in time, i.e. long-term exogenous institutions. These are institutions maintained by organisations such as schools, hospitals or laws on intellectual property rights. Type 1–Type B are institutions universally regulated but fixed in time, short-term exogenous institutions. Examples of this category would be non-permanent policy programmes. Type 2–Type A institutions would include institutions stemming from organisational choices regarding modes of coordination within an organisation, i.e. long-term endogenous institutions. The last category, the Type 2–Type B institutions, are also presumably choices stemming from within organisations rather than universally, but with a much shorter and limited time span, i.e. short-term endogenous institutions. Most contracts fall into this category. These four institutional types are displayed below.

	Long term	**Fixed term**
Exogenous	Law, Mission of public agencies	Public policies, programmes
Endogenous	Organisational choices regarding modes of coordination	Contract

Van de Donk and Snellen (1989) distinguish between four different rationalities that may influence the actions and decisions in public administrations. These are political rationality, legal rationality, economic rationality and scientific rationality. This framework, in a slightly modified version by Gregersen (1992), will be used to analyse innovation in public agencies where the starting point is an organisation. Viewed in the light of the institutional model inspired by Coriat and Weinstein, the four-rationality model becomes useful in analysing the institutional match between endogenous institutions in different organisations. In the model, a public contract involving innovation happens as a result of an institutional match between actors. In this perspective, institutional match occurs as the result of compatible rationalities among collaborating actors. Similarly, a contract may not happen if the rationalities of the collaborating actors are too different from each other.

3.2 Format of the Case Study Reports

Yin (1994, pp. 137–138) indicates several alternative structures for written case study reports. These are linear-analytic, comparative, chronological, theory-building, "suspense" structures and unsequenced structures. The report developed here will follow the most common one, the linear-analytic. One reason for this is that this is the structure most commonly used in research journals.

The report will begin with an introduction that addresses the scope and purpose of the case study. It may also be useful to include a presentation of the research field. A theoretical overview and a discussion about the analytical model should be included. One section will briefly cover methodological issues.

The next section of the report will deal with the empirical material gathered. It will start with a fairly descriptive presentation of the context of the case. The historical background of the procurement project will be discussed. The emphasis should be on discussing the case in terms of the institutional models developed. The report should end with a section summarising the conclusions of the case.

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Case Study Protocol for Paper 4

This case study protocol has been developed for a case study of a public procurement project. The overall purpose of this document is to provide a guide for the researcher who will carry out case the study and to increase reliability (Yin, 1994).

This document is organised as follows. Below are an overall statement of purpose for the project and a short description of its components and the context in which the case study is carried out. Section 1 briefly covers some procedural aspects of the case study. In section 2 the questionnaire is discussed. The concluding section 3 briefly covers how the collected data will be analysed and how a case study report should be structured.

Purpose

Since 2000, the role of public procurement as a means to spur innovation has been increasingly emphasised by the European Commission. By procuring innovations, public agencies will help reach the targeted R & D share of GDP of 3% in 2010, and thus contribute to the goal of making Europe the most advanced knowledge economy in the world (Lisbon European Council, 2000).

One reason for emphasising public procurement as an innovation tool lies in the perception of its significant contributions to most national economies in Europe. It has been argued that "with public procurement accounting for 16% of EU GDP, public authorities are big market players", and that public agencies "have powerful means to stimulate private investment in research and innovation" (European Commission, 2005). For some countries, the UK for instance, and in some market areas, medical equipment for instance, the share might be even bigger. This means that the public sector constitutes a purchasing power that, if managed accordingly, could positively affect innovation. The demand side of public innovative procurement has been emphasised (see e.g. Edler et al., 2006; Edler 2007). The issue that relates to this general theme and is of interest here is how public agencies adopt emerging private sector innovations. As a complement to the prevailing focus on developmental technology procurement (Edquist, Hommen and Tsipouri, 2000, p. 21), this case study will attempt to add to existing understanding by emphasising the role of adaptive public technology procurement of goods and services. In light of that often-mentioned public purchasing power, and the perception that "without diffusion, innovation have little social or economic impact" (Hall, 2005, p. 459), the objective in this paper is to study further how a large public agency adopts private sector innovations. The research question addressed is formulated as follows:

What factors determine the diffusion of the Bardex Catheter into the NHS?

1. Procedures

This study will deal with an attempt by the National Health Service (NHS) in England to procure and diffuse a new catheter throughout its Trusts. The NHS is one of the largest organisations in the world, consisting of some 600 organisations. Within the organisation there is no stipulated route for the supply of consumables, and any single NHS trust may utilise supply routes as it finds most appropriate. This project will be carried out in collaboration with the Centre for Research in Strategic Purchasing and Supply (CRISPS) at the School of Management, University of Bath, UK. This is a research unit which possesses (among other virtues) a very strong interface towards practice. Participants for interviews should be accessible through CRISPS' network of practitioners. The procedures to deal with these are outlined below.

1.1 Initial Arrangements

When a person or a case has been selected, arrangements should be made to set up interviews with the relevant persons (as specified in section 1.1). Sometimes an initial contact will provide information that leads to the identification of another person who is relevant for the case and can be asked to participate in the interviews. The application of this snowball procedure is encouraged, though with some restriction due to the time available.

On every occasion when a person is asked to participate in the interviews, background information about the project should be provided in which the context and purpose of the research project are outlined. To this end, a one-page leaflet, "Public Procurement Projects as Innovation Policy: Understanding Causes for Innovation", has been produced and it is recommended that it be distributed to each respondent.

1.2 Procedures for Data Collection: Interviews

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 about 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 that will be carried out belong somewhere in between "open-ended" and "focused" (Yin, 1994, p. 84) on this continuum. This means that questions have been 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 strongly recommended to make use of additional information provided by the respondent that goes beyond the questions. Through this, the interviews might provide additional information of interest to the case, and eventually to the cross-case analysis. In addition to face-to-

face interviews it may also be necessary to conduct telephone interviews. The principles applied in the face-to-face interviews should apply as far as possible for telephone interviews as well.

It is strongly recommended that a recording device be used in the interviews. The use of other complementary sources of information is also strongly recommended. Examples of these are news archives, web pages, newspaper articles, policy documents, etc. Ideally, relevant additional available sources should be retrieved before the actual interview is carried out.

One point, emphasised by Yin (1994), concerns the material collected during the field work of the study: It is strongly recommended that the material, including documents and other written material, be stored for later retrieval, should the need arise for further studies.

1.3 Other Sources of Information

In addition to interviews, other sources of information should be used, where such sources are available. Examples of other sources are documentation e.g. related to the tender call, web sites and perhaps newspapers (see Yin, 1994, p. 80). If possible, the sources relevant for a given case should be studied prior to the corresponding interview session. Another important use of these sources is to corroborate and augment evidence (ibid., p. 81), such as that collected in the interviews, for instance. These sources can also be used to verify spelling or names of organisations mentioned in the interviews.

1.4 The Review of Draft Case Study

After each interview, the written draft version of the case report should be submitted to the informant(s) as a way of corroborating essential facts and evidence.

Similarly, the finished case study report should also be submitted to informants. Although informants may disagree with conclusions made, the final version should not include any disagreements about facts and evidence (ibid., pp. 144–145).

2. Case Study Protocol and Questions

The case study questions are specified below. The questions are organised under the following headings: Background Information, Questions Relating to a Specific Case of Public Procurement, Questions Relating to the Procurement Decision, Questions Relating to the Context of the Procurement, and Questions Relating to the Outcome of the Procurement.

Analytically, these questions can be divided into three categories; context, actors and events. The questions under the heading “Background Information” correspond mainly to

the context category, but questions are also listed here that are related to the actor category. The main purpose of the questions under the heading "Questions Relating to a Specific Case of Public Procurement" is to establish the character of the procurement process, e.g. to verify that the procurement actually involved innovation (i.e. as distinct from regular procurement). In that sense, the questions under this heading can be put in the context category. The questions under the headings "Questions Relating to the Procurement Decision" and "Questions Relating to the Context of the Procurement" correspond to all three categories.

3. Analysis Plan and Case Study Reports

Taking a theoretical point of departure in diffusion theory (Rogers, 1995), an analysis of the case will be done as outlined in the following.

3.1 Analysis

Following Yin, it is important for anyone doing case study research to have an analytical strategy in order to know what to do with the collected data. Also, any description of a case involves a selection of facts (De Vaus, 2001, p. 251). Such a selection can follow from the theoretical propositions on which a study relies, if such theoretical propositions have been developed. The analysis draws on applicable parts of the four elements that determine a diffusion process, as described by Rogers (1995). The analysis includes a selection of concepts used in a sensitising 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 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 during which adopters go through a process that may lead to the decision to adopt the innovation; and the social system, individuals, groups or organisations that are engaged in "joint problem-solving to accomplish a common goal" (ibid., p. 23).

The characteristics that determine the diffusion of the innovation are 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 the 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.

With an institutional approach to how public agencies adopt innovation comes an interest in how adoption may be propelled or hindered because of prevailing institutions. Within organisations internal rules, formal power structures, work descriptions, assigned budgets, incentive structures, etc. may affect how information is utilised by individuals. An individual working in an organisation may have processed available information regarding a specific innovation and arrived at a decision favouring adoption. Due to the institutional set-up within the organisation, the individual may or may not be able to implement such a decision. This means that attention should be paid to institutional effects found in the case.

As this case is about a product that may still be in its early phases, a complete ex-post diffusion analysis may not be possible to do. What should be possible to do, however, is to discuss any problems identified in the diffusion process that may be of relevance for an understanding of public procurement as a way of adopting private sector innovation.

3.2 Format of the Case Study Reports

Yin (1994, pp. 137–138) indicates several alternative structures for written case study reports. These are linear-analytic, comparative, chronological, theory-building, "suspense" structures and unsequenced structures. The report developed here will follow the most common one, the linear-analytic. One reason for this is that this is the structure most commonly used in research journals.

The report will begin with an introduction that addresses the scope and purpose of the case study. It may also be useful to include a presentation of the research field. A theoretical overview and discussion of the analytical model should be included. One section will briefly cover methodological issues.

The next section of the report will deal with the empirical material gathered. It will start with a fairly descriptive presentation of the context of the case. The historical background of the procurement project will be discussed. The emphasis should be on discussing the case in terms of the institutional models developed. The report should end with a section summarising the conclusions of the case.

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Case Study Questions Papers 3 and 4

This interview programme makes up part of a project titled "Public Procurement and Innovation: A Comparative Analysis of Sweden and Great Britain". The project is a component of a Swedish (Lund University) Ph.D. thesis project investigating public procurement as a demand-side innovation policy instrument. The Ph.D. has been funded by the Swedish Governmental Agency for Innovation Systems with contributions from the European Commission. This project is being carried out in partnership with the Centre for Research in Strategic Purchasing and Supply (CRISPS) at the University of Bath School of Management.

The purpose of this study is to understand the factors promoting the procurement of innovations as opposed to regular, off-the-shelf products.

The questions have been organised into five sections. Each section starts with a brief description of the specific purpose (in italics).

1. Background Information

The purpose of the questions here is to provide background information.

a. Name of Interviewee

b. Organisation

c. Profile of organisation (main line of business activity, special competence(s), historical background, market share, international activities, R & D spending, etc.)

d. Contact Details

e. Position/ role of interviewee.

2. Questions Relating to a Specific Case of Public Procurement

The purpose of these questions is to collect basic data on the procurement project and to establish whether the supplier performed R & D in order to deliver.

a. Could you please describe the procurement project in some more detail?

For example:
Procured good/ service?
Price of the good/ service?

Date(s) of procurement, tender call, contract award, delivery?
Number of competing bids in the procurement process?
The supplier selected?
Procurement Procedure (open, restricted, negotiated, competitive dialogue) used?

b. Has the procured product or service been used before?

For example:
By the organisation?
Elsewhere?

c. To what extent did the supplier carry out any kind of development in order to deliver the procured good, system/ service?

For example:
Software development?
Adoption?
Design/ Construction?

3. Questions Relating to the Procurement Decision

The purpose of these questions is to collect data on the decision process leading up to the procurement project.

a. Please describe the decision-making process leading up to the procurement.

For example:
Who (what level) made the decision?
Main stakeholders?
Where the need first was identified?
Who was involved in outlining the specifications?

b. To what extent were there any alternative suppliers/ technologies considered? (Why/ why not?)

For example:
Search/ market consulting?

4. Questions Relating to the Context of the Procurement

The purpose of these questions in this section is to establish the conditions under which the decisions to procure took place.

a. Why did the process take place in the way it did?

For example:
Policies?
Incentives?

Budget?
Law?
Organisational changes?
Replacing existing technology?
User training?
Other investments?

b. What prevented you from making a different decision (procurement of innovation rather than regular procurement; or regular procurement rather than procurement of innovation)?

For example:
Risk?
Problems?

5. Questions Relating to the Outcome of the Procurement

The purpose of the questions in this section is to establish the outcome of the procurement project.

b. What was the outcome of the procurement project?

For example:
Success/ failure?
Procured item used later on elsewhere?

Appendix B

Planning and preparation: Gearing up for procurement
Market consultation and establishing need
Assembling the teams and partnerships needed to manage the process
Project definition
Selection of procurement procedure
Determination of contract award criteria
Notification and pre-qualification (if applied)
Initial advertisement and contract notice, inviting expressions of interest
Assessment of expressions of interest
Definition of shortlist
Tendering
Issue of tender invitations
Arranging for dealing with clarification requests from bidders
Receipt of tenders
Evaluation
Formal tender opening and checks for compliance with requirements
Tender evaluation of quality and price
Arranging tender presentations (if applied)
Negotiating with selected tenderers (if applied)
Selection of the most economically advantageous tender
Contract Award
Notification to successful tenderer
Notification to unsuccessful tenderers
Contract Management
Monitoring that delivery meets specification
Evaluation
Draw lessons that might improve future procurement projects

Outline of the procurement process (freely after Lewis, 2003)

Paper I

PUBLIC PROCUREMENT AND INNOVATION -- TOWARDS A TAXONOMY

Leif Hommen and Max Rolfstam*

ABSTRACT

The role of public procurement as an instrument to stimulate innovation has been increasingly emphasised by European policymakers. This perspective raises demand for the understanding of public procurement as an activity taking place in a variety of different procurement contexts and as an act of innovation. Accordingly, this paper proposes a taxonomy of public procurement and innovation, combining interactive learning and evolutionary perspectives on innovation processes to account for the broad range of different 'interaction environments' or 'resource interfaces' in which government or public sector organizations may act as lead users of innovations. On this basis, the taxonomy draws practical policy implications for the design of programmes and initiatives for the public procurement of innovations.

INTRODUCTION

Current policy and research literature on the public procurement of innovations lacks strategic perspective and attention to context. EU

* *Leif Hommen, Ph.D., is an Associate Professor at the Centre for Innovation, Research and Competence in the Learning Economy (CIRCLE), Lund University, Sweden. Max Rolfstam, M.Sc., is a Ph. D. Student at the Centre for Innovation, Research and Competence in the Learning Economy (CIRCLE), Lund University, Sweden*

policy-makers have increasingly encouraged "public procurement of innovative products and services" as a policy instrument appropriate to realizing the Lisbon and Barcelona goals for raising private sector R&D investment in member states (European Council 2005: 6; National IST Research Directors Forum 2006). Several EC-funded projects, as well as individual national authorities, have specified principles, models, and examples of 'best practice' (Edler et al 2005; Georghiou and Cave 2005; OGC 2004). But such guidance has been based on generic models of the procurement process and a focus on particular projects, viewed as transactions and evaluated from the standpoint of public sector organizations as 'buyers'. This approach is unable to account for variety and change in the dynamics of user-producer interaction and longer-term processes of technological development and cannot inform broader strategies for the public procurement of innovations.

We propose a taxonomy that draws upon theory and research in innovation studies and related fields to map the variety of contexts and identify key features of context that should be addressed in planning and conducting public procurement of innovations. Theoretically, the taxonomy's main conceptual dimensions are drawn from interactive learning and evolutionary views of innovation, and for both of these main dimensions several sub-dimensions are elaborated. With respect to evolution, for example, the framework takes into account not only technological trajectories but also institutional aspects of market development and shifts in the balance of power and capability within established networks of innovation. The taxonomy also addresses key aspects of the design of programmes and initiatives for the public procurement of innovation. These aspects include the role of public *vis-à-vis* private demand, the goals for technology development, the character of innovation pursued, and the modalities employed.

A taxonomy is one of two kinds of typology. The methodological literature identifies typologies as theoretical constructs that are particularly useful for multiple case study research designs (de Vaus 2001: 252). Dess et al. (1993) identify one of the chief virtues of typologies as "express[ing] complicated and interrelated relationships among many variables without resorting to artificial oversimplification". Some authors emphasise that typologies are conceptually derived classification schemes, resulting in complementary sets of "ideal types" (Bozarth and McDermott 1998), constructed either deductively or

inductively. The term 'typology' is sometimes applied to all such classification schemes. However, Turner (1992) has differentiated "*naturalistic schemes*, which try to … capture the way in which invariant properties of the universe are ordered", from "*sensitising schemes*, … intended only to sensitise and orient researchers and theorists to certain critical processes" (ibid.: 10). Similarly, Sayer (1992) has distinguished between *causal groups*, and *taxonomic groups* (ibid.: 244).Hence, we reserve use of the term *typology* for what Turner (op. cit.) refers to as a "naturalistic" scheme, and apply the term *taxonomy* to its counterpart, the "sensitising" scheme. Below, we develop a taxonomy to guide exploratory case study research on public procurement and innovation.

There have been few attempts to classify the relations between public procurement and innovation. Edquist and Hommen (2000) developed a four-field matrix based on two dichotomies. The first was between "direct" and "catalytic" procurement (the latter being carried out on behalf of other eventual end-users) and the second was between "developmental" and "adaptive" technology procurement, (the former involving radical and the latter incremental product innovation) (ibid.: 20 - 23). However, this matrix has never been fully tested, since it has not yet been applied to any cases of "catalytic" procurement (Edquist et al. 2000). It also fails to recognize instances where several public buyers act in concert (e.g., Kaiserfeld 2000). Cave and Frinking (2003) have addressed the design and implemention of public procurement projects to promote innovation in terms of four key "dimensions" – relations between public and private demand, reasons for innovative procurement, the type of innovation involved, and the modalities available. However, they generate only a checklist, and not a typology. (Ibid.: 11 – 22, Annex A). Our work incorporates key elements of Cave and Frinking's framework within a comprehensive classification scheme. We can also identify some relevant typologies developed for the study of the *private* procurement ('purchasing' or 'acquisition') of innovations, such as Håkansson and Johansson's (1993) early work on forms and contexts of user-producer interaction, and Stock and Tatikonda's (2000) more recent "inward technology transfer (ITT) typology". However, these sources have neglected the general case of public procurement and innovation, not to mention its variants (some of which may have no parallels in the private sector). We combine and integrate these perspectives with the aforementioned approaches to the study of public procurement to develop a specification of the relations between public procurement and innovation. The resulting taxonomy is based on the identification of two

key dimensions: the interaction of users and producers and the evolution of technologies and markets.

The remainder of the article is organised as follows. The next section provides definitions in order to clarify the meaning of more specialized concepts. The distinction between product and process innovations is discussed, and related to a parallel distinction between procurement *of* innovations and innovations *in* procurement, drawn in order to clarify the empirical focus of this article. Then the theoretical foundations of the taxonomy that we develop are discussed. This is done by drawing upon the innovation studies literature to explain the main ideas underlying the taxonomy's two main dimensions: interaction and evolution. Subsequently, following from that we elaborate on the key sub-dimensions of each of these two main dimensions. The section titled 'Public procurement of innovation: a Taxonomy' presents the taxonomy and provides illustrative examples. The section thereafter discusses results from case study research related to the taxonomy, and, finally, the article discusses implications for theory, practice, and future research.

DEFINITIONS

Public procurement refers to the acquisition (through buying or purchasing) of goods and services by government or public sector organizations. In order to affect *innovation*, public procurement must influence either or both the direction and rate of technological change (Dalpé 1994; Edquist and Hommen 2000; Geroski 1990). Influencing the rate of innovation may involve either raising investments in R&D or increasing the application of R&D results. Influencing the direction of innovation involves selecting certain technological alternatives. In addition, public procurement can also influence innovation indirectly, by disseminating R&D results, reducing the costs and risks of innovation, and supplementing existing 'dedicated' R&D. (Cave and Frinking 2003: 17). In all of these cases, public procurement affects innovation through transactions related to the development of new *technology*, a term that refers not only to artefacts but also to applied scientific and technical knowledge and operational skills or 'know how (Layton 1974).

Innovative public technology procurement occurs when a public agency acts to purchase, or place an order for, a product – service, good, or system – that does not yet exist, but which could probably be developed within a reasonable period of time, based on additional or new development work –e.g., R&D -- by the organization(s) undertaking to produce, supply, and sell the product (Edquist and Hommen 2000: 5). In contrast, "regular public procurement" occurs when public-sector organizations buy ready made products for which no R&D is required and about which purchasing and supplier selection decisions can be made on the basis of readily available information about price, quantity, and performance, given the existence of standardized markets, (ibid.).

Innovation, according to Schumpeter (1939) "consists in carrying out New Combinations" (ibid.: 87 – 88). Edquist et al. (2000) translate this broad definition into a taxonomy of innovations that distinguishes between product and process innovations, as well as between product innovations in 'material goods' and 'intangible services' and between organizational and technological process innovations (ibid: 19). For us, the distinction between product and process innovations is of central importance.

We follow Schumpeter (1911) in defining product innovation as "the introduction of a new good … or a new quality of a good", and process innovation as "the introduction of a new method of production … [or] a new way of handling a commodity commercially" (ibid.: 66). Essentially, this is a distinction between what is produced and how it is produced. *Product innovation* is fundamental to innovative public technology procurement as defined above, for the reason that any procurement entails the purchase of an economic good or commodity (Lundvall 1985, 2003). In contrast, *process innovation* is only incidental, since it can occur without any transaction, and taking place entirely within the boundaries of a producer organization (Arrow 1962).[†] As a special case of product innovation, then, innovative public technology

[†] Theorized as s "learning-by-doing" carried out by firms within competitive markets, process innovation is essentially concerned with increasing efficiency and achieving optimal resource allocation of resources (Arrow 1962). If this were the sole form taken by technical progress, Lundvall (2003) has argued, "the end result would be stagnation, de-qualification of the labour force and technological unemployment" (ibid: 3).

procurement "involves buying things that go beyond where the market is at the moment" (Cave and Frinking 2003: 17).

We will now make a final clarification concerning the difference between the procurement *of* innovations and innovations *in* procurement. As indicated, we are concerned with the procurement *of* innovations – that is, the purchase, by government or public sector organizations of products that are innovative, or 'new', in Schumpeter's sense, and whose development typically involves significant R&D expenditure. We do not propose to address innovations *in* procurement – i.e., changes or process innovations in the means by which procurement itself is carried out, as, e.g., in the introduction of 'e-procurement' – except insofar as the acquisition of new systems for public procurement can be regarded as an instance of innovative public technology procurement.

THEORETICAL FOUNDATIONS

User-producer *interaction* is a fundamental aspect of product innovation, which typically involves interactive learning – i.e., inter-organizational learning processes based on such interaction (Lundvall 1985, 2003). Interactive learning can take place in a wide variety of contexts and involve exchanges of different kinds of knowledge (Lundvall 1988; Lundvall and Johnsson 1994). The innovation studies literature includes various typologies of learning (see, e.g., Malerba 1992), but we focus here on networks as learning mechanisms (Lundvall and Archibugi 2001: 11). Von Hippel (1988) has shown that dyadic user-producer collaboration involving only two actors represents the most elementary kind of network relation. However, "development pairs" (Fridlund 1993) are only one of several kinds of innovation networks. (Powell and Grodal 2004; Tidd, Bessant and Pavitt 1997: Chap. 8) Håkansson's distinction (1989) between 'vertical' and 'horizontal' network relationships provides an important basis for classifying extended networks. Horizontal relationships predominate in 'knowledge' networks based on co-operation, whereas vertical relationships are the main feature of 'trade' networks based on commodity exchange (Gelsing 1992). Although user-producer interaction is always vertical, it may or may not also involve additional interactions or along the horizontal axis, and relationships along the vertical axis may be either simple or extended.

Another important aspect of user-producer interaction is the number of actors involved (Lundvall 1985, 2003). Typically, it involves "small numbers", as well as "information impactedness" and "uncertainty and complexity" – problems of imperfect competition that are resolved by means of extensive exchanges of qualitative information in the context of stable cooperative relations mediated by a hierarchy rather than a market (Lundvall 2003: 14 – 15). In some instances, the hierarchical mechanisms involved might take the form of simple 'development pairs' – i.e., "long-term intimate collaboration on joint development between large manufacturers and large customers" (Fridlund 1993: 4). However, the classification of markets into the categories of monopsony (single buyer), oliogopsony (several buyers), and polypsony (many buyers) points to the need for alternative solutions (Edquist and Hommen 2000: 34 - 43; Rothwell and Zegveld 1982: 93 - 99). Close relationships between single buyers and single producers might be highly problematic in oligopsonistic and polypsonistic markets. In industrial markets where potential buyer networks lack central coordination, there is a strong possibility that demand for emerging capital goods may remain in a "low-level equilibrium trap" (Teubal, Zinnon and Zuscovitch 1991: 382). In mass markets where many individual consumers may seek better products, and producers are aware of possibilities for improving products but not of the potential demand, the lack of a collective 'voice' for consumers can result in situations where "optima will not be sought, nor maintained, under normal market conditions" (Nilsson 1994: 7n; Rothwell 1994: 637).

A further key aspect of user-producer interaction is the kind of need that motivates such relationships. Public procurement of innovations naturally "takes societal problems and needs as its point of departure" (Edquist and Hommen 2000: 23), but the concept of needs is "fuzzy", and requires clarification (Lundvall 2003: 7). Understanding 'need' in the sense of "interdependence among economic agents" (Smith 1997: 87) and building upon an earlier dichotomy between "direct" and "catalytic" public technology procurement (Edquist and Hommen 2000: 22 - 23), it is possible to identify three different categories: 1) needs that are *intrinsic* to the organization that acts as the 'buyer' in public procurement; 2) needs that are *congeneric* to, or jointly shared by, a number of organizations (possibly including private- as well as public-sector actors); and 3) needs that are *extrinsic* to the public agency or authority that acts as the 'buyer' – which, in this instance, acts to procure innovation on behalf of other actors. Needs of the first type can be

illustrated by the "mission" requirements of a government authority or public sector agency – for instance, the military's need for new weapon systems (Bozeman and Dietz 2001: 67 - 73). Needs of the second kind can be exemplified by common or overlapping demands placed on the "knowledge infrastructure" by diverse groups actors – for instance, the multiple users who rely for innovation inputs on the stocks of knowledge maintained by libraries and other public in formation systems (Smith 1997: 101 – 102). Needs of the third variety can be elucidated by referring to cases where government or public sector bodies, to meet their own objectives, represent the needs of end-users other than themselves. In efforts to reduce demands for energy provision by public utilities through public procurement of energy-efficient home appliances, the main end-users are private individuals and households motivated to reduce energy costs (Westling 1996).

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Evolution is a central theme in studies of innovation (Nelson and Winter 1982), and work in this tradition has typically paid careful attention to stages of technology, industry and market development. Edquist and Hommen (2000: 21 - 22) have differentiated between 'development' and 'adaptation' in innovative public technology procurement, following Schumpeter's (1939) distinction between 'creation' and 'diffusion' as successive stages of innovation. A technology's evolution, though, is tied to and influenced by its pattern of diffusion (Dosi 1982; Grübler 1989; Rosenberg 1972; Sahal 1981; Silverberg 1987; Silverberg 1990a & 1990b; Silverberg et al. 1988). The widely influential product-life-cycle (PLC) model (Abernathy and Utterback 1978) therefore describes three consecutive phases, characterized by distinctive patterns of *both* creation *and* diffusion (Utterback 1994). In this model, innovation and industrial evolution proceeds from an initial 'fluid' stage marked by extensive product innovation through a 'transitory' stage in which process innovation predominates towards a final 'specific' stage in which innovation is minimal. The PLC model does not, however, apply well to many long-established complex product systems (CoPS) (Prencipe 2003).[‡] Moreover, not all product technologies eventually lose innovative dynamism in the 'specific' stage (Hidjefäll 1997). Boisot (1995) and Nooteboom (2000) have therefore elaborated extended, cyclical models of innovation, which stress the potential for creative

[‡] The definition of CoPS refers to "multi-technology, multi-component products, often produced in multi-firm alliances, as a one-off or in small batches for specific customers" (Prencipe 2003: 114).

activity in later stages.[§] Nooteboom, for instance, describes a cycle of exploration and exploitation consisting of three main phases – consolidation of novel combinations, generalization, and differentiation and reciprocation – that "can be characterized succinctly as an alternation of variety of content and variety of context (ibid.: 184). In addition, Boisot's and Nooteboom's models recognise that the evolution of new technologies depends on the market contexts in which they first develop and to which they later spread. Particularly in their emphasis on the possibilities for launching new trajectories in later stages, they support Langlois's (2003) argument that innovation in mature technologies and industries can be boosted by re-aligning organizations, institutions and technologies.

Understanding market development is an essential aspect of the development of new technologies requires moving beyond conventional notions of markets as largely pre-given contexts and addressing the 'construction' of markets (Coombs et al. 2001; Laestadius 2003: 782). Historical studies of industrial organization have focussed primarily on producer strategies for creating or structuring markets (Berk 1994, de Grazia 1998, Glimstedt 1995, Herrigel 1996, Sabel and Zeitlin 1997, Scranton 1997; Zeitlin and Herrigel 2000). Economic sociologists have also emphasized the role of producers (Granovetter and McGuire, 1998). Fligstein (2001) has propounded a theory of market development as a process of institution-building, driven by ongoing struggles between 'incumbent' and 'challenger' firms and arbitrated by the state. The process entails the elaboration of "four types of rules": property rights, governance structures, rules of exchange, and conceptions of control (ibid.: 32 – 36). This theoretical framework also develops propositions related to three main phases of market development: emergence, where there is open rivalry amongst firms with alternative strategies; stability, where status hierarchies are established among firms; and crisis, where incumbent firms begin to fail and are reorganized along the lines of successful invaders, (ibid.: 75 – 98). Contests between incumbents and

[§] In this spirit, Boisot (1995) has argued that "Design and development, contrary to the way they are usually depicted, can never be reduced to the mere application of an existing stock of knowledge which itself remains unmodified by the exercise" (ibid.: 211). Similarly, Nooteboom (2000) holds that "exploitation and exploration are complements rather than substitutes; one can continue exploitation in a way that contributes to exploration at least up to the point that a breakdown of architecture occurs to form novel combinations (ibid.: 189).

challengers have often been discussed in innovation studies literature, but seldom in relation to institutions. Market development has been addressed by diffusion studies, which with only a few exceptions (e.g., Dutton 1999; Mansell and Silverstone 1996) have paid scant attention to institutional analysis.

The innovation studies literature has, however, not only focussed on *producers*, but also recognized the importance of *users* – particularly, 'lead' industrial users, but more recently also 'professional' and sophisticated 'amateur' end-users (von Hippel 1988, 2005). Work in this tradition has focussed on the competitive advantages that producers can acquire by establishing ties with key users or user groups (e.g., Ceruzzi 1998, Francke and Shaw 2003). Institutional implications have remained largely unexplored -- except in Lundvall's (1985, 2003) seminal contributions on 'organised markets'. Lundvall first establishes that neither perfect competition nor vertical integration is conducive to complex product innovation; subsequently, he specifies the most appropriate institutional set-up as a "vertical division of labour between producers and users belonging to different organisations" (Lundvall 2003: 16). Here, co-ordination depends upon "codes of conduct" expressing "mutual trust and responsibility" as well as "elements of hierarchy" (ibid.: 17). Social structure in markets develops and is eventually institutionalised on the basis of recurrent cooperative relations.[**] Over time, though, constellations of social structure often emerge that spawn 'unsatisfactory' innovation trajectories, due to producers' domination of users and related factors (ibid.: 19 – 24). In stable market contexts, 'industrial complexes' of major users and producers can foster "convergence and agreement on technological trajectories …, excluding new and more promising avenues" (Lundvall and Borrás 2004: 610). Hence, there is a need for policy oriented towards enhancing user capabilities, including those of 'final users'. Innovative public technology procurement addressing neglected users and other 'outside' actors may be particularly effective for such policy, since it involves state or public sector bodies as powerful 'lead users' and

[**] This analysis is mainly concerned with micro-economic organisation and focuses primarily on 'informal' rather than 'formal' institutions. In terms of the classification of institutional analysis proposed by Hollingsworth Rogers (2000), institutions are not addressed here at the level of "norms, rules, conventions, habits [and] values" but rather at that of "*institutional arrangements*: markets, states, corporate hierarchies, networks, associations [and] communities" (ibid.: Table 1).

can contribute directly to both technological innovation and the (re)organisation of product markets (Edquist and Hommen 2000: 5).

Far from being a simple progression towards a state of maturity marked by minimal uncertainty and clearly defined standard markets, technology development is a complex, non-linear process. To map it, we require a framework that "allows for intermediate cases" and captures "a spectrum of innovation and diffusion, of creation and realization" (Nooteboom 2000: 66). By relating different constellations of the key actors in product innovation to broad stages of technological development, we can discern different interaction environments characterized by different kinds of collaborative relations and constituted by activities in which the key actors combine, develop, exchange or create resources (Håkansson and Johansson 1993). Where the state – or the public sector -- enters as a 'lead user', we can expect its priorities to vary with respect to the role of public *vis-à-vis* private demand, goals for technology development, the character of innovation pursued, and the means employed (Cave and Frinking 2003: 11 - 22).

TAXONOMY DEFINITIONS AND SUB-DIMENSIONS

In this section we elaborate key sub-dimensions of the two main concepts or dimensions discussed in the preceding section – i.e., 'interaction' (especially of users and producers) and 'evolution' (of both technologies and markets). For each dimension, we relate sub-dimensions to concrete policy examples and discuss their main implications. We also address the design of policies and programmes for the public procurement of innovation.

Interaction

Our taxonomy's first dimension is interaction, particularly between users and producers, which is fundamental to product innovation (Lundvall 1985, 2003). Table 1 specifies three modes of interaction in public procurement of innovations: direct, co-operative, and catalytic. These categories are based on three important sub-dimensions of interaction. Namely, these are interactive learning, structure of demand, and the

needs that innovative public technology procurement responds to. Below, each is discussed in turn.

TABLE 1

Modes of Interaction

Modes of Interaction	**Aspects of User Producer Interaction**		
	Interactive Learning **Contexts (Networks)**	**Demand Structure**	**Needs Addressed**
Direct	*Development Pairs* (simple networks or dyadic relationships)	*Monopsony* (markets with a single buyer)	*Intrinsic Needs* (pertaining solely to buyer organizations)
Co-operative	*Knowledge Networks* (horizontally extended)	*Oligopsony* (markets with several buyers)	*Congeneric Needs* (shared by buyer and other organizations)
Catalytic	*Trade Networks* (vertically extended)	*Polypsony* (markets with many buyers)	*Extrinsic Needs* (pertaining to other actors than buyer organizations)

Interaction and thus *interactive learning* can occur in different *contexts* and be based on different kinds of *networks* (Lundvall and Archibugi 2001: 11). Since it encompasses both horizontal 'knowledge' and vertical 'trade' networks (Gelsing 1992), one particularly relevant context for public procurement of innovations is 'learning regions' (Asheim 1996, 2001; Cooke and Morgan 1998; Florida 1995; Lundvall and Maskell

2000; Morgan 1997). Here, flows of knowledge among actors are normally facilitated by common channels, codes, and conventions of communication, fostered by "shared institutional environments" and accumulation of social capital (Asheim and Gertler 2004: 293). Regional innovation studies point to numerous instances of the importance for economic advantage of markets and demand-side factors (Best 2001; Kenney and von Burg 1999; Langlois 1992, 2002; Saxenian 1994, 1999). One clear implication of such analyses is that, as suggested by Rothwell (1983), regions with 'traditional' industrial structure, where private sector demand may exert only weak influence on emerging technologies, might compensate by means of public procurement initiatives aimed at developing new market segments, to provide producers with stimuli and inputs for successful innovation.

Demand structure is important, since effective user-producer interaction usually involves only a few main actors with fairly stable inter-organizational relations (Lundvall 2003: 14 – 15), and in fragmented industrial and consumer markets, users and producers cannot communicate effectively. In such contexts, there may be compelling reasons for public procurement initiatives representing collective interests of individual users. Concern about potential 'information society' exclusion of disadvantaged groups (Haddon and Silverstone 1996) has prompted EC support for numerous RTD&D projects for inclusive product design in, e.g., telematics and overcoming barriers to use of electronic services (Silverstone and Haddon 1997). But problems of social exclusion cannot be resolved by 'technological fixes' alone; "they also require the evolution of institutions with mandates providing incentives for people to become prepared and motivated to seek ways of mitigating the issues of exclusion" (Mansell and Steinmueller 2000: 42)

Three types of *need* may be addressed by public procurement of innovations: intrinsic, congeneric, and extrinsic. In certain areas, all three types of need may be present, requiring differentiated strategies. One example is technological innovation policy initiatives for environmental sustainability (Meyer-Krahmer 2001a).Here, there remains considerable scope for conventional 'mission-oriented' projects, but there are also increasing requirements for "active participation of a wide range of [public sector organizations] and firms", and an imperative to lead not only firms but also consumers (ibid.: 185 – 188). When public procurement of innovations addresses this wide range of actors, needs,

and interests, coordination becomes essential. It becomes necessary to maximize complementarity of diverse initiatives through close interaction of firms, consumers and public authorities. For these reasons, "Regions can act as pioneers … because they are an ideal platform for such social innovation experiments (ibid.: 189).

Evolution

The second dimension of our taxonomy is the evolution of technologies, markets, and networks, which can affect direction of demand in public procurement of innovations, sources of innovation, and aspects of procurement mechanisms (Nelson and Winter 1982; Nooteboom 2000). The Product Life Cycle (PLC) model (Utterback 1994) specifies three main phases: early, middle, and late. In Table 2, these phases are related to key sub-dimensions: technological trajectories, institutional aspects of market development, and the balance of power and capability in network relations. Below, we discuss each in turn.

With regard to *technological trajectories*, unilinear models have given way to multilinear models (Boisot 1995; Nooteboom 2000), where possibilities for innovation do not necessarily diminish with wider diffusion in the middle and late stages. Rather, diffusion presents opportunities for developing new trajectories. US innovation policy debates on 'dual use' technologies and 'conversion' of military technologies into civilian applications provide insight into these possibilities (Bozeman and Dietz 2001; Mowery 2001a). In the late 1980s and early 1990s, such concerns led to several major programmes complementing US Department of Defence (DOD) technology procurement with cooperative development of civilian applications in strategic high technology sectors. (Mowery 2001a: 26 – 29) Although US 'dual use' initiatives were largely abandoned by the late 1990s, along with 'cooperative' technology development policies, they still provide models for exploration and exploitation along multiple trajectories via public procurement and related measures. Moreover, that model could still be revived if commercialization of defence and other Federal Government 'mission' technologies regains high priority in US economic policy. (Bozeman and Dietz 2001: 72 - 75)

TABLE 2

Phases of Evolution

Phases of Evolution	**Aspects of Evolution**		
	Technological Trajectories	**Institutional Development of Markets**	**Balance of Power and Capability**
Early ('Fluid phase' marked by extensive product innovation)	*Consolidation of Novel Combinations* Closing variety of content to establish efficient production and clear paradigms or platforms for development.	*Emergence* Open rivalry and shif-ting alliances among incumbent and challenger firms with varying ideas on con-trolling competition. Coalition building.	*User-led Innovation* Producers depend on key users for vital in-formation. Competent lead users are instru-mental in selecting dominant designs and successful firms.
Middle ('Transitory phase', with a main focus on process innovation)	*Generalization* Opening variety of context, for insight in-to misfits, needs and opportunities for adaptation. Avoidance of 'distant' contexts.	*Stability* Identities and status hierarchies among producers are firmly established. Strong isomorphism in firm strategy and structure.	*Industrial Complexes* Convergence of vested user and producer interests; agreement on certain trajectories. Some promising avenues may be neglected.
Late ('Specific phase', featuring minimal innovation by major producers in either processes or products)	*Differentiation and Reciprocation* Opening variety of content for different versions and extensions; transfer of elements between practices and contexts; new combinations.	*Crisis* Failure of incumbent firms and re-organization to emulate successful invaders. Markets in crisis are highly susceptible to transformation.	*Producer Domination* Users are increasingly marginalized by established producers. New technological alternatives can arise out of new user-producer constellations

Concerning *institutional aspects* of market development, conflict between 'incumbents' and 'challengers' drives elaboration of rules concerning property rights, governance structures, rules of exchange, and conceptions of control (Fligstein 2001: 32 – 36). Mansell and Steinmueller (2000) distinguish between "incumbent" strategies" based on the control of unique fixed assets supporting dominant market positions and "insurgent" strategies that combine network externalities with economies of scale. They also point to both commercial and non-profit "virtual community" strategies. (Ibid.: 26 – 31) They argue that "the virtual community strategy offers a particularly attractive avenue for European information society development", not only due to potential employment creation, but also because insurgent strategies advantage North American producers (ibid.: 456 – 457). But EC public policy actions have tended to "tilt the playing-field" against virtual communities – notably in decisions on copyright (ibid.: 458; Chap. 7). Public procurement could contribute to building virtual communities through new infrastructure and public applications for information systems (ibid.: 458; Chap. 9). However, it could only level the playing-field for virtual communities if combined with institutional reforms in areas such as copyright, standards development, and governance.

With respect to changing *balances of power and capability* in network relations, longer-term trends towards producer domination have negative consequences for innovation (Lundvall 2003: 19 – 24). In telecommunications, innovation is demand-led (Garrard 1998), particularly in software (Meyer-Krahmer 2001b: 242). National or regional competitive advantage in this field depends on sophisticated markets and competent users. However, liberalization of telecommunications in the EU (and elsewhere) has transferred 'system competence' from operators to equipment manufacturers (Hommen and Manninen 2003; Hommen 2003). ETSI (European Telecommunications Standards Institute) and other regional standards development organizations (SDOs) have provided "important epistemic communities" (Humphreys and Simpson 2005: 48) for "user-led" standards development (Hawkins 1995: 29). Nevertheless, 'standards-led' EC competitive strategy faltered by the late 1990s (Glimstedt 2001; Humphreys and Simpson 2005: Chap. 8) – as did EC procurement policies that advantaged European vendors by requiring reference to European standards developed by ETSI and other EC-recognized SDOs (Bekkers 2001: 111 – 115). Although the EC has more recently moved towards "technologically neutral" telecommunications public supply

contracts, past policies and their effects on infrastructure investment have continued to induce strong bias in technological choices made in procurement (ibid.: 116 – 117). Further reform should arguably include measures assuring non-restrictive, unbiased competition of both formal and non-formal technical standards (ibid.: 565). Of course, it should also address how to improve competence among telecommunications operators and other 'lead users'.

Design of innovative public technology procurement

Cave and Frinking (2003: 12 - 14) identify four key aspects of design of public procurement programmes promoting innovation: relations between public and private demand, reasons for intervention, kinds of innovation involved, and choice of modalities. These design aspects entail both 'interactive' and 'evolutionary' issues.

In the *relation between public and commercial demand*, interactive issues arise regarding strength and variability of public relative to commercial demand. A monopsonistic public agency pursuing its own priorities can behave quite differently from one that attempts instead to lead a group of buyer organizations with related but perhaps only partly overlapping agendas. Evolutionary issues concern direction of demand – i.e., whether public demand influences commercial demand, or *vice-versa*.

Regarding *reasons for public intervention*, some major issues concern interaction -- in particular, questions of need. As noted, public technology procurement initiatives in areas like environmental sustainability may be simultaneously motivated by several complementary types of need, requiring effective co-ordination. Evolutionary issues also arise – particularly, those concerning distribution of power and capability between users and producers. In later stages, intervention may be directed towards enhancing user capabilities or encouraging interaction with non-incumbents to foster new alternatives.

Concerning *kinds of innovation involved*, interactive issues concern forms of innovation – i.e., product vs. process innovation. Both needs and networks are important. Where public agencies sponsor design contests to establish effective communication between producers and other potential end-users, e.g. consumers, they will focus strongly on product design criteria, and require vertically extended learning networks. Evolutionary issues are reflected in whether innovation occurs only directly within transactions between 'buyer' and 'seller', or also indirectly – i.e., further along supply chains.

In *choice of modalities*, interactive issues are reflected in strategies to facilitate innovation, and organization of procurement projects. With high levels of risk and uncertainty, public-sector agencies may have to provide direct support for innovation through strong co-operative ties such as 'development pairs'. Evolutionary issues arise concerning selection of suppliers and how specifications are made. Use of multiple suppliers has long been recognized as an aspect of US military procurement policies beneficial to commercial 'spin-off'. Regarding specification, a functional approach maximises competition among suppliers, encourages buyers to explore alternatives, and avoids technological lock-in, especially in mature industries -- a point illustrated by EC 'technological neutrality' in public supply contracts in telecommunications.

PUBLIC PROCUREMENT OF INNOVATION: A TAXONOMY

Tables 3 – 5 below present a taxonomy of public procurement of innovation, emphasizing product innovation and development of relevant supplier industries and product markets. Key characteristics in focus are policy 'design' aspects discussed earlier by Cave and Frinking (2003). We identify nine separate kinds of procurement of innovation, specified by discussing three different modes of interaction at early, middle, and late stages.

We begin with *direct* procurement of innovations (Table 3). Classic *early-stage* examples include military procurement of radar and sonar technologies, and more recently, the Internet (Mowery 2001b). In this cell, public demand is far in advance of public demand and procurement

is oriented towards 'mission critical' issues. It exerts direct 'demand-pull' on suppliers, often through long-term contracting arrangements. The *middle stage* is exemplified by public utilities' procurement of established but still developing – and possibly also 'alternative' -- production technologies for their own commercial purposes, advancing generals market for these technologies and improving the technologies themselves. A specific instance is the Swedish power company Vattenfall's recent procurement of wind power technology, in the form of 48 offshore wind power plants located in southern Sweden (Vattenfall 2004). Here, 'own account' public demand typically establishes performance requirements superior to existing market requirements, and may thus lead, via 'indirect demand pull' to new commercial applications. Dual or multiple sourcing is a preferred modality for developing competitive supplier industries.

In *late-stage* 'direct' procurement, new solutions to 'mission critical' needs may be sought. Public demand often becomes increasingly different from private demand, but may still complement it. One example is Sweden's ongoing "24/7" programme to make public services accessible to citizens at all times and interconnect government offices and public agencies, by integrating information and communication technologies such as Internet, telephony, and television (Statskontoret 2000, 2002). Although "24/7"has been in progress since the late 1990s and several contracts have been awarded (Karlberg 2004), inter-agency co-ordination and technological integration have continued to raise problems (Kleja 2004). Achieving these goals will help facilitate full interoperability of government IT systems with commercial ones – as in electronic procurement systems (Single Face to Industry 2004). New solutions of this kind may also be made mandatory for the private sector, thus facilitating 'supply push' on the part of producers. More generally, governments can encourage the suppliers of directly innovative public services to find commercial applications, which could find a ready market among 'neglected' users for whom standard solutions have become problematic (Cave & Frinking 2003: 20). Since established producers tend to disregard many users' needs in late-stage technology and market development, direct public technology procurement requires increased market power vis-à-vis producers, to motivate product improvements and induce innovation. Several countries have therefore created centralized agencies, such as National Procurement Ltd in Denmark (SKI 2005), OGC buying solutions in the UK (OGCbuying.solutions 2005), and the US Federal Energy Management

Program, FEMP, (Oak Ridge National Laboratory, 2004). Another, already-discussed strategy for boosting innovation at this stage is 'technological neutrality' (Bekkers 2001: 111 - 115).

TABLE 3

Direct Procurement

DIRECT PROCUREMENT			
Modes of Interaction / Design Aspects	**Phases of Technology and Market Evolution**		
	Early (Fluid)	**Middle (Transitory)**	**Late (Specific)**
Relationship of Public to Private Demand	Path-finding (far in advance of private demand)	Pace-setting (higher requirements than private demand)	Differentiation but possible comple-mentarity
Reasons for Public Intervention	Mission critical (solving urgent problems)	Own account (improving standard solutions)	Mission critical (fostering new alternatives)
Type of Innovative Activity	Direct demand pull (on a 'new' product market)	Indirect demand pull (on commercial application)	Supply push (to new commercial markets)
Characteristic Modalities	Long-term contracting	Dual or multiple sourcing	Technological Neutrality

In *co-operative* public technology procurement (Table 4), one of the main historical motivations has been to revitalize declining commercial 'spin-off' from mission-oriented direct procurement of innovation, especially in late-stage technology development (Brody 1996; Fukasaku 1999). Aggregation of public and private demand to stimulate private sector innovation is an important rationale for cooperative procurement. This is often primarily a public sector effort in *early stages*, where public procurement typically leads an emerging market, and not only 'critical mass' but also infrastructure is important. US Government procurement of Alternative Fuelled Vehicles (AFVs) has responded to perceived threats to fossil fuel supplies through coordinating targeted acquisitions by several government departments of fleet vehicles with alternative power sources and cooperating with other levels of government to develop supporting infrastructures (The Advanced Battery Consortium

and the Partnership for a New Generation of Vehicles, cited in Cave & Frinking 2003: 37). Eventually, private sector organizations and individuals, as well as public sector organizations other than the initial public procurers will become buyers and users of these vehicles. In *middle stage* technology and industry development, relations between public and private demand shift from creating initial markets to providing introductions to new market segments, via 'show-case' demonstrations and identification of 'best practice' models acquainting private sector buyers and producers with new criteria for purchasing and product design. Public sector procurement typically fosters producer innovation by rewarding high performance, and requires special forms of cooperation with both producer industries and capital markets. In Denmark, all public agencies are required to consider environmental issues and energy efficiency in all procurement activities. The Environmental Protection Agency (EPA) assists with documenting these considerations in public procurement plans. The objective is to boost and stimulate markets for environmentally friendly products, and to develop broader markets of both private- and public-sector buyers. (Cave & Frinking 2003: 28)

In *late-stage* cooperative technology procurement, public demand progresses from 'demonstrating' new or alternative technologies and introducing them to new market segments to promoting them actively across a range of market segments. Here, public sector demand provides a large 'launching market'. Innovative activity typically entailös developing and defining product standards. In this connection, 'producer domination' typical of technologies and industries in late stages of development can be counteracted through standards development processes that insure wide user inclusion and lead to systematic articulation of functional requirements. These, in turn, provide a basis for approved purchasing lists, labelling, and endorsement of performance assessment. Such practices are exemplified in the listing of "best practice" products by the USA's Federal Procurement Challenge, which aims at private market development. Here, the public sector acts as a 'leading consumer', and its market power is directed not towards short term price reduction but rather towards incentives for innovation and levels of demand that will eventually sustain lower prices. (Cave & Frinking 2003: 30 - 31)

TABLE 4

Cooperative Procurement

COOPERATIVE PROCUREMENT			
Modes of Interaction / Design Aspects	**Phases of Technology and Market Evolution**		
	Early (Fluid)	**Middle (Transitory)**	**Late (Specific)**
Relationship of Public to Private Demand	Leadership of an emerging market	Introduction to new market segments	Sponsorship/ promotion across market segments
Reasons for Public Intervention	Demand aggregation via concertation (mainly) within public sector	Demand aggregation via 'show-case' models & 'best practice' criteria	Demand aggregation via large, mandated 'launching markets'
Type of Innovative Activity	Achieving initial critical mass in new/alternative technologies	Introducing new decision criteria to suppliers & buyers.	Influencing product standards to ensure wide user inclusion
Characteristic Modalities	Directed purchasing and development of essential supporting infrastructure	Co-operation with industry and financiers; performance rewards	Purchasing, labelling and endorsement based on functional criteria.

In *catalytic* public technology procurement (Table 5), public sector organizations that act as buyers are not intended end-users. Intervention is, therefore, 'on behalf of others', and public demand articulates, sponsors, and helps to shape private demand. *Early-stage* innovative activity focuses on investigating private demand to inform dialogue with producers. The main operational mode is to formulate functional requirements based on user contexts. Sweden's Commission on

Environmental Technology stimulates and facilitates procurement of sustainable technologies in collaboration with users. It formulates functional specifications for environmental products to create new products, processes, and technologies. Here, the procurer does not obtain anything, but potentially contributes to creating new markets. (Cave & Frinking 2003: 41 - 42) One important offshoot in Sweden has been NUTEK's Design for Environment (DFE) programme to support specific product development projects in SME-based networks (NUTEK 2006). In *middle-stage* catalytic technology procurement programmes like DFE, public demand promotes private market acceptance through pilot projects and evaluations. Innovative activity concentrates on matching user and producer 'searches' through collaborative experiments, and characteristic modes of intervention are 'design contests', trials, demonstrations, and dissemination. Such measures are exemplified by activities of the OECD-sponsored International Energy Agency (IEA), which coordinates collaborative research, development, and demonstration of new environmentally friendly energy technologies. IEA conducts collaborative procurement actions to introduce innovative, energy-efficient, products that have not yet reached the marketplace. A leading example of the kinds of measures discussed here would be IEA's "DSM Awards of Excellence", where companies were challenged to develop technology meeting environmentally friendly and/or energy saving criteria. (International Energy Agency 2000)

In *late-stage* industry and technology development, catalytic technology procurement is less concerned with creating or stimulating private demand than with focusing it. This is usually accomplished by ensuring that products meet or surpass essential requirements and promoting those that do. Thus, innovative activity by procuring agencies typically takes the form of setting performance standards and testing for product approval, and key modes of intervention include labelling and official endorsement, as well as subsidies to private consumers – or, possibly, regulatory requirements that only products meeting certain standards can be used. Labelling, whereby procuring organizations introduce standards into mature markets on behalf of end-users and also reflecting consumer preferences, is widespread internationally. The USA's Federal Procurement Challenge supports "best-practice" energy-efficient, renewable, and water-conserving products by assigning the "Energy Star" to products that meet recommended performance levels (Cave & Frinking 2003: 26). In Sweden, there is a similar practice of labelling environmentally friendly products with the "Krav" label. Any product

bearing this symbol must live up to certain standards concerning environment, animal husbandry, health, and social responsibility (KRAV 2004). Where performance standards or criteria employed are functionally defined, they provide producers with considerable latitude for innovation in designing products and production processes.

TABLE 5

CATALYTIC PUBLIC PROCUREMENT

CATALYTIC PUBLIC PROCUREMENT			
Modes of Interaction / Design Aspects	**Phases of Technology and Market Evolution**		
	Early (Fluid)	**Middle (Transitory)**	**Late (Specific)**
Relationship of Public to Private Demand	Defining and representing private demand	Promoting private market acceptance	Focussing expression of existing private demand
Reasons for Public Intervention	On behalf of others, by initiating and mediating dialogue between end-users and producers.	On behalf of others, by soliciting, piloting and evaluating new solutions addressing user needs	On behalf of others, by ensuring that products meet or surpass essential requirements
Type of Innovative Activity	Investigating and articulating private demand	Matching user and producer 'searches' via collaboration and trials.	Performance standards and testing for product approval
Characteristic Modalities	Formulation of essential functional requirements based on user contexts	Design contests and trials; demonstration and dissemination.	Labelling and official endorse-ment; subsidies to private consumers.

RESULTS

In this section, we discuss results from exploratory case study research related to the taxonomy. Empirical research for the case studies presented here was conducted in 2004 and 2005 within the framework of two EU-funded research projects. One project, *Innovative Utilities*, included three in-depth case studies of 'innovation-friendly public procurement' in a key public utility sector, telecommunications, and a further three case studies of an important public service sector, healthcare. The other project, *Innovation and Public Procurement*, provided an additional eight case studies of the procurement of innovations by government and public sector organizations in a number of EU member states. Together, the two projects generated a total of 14 case studies covering eight EU member states, plus Norway. For analytical purposes, though, the number of cases was effectively reduced to 12 by treating the three healthcare cases from the *Innovative Utilities* project as a single complex case. The comparative analysis of these cases was based primarily on the six (or four) case studies conducted for the *Innovative Utilities* project, but case studies compiled for the *Innovation and Public Procurement* project were referred to verification. Case summaries and details of the analysis are documented in Section 4 of the *Innovative Utilities* project's 10th Deliverable report *Towards an Innovation-Friendly Public Procurement Framework in Europe* (Hommen 2005).

The case studies were exploratory investigations of successful public procurements of innovation. Data collection from interviews and documentary sources, including archival materials and secondary sources, was conducted according to the methodological procedures for descriptive case study research specified by Yin (1994). Analytically, the research followed the inductive or 'theory-building' strategy outlined by Eisenhardt (1989). Thus, we began by conducting a 'within-case' analysis for each case, focusing on the identification of the main problems encountered and the solutions that were applied to them. Subsequently, we conducted a 'cross-case' analysis that involved relating each of the cases to the composite set of problems and solutions that could be derived from all of the cases. The series of problems or issues elaborated by these procedures could be subdivided into three basic categories corresponding to different levels of analysis: Institutional and

Regulatory issues (macro-level), Inter-organizational issues (meso-level), and Organizational (or Intra-organizational) issues (micro-level). The analysis sought to identify alternative solutions to common problems, and also to indicate the conditions under which particular solutions might be most appropriate. In this connection, we employed the taxonomy presented above as a comparative framework that could be used, among other things, to assess the "generalizability" of both problems and solutions across different types of cases. The analysis therefore involved situating cases within the taxonomy, which provided a basis for what Eisenhardt (1989) refers to as "shaping hypotheses" about variation across cases.

In these respects, then, our analysis of case studies from the two research projects referred to above involved testing the taxonomy. It was not possible to determine how well the taxonomy accounted for variation along the horizontal axis of 'evolution', since without exception the various cases under investigation all corresponded to the middle-stage of technology and market development, involving the adaptation of existing technologies to new contexts of application. However, it was possible to examine variation along the vertical axis of 'interaction', since the cases provided examples of all three categories of direct, co-operative, and catalytic public technology procurement. Cross-case comparisons revealed that although some issues in innovative public technology procurement appeared to be evenly distributed and thus "universal", others were not. Some issues appeared to be more strongly associated with certain types than they were with others. These issues were those of external governance at macro-level, technological risk management at meso-level, and demand articulation at micro-level.

At the macro-level, *external governance* problems occurred mainly in co-operative procurement, though not exclusively. However, there were stronger requirements for effective regulation of inter-organizational conflict in co-operative procurement. These cases were large-scale projects involving multiple government or public-sector organizations, and also had serious implications for wide ranges of stakeholder groups. The findings indicated that there may be a higher incidence of external governance problems in inter-governmental projects, since they require cooperation and coordination among organizations with possibly conflicting agendas. As shown in one case, powerful government departments that are not represented within inter-governmental projects

can still demand to have input into governmental decision processes. In such instances, effective backing from and communication with higher-level decision-makers may be essential to securing positive outcomes. Another observation was that national regulatory frameworks can require projects to avoid resistance from key stakeholders – e.g., unions opposed to workforce reductions – by, e.g., adopting goals acceptable to them.

Technological risk management was a meso-level issue that had an especially high profile in cases of co-operative procurement. We observed that technological risk *per se* also posed a serious problem in other types of project, suggesting that the causes of technological risk may be related primarily to uncertainty arising out of a lack of technological competence or the complexity of a given technology, rather than the type of societal need addressed or the kind of demand structure involved. However, our findings indicated that there may be greater potential for mismanagement of technological risk, due to poorly defined managerial responsibilities and procedures, in co-operative procurement. Our set of 'verification' cases supported this proposition, indicating that failures to assess risks properly could be directly attributed to lack of effective coordination and an ambiguous division of labour among multiple buyer organizations. One case also showed that risk management problems could be overcome by, among other things, centralizing legal and administrative functions and expertise.

At the micro-level, *articulation of demand,* requiring both the competence to define appropriate specifications and the exercise of sufficient market power to influence suppliers and other key actors, constituted a serious problem in cases of both cooperative and catalytic procurement, but not in cases of direct procurement. One explanation concerns the involvement of multiple buyer organizations in both cooperative and catalytic procurement. This condition contributes to greater severity of scheduling and co-ordination requirements, since it requires more complex patterns of interaction and more complicated processes of interactive learning among buyers than in direct procurement. All of these cases demonstrated the importance of market power. The chief difficulty encountered was that of developing, mobilizing, and coordinating competence among multiple buyers. Key solutions included 'pooling' technical expertise, elaborating effective structures and routines for integrative knowledge management, and

relying upon ‘performance standards’ to place the burden of innovation squarely on suppliers.

DISCUSSION

In this article we have proposed and elaborated a taxonomy of innovative public technology procurement, meant both to guide research in this area and to inform strategies for the public procurement of innovations, including the design of policies and programmes. In the foregoing section, we have presented the results of exploratory case studies carried out in conjunction with the development of the taxonomy. In this section, we briefly discuss implications of our findings for theory, practice, and future research.

As stated, the case studies provided only a partial test of the taxonomy, since the selection of cases only permitted the examination of variation along one of two dimensions – i.e., the taxonomy’s vertical axis of ‘modes of interaction’. Lacking parallel sets of cases providing the same coverage of the early and late stages as we have obtained for the middle or ‘adaptation’ stage of technology and market development, we remain unable to address the taxonomy’s horizontal axis of ‘phases of evolution’. Moreover, since case studies can generate only indicative findings, even those conclusions that can be drawn from our research are at best propositions that require further empirical testing.

Notwithstanding these limitations, the case study results reported above indicate that the taxonomy makes useful distinctions among ‘direct’, ‘co-operative’ and ‘catalytic’ modes of interaction in innovative public technology procurement. These categories are not only fruitful at several levels of institutional and organizational analysis, but also practically relevant for the planning and execution of innovative public technology procurement. In particular, our case studies indicate that co-operative technology procurement is especially problematic, compared to other types, in terms of external governance, the management of technological risk, and the articulation of demand. The last-mentioned issue may also be a serious obstacle to the success of catalytic technology procurement projects where multiple buyers are involved. Consequently, the design of multiple-buyer projects should, in selecting modalities (Cave and

Frinking 2003: 12 – 14), pay special attention to stakeholder relations, the structure and operation of project teams in relation to risk and knowledge management, and the definition of product specifications. In addition, our case study findings have important implications beyond the project level. One strategic implication is that innovative public technology procurement programmes involving series of projects that include more than one mode of interaction should not assume that 'what works' in direct procurement projects will also work in co-operative and catalytic procurement projects – especially with regard to the issues addressed above.

We have noted that the taxonomy's distinctions among 'modes of interaction' did not account for variation with respect to some problems or issues, which might be 'universal' to innovative public technology procurement projects of all types. However, it may be premature to suggest that these problems are evenly distributed across all types, or that the taxonomy as a whole may be unable to account for the actual pattern of distribution. As mentioned, we have yet to explore the horizontal axis of 'phases of evolution'. Technological risk, for example, appears on the basis of the evidence discussed here to be a possibly 'universal' issue. However, we have investigated only cases corresponding to the middle or 'adaptation' stage of innovative public technology procurement, and the taxonomy suggests that much higher levels of risk could be encountered at both the early and late stages of market and technology development. As this example indicates, much more empirical research will be required in order to provide an adequate basis for testing the entire taxonomy, despite positive initial results.

Of course, particular typologies and taxonomies are always useful for certain kinds of purposes and not others. We do not suggest that the taxonomy outlined here can potentially provide explanations and solutions for any and all problems that might be encountered in the design and implementation of innovative public technology procurement policies and programmes. Important factors or variables that are not taken into account by the taxonomy include project scale (or size), technological complexity, the pace of technological change within a given market context, and regulatory bottlenecks such as those recently addressed by the recent EC report on *Pre-commercial Procurement of Innovation* (National IST Research Directors Forum 2006). We therefore recommend that the taxonomy presented in this article should not be

used on an exclusive basis for designing and executing innovative public technology procurement policies and programmes. Rather, it should be used in combination with other relevant frameworks, such as Stock and Tatikonda's (2000) ITT typology, which is particularly well suited to matching technology and organization at the project level. Other useful frameworks and sources of guidance include both recent EC reports (e.g., Edler et al. 2005; Georghiou and Cave 2005) and guidelines published by national authorities (e.g., OGC 2004).

ACKNOWLEDGEMENTS

The authors thank Olof Ejermo, Thomas Kaiserfeld, Annika Rickne, and Charles Edquist for comments on earlier drafts of this manuscript. The usual disclaimers apply.

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Paper II

The Utilities Directive and How it Might Affect Innovation: The Case of Innovative Procurement of Maritime Radio Technology

Max Rolfstam*

LT EC law; Public procurement; Utilities

1. Introduction†

In European policy-making, the perception of public procurement has changed rather dramatically the last 10 years or so. Traditionally, the European public procurement policy discourse addressed issues related to the basic foundations of the European Community, i.e. competition, avoiding corruption through increasing transparency, creating a common European market and preventing inefficient public spending.[1] In 2005, public authorities were described as "big market players" which "have powerful means to stimulate private investment in research and innovation" in order to reassure economic growth, facing global competition.[2] Also the Council of the European Union recommended that Member States should (among other things) focus on "encouraging public procurement of innovative products and services".[3]

In principle, all public procurement must comply with the EC Directives on Public Procurement. The recent developments outlined above provide one explanation why public procurement law, "has moved from relative obscurity to become a subject of great legal importance".[4] There is a clear need to understand how compliancy with these Directives may affect the possibilities for public agencies to procure innovation. This paper aims to contribute to this understanding by reporting from a case where Telenor A/S, the former state-owned telecom agency in Norway, acting as a public agency under the Directives on Public Procurement, procured a new system for maritime radio communication. The research objective in this paper is to study how the EC Directives affected the possibilities for this public agency to procure innovation. This is informed by innovation and design

* Lund University Sweden.

† The current paper reports from research carried out under supervision from and collaboration with Leif Hommen in the Inno-utilities project funded by the European Commission. Acknowledged are also comments made on an earlier drafts of the paper by Thomas Kaiserfeld, Franciszek Siedlok, Bent Dalum, and two anonymous reviewers.

[1] *Public procurement in the European Union.* Communication from the Commission. COM (1998) 143 final.

[2] *Implementing the Community Lisbon Programme: more research and innovation—investing for growth and employment: a common approach*. Communication from the Commission. COM (2005) 488, p.8.

[3] Council Recommendation 2005/601 on the broad guidelines for the economic policies of the Member States and the Community (2005 to 2008), p.6.

[4] S. Arrowsmith, *The Law of Public and Utilities Procurement* (Sweet & Maxwell, 2005), p.IV.

theory, where public procurement is seen as a special case of innovation and a design process, as will be developed in section 3.

The Directive that was applied in this case was the Utilities Directive 93/38, regulating entities operating in the water, energy, transport and telecommunications sectors. On May 1, 2004 the new Utilities Directive 2004/17 was adopted to replace the old one.[5] At the same time was also adopted a new Directive for the classic or public sector, Directive 2004/18. Telenor, today a private company, was at the time a public undertaking,[6] procuring technology for the provision of telecommunication services to be used on a market where they had a monopoly, the maritime radio network in Norway. The procurement procedure applied was the negotiated procedure with a contract notice. It should be noted here, that although Norway is not a member of the European Union, it has accepted to comply with the same procurement rules through its participation in the EFTA Agreement [7] and its membership in the European Economic Area (EEA).[8]

2. Background

The increasing interest for innovative public procurement can be traced back to the Lisbon European Council where the goal was set, ''to become the most competitive and dynamic knowledge-based economy in the world'' as a response to the perceived challenges in a knowledge-driven globalising economy.[9] Later, the European Commission concluded that, ''a stronger European impulse is needed'' to achieve the Lisbon goal.[10] In order to do this, the European Commission stated that:

> ''[T]he European Council should endorse action to: - strengthen the European area of research and innovation by setting a target of 3 per cent of GDP for the overall level of public and private spending on research and development by the end of the decade.''[11]

In 2003, research was carried out for the European Commission based on the perception that the targets initiated at the Lisbon Council will not be met without support from governments and the European Commission. This research emphasised (among other things) the importance of the right mix of different policies adapted to a given context. Among the measures listed was public technology procurement. It was also concluded that:

> ''[P]olicy instruments which attempts to link supply with demand have been relatively neglected . . . despite the fact that public technology procurement entailing a measure of R&D is the largest potential source of the financial resources needed to meet the Barcelona target. Public

[5] S. Arrowsmith, ''An assessment of the New Legislative Package on Public Procurement'' [2004] C.M.L. Rev. 1277.
[6] Directive 93/38 Art.2.
[7] EFTA, *Overview of the Vaduz Convention* (2006), *http://secretariat.efta.int/Web/EFTAConvention/AboutTheConvention/OverviewOfTheVaduzConvention/view*
[8] K. Weltzien, ''Avoiding the Procurement Rules by Awarding Contracts to an In-House Entity: the Scope of the Procurement Directives in the Classical Sector'' (2005) 14 P.P.L.R. 237, 238.
[9] Presidency Conclusions, Lisbon European Council, March 23 and 24, 2000. *www.uniovi.es/EEES/attachs/1080547066-1-PRESIDENCY_CONCLUSIONS_Lissabon.pdf* (April 1, 2005).
[10] *The Lisbon strategy—making things happen.* Communication from the Commission. COM (2002) 14, p.23.
[11] *ibid.*, p.24.

> authorities should be encouraged to be less risk-averse and take steps to increase the amounts of R&D associated with procurement decisions.''[12]

In 2003, the European commission also concluded that public procurement, ''is a leading or major component of demand in a number of sectors . . . where the public sector can act as a launching customer'',[13] and noted that:

> ''[A]n important objective is to raise public buyers' awareness of the possibilities offered to them by the legislative framework, and to support the development and diffusion of information enabling them to make full and correct use of these possibilities.''[14]

Public procurement can be ''a very seductive political tool'',[15] used for many purposes,[16] and is as such far from a new phenomenon.[17] Public technology procurement has been regarded as a policy instrument to address ''specific societal needs unlikely to be met by the market'',[18] but also, and therefore, a topic that invites for a debate on the balance between industrial policy goals and principles of openness and free competition.[19]

The innovation literature suggests that public procurement *can* be used as an instrument to stimulate innovation. Public agencies can act as competent technology procurers and play a significant role in creating multinational firms.[20] In the case of the development of the telecom sector in the Nordic countries, some authors have used the notion of development pairs to capture the multiplex long term relations such as those that existed between Ericsson and Nokia and their respective national public telecom operators.[21] In fact, both Nokia and Ericsson were exposed to public agencies that actually insisted on that technical development in certain areas should be carried out, whereas the corresponding private counterpart hesitated.[22] A similar ''public agency push'' effect has also been described in the relationship between, e.g. the Swedish public agency Vattenfall and its private counterpart Asea in the development of high voltage transformers in the mid 1950s.[23] Sometimes, however, innovative public procurement projects do not lead to the success initially intended.[24]

[12] European Commission, *Raising the EU R&D intensity—improving the effectiveness of the mix of public support mechanisms for private sector research and development* (2003).
[13] *Investing in research: an action plan for Europe*. Communication from the Commission. COM (2003) 226, p.20.
[14] *ibid*.
[15] J. Arnould, ''Secondary Policies in Public Procurement: the Innovations of the New Directives'' (2004) 13 P.P.L.R. 187.
[16] J.F. Martin, *The EC Public Procurement Rules: A critical Analysis* (Oxford: Clarendon Press, 1996).
[17] C. McCrudden, ''Using Public Procurement to Achieve Social Outcomes'' (2004) 28 *Natural Resources Forum* 257.
[18] C. Edquist and L. Hommen, ''Public Technology Procurement and Innovation Theory'', in Edquist *et al* (eds), *Public Technology Procurement and Innovation*, p.5.
[19] S. Kahn, ''Problems of Industrial Policy in High-Technology Collaborative Procurement'' in S. Arrowsmith and A. Davies (eds), *Public Procurement: Global Revolution* (London, The Hague, Boston: Kluwer Law International, 1998).
[20] C. Palmberg, ''Technical Systems and Competent Procurers—the Transformation of Nokia and the Finnish Telecom Industry Revisited?'' (2002) 26 *Telecommunications Policy* 129.
[21] This term was coined by Fridlund and defined as, ''a long-term relation between an industrial manufacturing firm and one of its major public customers related to their co-development of several new technologies''. M. Fridlund, *Den gemensamma utvecklingen Staten, storföretaget och samarbetet kring den svenska elkraftteknikken* (1999) (authors translation from Swedish).
[22] C. Bergren, and S. Laestadius, ''Co-development and Composite Clusters—the Secular Strength of Nordic Telecommunications'' (2003) 12 *Industrial and Corporate Change* 91.
[23] M. Fridlund, *Den gemensamma utvecklingen Staten, storföretaget och samarbetet kring den svenska elkraftteknikken* (1999).
[24] T. Kaiserfeld, ''A Case Study of the Swedish Public Technology Procurement Project 'The Computer in the School' (COMPIS), 1981–1988'' in C. Edquist, L. Hommenand L. Tsipouri (eds), *Public Technology Procurement and Innovation* (2000).

Several writers also acknowledge public procurement as one of many different policy options that may stimulate innovation.[25]

Public procurement is regulated by the EC Directives on Public Procurement, transposed into national legislation. Member States should themselves implement any regulations that concern them in the way they find most appropriate. In Sweden for instance, the Directives on public procurement has since the Swedish membership in the European Union been implemented by amendments in the Act on Public Procurement, *Lagen om offentlig upphandling*.[26] Denmark has chosen to directly incorporate the Directives *telles quelles*, i.e. without further adoption of the text. Although not formally being a Member State of the European Union, Norway has made the commitment to comply with the EC Directives through the EFTA Convention.[27] In practice, this means that public procurement must be carried out in compliance with the Public Procurement Directives. Although there are some national variations, for instance regarding procurement below certain threshold values, the principle institutional set-up is the same, i.e. they follow the EC Public Procurement Directives. Briefly, this means that the public procurer is required to advertise new contracts Europe-wide; to hold a competition between interested firms to determine the winner of the contract; to exclude firms with lack of financial or technical capacity; to respect minimum time limits to ensure that all interested firms have time to participate; award the contract based on criteria notified in advance; and provide information on the decisions made.[28]

The Directives co-ordinating public procurement have evolved since the first versions adopted in the 1970s. In the 1980s, as reported by research at the time, governments had adopted protectionist procurement policies; it was also perceived that preferential public procurement had led to inefficiencies; and that significant economies would accrue from a competitive EC-wide single market.[29] The aim with the Directives was to remove these prevailing barriers to trade in public procurement practices. Through the adoption of these rules, the best bid, regardless of origin in the Union, would be awarded a contract tendered for.

The intention was initially to exclude the utilities sector from co-ordination because those activities were in some Member States provided by public organisations, while in others by private firms. As it turned out, the utilities sector eventually became regulated, but with less stringent rules than for the classic sector.[30] These rules also regulated private firms operating in the utilities sector on the basis of "special or exclusive rights granted by a competent authority".[31]

The Public Procurement Directives in force at the time for the procurement project studied here were the Works Directive 93/37, the Supply Directive 93/36, the Service Utilities Directive

[25] See, e.g. R. Rothwell, "Creating a Regional Innovation-oriented Infrastructure: the Role of Public Procurement" paper submitted to the Conference on Public Procurement and Regional Policy, University of Neuchâtel (November 1, 1983); H. Westling, *Technology Procurement for Innovation in Swedish Construction* (Stockholm: Swedish Council for Building Research, 1991), D17; European Commission, *Raising the EU R&D intensity—improving the effectiveness of the mix of public support mechanisms for private sector research and development*. (2003)

[26] The Swedish Act on Public Procurement (SFS 1992: 1528).

[27] EFTA, *Overview of the Vaduz Convention http://secretariat.efta.int/Web/EFTAConvention/AboutTheConvention/OverviewOfTheVaduzConvention/view* (2006).

[28] S. Arrowsmith, *The Law of Public and Utilities Procurement* (London: Sweet & Maxwell, 2005), p.127.

[29] M.R.H. Uttley and K. Hartley, "Public Procurement in the Single European Market: Policy and Prospects" (1994) 94 *European Business Review* 2. See also S. Arrowsmith, *The Law of Public and Utilities Procurement* (London: Sweet & Maxwell, 2005), pp.120–125.

[30] P. Green, "The Utilities Directive 93/38: the Extent to which it Applies to Contracting Entities" (1994) 3 P.P.L.R. 173.

[31] Directive 93/38 Art.2b.

92/50 and the Utilities Directive 93/38.[32] The last was applied in this case. As mentioned above, in February 2004, two new Directives were adopted to replace the old regime, Directive 2004/18 (covering works, supply and utilities contracts) and Directive 2004/17 (covering utilities contracts).[33]

A central element of the Directives is the specification of procurement procedures a public procurer can apply to award a contract. The procedures specified in the old Utilities Directives 93/38 are the open procedure, the restricted procedure, the negotiated procedure and the design contest. The negotiated procedure, as was used in the case studied here, remains in both the new Directives.[34] The new Directives for the classical sector also include a new procedure, the competitive dialogue, developed for allowing more flexibility for complex contracts.[35] The competitive dialogue has not however, been included in the new Utilities Directives, "since utilities already enjoy free recourse to the flexible negotiated procedure with competition".[36] This means that within the new Utilities Directive, the most flexible and innovation-friendly procedure is still the negotiated procedure.[37]

In the literature,[38] as well as among practitioners, a concern has been raised derived from the tension between the perceived interactive characteristics of innovative procurement and the implicit assumptions built into the Public Procurement Directives, that the possibilities for public agencies to procure innovations may be limited.[39] The main purpose of this paper is to study this lack of strategic concern in relation to public procurement, as reflected in how the legal framework may affect the possibilities for public procurement of innovations.[40]

This is carried out through a case study of an innovative public procurement project—the procurement of a new maritime radio system in Norway. In this case, the procurement project was carried out by Telenor A/S, from the beginning Norway's public telecom agency. In many respects this procurement project was a success. Broadly formulated, this paper tries to discuss whether the public procurers were affected by the formal institutional framework and if it in any way affected or even reduced the possibilities to procure innovation. It also tries to capture some positive experiences from the case that may be useful knowledge for future innovative procurement projects.

In order to pursue this goal certain accounts of design theory and innovation theory are used as the theoretical point of departure for the understanding of the act of innovative public procurement. Propositions derived from this will be elaborated on in relation to the institutional setting, i.e. the EC Public Procurement Directives and through the report of a case study of an innovative public procurement project. Some brief remarks conclude the paper.

[32] See, e.g. S. Arrowsmith, "An assessment of the New Legislative Package on Public Procurement" [2004] C.M.L. Rev. 1277, 1278.
[33] See, e.g. R. Williams, "The New Procurement Directives of the European Union" (2004) 13 P.P.L.R. 13.
[34] Williams, cited above.
[35] S. Arrowsmith, "An Assessment of the New Legislative Package on Public Procurement" [2004] C.M.L. Rev. 1277.
[36] *ibid.*, p.1280.
[37] See also section 3 of this article.
[38] See, e.g. M. Rolfstam, "Public Technology Procurement as a Demand-side Innovation Policy Instrument—an Overview of Recent Literature and Events", DRUID Academy Winter 2005 PhD Conference: Industrial Evolution and Dynamics, Skørping, Denmark, January 27–29, 2005.
[39] C. Edquist, L. Hommen and L. Tsipouri (eds), *Public Technology Procurement and Innovation* (2000).
[40] *ibid.*, p.17.

3. Public procurement as design and innovation

Public procurement involves a procurer, i.e. a person or organisation with a specified need. The ultimate goal of the procurement process is to find a supplier that compensated with a certain amount of money will satisfy that need. The significant feature of innovative public procurement is that the satisfying item, i.e. the procured service or good, at least partly is created after the agreement between procurer and supplier has been made. This implies also that at least parts or aspects of the procured item are initially unknown. This in turn, creates certain characteristics that distinguish innovative public procurement from regular procurement, i.e. procurement of standard products where most aspects are known. These characteristics are discussed in the following.

3.1. Interaction, limiting factors and goals

From an innovation theoretical point of view, innovative public procurement would be seen as a special case of innovation, i.e. as, ''the search for, and the discovery, experimentation, development, imitation, and adoption of new products, new production processes and new organizational set-ups''.[41] In general, innovation, ''is a ubiquitous process going on almost everywhere, and almost all the time'', and, in a modern society ''characterised by a highly developed, vertical division of labour''.[42] This suggest that innovation is by no means a linear process, but a process where interactive learning and user-producer interaction takes place and almost never does this happen in isolation.[43] Put somewhat crudely, this is the same as suggesting that innovation, in most cases, presupposes interaction between innovating actors. Furthermore, the innovation literature also emphasises that the central activity in innovation is learning and that, ''learning is a social activity, which involves interaction between people''.[44]

Design theorists would understand innovative public procurement as a learning process driven by a vision towards a solution.[45] The initial perception of the design task is determined by the designer's ideals and thought figures, i.e. the designer's knowing or reasoning. To objectify the vision the designer develops an operative image from the vision. This is the result from the ''negotiating'' mediated by the designers thought figures between his perception of the design situation and his vision. The vision, so to speak, leads the development of an operative image, in the same time as it is affected by it. At some point in time the development of the operative image becomes established as the design suggestion, i.e. some kind of artefact.[46] It is a reflexive process where:

> ''the solution' does not arise directly from 'the problem'; the designers' attention oscillates, or commutes, between the two, and an understanding of both gradually develops . . .'' [47]

[41] G. Dosi, ''The Nature of the Innovative Process'' in G. Dosi *et al* (eds), *Technical Change and Economic Theory* (1988), p.222.

[42] B.-Å. Lundvall (ed), *National Systems of Innovation: Towards a Theory of Innovation and Interactive Learning* (1992), p.49.

[43] E. von Hippel, *The Sources of Innovation* (OUP, 1988). C. Edquist (ed), *Systems of Innovation Technologies, Institutions and Organizations* (1997).

[44] B.-Å. Lundvall (ed), *National Systems of Innovation*, above fn.42, p.2.

[45] E. Stolterman, *Designarbetes Dolda Rationalitet—En studie om metodik och praktik inom systemutveckling* (Doctoral dissertation, Department of Information Processing, Umeå University, 1991).

[46] R. Arnheim, *Picasso's Guernica—the Genesis of a Painting* (University of California Press, 1962); M. Rolfstam, *Design as Handling and Reflecting or Errors* (Department of Informatics, Lund University, Master thesis, 2001).

[47] N. Cross, ''On Design Ability'' Proceedings of International Conference on Theories and Methods of Design, Gothenburg (1992), p.49.

The design process is however not a "free" process, but restricted by the designer's internal limiting factors. The internal limiting factors, the "variety reducers",[48] is an expression of the designers pre-existing, "understanding of instrumental sets and solution types . . ." or ". . . cognitive capabilities".[49]

Another restriction of the design process comes from external limiting factors. The external limiting factors are components of reality such as customers' demands, costs, the requirements to follow certain standards or norms of appearance, and law.[50] These institutions, both formal and informal, affect, and in most cases reduce, the designer's freedom of choice. Applied to this case, both innovation theory and design theory suggest that procurement law might have some effects on public procurement of innovations. At the same time, lessons learned from studies of these phenomena can be used by policy-makers to re-shape the institutions affecting innovation,[51] should it be necessary.

3.2. Implications on the procurement process

A general problem with the Directives in force at the time of the procurement project studied here, which was also taken into account when they where eventually modified,[52] was that they were complex and needed to be simplified and become more flexible.[53] The International Energy Agency (IEA), that has hosted an array of procurement projects involving new energy saving technology quite early called for, "clarifications in the existing public procurement rules, for example the EC directives, in order to facilitate procurement efforts within innovation purpose".[54] An analysis of the EC Directives on Public Procurement concluded that there is:

> "[A] considerable degree of tension between the EU procurement rules and the need to accommodate informal co-operation in the form of user/producer interaction related to technical change."[55]

A central point in their argumentation is the perception that the law in practice forbids the formation of development pairs.[56] It is, of course, still possible to set up tender calls for development of new technology but the informal interaction possibilities between a national "champion" and the public procurer are inhibited in the Directives. Furthermore, the control of who will actually win a contract is also in principle lost, as a contract must be awarded to the tender that best meets the specified award criteria. It should be noted that these effects are quite in line with the underlying neo-liberal policies on which the legislation is based; to prevent nationalistic, protected and (therefore) inefficient procurement and instead promote the creation of a common European market.[57]

[48] B. Hillier, J. Musgrove and P. O'Sullivan, "Knowledge and Design" in H. M. Proshansky *et al* (eds), *Environmental Psychology—People and their Physical Settings*, 2nd edn (Holt, Rinehart and Winston, 1976).
[49] *ibid.*, p.78.
[50] *ibid.*
[51] C. Edquist, L. Hommen and L. Tsipouri (eds), *Public Technology Procurement and Innovation* (2000), p.284.
[52] S. Arrowsmith, "An Assessment of the New Legislative Package on Public Procurement" [2004] C.M.L. Rev. 1277.
[53] R. Boyle, "EC Public Procurement Rules—a Purchaser Reflects on the Need for Simplification" (1994) 13 P.P.L.R. 101.
[54] International Energy Agency 2000, p.14.
[55] C. Edquist, L. Hommen and L. Tsipouri (eds), *Public Technology Procurement and Innovation* (2000), p.308.
[56] M. Fridlund, *Den gemensamma utvecklingen Staten, storföretaget och samarbetet kring den svenska elkrafttekniken* (1999).
[57] A. Cox and P. Furlong, "The Jury is Still out for Utilities Procurement: the Impact of the EU Procurement Directives on the Location of Utility Contract Awards in the 'Twelve' Member States" (1996) 5 P.P.L.R. 57.

The procurement procedure used may in general have implications on the possibilities for innovation. As mentioned, the procurement procedures given in the old Utilities Directive are the open, restricted and negotiated procedures.[58] Given the view of public procurement of innovations as described in section 3.1, the most relevant procedure for procuring innovation under the old Utilities Directive, would be the negotiated procedure. The main reason for this is that in the negotiated procedure:

> ''[T]he contracting entity consults suppliers, contractors or service providers of its choice and negotiates the terms of the contract with one or more of them.''[59]

In other words, this would be the procedure that to greatest extent allows interactive learning between supplier and procurer.

The requirement that a technical specification must be included in order to compete for a contract may also, in principle, be problematic.[60] It may be difficult to possess sufficient knowledge in an early stage of a project characterised as ''experimentation'' towards ''a solution that gradually develops''. Similarly, working with an innovative project may sometimes reveal new solutions to a problem, which given the already set specifications that cannot be changed, may be impossible to exploit. Although the use of functional specifications has recently been encouraged,[61] e.g. in the context of green procurement,[62] because, ''[f]ocussing on the outcome or functionality desired gives suppliers the opportunity to be innovative'',[63] it might still be problematic to propose radically and previously unproven solutions in an early state of a project.

Another problem that becomes visible from this evolutionary perception of the knowledge developed in the context of a project concerns the selection of the supplier.

4. Method

This section describes the process of selecting a case, how data were collected and how the interviews were carried out.

4.1. Case selection

Initially, a search was made for cases of innovative public procurement by telecom operators in Sweden, other Scandinavian countries and the United Kingdom in the Tenders Electronic Daily (TED) database. This online database is maintained by the European Commission (available at: *http://ted.europa.eu*) and contains all tender calls above threshold values published the last five years. The search engine available for this database allows the user to retrieve subsets of the database based on an array of different search criteria such as country, procurement procedure used, date, etc.

[58] Directive 93/38 Art.1(7).
[59] Directive 93/38 Art.1(7c).
[60] Directive 93/38 Art.18(1).
[61] A. J. van Weele, *Purchasing and Supply Chain Management: Analysis, Planning and Practice* (Cornwall: Thompson Learning, 2002), p.52.
[62] European Commission, *Buying Green! A handbook of green procurement,* Brussels, August 18, 2004. SEC (2004) 1050.
[63] Central Procurement Directorate, ''Procurement Guidance Note 04/04 Subject: Integrating environmental considerations into public procurement'' (*www.cpdni.gov.uk/pdf-environmental-notes.pdf*, 2004), p.12.

The search strategy used was to focus on cases of public procurement carried out by telecom operators and occurring in Sweden or nearby countries, and on cases representing instances of the so-called ''negotiated procedure'', since this procedure is most closely associated with innovation, as discussed in section 3.2.

One firm that appeared in the result set was Telenor. The maritime radio case eventually selected did however not appear in the result set, but was identified after interaction with employees at Telenor. It completely met the specifications as outlined in the previous paragraph. The reason why the case had not been found in the database was that the tender call was published earlier than the last five years.

4.2. Data collection

As the case was identified, different search strategies were used to collect data. Central here was the use of web-based resources in order to collect background information. Eventually, it was possible to identify key people who were involved in the project. These were people who participated in the project team; a public procurement expert, a technical expert who was also the project manager of the project and the director of Telenor Maritime Radio. Interviews have been done either on location in Oslo or via telephone. Other public procurement experts possessing general knowledge of public procurement were also interviewed.

Before the empirical work was carried out a case study protocol was developed and a document listing a set of questions.[64] The directions provided in these two documents have throughout the work been followed as far as has been practically possible.

4.30 The interviews

In general, case study interviews can be carried out with different degree 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 that were carried out here belong somewhere in between ''open-ended'' and ''focused'' on this continuum.[65] This meant that questions had been prepared in advance and it was expected that each interview would generate corresponding answers to these questions as far as possible. Still, the ambition was to carry out the interviews in an open-minded and conversational manner where also any additional information provided by the respondent apart from the pre-defined questions would be collected and taken into account in the analysis.

The questionnaire included different categories or sub-sets of questions. Some questions provided background information, and contact data for the respondent and his or her role in the procurement project. Information of the affiliated organisation and its general innovative behaviour and to what extent the specific system that was procured was innovative, was also collected.

Another category of questions tried to provide answers on how the procurement process was organised, what needs it tried to satisfy, and how the process proceeded. Yet another set of questions

[64] R.K Yin, *Case Study Research: Design and Methods* (London, New Delhi, Thousand Oaks: Sage Publications, 1994).
[65] *ibid.,* p. 84.

dealt with issues related to interactive learning, e.g. trying to capture what knowledge and skills were provided by the different actors. The respondents were also asked questions relating to the perception of the procurement law in general and also in what way it had affected or even prevented innovation in this particular procurement case.

4.4. Analysis

In this case study, the collected data was organised chronologically. Analytically, the case has been divided into two phases, the pre-procurement phase and the procurement phase. The pre-procurement phase is supposed to capture the events that took place from the time when ideas started to emerge and needs were identified while the procurement phase starts the day the tender call was published and in principle ends at the day of the final delivery of the procured good.

A central element of the analysis is the findings of interactive learning (as discussed in section 3) and in what ways the Public Procurement Directives affected possibilities for interactive learning to take place. This has been emphasised in both the pre-procurement phase and the procurement phase.

5. A maritime radio public procurement project

Starting with a general historical background of maritime radio technology and Telenor, this section describes the procurement project. It goes through the pre-procurement phase and the procurement phase as described in section 4.4. A central element in the pre-procurement phase is the emergence of and the process of defining a need for the procurement. A central element in the procurement phase is the process towards finding the supplier that best can satisfy the need.

5.1. A historical background of maritime radio and Telenor

1897, when the Italian scientist Guilelmo Marconi conducted experiments where radio signals were exchanged between two Italian warships can be seen as the starting point for modern maritime radio communication. Then followed institutionalisation for instance through establishing requirements of radio operator certificates and standardisation.

Partly in the aftermath of the Titanic disaster, a maritime safety conference held in 1914 resulted in the International Convention for the Safety of Life at Sea, SOLAS. This Convention is today maintained by the International Maritime Organisation (IMO), as an agency organised under the United Nations. The IMO manages several other Conventions, e.g. the 1978 International Convention on Standards of Training, Certification and Watch keeping for Seafarers (STCW), and the 1979 International Convention on Maritime Search and Rescue. In 1992 the implementation of the Global Maritime Distress and Safety System (GMDSS) was started. The GMDSS includes specifications and requirements for transmitting and receiving distress calls, and other safety devices such as the use of emergency position indicating radio beacons (EPIRP).[66]

Since the late 19th century, when maritime radio communication consisted of sparks put together according to Morse code, a tremendous development has taken place, in which innovation has been

[66] S. Isaksen, "Maritime Radio—from Marconi to GMDSS" (*www.maritimradio.no/english/engelsk3.htm*, 2003).

a central feature. This development is of course also the result of innovation in supporting or generic technologies such as space technologies and ICT, etc.

Modern terrestrial coast radio involves an array of services for the shipping trade, the fishing fleet and leisure crafts. Examples of such services are the transmission of navigational warnings six times a day (warnings about dangers in the area such as, e.g. beacons out of order); traffic list (informs if ships have incoming telephone calls); medical advice; weather forecasts; general radio monitoring; rescue co-ordination; transferring of radio calls (from vessels) to the telephone network.[67]

In Norway, these services are provided by a special branch of Telenor, Telenor Networks Maritime Radio. The radio services concerning safety are laid upon Telenor and financed by the Norwegian State. In addition to the services mentioned in the previous paragraph, this branch also manages licences through its Radio Licensing Department and executes inspections of equipment installed on board ships through the Radio Inspection Branch.[68] Telenor Maritime Radio has about 100 employees.

The historical roots of Telenor go as far back as 1855, when Telegrafverket (the telegraph agency later to become Televerket, the public telecom agency) established the first telegraph connection between the two cities Drammen and Christiania.[69] In the 1990s, the company was transformed from a public monopoly to a private company. In 1994 the public agency Televerket became a public company, Telenor, and in 2000 the company was introduced on the Oslo stock exchange.

The developments of the last decades have meant that the company has had to adapt to a competitive environment. Telenor today is active in an international market, in satellite communication, telecommunication and on the domestic market, internet technologies.[70] In the case studied here the EU public procurement regulations applied. Today, in principle, Telenor acts as any private company, i.e. without an obligation to comply with public procurement rules, except in cases where the procurement concerns activities that are, ''exclusive rights granted by a competent authority of a Member state''.[71]

5.2. The procurement project

The tender call for a supply contract that was eventually published, on equipment for Norwegian maritime radio communication, compromised the following items:

- Approximately 30 operator positions, equipped PC/terminals in a Windows based environment (standard office equipment).
- Digital switches (eight to nine) with direct access to the public ISDN network, and interconnected via WAN and audio network.

One of these switches was to be set up on each coastal radio station. The switches were to be used to mediate communication between sea (i.e. radio traffic) and land-based communication networks.

According to the tender document the system should support:

[67] Maritim radio, ''Generelle tjenester Kystradio'' (*www.maritimradio.no/generelt/1g-kystradio.htm*, 2005).
[68] Maritim radio, ''Telenor Networks Maritime Radio'' (*www.maritimradio.no/english/engelsk1.htm*, 2005).
[69] Maritim radio, ''Generelle tjenester Kystradio'' (*www.maritimradio.no/generelt/1g-kystradio.htm*, 2005).
[70] Maritim radio, ''Telenor Networks Maritime Radio'', above fn.68.
[71] Directive 93/38 Art.2(1b).

- distributed operational control of any radio channel to all coast radio stations within the network;
- radiotelephony on VHF, MF and HF, calls to/from PSTN;
- automatic connections to/from PSTN using DSC-signalling (VHF and MF/HF);
- send and receive text messages (telex, email);
- handling of Morse telegraphy on MF and HF;
- internet access towards coast stations and possible to/from ships;
- distress and safety recommendations, SOLAS-74 and SOLAS-88 from IMO, must be fulfilled;
- accompanying databases;
- multiplexing and compressing equipment for data and audio;
- installation of the equipment shall also be part of the delivery.

Here, the following statement is assumed to be valid, ''Innovations are commercially successful applications, based on new knowledge or new combinations of existing knowledge.'' Both these kinds of innovation can be found in the procurement project under scrutiny here, as will be discussed below.

This particular system which included an implementation of distributed operational control (DOC) had not been built or used before and were different than other systems installed elsewhere at the time. For instance, the company which finally became the supplier to Telenor, Frequentis GmbH, had previously delivered a coast radio system to Lyngby radio in Denmark although the Danish version was not as technologically sophisticated as the Norwegian system. The most evident innovative component of the new system (distinguishing it from the Danish system) concerned new flexible ways to operate the different radio stations located evenly all over Norway, through the use of DOC. In Denmark, the system consisted of only one station, Lyngby Radio, and thus there was not an obvious need for such features. Frequentis had however used the principles of distributed technology on one emergency response system procured for fire stations in Germany. They still needed two years of software development before the complete system was delivered.

One way to view the innovative aspects of a public technology procurement project is in terms of the organisational changes that may be prompted by it. Replacing the analogue system by the new digital technology developed in the project meant also changes related to the organisation. With the analogue technology used before the procurement project, all stations operated individually and separately served their own geographical area. Through the application of DOC, it became possible to provide and maintain these services from remote locations. Basically this meant that one station could ''take over'' operations from another station, as all the coast radio stations in Norway in practice became interconnected. With the new technology installed a small station can have one person on duty and if something happens that requires the engagement of several radio operators; the operator can be assisted by other stations; the neighbour station or the main station. It is also possible to temporarily close down a station for the weekend or the night, e.g. in low peak periods. Given some minor changes in the new system, it would actually, in principle, be possible to serve the entire Norwegian coast from one location.

In principle, these features have also made it possible to reduce the number of manned stations and thus the number of operators without jeopardising operations.

Another innovation concerned the automation of calls to land-based systems. Previously, these kinds of calls were handled manually by operators. When a ship needed to make a phone call to the

land-based network, they used to call the operator manually by using the VHF radio and order a telephone call, which was then administrated (and billed) by the operator. The new digital system automated this procedure. If the proper radio equipment is installed onboard, a ship can in principle dial the desired telephone number (and receive the bill) without interacting with an operator.

The means to achieve this mainly consisted of software development and to some extent, configuration of hardware components. The hardware used was, at least as far as the subject matter of this study is concerned, existing products. Frequentis had already from the beginning a switch upon which the solution was built, and standard personal computers were used as platforms for the operator work stations. In that sense, the innovation can also be described as new combinations of existing knowledge.

Still another characteristic of this project was integration. A variety of equipment exist on different ships. The customers of the services provided by the system include all kinds of vessels ranging between small leisure boats to commercial ships. The technology that needed to be supported included ''plain'' VHF radio, and in order to be able to communicate with parts of the Russian fishing fleet, even Morse code, as well as ''modern'' requirements as specified by, e.g. the GMDSS standard. This meant that a lot of effort had to be made on assuring that all these technical standards and specifications of interfaces were adequately implemented in the system.

5.3. Phases of the procurement project

Some important dates of the whole procurement project are displayed in the table below. Briefly the process can be summarised as follows:

Table 1: Important events in the innovative public procurement of radio equipment

Autumn 1997	Work on definition of needs and specification.
March 10, 1998	Tender call was published.
April 14, 1998	Submission deadline for requests to participate.
April 29, 1998	Request for quotation sent to qualified tenders.
May 19, 1998	Refusal letter to participants.
June 30, 1998	Deadline submission of bid.
July 15, 1999	Contract signed.
April 4, 2000	Final design review protocol.
End of 2002	System delivered.

The procurement process (as outlined in the table) started in the autumn of 1997 with preparation, and was published on March 10, 1998. April 14, 1998 was the deadline for submitting qualifying documents, references, etc. by interested tenders. After being reviewed by Telenor, qualified companies were sent an offer—the request for quotation, on April 29, 1998, i.e. the specification of the system to be procured. June 30, 1998 was the deadline for submission of complete tenders.

Then another process of selection followed, and eventually Telenor initiated negotiations with a small number of tenderers.[72] Eventually, Frequentis, today a multinational supplier of communications and information systems, was awarded a fixed price contract.

Roughly one year after the deadline of the submission of bids, on July 15, 1999, the contract was signed.

5.4. The pre-procurement phase

As was mentioned above, this study distinguishes between the pre-procurement phase and the procurement phase. Accordingly, this section covers the events that took place from the beginning and the initiation of the procurement project up to the point when the tender call was published.

5.4.1. The need for the procurement

In 1990, Telenor was prompted by the Norwegian State to introduce new technology that would make it possible to make rationalisations and reduce number of employees working at the coast radio stations. It was also demanded from the government that before such a rationalisation could take place, the technology to be implemented in order to achieve this, should have proven its capability. Also within Telenor Maritime Radio, ideas had been discussed on the possibilities that might be offered by the emerging new digital technologies. Actually, some features of the system in operation today, were discussed by Telenor Maritime Radio employees already in the early 1990s. There was also an interest motivated by commercial considerations for pursuing a procurement project devoted to the development of new technology.

The technology that at the time existed within the organisation was becoming inefficient, especially in the light of emerging digital technology that if procured would allow for the implementation of new services as well as automation of existing ones. It was also perceived that the new technology would offer flexibility in order to serve all Norwegian waters at all hours. The average age of the personnel manning the radio stations had exceeded 50. Retirements and sick leave could potentially jeopardise operations in the future. A system allowing operators located elsewhere to take over some or all radio traffic previously earmarked for the closest radio station, would reduce operational risk due to these workforce-related problems.

As Telenor was in the process of being transformed from being a public monopoly to become a company on a competitive market, the need for considering new ways of making money was also emphasised. Some of the services, those handling safety and distress calls, were and are still funded by the state. Other services were included in the procurement project for commercial reasons. Examples of such services to be offered by the new system were automatic connection of calls by radio to the public telephone network and transmitting of other forms of data such as email and telex.

5.4.2. A previous project

Some years before the procurement project under study here were initiated, another procurement process was carried out (around 1995) with the ambition to procure new technology for the coast radio stations. This early project seems to have played an important role in providing knowledge

[72] Information of the exact number of firms that got to the negotiation stage has not been possible to collect.

and experience that was contributing to the success of the second attempt under study here. A short description of this case follows.

The supplier that was contracted used the name Garex. This company had delivered the analogue radio system that was in operation at the time at Telenor Maritime Radio. The digital switch which Garex intended to use in the new solution, had also proven its ability in other areas, e.g. in providing radio communication solutions for airports. Another reason that may have played a role when Garex was awarded this contract was that Telenor owned parts of the company at the time.

This first project was running for two years. As the project developed it started to encounter some problems. Although some equipment was delivered and tested by Telenor, the development process was eventually terminated in 1998. The main reason for this was that it was concluded that the technology delivered by Garex would not be able to meet the specifications. In particular, the suggested solution failed to implement the DOC features that were central to the procurers.

In retrospect, it is possible to identify some experiences from the first attempt that seem to have been very useful. For instance were the specifications of the system too general. This generated several late changes and amendments in the design process. Too unstructured project communication ways eventually led to a situation where no one had control over the development of the system. The supplier that had been chosen had not delivered the same technology elsewhere before. Fairly late in the development, it was discovered that the technology intended for the implementation of the system was not capable of implementing the wanted DOC principle. All these problems in turn led to that the project demanded more time and used more monetary resources than what was initially expected.

It is not unlikely that these experiences exposed problems that the following procurement management could make sure to avoid the second time. It was also emphasised by the procurement manager of the second successful attempt, that, ''before appointing a supplier, we wanted to be sure that we had chosen one that would be able to deliver''. The experiences from the first procurement project also meant that technicians were quite clear in terms of technical requirements.

5.4.3. Defining needs and finding potential suppliers

The preparation of the procurement that eventually became successful started in the autumn of 1997. As was indicated above, the earlier experiences may have assisted this work, both in terms of knowledge about the system that was about to be procured as well as general procurement management skills.

In this stage, emphasis was placed not only on defining the needs, but also on how to define needs in an open, technologically neutral way. In general in Telenor, it is company policy to use as open specifications as possible in order to attain the highest number of tenders as possible, i.e. to stimulate competition and thus reduce cost. According to the interviews, this policy had been applied without a requirement to comply with the Procurement Directives.

In principle, the specification used in the procurement process was a functional specification.[73] This means that rather than specifying certain technologies and how functions should be implemented, the required function of the procured system was described. As the system involves communications between different standards and protocols, these interfaces were also described in the tender document.

[73] A. J. van Weele, *Purchasing and Supply Chain Management: Analysis, Planning and Practice*. (Cornwall: Thompson Learning, 2002), p.52.

This means that the tender document was functional where possible, but specific (according to the interface specifications as used by other interacting systems) when so required. Many questions from the procurer to tenders at later stages of the procurement process, served to make the tender show that all these interfaces were to be implemented in the system to be delivered.

By applying a functional design, it will ideally make room for innovation, on the supplier side. In this case, the possibilities for the supplier to suggest alternative solutions were restricted as the level of detail was very specific. It should be noted that the procurer had not described how the supplier should adjust their technological platforms or use their capabilities, in order to meet with the requirements. ''But we had described exactly what we wanted'' as the project manager put it.

The tender call was published on March 10, 1998.

5.5. The procurement phase

The publishing of the tender call marks the start of the second phase, i.e. the procurement phase, which will be discussed below.

5.5.1. Diversity and selection

In brief, the procurement process applied by Telenor in this case can be summarised as follows: initially, efforts were made to attract as many tenders as possible in order to establish competition and make sure that competent tenders were participating. Once gathered, these tenders then had to go through a qualifying process, where the strongest candidates remained, and those judged to be less competitive were excluded throughout the steps in the process.

Towards the end, Telenor started negotiations with a small number of tenders and eventually, the contract was awarded to the tender that was most competitive technically and economically. The supplier which finally was awarded the contract was an Austrian firm, Frequentis GmbH.

Prior to the publishing of the tender call, Telenor had surveyed the market globally for potential suppliers. Several intermediate organisations and sources were used for this purpose: the Japanese, as well as the American embassy, the Australian Trade Commission, countries' ''yellow pages'' telephone directories, and other public agencies using similar technologies. For instance (what was then called) the Swedish Civil Aviation Administration was consulted on this matter. When the tender call was published, Telenor notified the suppliers that had been identified in the pre-procurement process and also encouraged them to participate.

5.5.2. The first step in the qualifying process

The tender call listed a number of requirements, minimum standards that any bidder had to be able to demonstrate in order to qualify as a tender, and be allowed to take part in the specification documents. These requirements were as follows:

- The tenderer should be able to show a certificate of enrolment on the professional or trade register under the conditions laid down by the laws of the state in which (s)he is established and, where applicable, statement of the registers classification.
- The tenderer should also be able to show that (s)he had fulfilled obligations relating to the payment of social security and taxes in his country as well as providing appropriate statements from bankers, presentation of the undertakings balance sheets or extracts from balance sheets.

- Statements of the firms overall turnover in respect to the services/works/supplies to which the contract relates for the previous three financial years where also required.
- Details of technicians or technical services available, whether or not belonging directly to the undertaking, with special reference to quality-control arrangements.
- Samples, descriptions and/or photographs of the goods to be supplied
- Certificates drawn up by official quality control institutes or agencies.

A special requirement was also formalised:

- Documentation that the customer adapted equipment within switches and radio telecommunication has been delivered and functions satisfactorily at another customer, is required.

As specified in the tender call, these requirements (and the corresponding documents) were used to select those candidates that later would receive the invitation to tender.

From the beginning about 20 companies communicated their interest in the project. Fourteen companies eventually made a formal submission in order to become qualified as a tender and thus receive the complete specification. These companies represented an array of different countries either acting from branches located in Norway or from abroad. Six companies situated in Norway submitted. Of these two were domestic and four international acting from local branches, representing Finland, France, Germany and the United States. Participating nations represented by companies acting from abroad were Austria (one company), Denmark (two companies), Germany (one company), Italy (one company), Sweden (two companies), and Switzerland (one company). Of these 14 companies that made a formal response, 10 companies managed to become pre-qualified and were sent the complete tender specification. Of the 10 pre-qualified companies, five finally submitted a real proposal. Of these, not all companies finally submitted a proposal that was considered as a potential candidate for the contract. Eventually the companies that had been most successful in demonstrating their capabilities as well as understanding what Telenor wanted were invited to negotiations.

5.5.3. Negotiations

In the general case, Telenor, shortlisted two or three candidates for negotiations. The tenders who eventually ended up on the shortlist, offered solutions that required some further development before it was possible to install the actual system, but they also had in their possession the elements that they could base this development on.

The deadline for submitting a bid was in June 30, 1998 and the day when the contract was finally signed was July 15, 1999. This meant that, once the companies to negotiate with had been selected, roughly a year was spent on negotiation in order to finally select a winner of the contract.

The offer that initially seems to be the most advantageous offer does not always come out as the winner. One reason for this is the different pricing strategies applied in the tenders. Some tenderers build in room for negotiations in their price offerings, while others submit a price that is already from the beginning very close to the lowest they can possibly afford, i.e. with very little room for negotiation.

Another issue that may be revealed in the negotiation phase is related to technical aspects of the contract. One such issue concerns the level of complexity for solutions of problems that may be different among the tenders. One tender may, e.g. specify 100 lines of programme code to solve a certain problem while another tender requires 1,000 lines of code to solve the same problem. This

difference is also usually, at least to some extent evident in the pricing. As a rule, complicated solutions usually correlate with a higher price than other suggestions aiming for smoother solutions.

The reason for awarding the contract to Frequentis was that the company out-performed competitors in an array of aspects of the project, as summarised in the following:

- Date of delivery.
- Profitably.
- Technological assistance.
- Services after delivery.
- Price.
- Operation costs.
- Quality.
- Technical value.
- Aesthetical and functional values. In this case, this mostly concerned functional values.

In retrospect, it is noteworthy that already from the beginning Frequentis distinguished itself as compared to the other competitors, in terms of its ability to demonstrate a clear understanding of what Telenor wanted to buy. Several of the other tenderers had written offers where they revealed a lack of such understanding. Frequentis had at the time some key people who possessed technical knowledge and skills as well as abilities to understand their customer's needs; they demonstrated an interest in delivering what the customer asked for. Frequentis also wanted to move into this market for strategic reasons. Winning this contract would provide a springboard for such a move.

The negotiators on the procurer's side had to comply with an upper price limit of NOK 50 million, set by the management of Telenor. The total price for the system was not allowed to exceed this figure and still, the functional requirements had to be fulfilled. These two requirements were met in the agreement. The final price agreed upon was significantly lower than most of the competing tenderers had initially proposed.

5.5.4. Refining the functional specification

As was indicated in table 1, between the signing of the contract and the delivery, another document, the design specification, was produced by the supplier and accepted by the procurer, as noted in the final design review protocol. This meant that on April 4, 2000, i.e. some 10 months after the contract had been signed, Frequentis had arrived at a satisfactory and definite description of how the complete system should be implemented. The completion of the document marked the end of an intense period of interaction between the two actors. Over this period technical meetings were held every month either in Norway or in Austria and an array of emails were sent between the organisations.

The design specification suggested by Frequentis, had gone through several review cycles characterised by interactive learning leading up to an (initially) preliminary design specification that was evaluated by Telenor. The review of the version of the design specification that eventually was accepted took roughly two weeks. The final design review documents were received by Telenor on March 17, 2000.

Basically, the end result can be seen as the refined result of iterations of this cycle. In for example, the time period October 10 to December 12, 1999, there was a period characterised as, ''exchange of technical documents with short time limit''. This basically meant that Frequentis required information from Telenor, necessary to develop the final design specification. A preliminary

report dated December 17, 1999, concluded that some aspects of the design specifications were "not satisfactory", and prompted the supplier to come back with a more detailed description, which they ultimately were able to in the first day of April.

5.6. The delivery

The delivery of the system was set up in different steps, whereby each step had to be finished and delivered before commencing to the next step. On each step several tests were performed such as acceptance tests and functional test. When the delivery of each step was found to meet the requirement, payment for the current part was transferred to the supplier.

The contract also specified measures to be taken if something did not follow the time schedule written into the contract. If the supplier was not able to deliver parts according to the set up time table, the supplier was forced to pay fines. This was however a clause that never needed to be invoked.

5.7. Project management

Within Telenor, the project was managed by a relatively small team with clearly defined tasks. It consisted of a project manager who had the over all responsibility for financial, technological and operational aspects of the project. The project manager also wrote the technical specification for the project. There was a project member responsible for assuring the system's compatibility with GMDSS standards. For a limited time also an external consultant was engaged with this issue. Another project member worked with the database in the system. A fourth member of the team was a procurement expert, who worked with the procurement process. When the tender process had been concluded and the contract awarded, this person was in principle disconnected from the project.

In general the project was managed in a rather tight way. Although a functional specification was applied, the specification was still quite detailed. Lots of efforts had also been made to get it right from the beginning. If something would have been omitted in the specifications, and further amendments in the specifications would have been necessary, this would have meant a severe increase of cost for the procurer. Clearly it was possible for Telenor to achieve this because of existing in-house competence.

Another feature of the project concerns the leadership in relation to the stakeholders of the new system. Although there was interaction between becoming users of the new system, the supplier and the procurers, a central policy was to stick to plans and agreed upon decisions. Occasionally the project manager had to act in a very harsh way to avoid potential delays associated with late changes because of emerged alternative suggestions on how to do things.

A third point that further illustrates the tight leadership concerns communication between the procurer and the supplier. All communication between them went through the project manager. This helped to avoid the project coming into a state where co-ordination was lost.

Clearly, the lessons learned from the first attempt to procure a new system contributed to this tight style of project management in the second attempt.

6. Discussion

The discussion includes a number of sections briefly outlined as follows. Initially, for analytical purposes and also to validate the study, a discussion on the innovative features of the project is made.

This is followed by a discussion on the interaction and innovative process required. Then follows a discussion on how the law affected the procurement process followed by a discussion based on a comparison between the first unsuccessful attempt to procure a new system and the second that turned out to be successful.

6.1. Establishing innovation

This case of public procurement project carried out by Telenor maritime radio clearly included innovation and design activities. With a development time lasting from July 1999 when the contract was signed, to the end of 2002 when the system was finally delivered, this was indeed an example of an innovative public procurement rather than an example of a regular procurement of an off-the-shelf system.[74] One could perhaps view the system as built on a new combination of existing knowledge, codified in maritime standards, based on in-house expertise and the supplier's technical capabilities. Although exactly the same system had never been built before and the project included R&D and technical change, the project correspond to what is sometimes called adoptive public procurement.[75] A further circumstance that may not be completely insignificant is the number of actors involved in the project and the relation to the market. This project is an instance of a direct procurement with an intrinsic need, i.e. the procured system would be used (in principle) exclusively by Telenor.[76]

6.2. Interactive learning in the pre-procurement process

Conceptually, innovation and design are activities that concern the creation of new products and/or services. This means that all aspects of a new product and/or service are not known in advance, i.e. that any innovative project involves different kinds of uncertainty and risk. One way of reducing uncertainty in innovative public procurement projects is to interact with different actors, for instance suppliers. The negotiated procedure, unlike, e.g. the open procedure, is a public procurement procedure that in a formalised way allows such interaction between the procurer and tenders.

As has been discussed earlier, a functional specification was used (where applicable) for this public procurement project. The procurer had the knowledge of the requirements, i.e. what the system was supposed to do, what interfaces it was supposed to handle, according to what standards, etc. The supplier, on the other hand, was expected to have in possession tools to solve any problems that might come up, i.e. to implement the functional requirements. This means, that in the beginning, neither of these two actors had in their possession sufficient knowledge required to design, develop and install the system without input from their counterpart. What made the innovation possible was interaction which allowed transfer of the different kinds of knowledge between procurer and supplier.

The central purpose with the negotiation phase was to reduce all uncertainty related to a project, i.e. to reach clarity. From a procurer's perspective the main purpose of the negotiation was to gain information in order to be able to select the adequate supplier who would be able to deliver. This was also underlined by the experiences from the earlier procurement project where it turned out that the supplier was unable to deliver parts of the intended system.

[74] C. Edquist, L. Hommen and L. Tsipouri (eds), *Public Technology Procurement and Innovation* (2000).
[75] *ibid.*
[76] L. Hommen, "Innovative Public Technology Procurement—Problems, Issues and Recommendations", PPT presentation prepared for the six countries programme meeting, Procurement and Innovation, Manchester, *www.6cp.net/documents/Leif%20Hommen%20Presentation.ppt*, 2005.

6.2.1. An illustrative example: the creation of a GUI

One example that would illustrate the interaction between different actors in the procurement project is the work towards specification of the graphical user interface (GUI) for the operator's workstations.

The general ambition was to make a graphical user interface in such a way that the operators did not require long periods of training in order to use the system, in the same time as the new system should enable more efficient operation. Different suggested solutions were available. For instance, they could chose between traditional PC monitors or touch screens. But there was also a need for decisions on how the design of the graphical forms displayed on the screen should look like. Decisions also needed to be made on ''where'' in the system a user should enter when starting the computer and how the application should be structured, i.e. issues concerning the interaction design of the programme.

The suppliers on the shortlist were allowed to study current work places that existed in the current system. These studies also involved the current work flow, i.e. how the work was carried out with the existing technology. Another reason for studying existing systems was to reduce the learning threshold for the new system. A user group consisting of employees at the coast radio stations was also involved and contributed to the features of the new system. The procurers also visited installations made previously by the short-listed tenderers. Examples of such installations were control rooms for railway systems, systems for co-ordination of emergency services, and air traffic control systems. The procurers also studied installations that they themselves had delivered to (other) customers.

6.3. Interacting according to the law

Non-discrimination is a central theme in the Directives. ''Contracting entities shall ensure that there is no discrimination between different suppliers, contractors or service providers''.[77] These principles were complied with in different ways throughout the project. A central conviction within Telenor was the importance of treating all tenders in the same way, in terms of the information that becomes distributed. If, for instance, a tenderer asked a question about the system to be built that required answers that had not already been made available to all the competing tenderers in shared documents, the answer was distributed to all tenderers.

Especially in the negotiation phase, one can of course suspect that there might be a risk for information leakage, e.g. that one tenderer's suggestion will be revealed to any other, competitor. In order to safeguard from any such leakages, internal meetings were held for technical personel to train them not to unintentionally reveal such tender specific information to a competitor. In general, it may happen that tenderers try to formulate questions that may cause procurers to reveal information about other tenders on the shortlist. In such situations, it is important to strongly emphasise that this is against company policy to reveal such information, i.e. it requires practical leadership at the negotiation table. In this particular case it was safeguarded by the presence of the procurement specialist on meetings with tenderers.

What is noteworthy is that this transparency and disclosure policy is also applied today, although it is not required by law. The rationale for applying this policy is to signal trustworthiness and professionalism to the market.

[77] Directive 93/38 Art.4(2).

6.4. Different kinds of interaction requirements

In the discussion in section 3, it was established that innovative procurement can be seen not only as interaction between collaborating actors, but also as a design process guided by a vision towards a goal. This means that a specific instance of such a process can be identified if a corresponding goal is identified. In this case it is possible to distinguish between two distinct processes and corresponding visions. The first processes occurred in the pre-procurement phase and were driven by the vision of finding a supplier. The issue was not primarily to develop the system, but to find a supplier that could demonstrate the best ''knowing and reasoning'' among the competitors, in order to reassure a delivery of a working system, once the contract was awarded.

The second process occurred in the procurement phase, i.e. from the point in time when the contract had been awarded and continued to the successful final delivery of the procured system. As was described in section 5.5.4, this was a period of extensive interaction between procurer and supplier, where conjectures were evaluated and sometimes disapproved to, finally reach acceptable quality. Thus, the interactive conditions in this second process correspond more closely to what innovation theory would predict for innovative projects. Another detail supporting this perception is the fact that the most important person in the procurement team when it came to monitoring that the law was not violated due to ''bad interaction'' was no longer active in this stage of the project.

6.5. Lessons from the first procurement attempt

In general, throughout a procurement process, the Directives function as an external limiting factor. There are things that a public procurer must do and there are things a public procurer may not do. On the other hand, compliance with the law does not necessarily inhibit, but may actually increase the possibilities for innovation and a successful outcome in general. Typical obligations specified in the old Utilities Directives are the requirement to publish a tender call in the *Official Journal of the European Communities*.[78] The contracting entity was also obliged to base the contract award on certain criteria.[79] The tender eventually chosen had to be the, ''most advantageous tender . . .'' or the offer with, ''the lowest price''.[80]

In the first attempt, the contract was awarded to a company that at the time was owned by the procurer. It seems as if the search for alternative suppliers had been very limited or even non-existent. In the second attempt, in accordance with the principle of stimulating competition, the procurers not only published the tender call, but also put significant efforts into market research before publishing. In this regard, compliance with the Directives encouraged a global search for suppliers, and selection of the most innovative company.

Another difference between the two attempts concerns the verification of the professional ability of the supplier. The Directives specify that contracting entities which select candidates, ''. . . to participate in negotiated procedures shall do so according to objective criteria and rules''.[81] In the successful attempt, especially with the failure still in mind, finding a supplier that would be able to

[78] Directive 93/38 Art.21.
[79] *ibid.*, Art.34.
[80] *ibid.,* Art.34(1).
[81] *ibid.,* Art.31.

deliver was considered a critical issue.[82] In the first attempt, the project had to run several years before it was discovered that the supplier would not be able to deliver according to specification.[83]

The experiences from the first attempt seem to have reinforced the procurers' emphasis on producing a clear specification in the second attempt. The clear specifications were also seen as a success factor. Following Nonaka, ''innovation'':

> ''[C]annot be explained sufficiently in terms of information processing or problem solving. Rather, innovation can be understood as a process in which the organization creates and defines problems and the actively develops new knowledge to solve them.''[84]

In principle, what Nonaka describes is a reflecting process, where knowledge is created through conversion between tacit and explicit knowledge. Viewed as such, the actual process of writing the specification for the system to be procured, forces tacit knowledge to become explicit knowledge. This means that the writing of a specification per se may be understood as an opportunity to learn about the system to be specified and actually it should be understood as part of the innovation process. In that sense, the requirement of a specification actually becomes something that stimulates innovation.[85]

7. Concluding remarks

This paper reports from a case study of public procurement of innovative technology where the Norwegian national telecom Telenor procured a new digital maritime radio system. Telenor was in this case acting as a public undertaking under the old Utilities Directive 93/38 as transposed into Norwegian law. The procurement procedure used was the negotiated procedure with a contract notice. The case demonstrates that the institutional setting did not inhibit innovation from taking place. In fact, as this paper attempts to argue, some features in the law actually enabled or even promoted innovation.

The fact that Telenor has undergone a transition from being a public agency to a private company opens up the possibility to compare the events that took place in the context of the public procurement project under study here and the actions taken dictated by the procurement law, and what a private firm would have done in similar situations. Interestingly enough the general view among the interviewees was that most things in the process would actually been carried out in the same way even without the obligation to comply with the Directives. Sometimes the processes around managing the tender calls become somewhat ''bureaucratic'', as the public procurer is for instance required to publish information in certain ways. But in principle, the procedure implied by the Directives, is still followed today by Telenor, although in the general case, there is no requirement for the company to do so.

Innovative public procurement, viewed as innovation or a design activity in general prompts attention to the possibilities for interactive learning and user-producer interaction. One significant determinant in that perspective is the procurement procedure applied. In order to enable innovation,

[82] Section 4.5.2 of this article.
[83] Section 4.4.3 of this article.
[84] I. Nonaka, ''A Dynamic Theory of Organizational Knowledge Creation'' (1994) 5 *Organization Science* 14.
[85] Directive 93/38 Art.18(1).

ideally the procurement procedure should allow this kind of interaction to take place. Of the procedures that were available in the old Utilities Directive, the negotiated procedure would be the procedure that would to the most extent provide such innovation friendly flexibility.

The use of the negotiated procedure is however exceptional. In the old Utilities Directive, a contracting entity could choose "any of the procedures" among the procedures available, once a call for competition had been made.[86] In the (old) Directives regulating the classical sector, the use of the negotiated procedure was much more restricted. To allow more flexibility in certain situations, the competitive dialogue has been introduced in the new Directive 2004/18 for the classic sector. In a more general sense, this in turn suggests that to be able to discuss how the Public Procurement Directives may affect or even inhibit innovation, it becomes important to specify what procurement procedure is referred to, and in what situations a given procedure may be used.

From a policy perspective emphasising the role of public procurement as a means to stimulate private sector innovation, the situation becomes slightly different. Such a perspective would be focused on finding "best cases" that demonstrate the possibilities within the given legal framework to perform public procurement of innovations. Taking this (latter) view then, it can be said that this case demonstrates that it was possible for a public agency to procure innovations given the Directives in force at the time for the procurement.

It is however important to avoid the risk of being led into a "cul-de-sac" of preconceived theories.[87] Lessons learnt from this case may not be applicable in any other innovative public procurement project. For instance, the conditions can be rather different in projects where several collaborating public agencies are procuring innovations for, e.g. market catalytic purposes in a project consisting of several tender calls. Also, although there are theoretical arguments for choosing the negotiated procedure for procurement projects involving innovation, other practical reasons may justify the use of other procedures.

Before close interaction was initiated in the pre-procurement phase, in line with the intentions of the Directives to utilise market forces, extended worldwide market search was carried out, in order to maximise the number of submitting tenderers. The winning bid came from a firm previously unknown to Telenor, originating from another country. In a survey of public procurement in 1993 it was concluded that in 88 per cent of the contracts awarded, the supplier had a local address in the country where the procurement took place.[88] In 2004, the number of direct cross-boarder procurements still remained low.[89] Although the majority of the bids came from foreign firms (which, one would assume, would increase the chances that a foreign company would actually win the contract), this case has actually developed according to the visions of creating a common European market. Furthermore, in this respect, complying with the Directives did actually help finding the supplier of the technology judged as being the most adequate for the context.

After the supplier had been identified, the interaction characteristics significantly changed in the project. Up to that point much effort had been spent on assuring equal treatment of the tenderers.

[86] Directive 93/38 Art.20(1).

[87] A. Cox, "Improving Procurement and Supply Competence: on the Appropriate Use of Reactive and Proactive Tools and Techniques in the Public and Private Sectors" in R. Lamming and A. Cox (eds), *Strategic Procurement Management Concepts and Cases* (1999).

[88] A. Cox and P. Furlong "The Jury is Still Out for Utilities Procurement: the Impact of the EU Procurement Directives on the Location of Utility Contract Awards in the 'Twelve' Member States" (1996) 15 P.P.L.R. 5.

[89] *A report on the functioning of public procurement markets in the EU: benefits from the application of EU Directives and challenges for the future*. European Commission, 2004.

The interaction possibilities were also in general quite restricted by the Procurement Directives. The purpose of the interaction also changed at that point. Initially the primary task was to find a supplier that was able to demonstrate its capacity to eventually deliver the procured system. Once the contract had been awarded the purpose of the interaction became to provide the supplier with information critical for the implementation of the system. Also the fact that it took a further nine months after the contract was signed to develop a design specification that could be used to actually build the system suggests that it is possible to talk about two processes with different purposes, the process to find the supplier and the process to develop the actual product. When arguments about the restricting effects the Directives might have on interactive learning and user-producer interactions are brought forward,[90] making the distinction between the two processes may contribute with some clarity. Up to the point when the supplier has been appointed, the Directives do restrict interaction. But after that point, all the processes associated with innovation that enables the supplier to deliver the specified product may take place.[91]

This case as outlined in the two previous paragraphs also brings forth the difference between the negotiated procedure with a prior publication of a contract notice, and the negotiated procedure without publication of a contract notice.[92] The innovation theory and design theory drawn on in this paper emphasises primarily the interactive aspects. It focuses less on the importance of a competitive selection process on a supplier market with several potential winners, which actually was a significant success factor. In this case, ''[t]he negotiated procedure with both notice and competition . . . involve[d] competition almost to the same degree as open or restricted procedures'',[93] whilst at the same time it allowed interaction between the procurer and suppliers required to enable innovation.

The general conclusion that this case seems to support is that the Utilities Directive does not prevent innovation from taking place. However, in order to become successful, as suggested by the case, an innovative public procurement project needs certain specific competences attached to it—competences perhaps best referred to as innovative public procurement expertise. Based on the lessons drawn from this case three critical expertise areas can be mentioned:

1) Expertise on the public procurement procedures as specified in the Directives. In the pre-procurement phase, there was a person dedicated to make sure that legal requirements were followed. For instance, this person made sure that the communication to tenderers was managed in an open and transparent way. The response to any question asked by one tenderer was also distributed to other tenderers. This person also instructed technical personel on how to act in, e.g. meetings to avoid transferring competitive information between tenderers.
2) The vision and competence to be able to produce a specification. Another success factor that was emphasised concerns the technical competence Telenor possessed that enabled them to define and specify their actual need. As different from the earlier attempt to procure a new radio system there was also a clear vision of the intended outcome of the project. This suggests that although functional specification may give room for innovation by procurement in general, it cannot be applied in combination with a week vision of the outcome.

[90] C. Edquist, L. Hommen and L. Tsipouri (eds), *Public Technology Procurement and Innovation* (2000).
[91] As was discussed in section 3.
[92] S. Arrowsmith, *The Law of Public and Utilities Procurement* (2005), p.559.
[93] Above fn.92, p.561.

3) General project management skills. As was mention in section 5.7, the way the procurement project was managed also significantly contributed to its success. The project was managed in a rather tight manner, with a focus on sticking to the original plan where, e.g. late suggestions for alternative ways of doing things were not accepted.

Paper III

Public Procurement of Innovations and the Role of Endogenous Institutions

Max Rolfstam
Lund University
Box 118
SE-221 00 LUND
Sweden
E-mail: max.rolfstam@circle.lu.se
Phone: +46 (0) 46 2220388
Fax: +46 (0) 46 2224161

Abstract

The role of public procurement as a means to stimulate innovation has been increasingly emphasised in recent years within the European Union. Currently, knowledge of best practice in this area is being diffused within the EU and member states are developing implementation strategies to support the public procurement of innovations. This paper attempts to contribute to this process by investigating how institutions specific to particular organisations affect the possibilities for successfully concluding public supply contracts involving innovation. The analysis here focuses primarily on endogenous institutions, rather than dealing with institutions mainly as exogenous to the organisations concerned. Empirically, the paper discusses the renewable energy centre initiative in Bracknell, UK – a case of public procurement of innovation that had to be terminated without awarding a contract. The case demonstrates that endogenous institutions play an important role for public procurement of innovation. What also follows from the analysis is that in order to become effective, policy measures should not only be directed to typical procurement organisations but should be targeted to a much broader audience.

1. Introduction

Recently, policy makers in the European Union (EU) have increasingly emphasised public procurement as an instrument that can be used to stimulate innovation (Edler and Georghiou, 2007). These developments reflect and respond to a growing concern among EU member states and regions about how to maintain competitive advantage in an economic environment increasingly subject to global competition.

The Lisbon goals set for the EU in 2000 require it to become the most competitive and dynamic knowledge-based economy in the world by 2010 (European Council, 2000). In order to realise this ambition, the European Commission (EC) has urged EU member states to consider "encouraging public procurement of innovative products and services" (European Commission, 2005, p. 6). The EC has also recommended that, in order to create an innovative Europe, public procurement should be used to "drive demand for innovative goods, while at the same time improving the level of public services" (European Commission, 2006, p. 6). In line with this policy orientation, a recent high-level policy report has put forward explicit arguments in favour of "using public procurement to encourage innovation by providing a 'lead market' for new technologies" (National IST Research Directors Forum Working Group, 2006, p. 5).

Generally, the research literature concurs with policy makers' claims that public procurement can be a useful instrument for stimulating innovation (Geroski, 1990; Edquist et al., 2000; Rolfstam, 2005). The public sector can "play an important role as a stabilising and stimulating pacer in a situation where the private sector is confronted with extremely unstable environments" (Gregersen, 1992, p. 144). In order to stimulate private sector innovation by creating demand, a public agency can perform direct procurement (buying something to fulfil intrinsic need), acting as a proxy customer (e.g. by creating standards) or as a linkage creator between suppliers and users (Rothwell, 1994; Hommen and Rolfstam, 2006). It has been argued historically, in the case of the European semiconductor industry, that public procurement initiatives – if they had ever

been implemented – could have prevented European firms from lagging behind American companies that were supported domestically by large public contracts (Morris, 1990).

The increasing interest in public procurement as an instrument for innovation policies raises demands for knowledge about how public sector procurement activities aimed at stimulating innovation are carried out within the member states of the EU. Accordingly, the identification and adoption of best-practice models for the public procurement of innovations has assumed a high level of priority (Edler et al., 2005; European Commission, 2006) and the research literature now includes a growing body of best-practice case studies. A Swedish study has focussed on the National Energy Administration's successful coordination of demand- and supply-side stimuli for innovation in energy-efficient technologies (Olerup, 2000). A UK study has investigated the use of public procurement to adopt digital technology in hearing aids in England (Phillips et al., 2006). Other recent studies of public procurement activities in the UK have emphasised the innovation-related themes of market creation (Caldwell et al., 2005) and sustainable procurement (Walker et al., 2006).

However, studies that analyse the failure of projects aimed at public procurement of innovations can also provide very useful insights (e.g. Kaiserfeld, 2000). The present paper relates to this second type of study. It contributes to knowledge of factors that may obstruct, hinder, or detract from the effectiveness of the public procurement of innovations by analysing a failed initiative – i.e. a project whose goals were not realised, and for which no contract was awarded.

Following Edquist and Hommen (2000), this paper regards public procurement of innovation as a special case of product innovation involving user-producer interaction and, thereby, interactive learning. Innovation may be understood as "the search for, and the discovery, experimentation, development, imitation, and adoption of new products, new production processes and new organizational set-ups" (Dosi, 1988, p. 222). Typically, innovation – and especially product innovation – takes place in collaboration between agents, characterised by interactive learning (Lundvall, 1992) and user-producer interaction (von Hippel, 1988). Institutions play a crucially important role in this connection as determinants of the interactions involved in innovation (Nelson and Winter, 1982; Lundvall, 1992; Edquist, 1997; Hollingsworth, 2000; Whitley, 2002).

The application of institutional analysis in innovation studies frequently tends to assume an exogenous view (Jacoby, 1990, p. 139), where institutions are viewed mainly as constraints on human behaviour (Nelson and Nelson, 2002, p. 269), or as incentives or obstacles to innovation (Edquist and Johnson, 1997). What follows from this view is that firms and other organisations are seen as rather passive and their actions as essentially reactive – responses triggered by the institutional set-up. The institutional set-up in such analyses is typically limited to the relevant set of formal institutions – the legal and regulatory framework associated with a given innovation process – even though the concept is much broader in scope (Edquist and Johnson, 1997; Hollingsworth, 2000). Another, related limitation of this approach is its tendency to neglect the variety of organisational models and strategies among individual firms and other organisations (Coriat and Weinstein, 2002, p. 274).

In contrast to the usual approach to institutional analysis outlined above, this paper develops a special focus on endogenous institutions in order to take organisation-specific aspects of the institutional set-up into account. As will be argued below, this organisationally oriented kind of

analysis may be particularly important for understanding how institutional factors may affect the success or failure of multi-organisational collaborations in the public procurement of innovation.

The paper reports on a case in which an English local council, in collaboration with a number of other organisations, tried to procure a wood-chip-fuelled power plant intended to deliver sustainable energy to a renewed part of the town centre. In this case, the Bracknell Forest Borough Council failed in its attempt to procure a renewable energy centre as part of a larger urban development initiative. At the end of this process, there were no suppliers interested in obtaining the contract and the project was terminated. The paper attempts to explain this outcome by analysing the interaction of the organisations involved in the project, focussing especially on relevant organisation-specific aspects of the institutional set-up.

With regard to theory, the case is treated as an example of how the interplay of endogenous institutions may prevent collaborating organisations from innovating through public procurement. The paper therefore develops a theoretical framework that specifies the types and aspects of institutions relevant for such an analysis. The research question is formulated as follows: How may endogenous institutions affect possibilities for public procurement of innovation?

As this paper deals with concepts that are somewhat ambiguously used in the literature, the meanings attached to those concepts here are provided in the following sub-section 1.1. Subsequently, the theoretical framework is outlined in sub-sections 1.2, 1.3 and 1.4. Section 2 covers the research method applied in the empirical work. The analysis that follows in Section 3 relates the case findings to the theoretical framework. Section 4 summarises the main conclusions and discusses some policy implications.

1.1 Definitions

Procurement "refers to the function of purchasing goods or services from an outside body" (Arrowsmith, 2005, p. 1). Public procurement occurs when this function is performed by a public agency. This can be any public agency on any level in society: supranational, national, regional or a department in a local council of a municipality. Sometimes private firms acting on behalf of a public agency also perform procurement, which, at least from a legal perspective, is considered public procurement.

Conceptually, it is possible to distinguish between two broad categories of public procurement. One of these categories involves the procurement of already existing off-the-shelf products such as e.g. office stationary or fuel. The other category involves the procurement of innovations – i.e. products that require some kind of research and development process before they can be delivered (Edquist et al., 2000, p. 5). It is the latter type of procurement that is of interest in this paper. Note that this should not be confused with innovations in public procurement – i.e. process innovations achieved by e.g. adopting new software supporting the tender process or new means of invoice administration (Hommen and Rolfstam, forthcoming).

There are many different ways to define innovation. One is to adopt Schumpeter's idea of "new combinations" manifested as the introduction of a new good, a new method of production, the

opening up of a new market, the use of a new source of supply of raw materials, or new ways of organising industries (Schumpeter, 1934/ 1969, p. 65). Following this approach, Edquist (1997, p. 1) states that "[i]nnovations are new creations of economic significance", thereby distinguishing, at least implicitly, between innovation and invention. An invention, unlike an innovation, has not yet proven its success on a market, as discussed by Fagerberg (2005, pp. 4–5). The Schumpeterian definitional approach has been applied in studies of the public procurement of innovations by various authors (e.g. Edquist and Hommen 2000; Hommen and Rolfstam, forthcoming).

Schumpeterian definitions, however, treat innovation mainly from an *ex post* perspective – which is perfectly natural, as "outcomes of innovative efforts can hardly be known ex ante" (Dosi, 1988, p. 222). Still, this approach is less effective in capturing the underlying mechanisms that actually lead to innovation – a focus which is necessary for the purposes of this paper. In addition to understanding what innovation is, it may also be necessary to grasp how innovation occurs. Addressing the latter purpose, Dosi (ibid., p. 222) has therefore characterised the innovation process as "the search for, and the discovery, experimentation, development, imitation, and adoption of new products, new production processes and new organizational set-ups". This process is also cumulative in the sense that prior knowledge determines the possibilities to exploit new technical possibilities (ibid., pp. 222–223). Similar views have been stated by Lundvall (1992, p. 1) and Edquist (1997, p. 16). Public procurement of innovation has been defined from this learning perspective as something that "occurs when a public agency places an order for a product or a system which does not exist at the time, but which could (probably) be developed within a reasonable period" (Edquist et al., 2000, p. 5). Public procurement of innovation is thus a special case of innovation as a learning process, where a public agency becomes engaged in the search, discovery and development activities required to deliver a certain item. Further, it is also a special case of product innovation, and by definition it therefore requires interactive learning (Lundvall, 1992) based on user-producer interaction (von Hippel, 1988) in order to take place.

1.2 Innovation, Organisational Learning, and Institutions

As indicated above, innovation studies have often placed a primary emphasis on inter-organisational collaboration and interactive learning across organisational boundaries, especially where product innovation is concerned. However, learning within the organisation should not be disregarded. Rather, understanding organisation-specific learning can both illuminate and facilitate learning based on inter-organisational collaboration, in the sense that organisations can learn to become more effective at collaborating – and learning from collaboration (Garavan, 1997, p. 20). Organisational learning of this kind may be essential for developing the dynamic capabilities required by innovating organisations (Teece and Pisano, 1994). More generally, learning is accomplished within an organisational context, and can be understood from an organisational perspective as "those activities by which we create premises which are assumed, or are proven, to be valid and from which we draw conclusions about how to act" (Argyris, 1994, p. 7). Thus, learning is the outcome of the evaluation and possible alteration of pre-existing knowledge or premises, resulting from an action or a conjecture based on the pre-existing knowledge and premises (Schön, 1983; Rolfstam, 2001). This process is in turn affected by the organisational context, because organisations "can create conditions that may significantly

influence what individuals frame as the problem, design as a solution, and produce as action to solve a problem" (Argyris, 1994, p. 8).

Consistent with the scepticism of evolutionary economic theory about highly flexible adaptation on the part of individual firms (Nelson and Winter, 1982, p. 134), the population ecology approach in organisation theory regards the purpose or mission of an organisation as one of a few core organisational features that constitute major sources of structural inertia and thereby impose strong constraints on organisational change (Carroll and Hannan, 1995, 26–27). Accordingly, an organisation's mission can be expected to exert a decisive influence over the direction of learning within – and by – the organisation. In this respect, organisations can be seen to carry characteristic premises or rationalities, and to coordinate learning by means of routines reflecting these specific rationalities, which vary across organisations (Winter, 1988; Langlois and Robertson, 1995). For such reasons, evolutionary economists argue that "the firm is not simply an aggregate of individuals, physical capital and codifiable knowledge" but "also consists of idiosyncratic structures, relationships and routines that typically are not tradable and are specific to the firm itself" (Hodgson and Knudsen, 2004, p. 301).

The evolutionary perspective on organisational inertia and its implications for highly path-dependent processes of organisational learning points to the key role played by firms and other organisations in processes of institutional change. For example, Hodgson and Knudsen (2004, pp. 301–302) argue that "most or all of the firm's routines share the fate of the firm in which they reside", reasoning that the selection of firms in a competitive environment also entails selection for some of their constituent routines. Similarly, institutionalist perspectives on organisational change have pointed to "non-linear feedback between organizations and their institutional environments" (Hollingsworth, 2000, p. 620). Thus, while innovation researchers have consistently emphasised the role of institutions for the understanding of innovation (Dosi et al., 1988; Lundvall, 1992; Edquist and Johnson, 1997; Hollingsworth, 2000), they have in recent years increasingly drawn attention to ambiguities in the distinction between organisations and institutions (Nelson and Nelson, 2002). Ongoing debate on this issue demonstrates that although most innovation researchers agree that institutions are crucial to understanding innovation processes, they do not necessarily understand the term institutions to mean the same thing (Edquist, 1997, p. 24). In this respect, institutional analysis remains problematic for innovation research because it suffers from conceptual vagueness (Johnson and Edquist, 1997, p. 41).

Regarding innovation as essentially a social and interactive process involving different organisations naturally calls for an understanding of the governing rules underlying this process (Lundvall, 1992; Edquist, 1997). It is therefore unsurprising that, at present, the conventional understanding of institutions within the literature of innovation studies is mainly based on North's (1990, p. 3) definition of institutions as "the rules of the game in a society or, more formally, … the humanly devised constraints that shape interaction". Along similar lines, Johnson (1992, p. 26) has defined institutions as "sets of habits, routines, rules, norms and laws, which regulate the relations between people and shape human interaction", and Hodgson (2006, p. 2) has referred to "systems of established and prevalent social rules that structure social interactions". One advantage of the Northian conception of institutions is that it makes possible a sharp distinction between institutions as the rules of the game and organisations as its players (Edquist and Johnson, 1997, p. 45). However, this distinction hardly serves to resolve the problems outlined above, since although organisations can be viewed as operating within an

institutional environment or set of rules, it is equally valid to maintain that "institutions are …'embedded' in organizations, which may be seen as concrete hosts for specific institutions" (ibid., p. 59). Consequently, innovation research remains strongly interested in the interactions between organisations and institutions.

In relation to this topic, Coriat and Weinstein (2002) argue that innovation research has followed two separate trajectories, capturing either an organisational or an institutional dimension. The organisational approach has attempted to grasp how firms develop competitive advantages through innovation by taking organisation-specific decisions into account. The problem with this approach is that it "largely ignores the contributions of institutional approaches" (ibid., p. 274). Conversely, the institutional approach, while successfully disparaging standard economics' view of innovation as an exogenous process, and incorporating societal (often national) institutions into the analysis, has failed to grasp fully the role of individual organisations. This approach "implies the major risk of forgetting the key role of diversity within a system, and of the ways actors' behaviours remain largely autonomous and non-determined, and thus to underestimate the flexibility of a system and its possible transformations" (ibid., p. 280).

The solution proposed by Coriat and Weinstein is to bring these two trajectories together through the development of a typology that distinguishes not only between universal and organisation-specific institutions, but also between institutions concerned with long-run societal reproduction and those designed to operate on a fixed-term basis (ibid., pp. 281–284). The first of these dichotomies refers to "Type 1" vs. "Type 2" institutions, and the second to "Type A" vs. "Type B" institutions. Later sections of this paper will address Coriat and Weinstein's framework for institutional analysis at greater length. Here it may suffice to comment that although their distinction between Type 1 and Type 2 institutions can be applied readily to innovation processes in which firms are the main actors, their distinction between Type A and Type B, and especially their specification of Type A, institutions is based on examples and arguments that apply primarily to public sector organisations such as "schools, hospitals, and basic research labs" (ibid., p. 283). Hence, efforts to operationalise and test Coriat and Weinstein's typology should include public sector organisations, which provide more suitable contexts of application for some key aspects of this framework.[1]

1.3 Public Procurement of Innovations: Towards an Institutionalist Analysis

Studies of the public procurement of innovation are particularly appropriate for applying the institutional typology outlined above – especially when the object of analysis is to explore how multiple kinds of institutions affect the success or failure of innovation as a learning process occurring within, and among, organisations. Undertaking this kind analysis is important for a series of related reasons, outlined below. Their inter-relatedness points to the importance of complementarities among the various components and levels of the relevant institutional set-up. As argued by Amable (2000, p. 647), analyses that focus on single institutions "may altogether miss the genuine importance of institutions in the economy, which is of a combinative nature".

[1] Coriat and Weinstein's own application of this framework to the analysis of innovation systems concentrates primarily on private sector organisations and deals primarily with connections and interactions between "Type 1" and "Type 2" institutions (2002, p. 284).

Some recent studies have suggested that the EU's current underperformance in the use of public procurement to stimulate innovation is due to deficiencies in the design of formal institutions conceived as rules of the game (Nyholm et al., 2001). Such analyses echo the earlier statement by Edquist et al. (2000, pp. 307–308) that there is "a considerable degree of tension" between the EU procurement rules and "evolved 'co-operative' institutions concerning relations between buyers and sellers". However, research aimed at testing this proposition has found that following the EU procurement rules can actually facilitate successful innovation on the part of public sector organisations, depending on their adoption of appropriate organisational practices (Rolfstam, 2007). In this connection, though, innovation theory suggests that what have been referred to above as organisation-specific or endogenous institutions embodying crucial tacit knowledge may constitute some of the most difficult obstacles to the adoption of new organisational practices from other organisations (Amit and Belcourt, 1999; Hodgson and Knudsen, 2004).

At this point, institutions as resources to be used by agents enter the analysis. The transfer of practices between organisations is often impeded by the lack of either or both "a shared language across organizations" and the "procedural memory" required to complete task routines adopted from other organisations (Amit and Belcourt, 1999, p. 178). Similar problems can attend the adoption of common practices by separate organisations that are attempting to act in concert. Thus co-operative public procurement of innovation involving multiple buyers has been argued to be more difficult to co-ordinate than its direct counterpart involving only one: "A monopsonistic public agency pursuing its own priorities can behave quite differently from one that attempts instead to lead a group of buyer organizations with related but perhaps only partly overlapping agendas" (Hommen and Rolfstam, forthcoming, p. 17).

The research literature on public procurement of innovations remains small and oriented primarily towards empirical rather than theoretical work. Hence, few, if any, contributors to this literature have pursued specifically institutionalist theoretical issues or research agendas. Some years ago, however, Gregersen (1992) took some promising steps in this direction with her account of the public sector as a "pacer" in national systems of innovation. Focussing on a set of related activities including the public procurement of innovation, she discussed how the innovative performance of public agencies can be affected by factors such as their specific rationalities and more general goal orientations, as well as relationships with their external environments. Specifically, Gregersen argued that if interactive learning based on user-producer interaction "is assumed to be present also where public sector institutions participate as users", it follows that "the distinctive characteristics of the underlying goal orientations or rationalities of this participation may influence both the innovative capacity and the orientation of the learning process" (ibid., p. 132).

While Gregersen's work broached an important set of issues, it did not explore the relationship between organisational learning and different kinds of institutions, particularly organisation-specific or endogenous institutions, as fully as it might have done. For example, based on earlier work by Van de Donk and Snellen (1989) she distinguished four kinds of rationalities – political rationality, legal rationality, economic rationality and scientific or "paradigmatic" rationality – that may influence the actions of public administrations. Gregersen (1992, p. 133) also drew attention to the argument of these authors that "the four rationalities distinguish public administration from private enterprise", on the assumption that firms "may limit themselves to

economic rationalities and … scientific rationalities". However, she then rejected this argument and its underlying assumptions as "an unrealistic simplification" and turned to an analysis that did not examine specific kinds of rationalities but instead relied upon a broad distinction between "public interest" versus "private interest" goal orientations (ibid., pp. 133–134). Thus Gregersen first identified and subsequently abandoned organisational rationalities as an important point of departure for an institutionalist analysis of the public procurement of innovation.

This paper pursues the kind of institutionalist analysis suggested, but not actually carried out, in Gregersen's (1992) work on the public sector as a pacer in national systems of innovation. It analyses the Bracknell Forest Borough Council's unsuccessful attempt to procure a renewable energy centre as an example of how the interplay of endogenous institutions may prevent collaborating organisations' possibilities from innovating through public procurement. The paper draws upon Gregersen's work on rationalities for sensitising concepts but also makes use of the typology of institutions developed by Coriat and Weinstein (2002) to elaborate an appropriate analytical framework. The research question is formulated as follows: How may endogenous institutions affect possibilities for public procurement of innovation?

1.4 An Institutional Framework

As was discussed above, institutions can be seen as the rules of the game affecting social interaction, and accordingly innovation. These rules may be e.g. formal rules such as law, directives, policy programmes developed by national agencies, standards, traditions, incentives or premises within organisations. The problem really is not to suggest different institutions that may play a role in innovation, but how to determine which are the most relevant, and to structure these analytically in order to make them comprehensible. Coriat and Weinstein (2002) have developed a taxonomy based on two institutional dimensions of relevance in understanding innovation processes that may provide such comprehension.

In the first dimension, Coriat and Weinstein distinguish between Type 1 and Type 2 institutions. The former "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). Type 1 institutions also include an enforcement system that punishes any violation of the institutions. In real life such institutions are maintained, for instance, by the police or the justice system. 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). Here, these two types will be labelled exogenous and endogenous, respectively. Such a labelling is understood from the perspective of an organisation. Although both of these types influence an organisation's learning, the ways they do it are different. Exogenous institutions affect organisations from outside. They are imposed on organisations with little or no control from the organisation itself. Endogenous institutions are those originating and evolving from within the organisation. They may also change as a result of learning within the organisation. What may change within an organisation in relation to exogenous institutions is e.g. the perception of them or the response that might be triggered. This change is then an example of an endogenous institutional change.

Coriat and Weinstein's second institutional dimension essentially concerns the duration of the institution. Type A institutions rule the reproduction of the society as a whole, considered in the long run, whereas type B institutions are fixed in time. These two types will be labelled long term and fixed term, respectively. These two dimensions of institutional types, if put together, form a taxonomy consisting of four distinct categories as follows. Type 1–Type A are universally regulated institutions that are not fixed in time, i.e. long-term exogenous institutions. These are institutions maintained by organisations such as schools, hospitals or laws on intellectual property rights. Type 1–Type B are institutions universally regulated but fixed in time, short-term exogenous institutions. Examples of this category would be non-permanent policy programmes. Type 2–Type A institutions would include institutions stemming from organisational choices regarding modes of coordination within an organisation, i.e. long-term endogenous institutions. The last category, Type 2–Type B institutions, are also presumably choices stemming from within organisations rather than universally, but with a much shorter and limited time span, i.e. short-term endogenous institutions. Most contracts fall into this category. These four institutional types are displayed in Table 1.

	Long term	**Fixed term**
Exogenous	Law, Mission of public agencies	Public policies, programmes
Endogenous	Organisational choices regarding modes of coordination	Contract

Table 1: Institutional dimensions affecting innovative public procurement

If, as Coriat and Weinstein do, one acknowledges the existence of institutional hierarchy, the model provides an explanation in institutional terms of the requirements for contracts. In other words, for the purposes here, the model views public procurement contracts as the result of an institutional match between different institutional levels. Such a perception would stem from regarding long-term exogenous institutions as the highest level, setting the conditions for lower levels. This is clearly illustrated by the requirement to comply with laws and regulations that universally affect all actors. Fixed-term exogenous institutions would be the second highest level. Policy programmes would be set up in compliance with laws and regulations, i.e. long-term exogenous institutions, but clearly with the ambition to change behaviour at lower institutional levels. Long-term endogenous institutions would be the third level. Such institutions are synonymous with or very close to long-term business concepts on which an organisation is built. Although those choices are made within the organisation they are still affected by e.g. universal law, i.e. long-term exogenous institutions. Organisations may also deliberately or indirectly adjust these decisions to public policies, i.e. fixed-term exogenous institutions. Fixed-term

endogenous institutions belong to the lowest level in the hierarchy. Typically, instances of this type of institution can be derived from the long-term endogenous institutions in a particular organisation. To some extent, one can think of these as the implementation of long-term endogenous institutions. A tradition in an organisation of having well-trained staff with state-of-the-art knowledge of their methods is an endogenous long-term institution. The course a new staff member is taking to upgrade his or her skills would be a fixed-term endogenous institution.

Although the levels discussed above may correspond to organisational levels, it should be noted that this model is essentially an institutional model and not an organisational model. Still, endogenous institutions are specific to a specific organisation. They vary among individual firms, public agencies and other forms of organisations. A signed contract between a public buyer and a supplier means that the buyer and the supplier have compatible institutional set-ups. If one wants to emphasise the dynamics in this, one could regard the signing of a contract as a situation in which a public buyer and a supplier have reached compatible institutional set-ups. Other organisations affected by the same exogenous institutions – in the same country, for instance – may have developed institutions that do not fully match a certain public agency's institutional set-up. In such cases of institutional mismatch, the probability of a contract's being signed between these entities is low.

The preceding discussion suggests that it is critical to take the organisational level into account for an understanding of how public procurement contracts occur. This may also explain why research on the impact of European procurement laws on public procurement of innovation has reached ambiguous results. Edquist et al. (2000) are less prone to acknowledge the innovation-friendly features of the EU legislative package, while Rolfstam (2007) sees compliance with the rules as a way of enabling or even promoting innovation. In neither of these studies have the endogenous institutions been dealt with in any explicit way. The institutional model developed here as derived from Coriat and Weinstein (2002) thus seems to be a fruitful means to overcome this apparent anomaly.

Still, as was noted above, the discussion up to this point has involved an institutional model. In the practical world, institutions exist within contexts, and typically within organisations. Given the research question addressed in this paper, the discussion would also call for a capture device that starts off from the organisation and takes institutions into account, rather than the opposite. One such model that provides exactly such a perspective was developed by Van de Donk and Snellen (1989) and was discussed in the context of public procurement and innovation by Gregersen (1992). In the following, that model will be outlined.

1.5 Institutions as Rationalities

Any organisation fulfils its purposes under scarce resources. This means that actions carried out by an organisation are purposefully selected (Vanberg, 1997). This also implies that organisations must contain some kind of "procedure for determining the action to be taken" (Nelson and Winter, 1982, p. 57), or, in the terminology used here, rationality. This rationality will affect the conditions for learning (Argyris, 1994) and the creation of organisation-specific routines (Nelson and Winter, 1982), i.e. an organisation's endogenous institutions.

Van de Donk and Snellen (1989) distinguish between four different rationalities that may influence the actions and decisions in public administrations. These are political rationality, legal rationality, economic rationality and scientific rationality. This framework, in a slightly modified version by Gregersen (1992), can be used to analyse innovation in public agencies. The rationalities can briefly be summarised as follows.

Political rationality means essentially that the ruling group will act in such a way that it will remain in power. In order to do this it needs to address problems emerging in society, "the problems of the collectivity" (Van de Donk and Snellen, 1989, p. 10). This implies that "government actions and decisions reflect the – at any time – dominating political and economic interest groups or coalitions" (Gregersen, 1992, p.132). The solutions suggested by the ruling group will be sought in the direction which the ruling group finds most desirable, but also within the limits dictated by the integrity of society.

Legal rationality refers to the law and thus to the legal establishment. Public policy "must have its foundation in law, must honour the guarantee function of the law, and must ensure equality before the law and legal security" (Van de Donk and Snellen, 1989, p. 10). One law relevant in this case is the law regulating public procurement, i.e. the national transposition of the EC Directives on Public Procurement.

Economic rationality essentially refers to restrictions on public policy due to budgetary limitations. A public agency, for instance, is not supposed to waste taxpayers' money. The importance of economic rationality, following Van de Donk and Snellen (ibid., p. 10), varies over time, as the economic conditions change.

Scientific or, as suggested by Gregersen (1989, p. 132), "paradigmatic" rationality refers to institutional specificity in e.g. specialist public agencies, i.e. that "each sector in society recognizes its counterpart in a social-scientific discipline or technological discipline" (Van de Donk and Snellen, 1989, p. 11). For instance, we can expect agents occupied with technical infrastructure such as electricity or railway systems to give high priority to technical security, while medical, human and social professionalism and rationalities are expected in public welfare agencies and hospitals.

It should be noted that the four rationalities function interdependently with each other. Most policy outcomes will reflect a mix of various rationalities and will also demonstrate a sort of exchange relationship, where one rationality may be satisfied at the expense of another. The most interesting aspect of the model, however, is that it distinguishes public agencies from other organisations. While public agencies follow the four rationalities, private firms, research units, or other organisations may in principle be limited to one or a few of the rationalities. A private firm, for instance, may follow economic and paradigmatic rationalities. Similarly, a not-for-profit, non-government agency with a specific agenda of promoting a specific behaviour essentially follows paradigmatic rationalities.

Viewed in the light of the institutional model discussed in the previous section, the four-rationality model becomes useful for analysing the institutional match between endogenous institutions in different organisations. In the model, public contracts involving innovation result

from an institutional match between actors. In this perspective, an institutional match occurs as the result of compatible rationalities among collaborating actors. Similarly, a contract may not happen if the collaborating actors' rationalities are too different from each other.

2. Method

The research reported in this paper was carried out as a case study (Yin, 1994). This section briefly describes the procedures by which the case was selected, how data were collected, and how data were analysed.

2.1 Case Selection and Unit of Analysis

This project was carried out in collaboration with the Centre for Research in Strategic Purchasing and Supply (CRISPS), at the School of Management, University of Bath, UK. This is a research unit which possesses (among other virtues) a very strong interface towards practice. Through its network of practitioners, this case was eventually identified. In order to be able to deal with this rather extensive project with the resources available, some limitations had to be made. One such limitation follows from the choice of the unit of analysis, which is the attempt to procure a renewable energy centre in Bracknell Forest. This choice stipulates a concern for aspects of two separate but still related processes. One process was the formal public procurement process carried out by the Bracknell Forest Borough Council leading to the tender call in January 2005 (TED, 2005). The other process was the CONCERTO initiative, funded by the European Commission, where information on renewable technologies was developed and shared among the participants. These two processes involve an array of organisations from different countries which may have little to do with the immediate developments of relevance to the analysis here. The organisational emphasis here was on the Bracknell Forest Borough Council, the Bracknell Regeneration Partnership, TV Energy and the CONCERTO initiative.

2.2 Data Collection

Data were collected through interviews with people representing the organisations involved in the process and by consulting various kinds of written material available in public reports and on the Internet.

Two types of interviews were used, face-to-face interviews and telephone interviews. Both types were conducted in an open-ended and focussed manner. In an open-ended interview the respondent is asked for facts of a matter as well as the respondent's opinion about events. In this way the role of the respondent may become the role of an informant (Yin, 1994, p. 84). A focussed interview is usually associated with the use of prepared questions derived from a case study protocol (ibid., p. 85). In this case study, questions were prepared in advance and used at the interviews. The prepared questions were used in a way, however, that did not significantly inhibit the respondent's freedom. The mean interview duration was roughly one hour. At the initial contact each respondent was sent a personal cover letter (Yin, 1994, p. 67) in which the overall aims of the project were presented. The prepared questions were attached to the letter. In

most cases the interviews were recorded and transcribed. Some completing questions and clarifications were also made through e-mail communication after the actual interview. Drafts of this report were distributed to the interviewees. Comments received on errors or mistakes were taken into account in later versions. One set of interviews was held in the spring of 2006 and a second in the spring of 2007.

One example of an online resource which was consulted in the study is the Tenders Electronic Daily Database. This is a database maintained by the European Commission and contains all public procurement tender calls above certain threshold levels made in the last five years. As the procurement project under study involved many organisations with an interest in and concern for diffusing information to other communities as well as local residents, a lot of material was available online either as web pages or downloadable documents. Examples of the latter are information leaflets from the Bracknell Forest Council, press releases and the CONCERTO project web pages.

2.3 Analysis

Case study analysis is difficult because strategies and techniques have not been well defined in the past (Yin, 1994) and methods are not as developed as in other types of research designs (De Vaus, 2001, p. 249). In fact, case study research seems to involve lot of tacit skills acquired through practice, and "the experienced case study investigator is likely to have great advantages over the novice at the analytical stage" (Yin, 1994, p. 102).

Following Yin, it is important for anyone doing case study research to have an analytical strategy in order to know what to do with the collected data. Also, any description of a case involves a selection of facts (De Vaus, 2001, p. 251). Such a selection can follow from the theoretical propositions on which a study relies, if such theoretical propositions have been developed. Based on the theoretical propositions made here, the analysis of the empirical material that was gathered comes close to an explanation-building analysis (Trochim, 1989; Yin, 1994). Explanation-building analysis as a special case of pattern-matching is iterative in nature. It starts out from an initial theoretical statement or proposition which is compared with an initial case. This is followed by revision of the initial propositions, which are in turn compared with other details in the case, followed by further revisions of the propositions. What has not been possible with the current study is to proceed with the last step in the iteration, which is comparison with other cases (Yin, 1994, p. 111).

After the first set of interviews was held in the spring of 2006, a preliminary report was written. This report was presented in two academic settings, the Danish Research Unit for Industrial Dynamics Winter Conference 2007 (Rolfstam, 2007) and a seminar held at Lund University in the spring of 2007. The institutional model was also presented to public procurement experts from ten EU countries gathered in Stockholm at the VINNOVA (Swedish Government Agency for Innovation Systems) Procurement for Innovation Conference in June 2007. The comments from these events as well as from interviewees were used in the iterative process to improve the initial propositions to their current stage.

3. Case Findings

The analysis includes four steps. Initially, the degree to which the studied case involved innovation is elaborated. Secondly, the rationalities in the organisations that played the main role in the developments of the case are outlined. The third step deals with how these different rationalities affected the outcome of the process. The forth step discusses the results in the light of the institutional framework model.

3.1 The Procurement Process and the Intended Innovation

Bracknell Forest is one of several towns in the UK that were developed after the Second World War, essentially to provide housing for people who had lost their homes in the war (Wikipedia, 2006) and to provide housing to support the expansion of London. Situated within a thirty-mile radius of the capital, Bracknell Forest is where several major companies, including BMW, 3M UK, Waitrose, Hewlett Packard and Panasonic, have located their national offices (BRP, 2006a). Designed and constructed in the 1950s and 1960s, the town centre now faces the prospect of a major renewal scheme. Increased population and new developments around the town centre, in combination with relatively limited development in the town centre itself, have created stagnation and decline insofar as people nowadays tend to do their shopping and other leisure activities elsewhere. As a response to this situation, activities were initiated in the late 1990s "to transform Bracknell Forest town centre into a culturally self-confident centre that is mature, vibrant and truly mixed-use, hosting a wide range of shopping and leisure activities which are accessible to all" (Bettison and McCormack, 2002).

This £750 million regeneration scheme is quite impressive. The plans include the development of 56,000 m² of new retail space, 15,000 m² of new bars, cafes, restaurants, entertainment and leisure, 1,000 new homes, 3,500 new parking spaces, up to 62,000 m² of new and replacement business space, a 4,000 m² food store, extensive public spaces, transport improvements, a large health centre, a new library, a new bus station, better CCTV, a new police station, a new magistrates' court, and a new borough office (BRP, 2006b).

Concerns regarding sustainability and energy efficiency were also incorporated into the development plans. The town planners perceived that Bracknell Forest had a great opportunity "to show itself as an innovator and leader in this area by making the Town Centre demonstrably energy efficient" (Bracknell Forest Town Centre Master Plan, 2002, p. 13). Opportunities and/ or challenges mentioned were renewable energy technologies such as solar, wind and biomass energy; energy efficiency built into the design of the buildings; and issues concerning waste and transport (ibid., 2002). Among these opportunities was the idea to develop a renewable energy centre that would supply the new town centre with sustainable energy based on wood chips.

Eventually the project came to a stage where the formal procurement process started, and Bracknell Forest Borough Council published a contract notice in the Official Journal of the EU. The procurement procedure used was the negotiated procedure with a contract notice. This means that any interested bidder needs to be pre-qualified in order to be allowed to submit a proposal. In order to establish this, the bidders were asked to fill in a pre-qualification questionnaire to be

returned to the procurer for validation. This questionnaire included questions on technical capacity and economic and financial capacity. The tenderers also had to assure their sound legal position, i.e. that they comply with law. The tenderers that successfully passed the evaluation of the questionnaire and became pre-qualified would then be asked to submit a complete proposal. The number of suppliers to be eventually invited to tender was envisaged at between two and five. The notice was published on January 8, 2005, specifying that the winner of the contract was to form an energy service company (ESCO) to "commission the design, construction, installation of the facilities … and manage the commercial activities, maintenance and operation of the facilities and the distribution network over its economic life" (TED, 2005).

Four organisations became pre-qualified out of roughly dozens that initially responded to the contract notice. Many of the bidders that did not pass the evaluation wanted to deliver (small) parts to the project and not a complete energy centre. There was also a category of bidders that had prior experience in the technology required, but on a much smaller scale. As the supplier was supposed to finance the project as well, and thus accept a big commercial risk, the procurers judged that only bidders with prior experience both of projects on that scale and of financing such projects would become pre-qualified.

On April 11, 2006, the notice was officially cancelled. The reason given by the public procurers was that the scheme had been judged "commercially unviable" (TED, 2006), ultimately because the procurement process had not generated a supplier willing to sign the contract. As a result of this, the current energy supply plans for the new town centre are less ambitious in terms of scale and sustainability. Gas-fired options as well as conventional supply are being considered, and the capacity of the power plant, if it is built, will be one-fourth to one-half that of the initially intended energy centre.

The energy centre, if built according to the initial intentions, would have been an implementation of wood-chip energy technology on a scale never before attempted in the UK. The idea was also to get local farmers to grow fast-cropping timber that would be used as fuel for the power station. If successful, the project, at least as the Bracknell Forest Borough Council perceived it, would also have had a positive impact on an underdeveloped UK market for renewable energy in general. With reference to Schumpeter, as discussed above, this project clearly was innovative. It involved, at least on the national level, the introduction of a new good,[2] a new method of production, it would have opened up a local market for fast-cropping timber and, consequently, it would have meant a demand for new raw materials.

The ultimate reason given for terminating the project was that there was no guaranteed market for the new energy centre. The ESCO that would have committed itself to build and run the energy centre could in theory have ended up in a situation where town centre tenants were securing their energy supply from elsewhere. In that sense, the project failed to deliver an innovation due to the second aspect of innovation discussed above, the requirement to be successful on a market.

[2] The "good" refers here to the physical plant, i.e. the energy centre, which was based on technology applied on a scale never before seen in the UK. At a later stage, when finally delivered, this energy centre would in turn also be delivering sustainable energy. Understood as distinct from conventionally produced energy, this could also be regarded as a product innovation. The delivery of (sustainable) energy was not a part of the procurement process discussed in this paper, however.

This observation could essentially be the lesson learned from this project. However, although the analysis that follows will not change the factual circumstances outlined above, it will provide a more profound understanding of how organisation-specific endogenous institutions played a role. In fact, the apparently obvious conclusion that there needs to be a market for an innovation may not be the most critical observation that this case has to offer.

3.2 Collaborating Organisations and their Rationalities

The project of developing an energy centre for the new town centre to be built involved an array of different kinds of organisations: the Bracknell Forest Borough Council, regional public agencies, national agencies, private companies and organisations, universities, and temporary organisations funded by the European Commission. In this section, a selection of these organisations is briefly described.

The Bracknell Forest Borough Council was the public agency that administrated the public procurement process. For the purposes of the present analysis, it is important to distinguish between two different bodies within the public agency. One is the political side, i.e. the elected leadership of the Borough Council. The other is the professional entity consisting of public officers administrating the procurement process in a more practical sense. These two categories do not have the same requirements for satisfying the four rationalities. Given the ambition to get re-elected, the political leaders need to take all four rationalities into account. They need to run their Borough Council within budget, according to law and in agreement with expert knowledge in a way that the general public will find appropriate, if they are to be re-elected. The professional public officers in the Borough Council do not have the same requirements to satisfy political rationality, simply because as employees they are not as dependent on public opinion to keep their jobs. Instead, they may be much more inclined to satisfy the other three rationalities.

The Bracknell Forest Borough Council is developing the town centre in collaboration with a private joint venture that was formed in April 2003. The town's two major landowners, Legal & General and Schroders Exempt Property Unit Trust formed the Bracknell Forest Regeneration Partnership (BRP) to pursue the development and regeneration of the town centre. For the development work, BRP also brought in a consultancy firm, Stanhope Plc in London. Upon the formation of the partnership, collaboration with the Bracknell Forest Borough Council was initiated as well (Bracknell Forest Borough, 2003). The underlying purpose of the establishment of BRP was to counteract the ongoing decline of commercial activities in the town centre. If the decline continued and commercial life were completely taken over by shopping malls situated outside the town centre, the consequences for property owners in the town centre would obviously be negative. As a commercial entity, this organisation has a rationality that is primarily economic. The essential business of this organisation is property. Thus, it is also possible to distinguish a paradigmatic rationality.

One organisation involved in the pre-procurement process was Thames Valley Energy (TV Energy). TV Energy is a not-for-profit regional renewable energy agency that works on local, regional, national and international levels with "matters relating to the understanding, promotion and delivery of renewable energy projects", funded by different organisations in the UK as well

as the European Commission (TV Energy, 2005). TV Energy is not paid directly for carrying out its activities, as a private company is. Neither is it dependent on public elections to conduct its activities. The inclination to prioritise a legal rationality is also rather low, in the sense that it would not be its responsibility to comply with e.g. procurement laws. This organisation is driven mainly by a paradigmatic rationality, i.e. to contribute to the diffusion of renewable energy. This organisation played a significant role when it came to attracting funding for the project.

The project got grant funding from two sources, the European Commission through the CONCERTO initiative and from a national source, the Energy Savings Trust (EST).

The CONCERTO initiative is part of the 6th framework research programme supervised by the DG Energy and Transport of the European Commission. The purpose of the initiative is to proactively address "the challenges of creating a more sustainable future for Europe's energy needs" (CONCERTO, 2006a). In principle, this programme works in two ways, as a promoter of the development of new knowledge and as an agent for diffusing this new knowledge to others. The initiative supports local communities in forming strategies and development towards self-supply of sustainable energy and energy efficiency, currently in nine projects involving some thirty communities. A central idea for the projects in the initiative is also to offer "a platform for the exchange of ideas and experiences" between the participating communities, as well as with other cities committed to introducing similar strategies (CONCERTO, 2006c). Among the projects in the CONCERTO initiative, Bracknell Forest Borough Council became involved in the Renaissance project (Renewable ENergy Acting In SuStainable And Novel Community Enterprises). In addition to Bracknell Forest, the project involved the communities of Lyon in France and Zaragoza in Spain as active participants. There was also an array of communities in Europe affiliated as "observer communities" (Renaissance, 2006). The Bracknell Forest Renaissance team included an array of collaborating partners from the region in addition to the Borough Council: the University of Reading, the Bracknell Forest Regeneration Partnership, TV Energy, Waitrose, South East England Development Agency (SEEDA) and Slough Heat and Power (University of Reading, 2004). The main rationality governing this organisation was paradigmatic in the sense that it had a clear ambition to promote a certain paradigm, renewable energy.

Organisation	**Primary Rationality**
Bracknell Forest Political Leadership	Political, Legal, Economic, Paradigmatic
Bracknell Forest Public Officers/ Professionals	Legal, Economic, Paradigmatic
Bracknell Forest Regeneration Partnership	Economic, Paradigmatic
Thames Valley Energy	Paradigmatic
CONCERTO/ Renaissance project	Paradigmatic
Energy Service Companies/ Tenderers	Economic, Paradigmatic

Table 2: Organisations and their rationalities

The final category to be defined here consists of the ESCOs that would respond to the tender call, then build and eventually operate the energy centre on a commercial basis. These organisations are governed by essentially two rationalities. As commercial entities dependent on making a profit, they have an economic rationality at their centre. The means to do this is through utilising

their knowledge in energy technologies. Thus, it is possible to discern within these organisations a paradigmatic rationality as well. A selection of the organisations and their rationalities is displayed in Table 2.

3.3 Public Procurement of Innovation as Coordination of Rationalities

The formal public procurement process was carried out by Bracknell Forest Borough Council. Being a public agency procuring something above threshold levels, the Council had to do this according to public procurement law, i.e. rules transposed into national legislation from the EC Directives on public procurement. TV Energy was the organisation emphasising renewable energy. Before the formal public procurement started, TV Energy helped Bracknell Forest Borough Council conduct a feasibility study funded by the Energy Savings Trust. TV Energy also played a significant role when it came to attract funding to the project and in developing the renewable aspects of the specifications of the new energy centre. One funding network was the CONCERTO initiative, funded by the European Commission. BRP is the organisation leading the whole regeneration of the town centre. The energy centre was supposed to supply these new buildings with sustainable energy.

Essentially, the public procurement law serves to guarantee competition and transparency and to prevent corruption in order to economise public spending (European Commission, 1998), although the innovation friendliness in the rules has lately become a concern for policy makers. The law stipulates, for instance, how the public procurer should publish tender calls, diffuse knowledge and deal with award criteria, together with the principles that should apply for awarding contracts. One opinion about these rules is that they are unnecessarily cumbersome and bureaucratic (see Boyle, 1994). The view of the public procurers in the Bracknell Forest Borough Council was that by complying with the directives – rather than seeing them only as a hurdle to get over – they might bring something more to the scheme. For instance, compliance might attract suppliers previously unknown to the procurers that would eventually win the contract.[3] TV Energy did not emphasise the virtues of complying with the directives to the same extent. Its main concern was the technical aspects involved in promoting the development of renewable energy rather than the administrative procedures implied by the public procurement rules.

After the first step in the procurement procedure and the short-listing of four bidders, the project started to lose pace. The different views on the public procurement process created friction between TV Energy and the procurers at Bracknell Forest Borough Council, and this may have contributed to the delay of the project. The public procurers were exposed to a conflict between their legal rationality and TV Energy's paradigmatic rationality. Altogether, the delays meant that the procurers had to work in a tight time window in order to keep up with the development of the town centre. This further reduced the possibilities of coming up with innovative solutions in the interaction with the suppliers. This also put pressure on BRP, as it needed to know how the new buildings in the town centre should be configured in terms of the energy supply. The concern was that there would not be time enough to work with the winner of the contract to guarantee that

[3] This was in fact exactly what happened when a new maritime radio system was procured in compliance with the directives in Norway a few years ago (Rolfstam, 2006).

there would be an ESCO and an energy centre in place on time. For the BRP, essentially an organisation in the property business, priorities were the regeneration of the town centre and the commercial aspects of the whole project. Although BRP participated in the work to develop sustainable solutions, this would not be its first priority. One requirement it established was that the proposed energy centre scheme should be able to deliver energy six months before the new town centre was to be opened. A failure to do this would basically mean that a completed, renewed town centre would be without an energy supply. Such a situation, if it occurred, would be very costly to BRP.

The different rationalities were also manifested in the way the specifications for the tenderers were written. Here, what can be seen as a conflict between the public procurers' paradigmatic rationality and TV Energy's different rationality becomes evident. Although it is still debated, the use of functional specification (van Weele, 2002, p. 52) is often seen as a means of allowing innovative ideas to be submitted. Specifying outcomes rather than a specific technological implementation may create room for the submission of creative and innovative solutions. On the other hand, if a procurer is confident about exactly what item to procure, the use of functional specification may seem unnecessary. As was remarked in the interviews, "TV Energy put in quite a lot of detail what they wanted to see, because they thought it should be based on renewable technologies." This meant that the specifications became "[t]oo prescriptive". The effect of the tight specifications was that potential tenders involving existing technology or technology with ambitions that were not as high when it came to sustainability, were excluded. For instance, solutions based on proven commercially viable gas-fired alternatives that would still have meant energy savings in the new town centre could not be submitted. One view was that the public procurers should have encouraged supplier innovation, asking suppliers what they would propose to deliver for the town centre. According to this view, instead of explicitly demanding renewable technology, the public procurer should have encouraged submissions of such solutions.

The CONCERTO initiative and the Renaissance project essentially promoted the use of renewable energy. This environment provided a platform for knowledge sharing among the project members as well as funding aimed at contributing to the development of the individual members' projects. In that sense, the underlying paradigmatic rationality originates from these two activities, the promotion of certain behaviour (i.e. implementing sustainable technologies) and the diffusion of information. In order to get the funding for developing the renewable energy centre in Bracknell Forest, the participators had to sign an agreement. In the view of the BRP, the practical conditions provided by the CONCERTO agreement were not adapted to the conditions of commercial reality. The CONCERTO projected involved some thirty communities in Europe. The grant was actually one grant shared by these different organisations that were each developing renewable technologies in their respective regions. In the way the agreement was written, the whole grant could be revoked if one of the participants failed to deliver its part. Although the European Commission had informally communicated clearly that it would not implement those terms, the actual existence in writing of such a possibility led the BRP to refrain from signing the agreement. The pre-qualified suppliers thought the requirements connected to the funding made participation "too complicated". In addition to actually delivering the technology, they were supposed to share their experiences through written reports and by participating in training events across Europe. The position among suppliers was that their business is about supplying energy, not about tasks related to knowledge diffusion. These other tasks were also perceived as vaguely defined. In the view of the suppliers, they were being forced

to make a more or less open-ended promise in return for the funding. Another problem was related to the time schedule of the funding provided by the CONCERTO initiative. The allocated money had to be spent within a certain time frame, which was incompatible with the course of events for the regeneration project.

Ultimately, all the pre-qualified suppliers withdrew from the competition and the public procurement process was terminated before reaching the final tender stage. One important circumstance contributing to this development was the stipulations placed on the winner of the contract. The selected supplier was supposed to form an ESCO and build and run the energy centre on a commercial basis. In order to borrow money to do this, a supplier would have to produce for potential financers a proposal demonstrating that there was going to be demand for the services delivered by the new energy centre. This was not possible. The BRP, for instance, could not guarantee that several years on from the completion of the whole regeneration scheme the tenants would be using the energy supplied from the energy centre. Also, BRP would clearly stay away from a scenario in which it would have to turn down a large potential tenant because the latter had secured a supply of renewable energy from elsewhere.

Another possibility which was also brought up in the interviews concerns the role of Bracknell Forest Borough Council. Being a public agency and also a fairly significant future tenant in the renewed town centre, the Council's demand could have worked as a catalyser creating a local market for the renewable energy centre (see Hommen and Rolfstam, forthcoming). In the interviews it was suggested that such a commitment could have been included in the tender call. The view of the Bracknell Forest Borough Council, however, was that it could not make such a commitment due to restrictions in the procurement law. According to this interpretation, such an advance commitment could not guarantee that the Council would get value for money at all times. Instead, the supplier of energy for the public premises in the new town centre would be appointed through a separate public procurement process. Although it was indicated in the interviews that such arrangements have been made elsewhere in the UK, it is not the purpose here to determine this specific legal issue. What can be said, however, is that the Bracknell Forest Borough Council chose to follow a risk-aversive strategy.

Innovation is by nature an endeavour that involves uncertainty and risk. This particular project was also quite complex, in the sense that it involved a lot of different organisations. One problem, as reflected by one of the respondents, concerned the Council's capability to procure innovations. "It is not the Council's core business… it is not part of its everyday business, and it doesn't have the experience. So the Council is always considering risk regarding the innovation as well. And the Council will always choose the least risky strategy." Risk aversion is an interesting phenomenon, as it fits analytically into several rationalities. In a way it can be seen as a political rationality, as a risk-aversive position will avoid exposure to events that can threaten a powerful position. It can also be perceived as an economic rationality, as it may be regarded as a sound policy to avoid jeopardising taxpayers' money. Given the perception of a procurer as risk averse in general, it is also a paradigmatic rationality, as it would then be seen as a norm within a given prevailing institutional set-up.

The empirical material also suggests there is another aspect of the political rationality that is more risk-taking. From the beginning, the good publicity a successful project would render was clearly in the minds of the political leadership. The Bracknell Forest Borough Council's Chief

Executive, Timothy Wheadon, expected that the project would "add to Bracknell's profile as a high performing local authority and will make us stand out as a high quality town centre" (University of Reading, 2004). In interviews it was stated that "the Council is always about making things new and exciting about the town centre and that there has to be a balance. And the balance must be that it works into a timetable that is agreed." Another view, implying that the goals were set too high, maintained that "these things fail when you try to connect everything to them and make them so big".

Essentially related to the fact that the Council has limited experience in procuring innovations was the perceived lack of clearly defined goals for the project. Interviewees working for the Council stated that they "were drawn along by the agendas of … some of the other partners". "We didn't really take control and say 'This is what we want, this is how it is going to be.'" To some extent, some of the coordination problems may be explained by the fact that the leader of the Environment Group in Bracknell Forest Council, Councillor Terry Mills, died at a pivotal moment of the project. Cllr Mills was a champion of the project and it may have been difficult to find a replacement, which may in effect have reduced the high ambitions regarding renewable energy. This in turn provides an explanation for why the procurement was managed in a relatively poor manner (e.g. unclear goals, time delays, and eventual termination of the project). The ideas and visions seem essentially to have come from the private sector and more specifically, the two major property owners, Legal & General and Schroders (Bracknell Forest Borough Council, 2007). The Council's involvement, in terms of the analysis here, seems to be more of a response than an initiative. From such a perspective, the whole process at the Bracknell Borough Council can be seen as a response guided by a political rationality.

3.4 Institutional Framework of Public Procurement of Innovation

In the previous section an attempt was made to analyse the outcome of the procurement process in terms of the rationalities of the organisations involved. To a large extent, this was also an analysis of how different long-term endogenous institutions affected the procurement process. According to the model developed earlier in the paper, public procurement contracts involving innovation occur as the result of an institutional match between collaborating actors. The case studied here described developments in which such a match did not occur. In the following, the institutional framework model outlined above is discussed in the light of the case findings and the previous discussion of organisations' rationalities.

One example of a central long-term exogenous institution in this case is the public procurement law. Public procurement in Europe is regulated by EC Directives that European member states need to transpose into national law (see e.g. Williams, 2004). The current directives (Directive 2004/18/EC and Directive 2004/17/EC) were adopted in May 2004. The directives specify (among other things) different procurement procedures and their use, rules on publishing routines for tender calls, and how evaluations of tenders should be performed. Directives also exist for those situations in which bidders wish to challenge a decision made by a public procurer. These Remedies Directives are Directive 89/665/EEC for the Classical Sectors and the Directive 92/13/EEC for the Utilities Sector. In that sense, as would be expected for exogenous institutions, enforcement rules exist that lay out the principles for punishing any violation of the institutions.

As mentioned earlier, attempts have been made to study how the procurement directives affect the possibilities for public agencies to procure innovation (Edquist et al., 2000; Rolfstam, 2007). These studies, however, tend to view the relation between the law and public procurement of innovations as a single variable causality. The current case seems to justify a challenge to such a view. For instance, the different rationalities regarding the application of the public procurement law delayed the project. When it came to the application of the law, Bracknell Forest Borough Council followed its own paradigmatic rationality, as did the other organisations. The difference in rationalities, rather than the procurement rules per se, created the delay and some of the problems that eventually forced the public procurers to terminate the procurement process. In other words, it was a mismatch between long-term endogenous institutions among the collaborating organisations that obstructed their attaining the intended endogenous fixed-term institution, i.e. a public procurement contract for innovation.

This case also illustrates the relation between long-term exogenous institutions and long-term endogenous institutions. Technically speaking, the public procurement law is universal, i.e. it affects procurement activities carried out by any public actor. Still, the implications of the law, its virtues, the degree to which it is useful, etc., are determined by the rationality in any given organisation. The Bracknell Forest Borough Council concluded that it could not guarantee demand for the sustainable energy because of the procurement rules. The view of the public procurers at Bracknell Forest Borough Council was that the rules might support the process in general. For TV Energy, in possession of a clear view of the expected technical properties of the energy centre, the procurement procedure was a cumbersome element causing delay of the project.

As stated earlier, the essential purpose of fixed-term exogenous institutions is to induce change of behaviour on lower institutional levels. In situations characterised by disparate views due to a mismatch between long-term endogenous institutions, as in the present case, the need for fixed-term endogenous institutions becomes clearly discernable. The recent past offer several examples of initiatives set up to promote the use of public procurement as a means to stimulate innovation. The European Commission funded a research project devoted to finding good practices of innovative public procurement (Edler et al., 2005). The result was also presented to representatives from EU member states at a conference in Brussels in December 2005. The results have subsequently been used to feed into other projects. For instance, in 2007, within the Open Method of Coordination framework, a two-year initiative including partners from ten EU countries was set up to create awareness and to diffuse knowledge about practical tools for innovative public procurement. In the UK, HM Treasury and the Treasury Taskforce have published innumerable reports related to procurement projects of the type studied here to provide guidelines for procurement practice (Braun, 2003). The promotion of public procurement as a means to stimulate innovation has been included in several high-level reports in UK, for instance the Cox Review published in 2005 and the Innovation Report by what was then the Department of Trade and Industry in 2003. Public procurement of innovation has increasingly become a concern in the National Health Service (NHS) as well.

In the analysis in the previous section the CONCERTO initiative and its Renaissance project was dealt with as a participating organisation. From the perspective of the Bracknell Forest Borough Council and the institutional framework model, this network can also be treated analytically as a fixed-term exogenous institution. The CONCERTO programme clearly demonstrates an ambition

to change behaviour at lower institutional levels. The participating organisations were encouraged and also given incentives through the funding to have high ambitions for the renewable aspects of the technology to be used. In terms of this specific public procurement project, however, this behaviour came partly into conflict with a generic ambition to secure an energy supply. Had the specifications been more functional and less specific, there would have been a possibility for tenders based on technologies which, although not fully renewable, would still be better options than just connecting to the grid. It is not the aim here to develop further a discussion of the priorities and choices in relation to environmental issues in general. What is of interest is this story, understood as a goal conflict between two fixed-term institutional targets, innovation in general and the promotion of renewable energy. This, in turn, underscores the need for cross-sector and interdisciplinary councils of innovation and competence building as suggested by Lundvall and Borrás (2005). Such organisations could possibly contribute to a more harmonised fixed-term exogenous institutional set-up if the practical requirements of the public procurement process were taken into account.

4. Conclusions and Recommendations

This paper describes and analyses aspects of a case of public procurement of innovation for a new energy centre intended for the new town centre in Bracknell Forest, UK. The tender call was published in 2005 and cancelled the year after. The project eventually had to be terminated, ultimately because the suppliers that had participated in the procurement process withdrew.

The analytical framework used in the paper develops an institutional model inspired by Coriat and Weinstein (2002). The model distinguishes between four institutional types: long-term exogenous institutions, fixed-term exogenous institutions, long-term endogenous institutions and fixed-term endogenous institutions. The analysis also captures a certain type of endogenous institution associated with the different organisations that were involved in the project: the organisations' rationalities (Van de Donk and Snellen, 1989; Gregersen, 1992). The advantage of this theoretical endeavour is that it not only allows for explanations of innovation that take into account exogenous institutions such as public procurement law, but it also prompts a search for explanations of behaviour due to endogenous institutions, i.e. institutions stemming from within an organisation.

The analysis of the case identifies different stakeholders with differentiated rationalities (Lundvall, 1992, p. 46). These also came to affect the outcome of the project. In order for an agreement to be reached and a contract to be signed by a public procurer and one or several suppliers, in the terms of the model developed in this paper, there has to be an institutional match between the partners. In this case such an institutional match did not occur. There were, for instance, different views stemming from each organisation's rationality on how the public procurement directives should be applied in the project. The procurers at Bracknell Forest Borough Council viewed the procurement directives as a support to the procurement process, where other collaborators did not. With the funding from the European Community came a knowledge diffusion scheme, where experiences from the project were supposed to be communicated elsewhere in Europe. The participating companies regarded such schemes as outside their interest and scope. There were also critical views on the administrative obligations

tied to European Community funding. To some extent, the project also came to lack determined leadership from the local council. The tender call was specifically demanding renewable energy. This prevented less "green" but commercially more viable options from competing for the contract. If a more functional specification had been used in which these options were included, it might have been possible for the procurers to find a winner and award the contract.

Thus, the case studied here proposes that public procurement of innovation may be affected by endogenous organisation-specific institutions encapsulated by the organisations that participate in a specific procurement process. As was suggested in the previous paragraph, a necessary condition for a successful public procurement project seems to be that there is an institutional match between the organisations finally selected as supplier(s) and the public procurer. Also, if the procurement process does not achieve such a state, one could expect that the possibilities for a successful project in public procurement of innovation would be diminished. The understanding of endogenous institutions as evolutionarily determined and therefore organisation-specific, in turn underscores the specificity of public procurement processes involving several different collaborating organisations. Depending on the composition of organisations which participate in a specific procurement project, the constitution of institutions required to achieve an institutional match may therefore vary. A general implication of these assertions, which also find support in earlier research, is that "co-operative technology procurement is especially problematic, compared to other types, in terms of external governance, the management of technological risk, and the articulation of demand" (Hommen and Rolfstam, forthcoming, p. 28).

This paper is aligned with the position that "successful public sector pacing [of innovation] requires both maintenance and renewal of learning processes" (Gregersen, p. 144). The paper also contributes some insights in that regard, especially in the light of the increasing interest among policy makers in EU in promoting public procurement as an innovation policy instrument. Recently, such initiatives have typically had a tendency to target public agencies only. Following from the case studied in this paper, learning should involve not only public agencies but also other organisations that may in practice affect the outcome of public procurement processes. Potential suppliers, i.e. private firms and non-governmental agencies, are an example of such organisations. Further, efforts to asses the need for institutional redesign and harmonisation of rationalities should be considered in relation to organisations of this kind, not only to public agencies. These recommendations reflect a view which implies that in order to understand public procurement of innovation fully, and what is required for successful results, a wider perspective should be adopted. If public procurement of innovation is defined strictly as something that occurs when a public agency places an order for an innovation, many important components of this phenomenon will be missed.

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Paper IV

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

Max Rolfstam[1], Wendy Phillips[2], Elmer Bakker[3]

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. Although it is probably still early in the diffusion process, different institutional factors are identified which have had an affect on the adoption behaviour up to this point.

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

[1] Lund University Box 118 SE-221 00 LUND Sweden E-mail: max.rolfstam@circle.lu.se
Phone: +46 (0) 46 2220388 Fax: +46 (0)46 2224161
[2] Centre for Research in Strategic Purchasing and Supply School of Management University of Bath Bath, BA2 7AY United Kingdom E-mail: W.E.Phillips@bath.ac.uk Phone: +44 (0) 1225 386650 Fax: +44 (0) 1225 383223
[3] Centre for Research in Strategic Purchasing and Supply School of Management University of Bath Bath, BA2 7AY United Kingdom E-mail: E.Bakker@bath.ac.uk Phone: +44 (0) 1225 383152 Fax: +44 (0) 1225 383223

stimulate private sector innovation has been increasingly emphasised the last decade (Edquist et al, 2000; 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 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. Edler et al, 2006). 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 a systemic 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. The research question addressed in the paper is formulated as follows. How does coordination (or the lack thereof) among different kinds of institutional governance mechanisms affect performance in the public procurement of innovations?

2. Theoretical Background

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 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

Public procurement as a carrier of 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 sustainable procurement (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 communicated (Edler and Georghiou, 2007).

The assertion propagated here 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 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. 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 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. 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). By emphasising institutions, the decision weather or not to adopt or reject an innovation will be treated analytically as institutionally determined.

What is problematic, however, is that although many scholars acknowledge that institutions are important for understanding innovation, no consensus as to what is meant by institutions or institutional analysis has been reached (Hollingsworth, 2000; Edquist and Johnson, 1997) and "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). 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. 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 student 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).

In principle any institution, be it a formal law or a family tradition exists because it reduces uncertainty and relives cognitive and other resources. The reason why an institution exists is that it is somehow beneficial for its endorsers. 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 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 currently existing institutions exist because of historical success. Institutions are also over time changed or even abandoned. This refinement process is most clearly visible 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 may also be regarded as something that evolves 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). This line of thinking raises a need to also consider

institutional aspect of introducing an innovation in an organisation – i.e. what some authors refer to as institutional coordination.

2.4 Institutional Coordination

Innovation theory based institutional perspectives bring 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) raises 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).

Metcalfe (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). For the adaptive policy-maker, moreover, the central problem is not market failure but rather the "evolutionary paradox that competitive selection consumes its own fuel, destroying the very variety which drives economic change" (ibid, p. 30). 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). Institutional coordination that should be taken into account concerns also the coordination sometimes required to make public procurement of innovation successful. This may involve "developing, mobilizing, and coordinating competence among multiple buyers" (Hommen and Rolfstam, forthcoming, 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.

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 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 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 military sector as well as the education sector. One selection criteria was the judged possibility to gain access to interview persons and data. In the English case such access was secured through to the rich network of practitioners connected to the research environment at the Centre for Research in Strategic Purchasing and Supply (CRISPS). 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.

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 institutional approach on how public agencies adopt innovation comes the interesting question of how adoption may be propelled or hindered because of prevailing institutions. Within organisations different institutional elements such as internal rules, formal power structures, work descriptions, assigned budgets, contracts, incentive structures etc. may affect to what extent information is utilised by individuals. It should be noted that these institutional barriers may be unintentional and vary in duration and scope. Analysing institutional elements potentially inhibiting diffusion of innovation may not be sufficient for the purposes in this paper. Also attempts made to overcome institutional barriers should be taken into account.

4. Innovation Diffusion in a Large Health Organisation

This section starts with an introduction of the case, sections 4.1 and 4.2. This is followed by a discussion on the characteristics of the innovation to be diffused in. section 4.3 Two institutionalised structures are discussed in section 4. The section concludes with a discussion on endogenous institutions may affect 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 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 exist, 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; it can also be therapeutic, i.e. that indwelling catheters need to be used to help curing patients; they may be organisational, 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; and

observability (Rogers, 195). In the following 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. Characteristics of the innovation can be summarised as follows. The Bardex catheter is a catheter with a silver coating that is claimed to reduce the risk of getting a urine tract infection. It is used in the same way as a traditional catheter. 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.

Diffusion theory also highlights the role of communication in diffusing knowledge of an innovation. 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" (Roger, 1995, p. 18). The 'message' about the Bardex catheter is communicated predominantly through clinical evidence and publications of health care centres which have introduced this technology and then published results of their evaluation in peer-reviewed journals. Many early studies come from USA, but also new British studies are being conducted. Bard sales representatives also communicate the message about the Bardex catheter. Information about the Bardex catheter has also been communicated in reports written by different organisations within the NHS. As emphasised in institutional theory, 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). In the following some institutional aspects of the system are discussed.

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 and 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 and is to encourage industry to come with ideas that would tackle the problems related to health care associated infection. The panel's task is 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 IC silver alloy coated hydrogel catheter, supplied by Bard Ltd. This was a catheter originally developed and sold on the US market. The potential of this innovation can briefly be summaries as follows. One of the most common types of health care associated infections is CAUTIs. The use of catheters may disturb the body's natural defences and thus cause bacteria development. What distinguished the Bardex catheter from conventional catheters was 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. 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 is strictly an indicative function. This means that statements are made based on the 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 product. In the general case, the decision to use the Bardex catheter is the clinician's. 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

A trend in current institutional analysis is that it typically tends to be limited to formal institutions, i.e. the legal and regulatory framework associated with a given innovation process. This is problematic as the concept is much broader in scope (Edquist and Johnson, 1997; Hollingsworth, 2000). Thus, rather than applying this exogenous view (c.f. Jacoby, 1990) of the role of institutions, some account of the role of endogenous institutions for promoting the diffusion of innovations are discussed below.

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, up to this point, 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 is associated with what Coriat and Weinstein (2002) calls "type A" institutions. The objective of such long term institutions is "to rule the reproduction of the society as a whole, considered in the long run" (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 also underline the necessity for conducting research that would provide such evidence.

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. 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. Such decisions require the existence of innovation champions on the hospital trust board level.

Another barrier relates to the time delay associated with any framework agreements. Even if an adopting unit would like to change catheter, they generally wait until the 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.

5. Concluding Remarks

This paper provides a preliminary account of the diffusion of the Bardex IC silver alloy coated hydrogel catheter into the National Health Service in England. This is a diffusion process that has probably just started and it is still early to make statements on the degree of diffusion in the NHS. Also, to summarise in a paper the developments within one of the largest organisations in the world is of course an endeavour associated with limitations. Still some elements of the system of individuals, groups, organisations, and/or subsystems (Rogers, 1995, p. 23) have been touched upon here which provide for some suggestions as follows.

In the paper, some structures treated here as institutional barriers for the diffusion of the Bardex catheter were discussed. One such institutional barrier relates to 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 for a new product to become introduced into the NHS is clear scientific evidence verifying its benefits. One view prevailing within the NHS was that the evidence was not sufficient in order to justify adoption. The diffusion of an innovation is also affected by financial considerations. The Bardex catheter was introduced at a higher price than conventional catheters currently in use. The institutional problem however concerned the way budgets are organised rather than the price difference itself. One circumstance which was also regarded here as an institutional barrier comes from the fact that there is no clear champion for catheters as would be the case for other innovations more clearly associated with a certain medical speciality. The decentralised organisation of the NHS where trusts are independent and autonomous were also seen as a barrier in the sense that a decision to adopt a certain innovation typically is made locally.

Several examples of institutional re-design and coordination were also discussed in the paper. 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. Although this increased the use of the Bardex catheter, the adoption rate the first years were still rather moderate. As a response to the perceived deficiencies regarding evidence, several studies where more evidence has been collected have been made. Two examples of institutional elements related to re-design in hospitals were also discussed. One was a prevailing clear awareness by hospital management of the problem with urine tract infections and a determination to resolve it. Another measure discussed that was used to introduce the Bardex catheter was authority innovation-decision, i.e. a central decision to exclude from the supply system any other catheters but the Bardex catheter. Actions to overcome problems related to silo-budgeting were also discussed.

One preliminary conclusion that can be made from this case is that 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. This in turn harmonises well with the recently made initiative 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. It may also be necessary to redesign the institutional set-up and coordinate institutional governance in order to facilitate diffusion. 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.

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