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Public procurement and innovation—Resurrecting the demand side

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Abstract

Demand is a major potential source of innovation, yet the critical role of demand as a key driver of innovation has still to be recognised in government policy. This article discusses public procurement as one of the key elements of a demand-oriented innovation policy. The paper starts by signaling the new significance of public procurement for innovation policy strategies at the EU level and in a range of European countries. It then defines the concept of public procurement and embeds this concept within a taxonomy of innovation policies. The rationales and justifications of public procurement policies to spur innovation are discussed, followed by a consideration of the challenges and potential pitfalls as well as appropriate institutional arrangements and strategies, including some recent empirical examples of good practice. It concludes by confronting the public procurement approach with two of the most common objections to it and by considering future prospects.

Keywords: Innovation policy; Public procurement; Demand and innovation; Concepts of demand-oriented policy; Public sector innovation

1. Introduction

Demand is a major potential source of innovation yet the critical role of demand as a key driver of innovation has still to be recognised in government policy. Public demand, when oriented towards innovative solutions and products, has the potential to improve delivery of public policy and services, often generating improved innovative dynamics and benefits from the associated spillovers. Nonetheless, public procurement as an innovation policy has been neglected or downplayed for many years. In the 1970s, a number of empirical studies explored the meaning of procurement for innovation (for an overview, see Mowery and Rosenberg, 1979; Rothwell and Zegveld, 1981; Rothwell, 1984). Rothwell and Zegveld (1981) compared R&D subsidies and state procurement contracts without direct R&D procurement. They concluded that, over longer time periods, state procurement triggered greater innovation impulses in more areas than did R&D subsidies (see also Rothwell, 1984, p. 330). Geroski (1990, p. 183) also analysed the quantitative and qualitative meaning of state demand for innovation and concluded that procurement policy "is a far more efficient instrument to use in stimulating innovation than any of a wide range of frequently used R&D subsidies".

In a more recent survey of more than 1000 firms and 125 federations, over 50% of respondents indicated that new requirements and demand are the main source of innovations, while new technological developments within companies are the major driver for innovations in only 12% of firms (BDL, 2003). An analysis of the Sfinno data base collecting all innovations commercialized in Finland during between 1984 and 1998 (Palmberg, 2004;

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Saarinen, 2005) shows that 48% of the projects leading to successful innovation were triggered by public procurement or regulation.[1]

Not only demand as such, but also the interaction between demand and supply has crucial implications for innovation dynamics. Starting with von Hippel (1976) and Mowery and Rosenberg (1979, p. 148), a range of studies have argued that a major task for systemic innovation policy is the organisation of a discourse between users, consumers and others affected by innovations in order to articulate and communicate preferences and demand to the market (see also Smits, 2002). Furthermore, the scale and characteristics of demand in a given location have been recognised as major determinants of the competitiveness of locations and their innovation dynamic (e.g. Porter, 1990).

In principle, the potential for using public procurement as an instrument for innovation is considerable. At 16.3% of the combined EU-15 GDP (Georghiou, 2004), public procurement represents a key source of demand for firms in sectors such as construction, health care and transport.[2] Nonetheless, with a few exceptions, for many years the potential offered and challenges posed in using public procurement for innovation have been largely ignored in innovation policy, both conceptually and in practice. It has been argued that the introduction of more stringent competition regulations across the European Union has proven a major factor in the declining use of this instrument (Edquist et al., 2000). The extent of relative decline is indicated by statistics showing EU procurement four times less than the US in civilian sectors and two times less when defence is taken into account (Directors Forum, 2006). However, in the last 3–4 years, the issue has received renewed attention, especially at the EU level but increasingly so at national level in a number of Member States.

This article analyses the concept of public procurement as an integrated tool of innovation policy.[3] It explores the factors which have led to this renaissance of what has been considered a mature, if not obsolete approach, and its importance within the portfolio of demand-side policies. The paper starts by signalling the new significance of public procurement for innovation policy strategies at the EU level and in a range of European countries. It then defines the concept of public procurement and embeds this concept within a taxonomy of innovation policies. The rationales and justifications of public procurement policies to spur innovation are discussed, followed by a consideration of the challenges and potential pitfalls as well as appropriate institutional arrangements and strategies, including some recent empirical examples of good practice. The paper concludes by confronting the public procurement approach with two of the most common objections to it and by considering future prospects.

2. A new wave of interest: public procurement in the innovation policy debate at EU level

At European Union level a new interest has emerged in the meaning of demand-side approaches to innovation and, more concretely, in the use of public demand as an engine for innovation. The emphasis has been on the link between procurement and perceived under-investment in R&D by business. The way in which procurement has entered the policy agenda is in itself an interesting case-study in how an issue gets taken up by the system. Following the work of an expert group (Georghiou et al., 2003), procurement for innovation was incorporated as an element of the European Commission's Research Investment Action Plan to raise R&D expenditure to the 3% Barcelona target (European Commission, 2003). Follow-up work includes a specific action to support the development and diffusion of information to public buyers (for example, on best available technologies) and an initiative to set procurement in the broader context of "policy mixes", thereby exploiting synergies with other research and innovation policy measures, for example, technology platforms.

The issue gained further momentum within Europe when early in 2004 three governments issued a position

[1] There is further consensus in the literature, that military demand in systematic conjunction with military R&D programmes was the key to the development and diffusion of many technologies especially in the US (Internet, many further ICT technologies, Global Positioning System (GPS) and other satellite technologies (Alic et al., 1992; James, 2004; Wessner, 2004) and – lately – diagnosis and therapy methods within the military project Bioshields (James, 2004, p. 35)). However, the economic efficiency of procurement resting on military needs and only indirectly spilling over to private markets has been strongly challenged (Wessner, 2004; Cohen and Noll, 1991; Kelley, 1997; DOD, 1999; James, 2004, p. 29). Therefore, and because of the peculiarities of the defence market, defence procurement will not be dealt with in this article (see James, 2004 for an overview).

[2] There are alternative figures for the size of public procurement in different EU countries, depending on different assumptions concerning inclusion of all government levels. Audet (2002), for examples, reports slightly lower shares of public procurement within GDP. He also shows that the shares differs between the EU countries, in his calculation ranging from almost 5% in Belgium to slightly more than 13% for Sweden.

[3] For a broader overview on demand oriented measures in general, including the support of private demand, see Edler (2007a, 2007b, in press).

paper to the European Council which included a call for using public procurement across Europe to spur more innovation (French/German/UK Governments, 2004, p. 7). In November 2004 the "Kok Report", which was reviewing progress on the Lisbon strategy, recognised that procurement could be used to provide pioneer markets for new research and innovation-intensive products (Kok et al., 2004). The March 2005 European Council endorsed the mid-term review of the Lisbon strategy and the proposal to make jobs and growth its central focus and explicitly called on Member States to renew their focus on public procurement of innovative products and services (European Council, 2005). A new impetus for demand-side innovation policies was provided by the Aho Group Report "Creating an Innovative Europe" presented to European leaders at their Spring summit in 2006 (Aho et al., 2006). The Panel, previously mandated by the leaders to report on ways to accelerate the revised Lisbon Strategy, argued that an R&D-driven strategy was insufficient and advocated instead a four pronged approach focused on the creation of innovation-friendly markets, strengthening R&D resources, increasing structural mobility, and fostering a culture which celebrates innovation.

Central to the Group's approach was the observation that the reason business is failing to invest enough in R&D and innovation in Europe is the lack of an innovation-friendly market in which to launch new products and services. To create such a market they recommended actions on harmonised regulation, ambitious use of standards, a competitive intellectual property rights regime and driving demand through public procurement. Large-scale strategic actions were called for to provide an environment in which supply-side measures to raise investment in research and innovation can be combined with this process of creating an innovation-seeking demand and a market. The Group identified several application areas: e-Health, Pharmaceuticals, Energy, Environment, Transport and Logistics, Security, and Digital Content. In order to secure implementation, the Group called for the appointment of an independent High Level Co-ordinator to orchestrate European action in each area across Member States, different parts of government and the Commission, business, academia and other stakeholders.

The recommendations of the Aho report were widely endorsed. Again, the EU Council in Spring 2006 explicitly backed the report and called for the support of markets for innovative goods and services, including public procurement (European Council, 2006, p. 6), a point reiterated in the European leaders' informal summit on innovation at Lahti, Finland, in October 2006. The Finnish Presidency had opened its programme with an informal Ministerial meeting at which the background paper was entitled "Demand as a Driver of Innovation—Towards a More Effective European Innovation Policy" (Finland's Presidency, 2006). This focussed on "horizontal" measures to stimulate demand for innovation such as regulation, standards and IPR but also raised the possibility of using public procurement for innovation related purposes.

Further action at EU level included a broad study on public procurement activities across Europe and in selected non-EU countries (Edler et al., 2006) that feeds into a Commission Handbook on Public Procurement for Innovation published in spring 2007 (European Commission, 2007). In September 2006, the Commission issued a strategic innovation policy paper highlighting the importance of public procurement for innovation and the creation of lead market, especially in sectors in which the state is an important purchaser (European Commission, 2006a). A specific initiative in the ICT sector has been the proposal to explore "pre-competitive procurement of R&D" as an instrument exempt from some of the competition restrictions affecting procurement of innovative goods and services.

The increased interest in public demand to spur innovation is also evident at national level. The UK has the most systematic and advanced approach. The UK Government's Innovation Report of 2003 proposed a series of measures aimed at increasing the research and innovation impact of public procurement (DTI, 2003a). Consequent actions on various levels and including various sectoral ministries include the production of a guide by the Office of Government Commerce on "capturing innovation" (OGC, 2004) to make innovation procurement an issue at the operating level. The procurement strategies of the National Health Service and the Ministry responsible for the environment (DEFRA) are leading examples of efforts to change practice. Studies and/or promotional activities for innovative procurement have been carried out by the Irish Science and Technology Policy Agency, Forfás, in Spain, by the COTEC Foundation, and in the Netherlands by an internal group of experts set up by the government. In Germany the "Impulse Group Innovation Factor State" has been working on the possibility of promoting innovation dynamics from the market place by adjusting procurement practice in general, as well as through strategic procurement measures in selected technology areas (e.g. BMWI/BME, 2006). The absence of an explicit policy of procuring innovations does not signify a lack of action, as many countries have started activities especially in the ICT sector, without a framing strategy (Edler et al., 2006, p. IX).

Why, one might ask, has the recent interest in public procurement to spur innovation been so great? We may infer from the critical tone of the above-mentioned policy documents that the principal driver is a sense that traditional supply-side innovation policies are insufficient to meet the challenges posed in promoting competitiveness. Before, outlining the conceptual justifications, we position public procurement within the toolbox of innovation policy.

3. Public procurement in the context of innovation policy instruments

Since the 1990s innovation policy has been perceived as a means to act on and improve the performance of innovation systems. As well as explicit innovation policies, many other measures also affect innovation, though this is not their main object. This group includes macroeconomic policies, education more generally, regulation (e.g. pollution or health and safety), and competition policy. Crucially this group also includes public procurement.

There are long-running debates concerning the degree to which it is legitimate for governments[4] to intervene in the economy in support of innovation. Economic rationales for innovation policy rest on two main foundations, market and system failures, which in some senses compete and in others are complementary. We shall return to this discussion below in the context of public procurement.

The *innovation systems* perspective emphasises the significance of having a large and differentiated group of innovation actors and an enabling framework for learning-oriented interactions between them. Thus, policy is primarily aimed at optimising the interaction of various "components of the system", i.e. industry, basic research, applied research, financing *and demand* and at creating innovation-friendly framework conditions (Arnold et al., 2001). This understanding makes it clear that if innovation policy is to prove effective within the system, it must be capable of acting upon a large variety of actors and linkages and thus itself be differentiated. An important dimension of the systems perspective is that it fully integrates the *demand for innovations* on a conceptual level (for many Nelson, 1982; Lundvall, 1988, 1992). One would have expected that the effect of this perspective would be that demand should also have moved into the focus of innovation policy debate, yet if anything the range of policies directed towards demand has narrowed during the period in which the innovation system approach has become the received wisdom.

The lack of a demand-side orientation in innovation policy is reflected in two databases compiled on the basis of inputs from national correspondents under the sponsorship of the European Commission. The first is the Commission's "Trend Chart" (http://trendchart.cordis.lu/), which monitors innovation policy in EU member states and other regions and provides a comprehensive list and detailed information on national innovation policy measures. In total, this classification of innovation policy measures extends to 17 different types of measures. Not one of these types is *explicitly* oriented towards demand. Demand subsidies, state procurement of innovative goods and similar measures are not seen as *innovation policy* instruments in this categorisation. In addition, an inspection in 2005 of the various measures in those categories, which could in principle include the demand side, revealed that only in a very small number of approaches is the user directly promoted or supported.[5] A second, more narrowly defined, database of business support measures, classified information and consulting activities, training and education, finance, industrial premises and environment and strategic services (http://europa.eu.int/comm/enterprise/smie/overviewbytype.cfm) also shows little activity in support of technology diffusion. This cursory overview indicates that despite the inclusion of the user-perspective in innovation literature (Lundvall, 1988, 1992; for an overview, see Smits, 2002), conceptually very little consideration is paid to demand in innovation *policy*—while supply-side measures are highly differentiated.

In Plate 1, we present a first taxonomy that attempts to show both demand and supply-side innovation policy measures, and also to emphasise that broader policies not specifically targeted at research and innovation (here called framework conditions) can also influence these activities. For our purposes here, demand-side innovation policies are defined as *all public measures to induce innovations and/or speed up diffusion of innovations through increasing the demand for innovations, defining new functional requirement for products and services or better articulating demand*. Our taxonomy already indi-

[4] The term government here encompasses all levels including national, regional and supra-national and combinations thereof in multi-level governance.

[5] A search of the Trendchart's policy measures in 2007 indicates only one mentioning general procurement (access for French SMEs to defence procurement) and six using the term in the context of R&D procurement (http://trendchart.cordis.lu/tc_search_site.cfm).

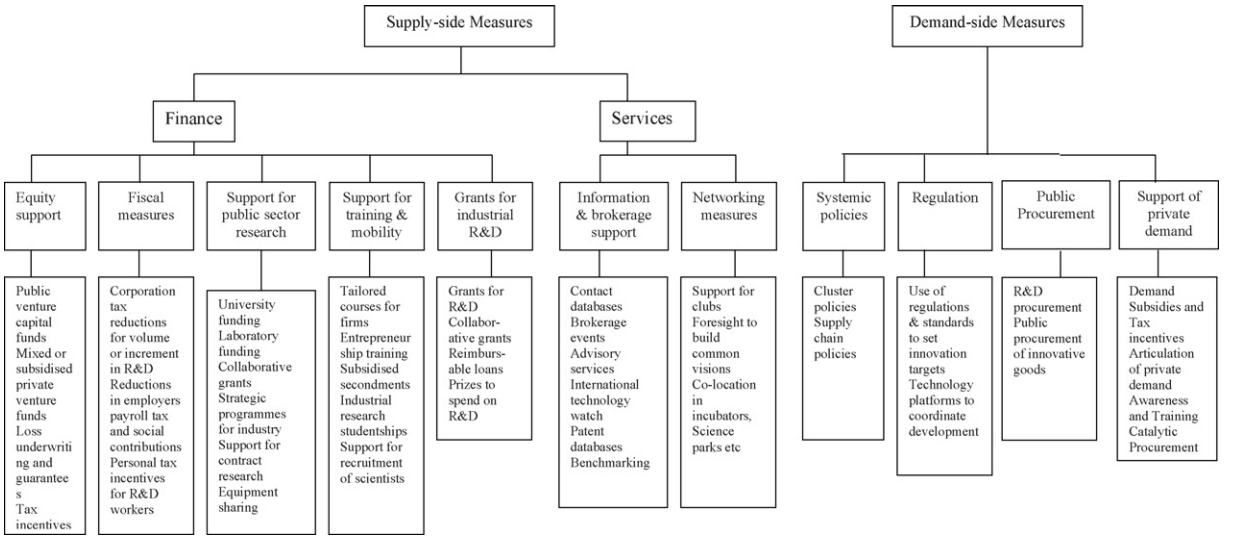

Plate 1. Taxonomy of innovation policy tools.

cates that if conceptualised in their innovation policy dimension—demand measures may be differentiated in the same way as supply-side measures (see Edler, 2007a, 2007b, in press), and that public procurement is only one of a range of measures.

It may be seen that demand-side policies can be presented in four main groupings, systemic policies, regulation, public procurement and stimulation of private demand. It is self-evident, that, as with any taxonomy, this is a simplified picture of reality. In particular, there are many policy measures that combine individual measures. As will be seen further below, public procurement can be a cornerstone of a co-ordinated and technology or sector specific mix of policies. Furthermore, in this paper, we focus on procurement, but it should be stressed that demand-side innovation policies also rest strongly on the use of regulation and standards and more broadly on the concept of promoting lead markets (Blind et al., 2004; Edler, 2007a; Georghiou, 2007). We include systemic policies in the demand-side category because of their critical role in bringing users and suppliers together.

4. Forms of public procurement

Public procurement of innovation as a strategy in innovation policy can take different forms. We can distinguish general procurement practice versus strategic procurement, direct public procurement (where the goods or services are exclusively for public use) versus catalytic procurement and, finally, commercial versus pre-commercial procurement.

4.1. General versus strategic procurement[6]

In state procurement two levels may be distinguished, which, in the literature at least, are usually not distinguished. At the first level, government procurement is *generally* organised such that innovation becomes an essential criterion in the call for tender and assessment of tender documents. Such an approach is being tried at present by the UK. As a rule, central procurement offices are generally responsible for procurement. They are located either in ministries of the interior or finance, but not in the ministries responsible for innovation policy.

The second level, *strategic* procurement, occurs when the demand for certain technologies, products or services is encouraged in order to stimulate the market. Strategic procurement is as a rule associated with sectoral policy and therefore to a large extent again is neither initiated nor co-ordinated by the ministries responsible for innovation.

A systematic utilisation of both forms of government procurement calls for co-ordinated action, i.e. co-ordination between various ministries and authorities and their admittedly widely different targets and incentive structures. We will return to these conditions below. We should also note the association of state procurement with the broader issue of innovation in public services,

[6] This and the following paragraphs are based on Edler (2007b, in press).

itself connected to public sector reform with, for example, increased outsourcing from private suppliers. The interface with the customer or user is identified as one of the key distinctive factors in public service innovation (Koch and Hauknes, 2005).

4.2. State procurement in connection with private users

There are procurement strategies where the state buys, not only to fulfil its own (original) mission, but also to support private purchasers in the decision to buy (Rothwell, 1984). So-called co-operative procurement occurs when government agencies buy jointly with private purchasers and both utilise the purchased innovations. Catalytic procurement occurs when the state is involved in the procurement or even initiates it, but the purchased innovations are ultimately used exclusively by the private end-user.[7] The crucial feature of catalytic procurement is that while the state often itself appears as buyer, the real market penetration effect is achieved by subsequent private demand. An example of this is the use of market transformation programmes in the energy sector in Sweden in the 1990s (Neji, 1999).

4.3. Commercial versus pre-commercial procurement

The desire to use procurement for innovation has led to new initiatives, especially at European level, that have further differentiated public procurement approaches. The basic idea behind public pre-commercial procurement is that it targets innovative products and services for which further R&D needs to be done. Thus, the technological risk is shared between procurers and potential suppliers. By definition, this means that potential producers are still in the pre-commercial phase, the products and services delivered are not "off the shelf". In practical terms the procurement in fact is an R&D service contract, given to a future supplier in a multi-stage process, from exploration and feasibility to R&D up to prototyping, field tests with first batches and then, finally, commercialisation.

The more innovative or idiosyncratic an innovation is, the more likely pre-commercial procurement can be appropriately applied. Within the pre-commercial stages and given that the benefits of the R&D contract are not solely for the contracting authority and the contract is not entirely paid for by the contracting authority, the WTO General Procurement Agreement (GPA) and the relevant European Directives do not apply (for details, see Bos and Corvers, 2007). This is the major difference from commercial procurement. The advantage in terms of innovation generation is that it gives procurers more freedom of selection, definition and interaction. The justification for this more flexible approach stems from the argument that R&D-intensive procurement needs more intensive interaction and cannot be judged on the basis of written specifications and proposals. To preclude monopolistic structures resulting from pre-commercial procurement, at least two competitors should enter the field-test stage. The pre-commercial procurement scheme being discussed at European level follows US approaches that have been implemented for many years by US multi-stage, multi-competitor R&D programmes, not only in the defence sectors (DARPA/DOD), but also in other areas such as energy, transport, health and in the cross-sectoral Small Business Innovation Research Programme (SBIR) (Directors Forum, 2006).

5. Rationales for applying public procurement as an innovation policy tool

The justifications and rationales for the use of public procurement to spur innovation relate to three levels: first, public procurement is a major part of "local" demand, which constitutes a major factor in the location decision of MNEs and in the inclination to generate innovations in a given location. Second, there is a range of market and system failures affecting the translation of needs into functioning markets for innovative products, and public procurement can prove effective in redressing this. Thirdly, the purchase of innovative solutions offers a strong potential for improving public infrastructure and public services in general.

5.1. The importance of local demand: lead markets and MNE location decisions

Domestic demand is a prime source for enhancing the competitiveness of locations and the enterprises therein. As Porter has shown in his pioneering work "Competitive Advantage of Nations" (1990), the *conditions of domestic demand* play a crucial role in the innovation dynamic of countries. Next to factor endowment, the industrial structure, and firm strategy (competitive situation), sophisticated and challenging demand is one of

[7] The classification of public procurement into public, catalytic and co-operative procurement has been coined by Edquist and Hommen (1998) and is based on the theoretically founded and empirically productive work on the innovation-inducing procurement system which was presented by a European team of analysts at the end of the 1990s (see Edquist et al., 2000, and also Rolfstam et al., 2005).

four key variables determining the attractiveness and performance of locations. Demand conditions also relate to the size of markets, with larger markets enabling local producers to reach economies of scale early on, and allowing more diverse feedback from users, etc. More importantly, demand conditions are determined by the sophistication of demand, which, in turn, drives producers to innovate, to meet new needs or regulations repeatedly, or in which an innovation-friendly culture is receptive to innovative products. Apparently, in each nation and even region, the quality of the demand for innovations and the inclination to adopt innovations is different, as evidenced by a survey from the World Economic Forum and other work (WEF, 2002; Tellis et al., 2003; early: Rothwell, 1984). As early as 1982, Nelson had argued that the bulk of new technology based companies in the US in the 1970s resulted from regional and national markets demanding innovations and accepting risk.

The inclination of populations and governments to absorb innovations at a certain location is shaped by many factors, the discussion of which is beyond the scope of this paper. However, there are locations where populations are more inclined to purchase and apply innovation than those from other regions. In Finland, for example, it has been shown that consumers and government traditionally tend to act as lead users and as prime movers when it comes to buying and applying new products and services. This has made the country for decades now a prime location for the introduction and diffusion of consumer electronics, and consequently has created a fruitful environment for the production of such products (Ebersberger, 2007). Thus, some countries are more internationally competitive in the areas in which they display challenging, future-oriented and international leading demand.[8] A strong factor endowment alone, i.e. the supply side, is not sufficient for sustainable, leading edge development and production.

This has also been demonstrated in the "lead user" concept of – among others – von Hippel.[9] Early users take the risk of working with a technology that may not be fully optimised in return for access ahead of their competitors or for achieving a desired solution to a problem more quickly. Innovators benefit from the learning and feedback that this environment offers. For small firms there is the added benefit of credibility gained by having an installation of their technology as the beginning of a reference list.

The concept of lead user can be extended to the concept of a lead market.[10] This requires early adoption of an innovation so that it becomes widespread through multiple users of this type or else through a single user with sufficient purchasing power to constitute a market on its own (this is where public procurement can make a difference). In such cases, the learning benefits are supplemented by a reduction of risk in the investment necessary to perform R&D and to innovate. The expectation is that other markets would then adopt the design thereby established giving it international dominance ("dominant design"). Characteristics of a lead market include customers willing to pay a premium for the particular characteristics of the innovation, or even in some consumer markets for its novelty per se. This could imply a high degree of customer "intelligence", meaning anticipatory knowledge of the technology. Compatible infrastructure may also be a factor. In general such markets should have sufficient scale for the costs of innovation to be viable. Market requirements should also be sufficiently generic to allow for expansion/export into wider markets as costs fall through continuing innovation or increasing scale of production. Finally, a lead market should provide the more general conditions favourable to innovation such as an efficient and responsive regulatory structure, security for intellectual property, etc.

There are, however, inherent risks in the lead market concept, notably the dominant design requirement. If a market requires product or service characteristics that are so specific (idiosyncratic) that the possibility of extension to other markets is foreclosed, the production and diffusion of an innovation in a local market does not result in a lead market. An example is the UK's System X telephone exchange developed by the then Post Office and launched in 1980 but failing to penetrate export markets. The French Minitel experience is a case where domestic success was not matched by exports in the face of emerging competition from the Internet.[11] A further risk in this approach is that in a narrow concept

[8] Although this general rule applies, Nachum and Wymbs (2002) have correctly emphasised that the characteristics of locations are of different importance not only in different sectors but also for different companies. For our issue of market endowments this means that while for some, the leading edge demand may be key for early development and innovation productions, for others the size of the market and thus production where economies of scale can be realised quickly is more important.

[9] von Hippel (1986) introduced the concept of lead users in innovation—defined as those whose present strong needs will become general in a marketplace months or years in the future.

[10] For a further discussion of lead markets, see Porter (1990), Meyer-Krahmer (2004, 1999), Meyer-Krahmer and Reger (1997), Beise (2001) and Beise et al. (2003).

[11] Wikipedia lists essentially failed efforts to introduce the Minitel in South Africa, Belgium, Canada, Ireland and the USA.

of lead markets, the suppliers of the innovation need to be located in the jurisdiction of the ministries responsible for the procurement policy. In fact, as empirical examples have shown, it is a major obstacle for agencies procuring innovations to pursue their goals when suppliers from abroad win the contract (Pinnau, 2005). However, the economic benefit is broader, as application of innovative products and solutions may lead to a technological upgrade of a location and a market. Such innovative products need to be installed and maintained, competing suppliers are put under pressure to catch up, complementary services and products need to be in place, users upgrade their skills and the location may gain a more innovative image. All of this benefits the local economy. In the case of the procurement of new, advanced lightning systems for the municipality and Federal State of Hamburg in Germany, for example, the responsible agency could convince decision makers and the public of the economic benefits of the purchase of these systems from abroad—in addition to the energy savings—and thus increased life cycle efficiency of the lighting system (Pinnau, 2005).

The role of the state in creating or assisting in creating lead markets mainly lies in the provision of a means to combine supply and demand-side measures. This includes provision of appropriate framework conditions that induce and enable innovative activity (infrastructure, sufficient R&D basis, support for co-operation, etc.). However, in addition, the state can support lead user and lead adoptions of innovations that promise to become a dominant design in the world markets. More importantly for our discussion on public procurement, the state can through the size or the peculiarities of public demand itself act as a lead user initiating lead markets.

5.2. Market and system failures and the role of public procurement

As with the justification for supply-oriented measures, there are market failures (mainly information asymmetries) and system failure (poor interaction) arguments.[12] Public procurement – adequately applied – may play a role in overcoming these failures.

The first set of failures is related to information problems. Especially, but not only, in fragmented markets there is a deficiency and an asymmetry in the information available to those intending to undertake or to purchase innovations. Purchasers, private and public, are often not aware, or fully aware, about what product and service innovation the market offers to them—or could offer to them. Suppliers of potential new products and services often lack the knowledge on what customers might want in the future. Suppliers, on the other hand, often fail to signal future solutions early enough. User–producer interaction and communication is often poor, with scattered demand not articulated sufficiently to make suppliers read the signals and translate them into innovations (e.g. von Hippel, 1976, 1986; Gregersen, 1992; Lundvall, 1988, p. 356; Moors et al., 2003; Rothwell and Gardiner, 1989; Smits, 2002). This is also related to a lack of trust for innovations and innovators on the side of private and public demand as well as lack of skills in order to use and exploit an innovation. All this entails risk – and even uncertainty – for suppliers.

Furthermore, the more radical an innovation, the higher the entry and switching costs. This relates to transaction and learning costs, to adoption of complementary equipment and to lock in and path dependency effects. Those problems of high entry costs are especially virulent in areas in which network effects occur. For products whose value rises with the units sold in the market, there is a high diffusion threshold, especially in ICT areas. The initial purchase of radical innovations is thus hampered. A strong initial demand in an early phase can have accelerating effects.

For a variety of reasons, public procurement may remedy those market and system failures and lead to the generation and/or better diffusion of innovations. Some of these reasons apply also to potential private purchasers, others are restricted to the state as purchaser (see also Geroski, 1990; Dalpé et al., 1992; Dalpé, 1994; Edquist, 1998).

Public procurement can achieve critical mass, through the sheer size of a single purchase or through bundling the demand of various public entities. Such public demand creates clear incentives for manufacturers, reduces their market risk, and enables early economies of scale and learning. This critical mass also structures the manufacturing branches connected with the innovation in question. This effect is especially strong for young technologies, i.e. when industry is able to react to strong impulses on the part of the state. In contrast to R&D subsidies, the concrete state demand for innovations leads not only to technological capacities, but at the same time to increased production capacities for innovations (Geroski, 1990, p. 189).

Public procurement may also lower the transaction costs of adapting to new products, either by the timely and large-scale use of an innovation or by demonstrating

[12] Chapters 5.2 and 5.3 partly draw on Edler et al. (2007) and Edler (2007a, 2007b, in press).

its use. The public uptake of an innovation further sends a signal to the private market; it demonstrates functionalities and thus raises early awareness (Rothwell, 1984; Porter, 1990). With this spillover to private demand, the catalytic function of public procurement may be more important than the initial public purchase, as the examples of market creation in the consumer electronics sectors especially in Sweden have shown (see below).

Finally, the state – supported by its purchasing power – may help to create meaningful standards, with convergence on a standard allowing firms to internalise spillovers and hence to increase the incentive to invest in R&D. Those standards further contribute to trust building for innovative products.

5.3. Public procurement to improve public policy and services

A further justification for public procurement that asks for leading edge products and services lies in the improvement of state functions and in contributing to achieving public missions (see the link to public service innovation noted above). The procurement of innovation may be linked to a normative policy goal, such as sustainability or energy efficiency, and this goal may be reached sooner and more effectively through innovation. The political goals are based on (perceived) social needs. As Mowery and Rosenberg (1979, p. 140) stated, a need does not equal demand that is articulated in and mediated through the market. This argument strengthens the case for public procurement as a market stimulating instrument, as it can be one means to translate perceived needs into concrete market demands. This is how the economic argument of triggering the innovation dynamic meets the sectoral, political argument of better performance in governance.[13] The justification for buying a costly innovation – to pay the innovation premium – and to invest in innovations at an early phase within the innovation cycle, then stems from this policy mission. The innovation lever of public procurement measures – and measures to improve private demand – which are designed to meet societal targets derives from the fact that most often societal goals underlying a procurement translate *new* needs into demand for which innovative solutions are called for (Gregersen, 1992, p. 144). Dalpé et al. (1992, p. 258 ff), have empirically shown that in satisfying new societal needs and providing infrastructure and public service, the state very often is more demanding than private consumers. In achieving its mission, in improving its function, the state very often acts as a lead user.

This close connection, namely to understand demand-oriented policy as innovation policy to achieve certain policy goals such as sustainability, energy efficiency, mobility, etc., is still insufficiently examined in the literature and poorly designed and taken advantage of in policy practice. Traditionally, sectoral policies that utilise public demand and mobilisation of private demand, have stressed their own specific mission without linking the dynamics that were triggered to innovation policy and related goals. In Europe, the green procurement movement (e.g. BMU, 2006; DTI, 2006) or activities in the ICT sector at EU level (Bos and Corvers, 2007) only recently have shifted in this direction (see below), expecting thereby to increase the momentum and public backing for the sectoral policy aims. This points towards the question about framework conditions and strategies conducive for public procurement policies geared towards innovation.

6. Implementation framework for innovation procurement policy—and some practical examples

Thus far we have seen that despite the strong interest in procurement for innovation, it does require certain circumstances conducive for its success. One requirement we have noted in Section 4 is the need for co-ordination across government, to resolve the problem of social returns not necessarily being within the ambit of the purchasing ministry. We have also noted in the same section that combination with private demand provides an additional dimension to procurement policy. We further stressed the critical role of linkages between supply and demand prior to and during the innovation process. In addition to these structural requirements there is also a need for changed practice at the level of the procurement professional. To overcome the challenge and to reap the benefits of public procurement in terms of innovation generation and diffusion, a complex implementation framework needs to be in place. We cannot be comprehensive in this article, but here focus on the four dimensions that appear to be of highest significance and address the issues raised here.

6.1. Changing rationales and comprehensive inter-department strategies

The basis for such an innovation-friendly procurement framework is the *general understanding across administrations* that the public purse can make a dif-

[13] McCrudden (2004) presents a number of cases in which the state has procured with a view to causing societal goals to be reached.

ference in the marketplace towards a more innovative culture. This of course cuts across different administrative cultures and rationales. Ministries responsible for innovation must acknowledge that the lever of public procurement, the purchasing budgets, sits elsewhere and that in order to mobilise these budgets co-ordination and convincing is needed. Decision makers in sectoral ministries or divisions are confronted with an additional major target – innovation-generation – that alters the political equation when it comes to formulating their goals, pushing through their policy and implementing decisions. These additional dimensions might be helpful, but at first sight might also result in target conflicts. As discussed above, these target conflicts may arise if the optimum purchase for the sectoral goal is not in line with the optimum in terms of innovation dynamics in a given innovation system. Most importantly, the immediate economic benefit may be realised by suppliers who happen to be located outside the jurisdiction of the purchasing ministry or agency. Furthermore, the learning and switching costs for administrations may be perceived as being prohibitively high. The basis to overcome all of these principle obstacles is a *strategic commitment* to change rationales across and within administrations, to integrate the innovation rationale within sectoral policy rationales and subsequently a *strong co-ordination* of efforts to create inter-administrative win–win situations.

The new initiatives discussed above of pushing pre-commercial procurement forward also in Europe, albeit to pursue the potential benefit of contracting more public R&D services leading to market innovations, add further to the policy challenges. As procurement covers the whole stage from R&D to application, there is even more need for co-ordination between responsible ministries. In countries like the US or Japan, which have applied pre-commercial procurement much more systematically and comprehensively, this co-ordination need is met through bundling of competences. In the US, mission-oriented approaches facilitate co-ordination as sectoral ministries are responsible for R&D in their areas, in Japan, METI has a broader portfolio and wider responsibilities than traditional ministries of economics in Europe. In other OECD countries, the challenge of co-ordination is immense.

The most sophisticated and consequent approach of horizontal, goal-oriented governance in this sense in recent years has been the innovation strategy of the UK (Winson, 2005). Here, the Department of Trade and Industry incorporated public procurement as an official policy dimension into their innovation strategy (DTI, 2003a), building upon a background report on the economic benefits and the innovation potential of the £125 billion per year spent by the public administrations on goods and services (DTI, 2003b). In addition, discussions with industry had revealed shortcomings in the procurement process hampering innovative bids to be successful or innovative solutions to be detected in the first place. Subsequently a detailed strategic plan including a concrete roadmap was drafted that committed sectoral ministries under the leadership of the DTI, including the local level and special provisions for SMEs (DTI/OGC, 2003). The strategy aimed both at general procurement, i.e. sensitising and enabling procurers at all levels as regards to innovation procurement (see below), and strategic procurement, i.e. selecting strategic areas of sectoral policy and combining the innovation goals and the sectoral policy goals. The commitment of sectoral ministries has been mobilised through political backing at the highest ministerial levels, an implementation roadmap with clear targets and regular co-ordination meetings of working groups including ministers or undersecretaries of state. How far a country needs to travel is illustrated by a general perception that these measures have yet to bear fruit—there are constant calls from industry and most recently from the Conservative Opposition party to make procurement a much more prominent innovation policy tool (STEM Task Force, 2006).

6.2. Linking up with private demand

As mentioned above, a further strategic and organisational challenge for integrated procurement strategies lies in the combination of public procurement and private demand measures. Such catalytic approaches had been tested in the US already in the 1970 in form of the Experimental Technology Incentives Program. These had mixed results, but there were some interesting lessons to be learned (Rothwell, 1984). Most importantly, while in pure public procurement the needs are defined directly by the public bodies themselves, in catalytic procurement the needs of private buyers need to be systematically ascertained. Public purchasers must be well aware of the needs and of the readiness of consumers to purchase an innovation, and design their measure accordingly. The more a public policy is designed to change behaviour of consumers, the more catalytic procurement will have to be accompanied by further demand measures. The example of market transformation in Sweden is a point in case here.[14] The Swedish energy

[14] For a broader discussion of the Swedish catalytical procurement case, see Neji (1999), NUTEK (1994), Suvilehto (1997), Suvilehto and Överholm (1998) and Edler and Hafner (2007).

agencies NUTEK and STEM implemented a complex policy scheme aiming at an accelerated diffusion of energy efficient technologies. The major characteristic of this initiative was a technology specific mix of instruments, with public procurement as an ice-breaker and catalyst and with a mobilisation of private demand through a whole set of awareness measures, organised discourse with users and – in selected cases – complemented by direct subsidies to procurers. The instrument mix and the targeting of specific markets was not equally successful for all technologies, but evaluations showed that for many technologies market diffusion has significantly accelerated (Neji, 1999).

6.3. Coping with complexity and procurement discourse: bringing public needs and supplier capacities into line

A further requirement for innovation procurement is to define which markets and technologies to tackle. On the one hand, suppliers need to be given early signals regarding concrete future public demands. On the other hand, there is an uncertainty on what suppliers are actually ready to provide in the future. The major requirement for a strategic procurement policy thus is to bring future needs and future supply together at an early stage. The basic idea can be summarised by quoting an industry member of the UK Sustainable Procurement Task Force and Chairman of the Environmental Advisory Group initiated by the DTI and DEFRA (see below): "Tools, guidance, good practice, awareness raising and the like are all fine, but the real issue for the public sector is that its supply chains don't deliver, and there is no clear sense of what future performance will be required", says Frost. "New technologies come on stream fast when there's enough confidence and clarity within a supply chain about the direction of developments – which makes it worthwhile for a supplier to make the investments in R&D to achieve new performance standards".[15]

Furthermore, to some extent the complaint of Gibbons and Gummett still holds true, according to which it is extremely complex to detect needs and to translate them into meaningful market demands (Gibbons and Gummett, 1984). However, as public procurement focuses on *public* demand, governments can put in place selective, limited discourses that define mid- and long-term public needs derived from policy goals and administrative strategies. If potential suppliers are included, the likelihood is high to define demands concretely enough that can be met by industry in the future. The broader the participation in these processes, the more likely that future demand can be aggregated, signals are spread widely and competition for future solutions remains open. In addition, public decision makers need to learn the readiness of industry to deliver innovations. Public procurement can be extremely detrimental to a novel technology if the procurement sets in too early in the innovation cycle, i.e. when it is not ripe yet for broader market diffusion. One approach to inform about future direction of technologies as well as of future needs is the use of foresight strategies to develop common visions between producers and users (e.g. Georghiou, 1996).

Current examples of such discourses are the Technology Platforms at the EU level (European Commission, 2006b).[16] One example with well-established structures and intensive dialogue linking national and European level is the European Construction Technology Platform (ECTP, http://www.ectp.org). In the ECTP a number of stakeholders join, including industrial suppliers (contractors, materials and equipment manufacturers, service and technology providers, designers, architects, engineers), scientists (research centres and universities), financial institutions and, last but not least the demand side (owners, operators, clients, users/consumers, cities and regions). In the area of "Cities and Buildings", for example, the central document of the Platform not only defines a common vision as to how cities will look like and function up to 2030, but also explicitly the importance of procurement to mobilise the innovative potential of the sector (ECTP, 2006).

Another more advanced and concrete example is that of the stakeholder discourses established in the context of sustainable and innovative procurement in the UK. Here, for a couple of years the discourse on sustainable procurement has been linked to procurement of innovation. To that end, an Environmental Innovation Advisory Group (EIAG) has been founded by DTI and Department of Environment, Forestry and Rural Affairs (DEFRA) comprised of a number of industrial leaders and assisted by an institutionalised secretariat. One major step of this group has been to introduce a so-called forward commitment process. This approach mirrors the supply chain management of private companies in that it develops

[15] Jack Frost, Johnson Matthey Fuel Cells, see http://www.greenfutures.org.uk/supplements/takefuture_page2532.aspx (accessed November 30, 2006).

[16] Links to all Technology Platforms can be found in http://www.eupvplatform.org/index.php?id=75, for a comprehensive overview see also: http://ftp://ftp.cordis.lu/pub/technology-platforms/docs/tps_status_report_final_090305.pdf.

long-term demand for products and services and signals, early on, these needs to industry and attempts to bring in line demand and supply. First pilots have been conducted in diverse areas such as HM Prison Service or London Fire and Emergency Planning Authority (DTI, 2006).

6.4. Activating and enabling the procurement chain

To include high level decision makers is important not only to gain compliance of administrations, but also to signal the backing up of the risk involved in concrete procurement action to the entire procurement chain and subsequently to change incentive structures and practices along this chain.[17] Procurement of innovations runs counter to the traditional behaviour of public officials, decision makers and procurers alike. Incentive structures in public administrations tend to award contracts to those with low initial costs – following a simplistic understanding of efficiency – and high reliability of the public service. Innovations, however, are often more costly in terms of their initial price, and they contain the risk of not delivering the service at all, or with delay, and with switching costs for citizens. The more radical an innovation is, the more this is the case. Thus, stamina and sophisticated risk management are needed in order to cope with innovations in public services. A new cost–benefit rationale that translates into life-cycle costing and the criteria of the so-called Most Economically Advantageous Tender (MEAT) is needed to replaces the lowest initial cost rationale.

Furthermore, as discussed above, decision makers and procurers need a much more encompassing knowledge of future needs and of potential improvement as regards public service as well as of the market that offers or may offer new solutions. A structure in which procurers are very close to or even involved in the daily business of their administrations increases their ability to understand needs of administrations and the related technologies.[18] Specialised procurers, on the other hand, need close co-ordination with those responsible for the future development of public service and would have to mobilise expertise on technologies and markets, if needed through professional service providers.

In addition, for the tender process to induce innovation in the market place, it is indispensable that it is based on specifying functionalities rather than designs. In the environmental sector in the UK, for example, 66% of companies in a recent survey stated that public procurement was a major hindrance as the tender specification locked suppliers into traditional technologies not allowing for scaling up to radical innovation (DTI, 2006, p. 17). The hindrance mentioned as being second in importance was finance (60% of companies).

All this also requires organisational change and systematic training of procurers at the operative level. There are several attempts already in Europe to facilitate this change through mobilising existing procurement organisations for the dissemination of new practices. For example, in a recent initiative in the Netherlands (PIANO) procuring agencies are networked and share experience, good practice and new approaches (Bodewes and Boekholt, 2006), through electronic exchange, an electronic platform, annual events, and regional procurement sessions devoted to specific topics.

As regards procurement regulation, at the EU level the new directives 2004/18/EC and 2004/17/EC have created opportunities for public authorities to purchase innovative solutions, with key changes including:

- The facility to specify requirements in terms of functional performance or standards that allows suppliers to produce any configuration of technology they feel can meet the need.
- Options to permit variants, thus opening up bids to alternative ideas.
- Conditions that allow transfer of intellectual property to the suppliers, and hence allow them to exploit their innovations in wider markets.
- Possibilities for technical and competitive dialogues between purchaser and supplier, a necessary condition if each side is to understand the other.

7. Conclusions

In this article, we have outlined the rationales, potential and necessary framework conditions for the use of public procurement as one type of innovation policy measure. The recent ongoing public debate especially in Europe but also in catching up countries such as China has revitalised this concept. There are obvious opportunities opened up through public procurement for

[17] Wilkinson et al. (2005) give a very detailed prescription on how to tailor the various phases of the procurement cycle towards more innovation. Here only major issues are highlighted. The Office of Government Commerce has issued guidelines for procurers in order to act as an "intelligent customer" striving for innovations in the procurement process (DTI/OGC, 2003), and this model is followed by other countries as well (e.g. Germany, BMWI/BME, 2006).

[18] In Edler et al. (2006), there is an example of the procurement of a Voice over IP system within the municipality Heidelberg, Germany, in which the procurer was at the same time responsible for the internal maintenance and development of the system. This enabled a two-way translation of needs and skills on the one hand and market offers on the other hand.

mobilising innovation and at the same time better achieving public policy goals and delivering better service to the citizens.

There is a clear potential danger that globally, but especially within Europe the national champion policy might make a comeback through public procurement favouring local companies. In principle, the WTO rules (Government Procurement Agreement, GPA) and the EU directives do not allow this. However, in countries that are not bound by the WTO GPA this is an obvious issue and opportunity. China, for example, has recently put in place a policy that explicitly discriminates against foreign owned companies when it comes to procurement of innovations. In fact, such procurement is a cornerstone of a new catching up strategy that increasingly relies on the increase of innovative capabilities of indigenous firms (Edler et al., 2007). From the perspective of internal market and free trade, this is a problem—especially within the EU. Not to violate the rules of free trade and open competition on the one hand and still to justify procurement in terms of innovation is – next to the institutional adaptation discussed above – the major challenge for procurement policies integrated in innovation policy strategies.

To reiterate our argumentation above, there are two possible answers to this challenge. One is the definition of benefit for the country, region or municipality that procures. This benefit not only lies in the direct production of a supplier, but in the accompanying services, the installation and maintenance needed and so on. Learning and technological improvements tend to spill over within the market in which the procurement takes place. Second, following the logic of technologically driven competition in conjunction with "demanding demand", advanced public procurement may enhance the technological level of competition, and also set incentives for local producers to face the technological challenge posed by advanced demand. Competition among producers and accompanying services and suppliers of the innovation is upgraded. In the long run, this benefits all related economic agents in a location.

To deal with one last apparent objection, is public procurement about choosing one solution over the other through state intervention rather than letting markets decide; is it another variation of a "picking-winner strategy"? Not really. Picking winners was about selecting firms (national champions, sometimes ailing national champions) or about selecting technologies (specific solutions). Strategic public procurement is about selecting whole market areas in terms of their importance in the economy and their apparent ripeness for innovation. No specification is to be made of which firms or even of which solutions should be pursued in the first instance (Georghiou, 2006). Eventually under competitive conditions preferred solutions and suppliers will emerge but this happens in all markets. What must be achieved is an open process the result of which is that winners emerge. It is possible to deal with other concerns by the ways in which lead markets are promoted as a policy. First, a demonstrated level of commitment from business should be a prerequisite for action—a sector where the desire for co-ordination has already emerged. Secondly, the measures taken within that sector should preserve competition wherever this is feasible. For example, in procurement second sourcing, perhaps from an innovative SME could keep alternative options open.

The aim of this article was not to reignite the old discussion on the relative importance of demand vis-à-vis supply-side factors for innovation. Rather, we simply argue the need to take demand, more concretely public demand, more into the focus of innovation policy making and use it to complement existing and new supply-side measures. For reasons of space and focus we have concentrated on one aspect of demand-side innovation policy but the agenda is also potent in the use of regulation and standards as well as the various forms of public support to spur private demand for innovation (Edler, in press). It is not an exaggeration to say that finding ways to mobilise these potentially powerful incentives for innovation is the principal challenge currently facing those engaged in policy design.

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