Project no. 266959

Project acronym: PICK-ME

Project title: Policy Incentives for the Creation of Knowledge: Methods and Evidence

Dissemination level: Public

Thematic Priority: Cooperation-SSH

Funding scheme: Collaborative project

DELIVERABLE 8.1

PUBLIC PROCUREMENT FOR INNOVATION (PPI)

IN THE CONTEXT OF DEMAND-DRIVEN INNOVATION

Report on policy practices to support public procurement

Table of Contents

Introduction **3**

Definitions **3**

The European Union's PPI Policies **4**

Public Procurement of Innovation: Typologies and Rationales **6**

PPI in the Context of Procurement Instruments to Support Innovation **8**

Procurement Policies and Instruments **13**

Barriers to PPI **20**

Impact Evaluation of Procurement Policies **22**

Conclusion **23**

Bibliography **24**

Introduction

Under the EU's 2006 broad-based innovation strategy, the area of public procurement was highlighted as a top priority for reform and as a driver of innovation policy in Europe. This initial declaration has been developed further by additional policy documents, including Europe 2020's flagship initiatives, *Innovation Union*, *Industrial Policy*, and *Digital Agenda for Europe*, along with the European Commission's Communication "Regional policy contributing to smart growth in Europe 2020," stressing the role of public procurement as tool for innovation. Building on this early policy guidance, the Commission has also moved to concretely implement some of the tenets of this work, including introducing the concept of pre-commercial procurement and launching calls to support transnational networks of public procurers in lead market areas and for pre-commercial procurement. This report will provide the context for this use of public procurement and point the way to best practices for the Commission in taking this implementation forward.

Definitions

This section introduces the role of Public Procurement for Innovation (PPI) within the framework of innovation policy. Innovation policy consists of the regulatory environment (e.g. the allocation of intellectual property rights (IPRs) between universities, inventors, and the government, the business environment for start-ups, and entrepreneurs' access to finance) and government support for instruments for innovation (e.g. grants, research and development (R&D) tax benefits, technology transfer offices (TTOs), and incubators).

Within these, the potential of role of demand-side innovation policies in general, and public procurement in particular, has received significant interest in recent years.

Public procurement is understood as "the process of acquiring goods, works, and services, covering both acquisition from third parties and from in-house providers" (ODPM, 2003). Public procurement accounts for 12% of GDP in OECD member countries (OECD, 2011a) and, therefore, its potential to leverage innovation is significant. Public procurement of innovation has been defined as a government policy instrument whereby a public organization places an order for a product (i.e. a good or a service) that does not exist at the time, but could likely be developed within a reasonable period of time (Edquist, Public Procurement for Innovation (PPI) - A Pilot Study, 2009). Although public organizations procure the innovative good or service, private firms are responsible for conducting the innovation. Still, through the use of public procurement, public organizations are able to influence the demand environment in which the innovating firms operate. This has been defined

in contrast to “regular” procurement, which occurs when public agencies buy ready-made products “off the shelf,” where no innovation is involved.

The European Union’s PPI Policies

The EU is fully committed to mobilizing procurement in its drive to become more innovative as it commits to being the “Innovation Union.”

The introduction of EU procurement regulations aims at opening national markets and is a goal that is very much aligned with the idea of the common market. Until recent years, public procurement in the EU has been perceived as being a rigid process aimed narrowly at non-discrimination, cost efficiency, and transparency goals. However, recently, public procurement has also been recognized as a powerful tool to influence innovation processes. The EU directives on public procurement (Directive 2004/18/EC) published in 2004, incorporated the promotion of innovation as an explicit objective and introduced procedures such as competitive dialogue, which enabled the contracting authority to open up “a dialogue the aim of which shall be to identify and define the means best suited to satisfying their needs” (Directive 2004/18/EC, Article 29 §3).

Approximately 2 billion euro per annum, or about 17% of all public spending, is channeled through public procurement and related competitions, and the advisory body for the European Research Area (ERA, the European initiative to reform national research systems) has set an ambitious target of having 2% of this total procurement spending dedicated to innovation. While this target has not yet been met, the past three years have seen a number of initiatives launched by the European Commission and other public authorities in Europe to stimulate innovation through public procurement. In particular, and in a broader sense, procurement has been utilized to improve competitiveness among domestic firms by enticing “national champions” to perform R&D activities, as well as being wielded as a tool to remedy regional disparities and create jobs for so-called “marginal” sections of the labor force.

The EU Reports “Public Procurement for Research and Innovation” (DG Research, 2005) and “Creating an Innovative Europe” (Independent Expert Group, 2006) called on governments to “use public procurement to drive demand for innovative goods, while at the same time improving the level of public services.”

The European Commission launched the Lead Market Initiative (LMI) for Europe following the EU's 2006 broad-based Innovation Strategy. It recommended the development of innovation-friendly markets in a more targeted way by creating conditions to bring innovative products and services to the market quicker. "Action plans consisted of a tailored mix of demand-side policy measures in the fields of legislation, standardization and labeling, and public procurement, along with complementary activities (mainly through CIP and FP7)" (Edler et al., 2009).

Procurement is also mentioned as one potential tool to be included in regional strategies for smart specialization (as presented in the EC guide "Research and Innovation Strategies for Smart Specialization (RIS3)," European Union Smart Specialisation Platform, 2012). Smart specialization aims at concentrating resources on key priorities based on a region's economic potential. Within the new Cohesion Policy framework, smart specialization is an ex-ante conditionality: every Member State and region will need to have a national or regional research and innovation strategy for smart specialization (RIS3)" in place before they are eligible to receive financial support.

The RIS3 Guide recommends that a comprehensive strategy include a prior "identification of potential customers or fostering market opportunities (e.g. through stimulating private or public demand for eco-innovations)." This stress on demand issues is more likely to produce innovation than starting with R&D grants, as it enables a design of the innovation process to be more aligned with the market so as to achieve a quicker take-up of the innovation. The Guide notes, for example, "Some of the most successful innovation support schemes – such as the US Small Business Innovation Research scheme (SBIR) – take public sector demand for innovative, affordable, and high-quality solutions as a starting point." (European Union Smart Specialisation Platform, 2012).

A comprehensive innovation support strategy thus needs to include support for identifying potential customers and fostering market opportunities (e.g. through stimulating private or public demand for eco-innovations). Starting with demand issues provides more chances for successful innovation than starting with R&D grants, as it allows designing the innovation process to precisely match the market opportunity enabling faster market take-up of the innovation.

Using public procurement as an element of a regional research and innovation strategy for smart specialization offers multiple advantages, such as:

- "Better match of new needs to provide more and improved public services and infrastructures to citizens and firms than off-the-shelf products could offer,

- Cost-savings for public budgets in the medium and long-term thanks to more energy or resource efficient solutions (e.g. functional requirements),
- Higher impact of innovation investments thanks to a comprehensive strategy that combines R&D investments (e.g. in eco-innovation) with purchasing innovations (e.g. of energy efficient and low carbon buildings or transport), and
- Higher mobilization effect on private investors or venture capital, thanks to the faster market access and return-on-investment for innovative firms." (European Union Smart Specialisation Platform, 2012)

Public Procurement of Innovation: Typologies and Rationales

Innovation scholars and analysts have shown a long-standing interest in the innovation potential of public procurement. For instance, public R&D procurement has been seen as playing a key role in the evolution of the US industrial R&D industry since 1945 (Mowery, 2010). Both information technology (IT) and biotechnology benefited from large federal R&D investments. Defense-related procurement influenced the growth of a post-war industrial R&D system that contrasted with those of other industrial economies and that differed significantly from its pre-1940 structure (Mowery, 2010). The military applications of semi-conductors and computers meant that defense-related R&D funding and procurement were important to its early development. Three important general purpose technologies (GPTs), the internet, GPS technology, and the semi-conductor industry, are perhaps the most prominent examples resulting from government innovation-oriented intervention.

Early scholarly interest in the role of public procurement on innovation was thus associated with R&D in mission-oriented activities such as defense-related procurement and also, more recently, on large-scale national infrastructure projects (Edquist et al. 2000). Lately, academic interest in the role of public procurement has shifted to consideration of the development and adoption of innovations as broadly understood (Edler and Uyarra, 2013). Accordingly, we have witnessed a shift of interest from "public technology procurement" to "innovative public procurement" or "public procurement of innovation."

An example of a broad view of innovation is Max Rolfstam's definition of PPI as "purchasing activities carried out by public agencies that lead to innovation" (Rolfstam, 2012). Rolfstam's definition incorporates several kinds of Schumpeterian innovations, including 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 organizing industries.

The literature has also attempted to classify PPI by means of a number of typologies. This includes, for instance, a differentiation between general and strategic procurement, where the latter is associated with explicit goals to procure innovations (Edler and Uyarra, 2013).

Edquist et al. (2000, p. 21) differentiate between "developmental" and "adaptive" public technology procurement. Whereas the former refers to the procurement of completely new products, the latter is linked to products not new to the world but new to the country of procurement.

Hommen and Rolfstam (2009) emphasize the importance of interaction and differentiate between procurement that is conducted solely for the use of the procuring organization (direct) and that that is done in conjunction with (cooperative) or on behalf of private users (catalytic). Within each of these, Hommen and Rolfstam identify several dimensions of interaction, namely interactive learning (different forms of networks), the demand structure of the public sector, and the types of need addressed (see Table 1).

Table 1: Modes of Interaction

Modes of Interaction	**Aspects of User Producer Interaction**		
	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)
Cooperative	*Knowledge Networks* (horizontally extended)	*Oligopsony* (markets with a few buyers)	*Congeneric Needs* (shared by buyer and other organizations)
Catalytic	*Trade Networks* (vertically extended)	*Polypsony* (markets with many buyers)	*Extrinsic Needs* (pertaining to actors other than buyer organizations)

Source: Hommen and Rolfstam, 2009

Uyarra and Flanagan (2009), in turn, suggest that different procurement strategies relate to different categories of products being procured and distinguish between four types of procurement:

- Experimental: whereby procurement provides a testing-ground for innovative products,
- Technological: creating demand "pull" by guaranteeing a level of production and a reduction in uncertainty, which enables R&D investment,
- Efficient: setting up or encouraging particular standards for products and systems, thus allowing diffusion and market creation, and

- Adapted: tailoring existing technologies to identified niches, which satisfy unmet user needs.

Each of these types of procurement is associated with different types of innovation opportunities, different geographies, and different risks for procurers and suppliers (see Table 2).

Another differentiation often made is between PPI and pre-commercial procurement (PCP). PCP refers to the "procurement of research and development of new innovative solutions before they are commercially available. PCP involves different suppliers competing through different phases of development. The risks and benefits are shared between the procurers and the suppliers under market conditions."[1] According to Georghiou, Edler, Uyarra, and Yeow (2013:6), PCP supports the development of prototypes by "financing the underlying R&D as a starting point for general procurement." The most important example is the US Small Business Innovation Research (SBIR), which is described in Box 1 below, while similar organizations have been developed in the UK, Australia, the Netherlands, and Belgium. PCP is promoted by the European Commission as an exception to the European procurement directives that allow direct procurement of R&D services which do not deliver commercial applications (Rolfstam, 2013).

PPI in the Context of Procurement Instruments to Support Innovation

It is important to consider PPI in the context of innovation policy and within the spectrum of instruments used by governments to support innovation. The interventions commonly used by governments to foster innovation can be classified into one of four distinct groups:

- Removing barriers to innovation for private companies,
- RDI via government-owned organizations, instead of the private sector,
- Direct government budgetary support to RDI in private companies (e.g. subsidies, grants, and tax credits), and
- Public procurement of RDI from private companies, which is the PPI mode.

In regards to the other three instruments for innovation policy, the first group of interventions aims at "improving the investment climate for innovative firms, which includes reinforcing the regulatory reform agenda, removing barriers to competition, and fostering skills development. In parallel, policymakers should adopt policies to spur participation in global R&D, as collaboration with researchers and multinational corporations abroad is an effective way to tap into the global

[1] Taken from "A Digital Agenda for Europe," http://ec.europa.eu/digital-agenda/en/pre-commercial-procurement.

knowledge pool, enabling both technological and intellectual transfer of know-how. These policies include a collaboration-friendly intellectual property rights regime, a subsidized exchange study abroad for scientists and those with doctoral degrees, free immigration of researchers, and incentives for multinational corporations to establish R&D centers in the host country" (Goldberg et al., 2010, p. 11).

The second group of interventions is the direct opposite of improvement of the investment climate, instead focusing on state-led initiatives and state-ownership as the tool to support innovation. Well-known examples of this approach include the national labs run by the Department of Energy and the Department of Defense in the US, the Fraunhofer Society in Germany, and public organizations such as the National Center for Scientific Research (CNRS) in France, all of which are public sector entities. As can be seen by these examples, state-led initiatives are often concentrated in the defense and energy sectors, based on the rationale that these "sensitive" sectors are important for national defense. Thus, innovation is based more on national interest than market forces, but may have spillover effects for consumers.

The third group of interventions reflects a blending of the first two approaches, where budgetary support for favored firms takes the place of direct government ownership. There are a long list of support instruments and subsidies that can be utilized for innovation purposes, including matching grants, loans, incubators, industrial parks, guarantees, equity in venture capital funds, creation of special economic zones (SEZs), and institution of technology transfer offices (TTOs).

In practice, it is not uncommon to find one or more of these instruments co-existing within a government, as each instrument may be appropriate under certain circumstances. For example, the United States, being decentralized, has both state-level investment climate initiatives competing with federal-level (and federally-managed) departments such as Defense and direct budgetary support to private sector firms in the energy field.

The fourth instrument, public procurement, has many advantages but despite this reality is probably the least-utilized governmental instrument to support RDI (R&D and innovation) in Europe. Public procurement in some specific instances is more effective than other instruments (Aschhoff and Sofka, 2009); for example, PPI could be preferable to subsidies because more direct interventions allow for closer guidance of the path of the innovation research. Moreover, PPI is a more market-oriented policy than funding state-owned R&D labs, and Edler et al. (2014) argue that public sector procurement can be a source of innovation by catalyzing private markets to innovate. PPI also has the advantage of having its effectiveness magnified when complemented by other instruments

(Guerzoni and Raiteri, 2012). For example, public procurement is more effective in those markets where the public sector is already a large player, as in energy, health, public transport, or defense (OFT, 2004).

However, there are conditions under which public procurement is less suitable, such as when public procurement allows the stimulation of products or services that governments cannot procure or do not need. Cave and Frinking (2004) discuss the potential for encouraging R&D through public procurement and argue that "where commercially available goods and services do not offer the best solution, procurement itself is a priority, while where procurement is to be used to encourage R&D, contracting out (or partial privatization) may be needed to create incentives for investment in R&D."

More generally, the use of PPI has been associated with a number of benefits (Edler and Uyarra, 2013) and its use in policy has been justified on the basis of its potential to offset market and systemic failures hindering innovation (Edler and Georghiou, 2007).

For instance, the European Commission argues that the use of demand-side innovation policies, and PPI in particular, is able to deliver a number of benefits, namely:

- "Act as potential lever for action: 19% of EU GDP,
- Deliver better public services for societal challenges,
- Foster and accelerate access to market for innovative solutions (i.e. lead customers, first client),
- Foster the EU's internal market to the benefit of EU businesses (SMEs), and
- Provide a policy mix and international rising field of innovation support policies" (Wert 2013).

Public procurement can, indeed, contribute by enlarging the market for new goods and by providing an early demand for innovative goods and services. Given its large purchasing power (actual or potential through centralizing or aggregating demand), the public sector can create a large enough market to counteract the technological and market uncertainties associated with R&D.

By acting as a demanding and sophisticated buyer, the public sector can demonstrate the utility of innovative goods or services in wider markets, even the creation of "lead markets" (Georghiou, 2007), which are understood as "regional markets with specific attributes that increase the probability that a locally preferred innovation design becomes internationally successful as well" (Beise and Cleff, 2004, p. 455). For instance, Uyarra and Flanagan (2009) argue that supplying the

public sector "may grant firms reputational or learning benefits that can be useful in other buyers' markets, including foreign ones."

Public procurement can also counteract the systemic failures associated with a lack of user-producer interaction and communication, which often hinder innovation. 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). Procurement can bring together users and suppliers as well as articulate and signal unmet needs to the market.

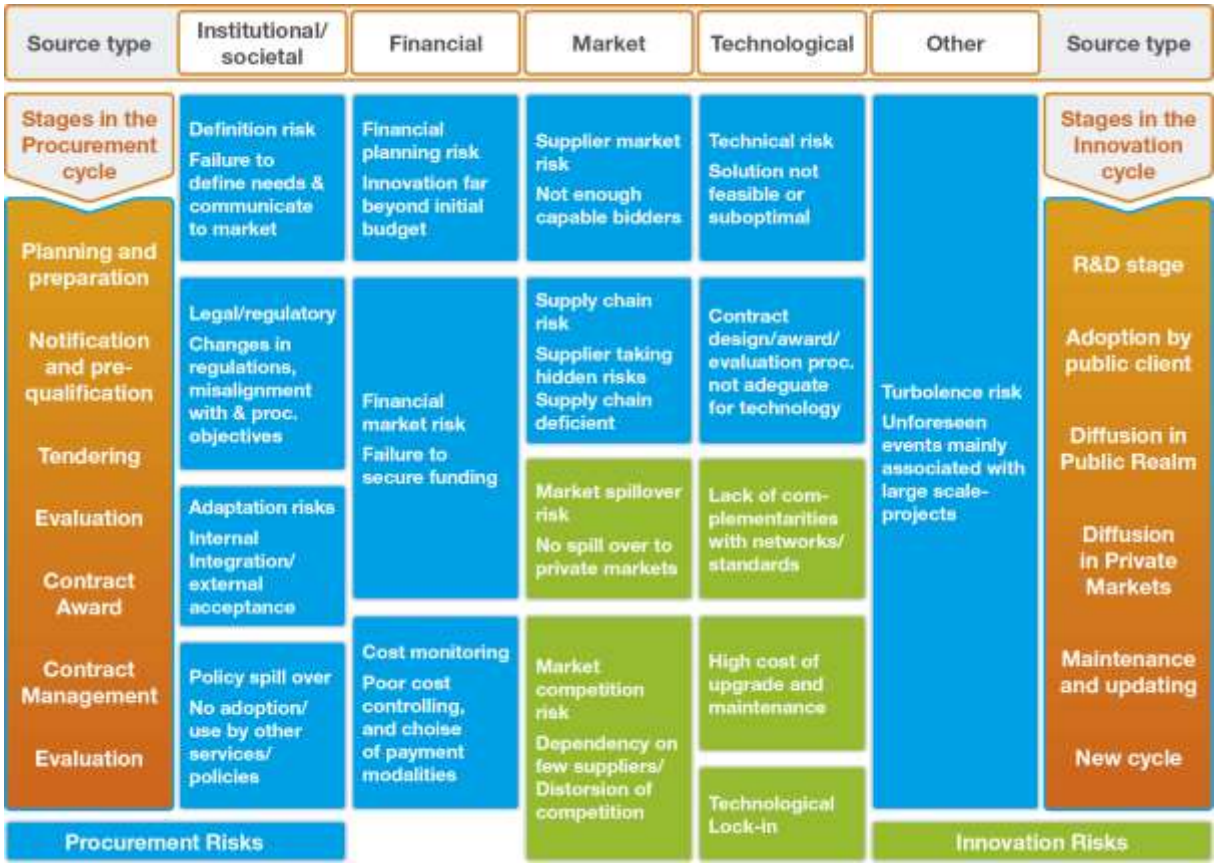
Public demand can also influence standards by choosing to adopt a particular standard or technology on a large scale. Standardization and standards imposed by a government affect innovation processes in a complex way. Various micro-based studies show a positive relationship between companies' involvement in standardization and its spending for research and development and its turnover with innovative products (Blind, 2013). However, the limited empirical evidence about the impact of standardization is not always supportive. Sector-specific rules and regulations are often perceived as a contradiction to innovation and have restraining effect on innovation. It can be considered as a reduction of the possibilities to procure innovation by procurement support policies.

Finally, the use of public procurement is associated with further advantages, such as the potential to deliver better public services to citizens and the potential to deliver on societal challenges such as sustainability and social inclusion.

Despite a high level of political interest, the potential of PPI has not been fully exploited. This is because the application of PPI is associated with multiple operational, competence, and institutional challenges. The literature has dealt with some of the barriers associated with the use of PPI, which are discussed later on in this report. One key challenge is the risk aversion associated with the public sector. According to the OECD (2011b), "demand-side innovation policy gives a more pivotal role to public administrations (e.g. through procurement, regulation, and setting and certifying standards)" and hence puts greater pressure on it to play a leading role in driving innovation. This requires investments in skills and competences in public administration, as well as organizational and cultural change. However, there are arguments that civil servants are inhibited in risk taking and innovation. The OECD acknowledges that there are, indeed, many structural features of government that inhibit risk taking and innovation; although, boosting innovation with public procurement can contribute to increasing business' investments in research and innovation, it is well-known that public sector bodies are more risk-averse than private sector bodies since benefits can be longer than the political cycle. This risk-aversion can inhibit the innovation process in public procurement and, as a result,

inhibit innovation in the private sector. A recent paper by Uyarra et al. (forthcoming), finds that the perception of suppliers in relation to how risk is managed in procurement has an influence on innovation. As Edler and Uyarra (2013) note, there is a basic mismatch between those who benefit if the innovation is successfully adopted (the public sector and, possibly down the line, consumers) and those who bear the consequences of failure (the private sector). They recommend reducing risk aversion and allowing risk sharing as important factors for strengthening the role of public procurement as a means to stimulate innovation.

Figure 1: The Risk Map in Public Procurement for Innovation



Source: Risk management in the procurement of innovation. Concepts and empirical evidence in the European Union (2010)

As illustrated in the figure above, the EC Report on Management (2010) argues that to manage risk one must analyze the different types of risks that lay underneath the innovation risks (e.g. process risks). The report identifies different types of risk (e.g. technological, organizational, market, financial, and turbulent risks), and how they are linked to different stages in the procurement and innovation cycles.

Procurement Policies and Instruments

Several countries and regions (such as Austria, Netherlands, Spain, and the UK) are exploring in detail how to make effective use of procurement tools to drive innovation. Aligning public sector agencies around innovative procurement and ensuring the implementation of rules (and appropriate monitoring and evaluation metrics) to make innovation a part of the procurement process is an important step, but many countries are going further and taking a more proactive role in integrating innovation into procurement. A common example from the EU and elsewhere is having governments host competitions for new technologies and ideas; through these open competitions, innovative individuals or firms can access short-term development grants for public goods and services that might not have otherwise been available. Moreover, almost every EU country has systems to move from ideas to prototypes (an approach that does not only apply to PPIs but definitely includes them). One example is the Finnish Tekes, which funds start-ups, SMEs, and larger companies to prototype and test innovations.

Most examples of PPI deal with national level initiatives; however, procurement can take place at multiple levels of government, particularly in countries with a high level of decentralization (e.g. federal states). Local authorities collectively account for the majority of the public procuring volume in most EU countries (UNU-MERIT, 2012), and municipalities often hold devolved powers for education, transport, social care, and waste. This alone would mean that they should wield influence innovation in the sectors for which they have strategic responsibilities. A further special benefit of procurement at the regional and local level is (generally) greater flexibility in deciding terms or conditions of contracting. The subsidiarity principle also appears to apply in these cases, as the close distance or co-location of supply and demand, which facilitates face-to-face interaction between buyers, suppliers, and end-users, may enable more efficient innovation by procurement policy than at a more aggregated level. This is most evident in the phenomenon of “living labs,” which serve as localized playgrounds of user-driven innovation and can be partially financed by regional authorities.

However, unlike the EU and national-level policy makers, lower-level policy makers often lack the power to change procurement regulation (and its interpretations) in order to achieve political goals. Local authorities can also be at a disadvantage due to lessened purchasing power or due to low capabilities of procurement staff (however, these capabilities can be sometimes be overcome through procurement collaboration across local authorities (Uyarra, 2010)). To overcome these realities, regions and localities can sometimes participate in EU and national-level initiatives to promote innovative public procurement at the regional level. An example of such a national funding instrument to encourage this public procurement of innovation was launched by the Finnish

innovation agency Tekes in 2009, which targets funding at all contracting authorities in the public sector (national, regional, and local). For example, Tekes funds the preparation of contracts aimed at public service procurement (such as utilities), with projects designed to focus on developing innovation through local authorities' own procurement processes in the social and health sectors or on sustainable development and energy efficiency.

In general, government initiatives to support the public procurement of innovation take different forms. They may involve the issuance of legislation or the development of guidelines, incentive schemes, targets, or programs to update the competences and skills of procurers. Georghiou et al. (2013) elaborate on the policy framework and taxonomy to understand such interventions (see Table 2). Their framework is based on the functions and rationales of PPI. They distinguish between four types of interventions: framework conditions for procurement; measures addressed at improving organizational arrangements and capabilities for innovation procurement; instruments to improve the identification, specification, and signaling of needs; and incentives for suppliers to develop innovative solutions.

Table 2. Policy Measures in Support of Innovation through Public Procurement

Policy Category	Deficiencies Addressed	Instrument Types	Examples
Framework Conditions	• Procurement regulations driven by competition logic at the expense of innovation logic • Requirements for public tenders unfavorable to SMEs	• Introduction of innovation-friendly regulations • Simplification of and easier access for tender procedures	• 2005 change in EU Directives, including functional specifications • Paperless procedures, electronic portals, and targets for SME share
Organization and Capabilities	• Lack of awareness of innovation potential or innovation strategy in the organization • Procurers lack skills in innovation-friendly procedures	• High-level strategies to embed innovation procurement • Training schemes, guidelines, and good practice networks • Subsidies for additional costs of innovation procurement	• UK IPPs 2009-10 • Netherlands PIANOo support network • EC Lead Market Initiative networks of contracting authorities • Finnish agency Tekes meeting 75% of costs in planning stage
Identification, Specification, and Signaling of Needs	• Lack of communication between end-users, commissioning, and procurement functions • Lack of knowledge and organized discourse about the wider possibilities of suppliers' innovation potential	• Pre-commercial procurement of R&D to develop and demonstrate solutions • Innovation platforms to bring suppliers and users together • Foresight and market study processes • Use of standards and certification of innovations	• SBIR (USA, NL, Australia), SBRI (UK), PCP (EC) • Competitive dialogue procedure • Lead Market Initiative (EC), Innovation Platforms (UK, Flanders) • China equipment catalogues (to 2011)
Incentivizing Innovative Solutions	• Risk of lack of take-up of suppliers' innovations • Risk aversion by procurers	• Calls for tender requiring innovation • Guaranteed purchase or certification of innovation • Guaranteed price, tariff, or price premium for innovation • Insurance guarantees	• German law enabling innovation demands in tenders • UK Forward Commitment Procurement • Immunity and certification scheme (Korea) • China innovation catalogues (to 2011)

Source: Uyarra, 2013, adapted from Georghiou et al., 2013

An example of initiatives to support the identification and communication of needs includes the use of pre-commercial procurement (PCP) aimed at conducting R&D to develop and demonstrate

innovative solutions before commercialization. As mentioned earlier, such initiatives have been introduced in a number of countries, often trying to follow the lead of the US Small Business Innovation Research (SBIR) program, which is an example of an instrument similar to the PCP practiced in the EU, as it aims to generate multiple R&D-based knowledge outputs (Wessner, 2008). These R&D outputs may later reach the market through a mix of post-SBIR funding from a variety of sources, including venture capital, non-SBIR federal funds, or foreign investment. Building off of this model European countries have attempted to reproduce this success - for instance, in 2001, the UK launched its own Small Business Research Initiative (SBRI, see Box 1).

Box 1: UK SBRI

> The UK Small Business Research Initiative (SBRI), which was established in 2001, was initially designed to increase the access of small and medium-sized enterprises (SMEs) to public sector procurement and to support the procurement of R&D with the potential to procure the innovation generated by the R&D contract. By enabling the public sector to access novel ideas and companies through a risk-managed mechanism, the SBRI would provide access to lead customers and a route to market while supporting follow-on investment through the validation of ideas. The SBRI has two main roles: the first involves the government acting as a lead customer for new products and services, and the second involves supporting strategic objectives, such as providing a route to market for innovations that support broad policy objectives, with the solution developed through SBRI providing opportunities for the market more broadly. Similar to the US SBIR program, the SBRI represents a hopeful move for a European agency; however, as Lamber et al. (2014) note, currently "there are no statistics available on how many competitions have led to new products being procured by departments. To date, there has been no external evaluation of the SBRI scheme." Such an evaluation will be helpful for determining the efficacy of its efforts moving forward.

However, the lessons regarding procurement from US SBIR and their transfer to the EU are not straightforward. Neither of the roles of government procurement in the US SBIR and the proposed Horizon 2020 are clear. There is also variation in the role of procurement in the US SBIR, especially in the third phase, where commercialization is expected from the R&D undertaken in the first two phases of the program. This can be seen in the emphases across agencies: while DOD and NASA solicit topics that channel applications toward areas that are high acquisition, the NIH primarily supports investigator-driven research. At NSF and DOE, topics are used to serve the needs of agency management, not as a method of acquiring technology priorities for the awarding agency (Wessner

2008). Moreover, according to Audretsch and Aldridge (2012), "SBIR firms tend to be dependent on SBIR funding and therefore lack the necessary private venture capital network that is needed to attract investments for large-scale production. Due to the lack of private venture capital interactions, private markets have a more difficult time appropriating the potential value of the product. Moreover, private venture capital markets are more likely to avoid funding innovative firms that are heavily funded by SBIR due to a relatively higher regulatory burden and contract costs. Indeed, the 11 US agencies that are authorized to acquire products may also have a bias against SBIR firms due to the aforementioned mandated 2.5% R&D budget allocation going to SBIR firms."

Another challenge for applying SBIR Phase 3 procurement in the EU is bridging the "funding gap" or so-called "valley of death" in Europe. The market for Phase 3-type products is bound by regions and languages. Moreover, just as US venture capital markets are averse to governmental procurement transaction costs, one would expect a greater averseness to higher EU procurement costs (Audretsch and Aldridge, 2012).

Another key mechanism is a "competitive dialogue procurement procedure," aimed at enabling fruitful discussions between tenderers and procurers as part of the procurement process. The competitive dialogue procedure was introduced as a new procedure by European Public Sector Directive 2004/18/EC, with four main features:

- "Dialogue is allowed with selected suppliers to identify and define solutions to meet the needs and requirements of the contracting authority;
- The award is made only on the most economically advantageous tender criteria;
- Dialogue may be conducted in successive stages, with the aim of reducing the number of solutions or bidders; and
- There are explicit rules on post-tender discussion." (Stern et. al 2011:5).

While adopted at the Union level, the actual application of competitive dialogue procurement varies across Europe, with 80% of the total procurements using competitive dialogue taking place in the UK and France (Georghiou et al., 2014).

Fostering a dialogue between procurers, potential suppliers/service providers, and the scientific community writ large is vital. Public procurers often only have a vague idea of what is needed, and even less idea on what possibilities there are to achieve these goals. In addition, a deeper and recurring dialogue with bidders enables a better procurement process and a better product in the end that can fulfill the specific needs of the procurer (Stern et. Al, 2011). Thus, the

competitive dialogue procedure not only maintains competition based on market-forces and delivers a more tailor-made solution for the private sector; it also crucially imposes discipline on all parties in regards to expectations while establishing good working relationships between the public and private sectors. However, there is a consensus that competitive dialogue is only efficient when it is conducted appropriately. If not, it could be too expensive and burdensome (HM Treasury, 2010).

Additional initiatives aimed at enhancing competences and skills and improving the organizational environment in which public procurement takes place have been introduced by several member states. These initiatives include the establishment of networks to improve expertise and sharing of best practices within Europe (e.g. the Dutch PIANOo initiative) and the development of programs such as the UK's innovation procurement plan (see Box 2).

Box 2: UK Policy for Innovation in Public Procurement

The UK's Innovation Procurement Plan (IPP) was proposed in the 2008 Innovation Nation White Paper as a part of government departments' commercial strategy. The plan imposed an obligation to departments to specify how it would use "innovation procurement" mechanisms and embed innovation in its procurement practices. The initial IPPs were valuable in identifying the extent to which innovative procurement is already effectively embedded in current practices, but because of a lack of measurable objectives, it was difficult to assess whether the department had delivered its stated goals. As a result, the government decided to discontinue the requirement for IPPs.

(Source: Uyarra, Edler, Gee, Georghiou i Yeow, forthcoming)

Box 3. Denmark's Fornyelsesfonden (Renewal Fund)

The Danish Government has established a Business Innovation Fund, called Fornyelsesfonden (the Renewal Fund), which focuses on public-private partnerships and public procurement. As the Nordic Innovation Center (Stern et. al 2011) has noted, "the aim of the Business Innovation Fund is to promote growth, employment, and export by supporting business opportunities within green growth and welfare, as well as providing support for a change-over to exploit new business and growth opportunities in less-favored areas of the country." Public players can also enter into consortiums with private enterprises and apply for grants from the Fund.

An example of the public sector incentivizing the uptake of innovative solutions is the UK Forward Commitment Procurement (FCP). The FCP model was jointly designed by the UK Office of Government Commerce and the Environmental Innovations Advisory Group (an industry group) as a "means to enable the public sector to secure the technologies and products it needs to achieve its sustainability targets and to deliver them in the required timeframe and at an affordable price" (Stern et al., 2011: 5-6). Under the FCP model, the contracting authority provides the market with advance information about its requirements or unmet needs. It also offers long-term contracts to drive innovative practices within large firms. As Stern et al. (2011) correctly, say, "the basic idea is that by giving clear visibility to credible procurement needs, and by making it clear that innovative solutions will be fully encouraged and considered, suppliers' development efforts will be stimulated".

Last but not least, framework conditions can be altered to make the promotion of innovation more likely. These include improving access to tenders, simplifying procedures, and encouraging public contracting of particular types of suppliers such as SMEs. This is particularly important for SMEs who struggle to access tenders and win contracts.

One-stop eProcurement websites also allow private sector firms to easily locate and apply for government contracts, as well as ask questions and seek clarifications on procedures. For example, the European Commission publishes the "Tender Electronic Daily" (TED) to alert all potential bidders to upcoming contracts in their various areas of expertise. Training programs can be offered on how businesses can use the software and website. Also, a certain quota of PPI can be created for SMEs for more efficient innovative solutions. However, new legislation would be required for the EU since current European treaty principles do not allow such a quota. Additional barriers to SMEs using eProcurement involve technical constraints (e.g. no eSignature, which is required to submit offers via eProcurement, GHK, 2010a).

EuroPROC is another initiative designed to improve SME access to public procurement markets. As first noted by the agency itself, "it aims at consolidating public procurement as a key element of the SMEs business strategy by adapting and improving the services offered to their support." The objective of the program is to "unlock [SMEs] growth and innovation potential with a positive impact on the European economy."[2]

[2] For more information, including the source of this quote, please see the EuroPROC website, http://www.euro-proc.eu/en/europroc/whats-europroc-about/9/.

Barriers to PPI

Despite its potential, it has been argued that PPI is underexploited. For instance, Georghiou et al. (2013) noted how the procurement practices that are considered by suppliers to be most conducive to innovation (such as early interaction with suppliers, advanced communication of needs, the use of outcome based specifications, and incentive contracts) are also some of the least frequently encountered.

The challenges associated with greater use of PPI are diverse. For instance, Edler and Uyarra (2013) mention the fragmentation of public demand between different levels of government, different priorities within the procuring government agencies, which send contradictory messages to the marketplace, and neglect of the pre-procurement phase. In a survey of 800 suppliers to the public sector in the UK, analyzed in Georghiou et al. (2013) and Uyarra et al. (forthcoming), the main barriers reported by firms were a lack of interaction with procuring organizations, the use of rigid as opposed to outcome-based specifications, low competences of procurers, and poor risk management.

Given the nature of the innovative process and its capital-intensity, public procurement of innovation usually has more stringent requirements for interaction between buyers and potential suppliers than "regular" public procurement procedures. A key barrier thus relates to the lack of user-producer interaction: low interaction with procuring bodies was reported as a very significant barrier by 46% of respondents in the UK survey (Georghiou et al., 2013).

An important aim of state public procurement, within the EU's principles of non-discrimination and competition, is to achieve value for money for the taxpayer via lower cost or price. Yet, governments aim to promote innovation when awarding public sector contracts. From the provider point of view, an emphasis on price rather than quality is the real brake to innovation. Sixty percent of respondents to the UK survey considered this as a very significant barrier to innovation. Other respondents noted too prescriptive specifications (found by 38% of respondents to be a very significant barrier). Additional key concerns included poor feedback, a low appreciation of unsolicited ideas and previous private sector delivery history, and cumbersome pre-qualification procedures and conditions.

Empirical studies have also specifically examined the barriers SMEs face by examining the question of whether public procurement leads SMEs to innovation. While small and young firms often enter the market with new products and/or innovative and flexible business models, they often face difficulties winning government contracts because of rules written to favor incumbent firms (such as experience

requirements that place emphasis on similar experience or prior contracts won). Moreover, as cost minimization can be a primary factor in determining the awarding of public contracts, larger firms that can cross-subsidize or offer economies of scale often have an advantage. This reality has also benefitted government as well as large suppliers, by making procurement a less time-consuming task, if the same bidders have been dealt with on previous occasions. However, the effects of reduced SME participation can lead to less competition and participation overall, reducing variety and the likelihood that an innovative solution will be selected.

A 2010 report by GHK, "Evaluation of SMEs' access to public procurement," analyzed contract award notices and contracts awarded between 2006 and 2008. They found that SMEs had different degrees of success in securing contracts. They found, for instance, that SMEs tended to secure a larger share, in terms of value, of public procurement launched by local governments, and were less successful in tenders by utilities and central government bodies. In terms of supply markets, they were successful in business services and the supply of manufactured goods (other than machinery and equipment) but rarely won contracts for pharmaceuticals or commodities and food. They also conducted a survey of SMEs in Europe and found that that the most frequently encountered barrier was the overemphasis on price (54% of companies experienced it "always" or "often"), followed by unfavorable (i.e. too long) payment terms (40%) and late payments (38%). Additional constraints mentioned by SMEs included excessive administrative burden (34% of companies experienced it "always" or "often") and unclear requirements set out by public authorities (30%). The least frequently mentioned obstacles to procurement were too large contract values (7%).

Additional barriers to participation in public procurement have been noted by GHK (2010a:49) to include:

- "Insufficient information about tendering opportunities,
- Information about the tender is received too late to prepare a tender,
- Information on the requirements is not clear or difficult to interpret,
- Insufficient opportunity to ask questions about prior to tendering,
- The contract value is too large relative to the size of the company,
- The administrative requirements involved are onerous,
- Technical qualification levels and certification criteria demanded are too high,
- Financial requirements such as bank guarantees are too onerous,
- Joint fulfillment of the requirements by members of the consortium is not allowed,
- Over-emphasis on bid price in selection of contractors, rather than quality and flexibility,

- No information why your tender was not chosen,
- The deadline for payments from the public authority as set in the contract are too long,
- The payments made by the public authority arrive significantly later than set in the contract, and
- Tenders are not evaluated fairly and objectively".

Impact Evaluation of Procurement Policies

Despite the policy interest in the use of PPI, there are concerns about the quantification of the impact and the evaluation of PPI policies. In a systematic review of measures in support of public procurement of innovation, Uyarra (2010) finds that "evaluations of public procurement of innovation are rare and that evidence of impact is rather fragmented and restricted to individual "success" cases rather than actual impact."

Assessment is made difficult by lack of reliable procurement data and suitable indicators, problems attributing cause and effect, and adequately delineating the PPI intervention.

According to the OECD report "Evaluation of Industrial Policy" (2014), the most systematic impact evaluation of procurement policies and R&D subsidies to date is that of Guerzoni and Raiteri (2012). As Uyarra (2010) notes, this study used " data from 5,238 firms from the Innobarometer on strategic trends in innovation from 2006-2008 in the 27 EU Member States, Norway, and Switzerland" and designed a "a quasi-experimental framework to assess the causal effect of both, potentially coexisting policy tools." The study reports that a "positive and significant effect is also found for innovative public procurement on private R&D: 11.2 percentage points more firms report increasing their R&D in the treated group. However, when assessed in isolation from the other instruments, the positive impact of R&D grants on R&D private investment ceases to be significant." Although the study, according to the EC evaluation report, suffers from significant data limitations, it illustrates the kind of the impact assessment that is badly needed.

The survey conducted within the UNDERPINN (Understanding Public Procurement of Innovation) study,[3] and reported in Georghiou et al. (2013), linked procurement practices with the innovation performance of suppliers. From the 94% of innovating organizations in the responding sample, 67% indicated that bidding for or delivering contracts to public sector clients has had some impact on its innovation activity. Twenty-five percent of the innovating organizations claim that all of its innovations have been the result of public procurement. Furthermore, 56% of the sample reported

[3] For further information see https://underpinn.portals.mbs.ac.uk/.

that they won a public sector contract in the last three years because of innovation (Georghiou et al., 2013).

Conclusion

Within the framework of innovation policies, PPI is a demand-side instrument that complements supply-side instruments (e.g. subsidies to R&D). Within the EU Cohesion Policy framework, the RIS3 Guide recommends starting with demand issues by first identifying customers, which can sometimes be more effective in encouraging innovation than starting with R&D grants.

One key element of inhibiting PPI is risk aversion. In order to address this barrier it is necessary to understand and identify the origin of these risks adequately, and to find ways to mitigate the consequences of those risks as well as adequately sharing those risks among key stakeholders. This could include insurance schemes for public procurers able to mitigate the risks involved in purchasing innovations.

There are a series of practices within public procurement that have been proven to favor the development of innovative solutions by suppliers. These include early communication with suppliers and the use of outcome-based as opposed to functional specifications. Research finds that outcome-based specifications are not used as frequently as would be desirable. Action should be taken to remove organizational and other barriers (such as lack competences and skills of suppliers) that impede wider use of these practices.

Framework conditions such as improving access to tenders, simplifying procedures, and encouraging public contracting of particular types of suppliers such as SMEs should be improved. This includes well-functioning tender portals, good feedback mechanisms for unsuccessful tenders, and alignment and simplification of requirements across the public sector.

Impact evaluations of PPI, which so far seems to suffer from data limitations, should be taken into account in the early design of the procurement process so as to increase data availability in the evaluation stage.

Bibliography

Arrowsmith, S., & Treumer, S. (2012). *Competitive dialogue in EU procurement.* Cambridge: Cambridge University Press.

Aschoff, B., & Sofka, W. (2009). Innovation on demand — Can public procurement drive market success of innovations? *Research Policy, 38*(8), 1235-1247. doi:10.1016/j.respol.2009.06.011

Audretsch, D., & Taylor, A. (2012). The Development of US Policies directed at Stimulating Innovation and Entrepreneurship. (I. Goldberg, F. Biagi, & P. Desruelle, Eds.) *JRC Scientific and Policy Reports*. doi:10.2791/64747

Beise, M., & Cleff, T. (2004). Assessing the lead market potential of countries for innovation projects. *Journal of International Management, 10*(4), pp. 453-477.

Blind, K. (2013). *The impact of standardization and standards on innovation.* Report within the MIoIR-NESTA Compendium of Evidence on Innovation Policy, Manchester Institute of Innovation Research, London/Manchester. Retrieved from http://research.mbs.ac.uk/innovation

Cave, J., & Frinking, E. (2004). *Public procurement for R&D.* RAND Europe, Cambridge. Retrieved from http://www2.warwick.ac.uk/fac/soc/economics/staff/jakcave/publications/pp_for_rd.pdf

Edler, J., & Georghiou, L. (2007). Public procurement and innovation - Resurrecting the demand side. *Research Policy, 36*(7), pp. 949-963. doi:10.1016/j.respol.2007.03.003

Edler, J., & Uyarra, E. (2013). Public Procurement of Innovation. In L. Brown, & S. Osborne (Eds.), *The Handbook of Innovation and Change in Public Sector Services* (pp. 224–237). Cheltenham: Edward Elgar.

Edler, J., Georghiou, L., Uyarra, E., Cox, D., Rigby, J., Nugroho, Y., & Blind, K. (2009). *Monitoring and Evaluation Methodology for the EU Lead Market Initiative - A Concept Development.* Manchester Business School, University of Manchester.

Edler, J., Georghiou, L., Uyarra, E., James, A., & McMeekin, A. (2014). *Understanding Public Procurement of Innovation.* EC Grant reference: RES-598-25-0037.

Edler, J., Georghiu, L., Blind, K., & Uyarra, E. (2012). Evaluating the demand side: New challenges for evaluation. *Research Evaluation, 21*, pp. 33-47.

Edquist, C. (2009). Public Procurement for Innovation (PPI) - A Pilot Study. *CIRCLE Electronic Working Papers, 2008(17)*. Lund: CIRCLE, Lund University. Retrieved from http://progreast.eu/files/200913_Edquist.pdf

Edquist, C., & Hommen, L. (2000). Public technology procurement and innovation theory. In C. Edquist, L. Hommen, & L. Tsipouri (Eds.), *Public Technology Procurement and Innovation.* Boston, MA: Kluwer Academic Publishers.

Edquist, C., Hommen, L., & Tsipouri, L. (200). *Public Technology Procurement and Innovation* (Vol. 16). Springer.

European Parliament and European Council. (2004). *Directive 2004/18/EC - on the coordiantion of procedures for the award of public works contracts, public supply contracts and public services contracts.* Retrieved from Official Journal of the European Union: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2004:134:0114:0240:en:PDF

European Union Smart Specialisation Platform. (2012, May). *Guide to Research and Innovation Strategies for Smart Specialistaions (RIS 3).* Retrieved from http://rpo2020.lubuskie.pl/wp-content/uploads/2013/03/RIS3_guide_final_2012_2.pdf

Flanagan, K., & Uyarra, E. (2010). Understanding the innovation impacts of public procurement. *European Planning Studies, 18*(1).

Gee, S., & Uyarra, E. (2013). A role for public procurement in system innovation: the transformation of the Greater Manchester (UK) waste system. *Technol. Anal. Amp Strateg. Manag., 25*, pp. 1175–1188. doi:doi:10.1080/09537325.2013.843660

Georghiou, L. (2007). *Demanding Innovation: Lead Markets, Public Procurement and Innovation.* London: NESTA .

Georghiou, L., Edler, J., Uyarra, E., & Yeow, J. (2013). Policy instruments for public procurement of innovation: Choice, design and assessment. *Technological Forecasting and Social Change, 86*(125), pp. 1175–1188. doi:10.1080/09537325.201

Geroski, P. (1990). Procurement policy as a tool of industrial policy. *International Review of Applied Economics, 4*(2), pp. 182-98. doi:10.1080/758523673

GHK. (2010a). *Evaluation of SMEs' access to public procurement markets in the EU.* Retrieved from http://ec.europa.eu/enterprise/policies/sme/business-environment/files/smes_access_to_public_procurement_final_report_2010_en.pdf

GHK. (2010b). Evaluation of SMEs policy as a tool of industrial policy. *Int Rev Appl Econ, 4*(Choice, design and assessment. Technology. Forecasting and R&D subsidies: compounding effects and new empirical evidence on technological policies in a quasi-experimental settings), pp. 182–198.

Goldberg, I., Goddard, J., Kuriakose, S., & Racine, J. (2010). *Igniting innovation. Rethinking the Role of Government in Emerging Europe and Central Asia.* Washington DC: World Bank.

Guerzoni, M., & Raiteri, E. (2012). Innovative public procurement and R&D Subsidies: hidden treatment and new empirical evidence on the technology policy mix in a quasi-experimental setting. *University of Turin, Department of Economics and Statistics Cognetti de Martiis LEI & BRICK - Laboratory of Economics of Innovation "Franco Momigliano", Bureau of Research in Innovation, Complexity and Knowledge, Collegio Carlo Alberto. WP series, 201218*.

HM Treasury. (2010). Review of Competitive Dialogue. London: HM Treasury.

Hommen, L., & Rolfstam, M. (2009). Public Procurement and Innovation: Towards a Taxonomy. *Journal of Public Procurement, 9*(1).

Lember, V., Kalvet, T., & Kattel, R. (2011). Urban Competitiveness and Public Procurement for Innovation. *Urban Stud, 48*, pp. 1373–1395. doi:10.1177/0042098010374512

Mowery, D. (2010). Nanotechnology and the U.S. national innovation system: Continuity and Change. In U. Fiedeler, C. Coenen, R. Sarah, & A. Ferrari (Eds.), *Understanding Nanotechnology: Philosophy, Policy and Publics* (1 ed., pp. 85-99). IOS Press. Retrieved from http://www.thesnet.net/site/wp-content/uploads/2013/09/6_Mowery_Nanotechnology-and-the-US-Innovation-System.pdf

ODPM. (2003). *National procurement strategy for local government in England (2003-2006).* London: ODPM.

OECD. (2011a). *Government at a Glance.* OECD Publishing. doi:http://dx.doi.org/10.1787/gov_glance-2011-en

OECD. (2011b). *Demand-side Innovation Policies.* Paris: OECD Publishing.

OECD. (2014). *Evaluation of Industrial Policy: Methodological Issues and Policy Lessons.* Directorate for Science, Technology and Industry/ Committee of Industry, Innovation and Entrepreneurship. OECD. doi:10.1787/5jz2bz8g00jj-en

OFT. (2004). *Assessing impact of public sector procurement on competition.* London: Office of Fair Trading.

Rigby, J. (2013). *Review of Pre-commercial Procurement Approaches.* Report within the MIoIR-NESTA Compendium of Evidence on Innovation Policy, London/Manchester.

Rolfstam, M. (2012). Understanding Public Procurement of Innovation: Definitions, Innovation Types and Interaction Modes. *SSRN*. doi:http://dx.doi.org/10.2139/ssrn.2011488

Rolfstam, M. (2013). *Public procurement and innovation: the role of institutions.* Cheltenham: Edward Elgar Publishing.

Rolfstam, M. (2014). 3d Lundvall Symposium. Aalborg, Denmark.

Stern, R., Hellman, J., Rijnders-Nagle, M., Terrell, M., & Astrom, T. (2011). *How Public procurement can stimulate innovative services.* Retrieved from NORDEN: Nordic Innovation: http://www.nordicinnovation.org/no/publikasjoner/how-public-procurement-can-stimulate-innovative-services-new-study/

TEKES. (n.d.). *PCP Related Initiatives in Finland.* Retrieved from http://cordis.europa.eu/fp7/ict/pcp/docs/pcp-case-finland-v3.pdf

Treumer, S., & Uyarra, E. (2012). Competitive dialogue and contractual design fostering innovation and need analysis. In T. a. procurement, G. Piga, & S. Treumer (Eds.). London: Routledge.

Tsipouri, L., Edler, J., Rolfstam, M., & Uyarra, E. (2010). *Risk management in the procurement of innovation. Concepts and empirical evidence in the European Union.* European Commission, Brussels.

UNU-MERIT. (2012). Thematic Paper 3 - Demand-side innovation policies at regional level 3. *Regional Innovation Monitor*. Retrieved from http://ec.europa.eu/enterprise/policies/innovation/policy/regional-innovation/monitor/sites/default/files/report/rim_thematic_report3_demand_policies_final_23feb.pdf

Uyarra, E. (2010). *Opportunities for innovation through local government procurement: a case study of Greater Manchester.* Manchester Institute of Innovation Research. NESTA. Retrieved from http://www.nesta.org.uk/sites/default/files/opportunities_for_innovation_through_local_government_procurement.pdf

Uyarra, E. (2013). *Review of measures in support of public procurement of innovation.* MIoIR-NESTA Compendinum of Evidence on Innovation Policy, London.

Uyarra, E., & Flanagan, K. (2009). From regional innovation systems to regions as innovation policy spaces," , Public policies and local development. *Openloc Working Papers, 0906, Public policies and local development*. Retrieved from http://www.openloc.eu/cms/storage/openloc/working_papers/2009/UyarraFlanagani2009.pdf

Uyarra, E., & Flanagan, K. (2013). Reframing regional innovation systems: evolution, complexity and public policy. In P. Cooke (Ed.), *Re-Framing Regional Development: Evolution, Innovation and Transition.* London: Routledge.

Uyarra, E., & Gee, S. (2013). Transforming urban waste into sustainable material and energy usage: the case of Greater Manchester. *Journal of Cleaner Production, 50*(1), pp. 101-110.

Uyarra, E., Edler, J., Garcia-Estevez, J., Georghiu, L., & Yeow, J. (n.d.). Barriers to innovation through public procurement: A supplier perspective. *Technovation, 34*(10), pp. 631-645. doi:10.1016/j.technovation.2014.04.003

Uyarra, E., Edler, J., Gee, S., Georghiou, L., & Yeow, J. (forthcoming). Public procurement for innovation: the UK case. In L. Lember, T. Kalvet, & R. Kattel (Eds.), *Public Procurement Policy for Innovation: International Perspectives.* New York: Springer.

Wert, B. (2013). Driving Innovation via Public Procurement of Innovation. *Support of Horizon 2020.* Brussels: DG Eneterprise and Industry - Innovation For Growth Unit. Policy Development for

Industrial Innovation. Retrieved from http://ec.europa.eu/enterprise/sectors/construction/competitiveness/files/innovation-procurement_en.pdf

Wessner, C. W. (2008). *An Assessment of the SBIR Program.* National Research Council. Committee on Capitalizing on science, Technology and Innovation. Washington D.C.: The National Academics Press.

Yukins, P., & Piga, G. (2012). Dialogue: Set-asides for small and medium firms, as in the USA system with the Small Business Act that reserves shares of tenders to SMEs only. In G. Piga, & S. Treumer (Eds.), *The applied Law and Economics of Public Procurement.* London: Routledge.