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Public procurement of innovation

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1. Introduction

Public procurement is defined as the acquisition of goods and services by the government or other public bodies from companies. Public procurement can be used as a mean to stimulate innovation by increasing the public demand for an innovative good or service. This phenomenon has become increasingly popular in recent years and it has been recognized as an effective mean to incentivize the private sector to invest in R&D. Procurement can also come from private firms directly, in cases in which big players in an industry have interest in pushing a specific technology forward. In this work, though, we will focus on public entities in the European Union, where public procurement is regulated by EU directives. Public procurement can happen at any level of society: from the smallest local department to the national and supranational level. Furthermore, for public agencies every good and service is considered as acquired through public procurement, due to regulations for public purchases which force them to go through some sort of tendering process to select their suppliers. The difference between standard public procurement and public procurement of innovation (PPI) is the outcome. “Innovations are new combinations manifested as the introduction of a new good, a new method of production, the opening up of a new market, or the use of a new source of supply of raw materials or new ways of organizing industries”.[1] The distinction between PPI and “standard procurement” is important, and sometimes it is hard to distinguish between procurement activities that lead to innovation and the sourcing of products and services that can fall under the definition of “materials and forces within our reach”[2]. Identifying innovation is extremely important to correctly reward the supplier that best satisfied the needs expressed by the procurer. Two other concepts related to innovation are diffusion and adoption. For an invention to be innovative, it must be adopted by users. The pattern of adoption (or diffusion) of a product can change and can be alter by post-invention innovations that can make it more or less appealing to users. Public procurement can be used to make a product more widely diffused, this is especially true in case of

1. Schumpeter (1934)
2. Schumpeter (1934)

unsolicited bids, that is, when a supplier shows an offer to a public body without having been solicited to do so, for instance, through a tender call. PPI can also be seen as a mean to generate knowledge that doesn't translate to an immediate product, but can be used in later stages of development. Knowledge can also be the aim of a procurement projects through "pre-commercial procurement", EU directives in fact allow a public agent to procure R&D services with no immediate commercial use. The concern of legal rules regarding public procurement is the contracts made in writing, the set of procedures invoked by the procurer: the open procedure; the restricted procedure; the competitive dialogue; the negotiated procedure and design contests. Finally, the types of contracts that can be awarded are defined, such as: public works contracts; public supply contracts; public service contracts; different concession contracts; and framework agreements. EC rules do not regulate the content of procurement activities nor they make a distinction between standard procurement and procurement of innovation, since they are both purchasing activities carried out by public agencies, with the only distinction being that the latter leads to innovation. The role of innovation in long-term growth and sustaining competitive advantage is widely understood. To stay competitive, a firm must continuously seek out opportunities to innovate, but this doesn't mean that we should exclusively rely on firms' need for competitive advantage to generate innovation. There are multiple means that public agencies can use to stimulate it, that can be put in three categories: environmental, supply-side and demand-side measures.[3] Examples of environmental measures are: tax allowances for firms investing in R&D and intellectual property laws granting temporary monopolistic powers. Supply side measures include public provision of scientific training, public laboratories and R&D grants. Procurement, instead, falls on the demand side, together with systemic policies, regulation and standardization aimed at the technical development and support of private demand. Linking supply and demand directly through procurement can not only give sufficient incentives to the private sector to invest in R&D but it can also increase tax income

3. Rothwell (1981)

through higher intake of company taxes and individual income taxes. It can, in the end, increase public purchasing power that can sustain further procurement, strengthening the cycle. The same good or service could be produced and offered at a lower price because intrinsic needs have been satisfied through the procurement project. It can result in the delivery of a better public service. Finally, procurement has a strong impact on market transformation since it not only influences the firms directly involved in the projects but also the remaining competing firms and firms in adjacent markets.

Procurement in the EU in recent history

Procurement represents 16% of EU GDP, so directing this share of the demand towards innovation and R&D expenditure can have a strong impact on European economy. The policies applied by the US and Japan have increased the pressure to focus on developing our own. Public procurement has been used as a policy tool since the 19th century. It is only in recent years, though, that it has been used to stimulate technical development, for instance in the building sector (Westling, 1991); for creating environmentally friendly technology (IEA, 2000; Erdmenger, 2003); and as a way to coordinate demand and bring new technology more quickly to the market (Phillips et al., 2007) or induce market transformation (Neij, 2001).[4] At the end of the 20th century though the idea of public procurement as a demand-side policy tool wasn't established yet, even though the topic was deeply understood at the time, because the general approach was to stress market mechanisms and promote a free market, with little public intervention. This changed starting from the Lisbon European Council meeting in 2000. During the meeting, it was established that the challenges posed by global competition and the newly formed knowledge-driven economy were not being addressed properly in the European Union, although the economy was healthy in terms of interest rates, inflation level, public deficits and educational levels. The EU set the goal "to become the most competitive and dynamic knowledge-based economy in the

4. Max Rolfstam - Public Procurement and Innovation, The Role of Institutions (2013)

world" by 2010 and to achieve this result it would have applied "better policies for the information society and R&D, as well as stepping up the process of structural reform for competitiveness and innovation"[5] To reach the goal R&D had to increase from 1.9% of GDP, which was the level in 2000, to 3% in 2010, the target year for the goal. An increase in the level of business funding of R&D from 56% to an approximate 66% was also needed. The public sector had to revert the tendency to buy already established technology in favor of emerging technologies. It was clear that the goal would have not been met without the right use of policies. Public technology procurement was recognized as a key measure, as a funding source for public infrastructure and to stimulate research in the private sector. In the subsequent years the European Commission made many observations regarding this mater, like:

"Policy instruments which attempt to link supply with demand have been relatively neglected … despite the fact that public technology procurement entailing a measure of R&D is the largest potential source of the financial resources needed to meet the Barcelona target. Public authorities should be encouraged to be less risk-averse and take steps to increase the amounts of R&D associated with procurement decisions.";

"an important objective is to raise public buyers' awareness of the possibilities offered to them by the legislative framework, and to support the development and diffusion of information enabling them to make full and correct use of these possibilities";

"public authorities are big market players which have powerful means to stimulate private investment in research and innovation";

"member states should (among other things) focus on encouraging public procurement of innovative products and services"

The idea of using public bodies as launch customers or lead users creating lead markets also gained

5. European Council (2000)

traction, even though the latter hasn't been very effective in practical uses, possibly due to budget or constraints or to the difficulty of generating lead users through top-down intervention. In 2007 a guide for innovative solutions in public procurement was published by the European Council to help policy makers in developing and implementing procurement policies and solutions that promote innovation, and in general to emphasize the role of public procurement as a mean for innovation. The Council determined in 2007 that for procurement to be most effective it needed to be part of a larger system to promote innovation, which provides education, research, finance, knowledge transfer, support for small businesses, intellectual property management and a high quality regularity environment. Many projects started in subsequent years to realize the objectives of the Council. The Open Method of Coordination – Public Technology Procurement (OMC–PTP) project set up to bring together policy makers, practitioners and suppliers to establish a platform for learning, concerning various forms of procurement leading to innovation.[6] The STEPPIN Project intended to increase the focus on standards for the procurement of innovation.[7] The European Commission elected an expert group to work on public procurement and risk management and launched many coordination actions aimed at promoting the use of pre-commercial and other types of procurement. All these events are evidence of a shift in policy-making from free market forces to the public sector as a main agent in the pacing and stimulation of innovation. Citing Callender and Mathews (2002), "'Government is suddenly seen as a fundamental provider rather than an adjunct to the business of running the economy".

Public procurement as a connected phenomenon

This shift in policy causes a severe change in behavior and perspective in some public agencies that may require strong deviations from their previous way of doing business to increase their role in fostering innovation and becoming a market player. Taking into consideration the way public bodies have to adhere to the new rules and the new incentives

6. Bodewes et al. (2009)
7. Europe Innova (2008)

created by these policies is vital in understanding certain behaviors and decisions that may arise in procurement cases, otherwise their underlying motives may be misunderstood as stand-alone phenomena. In conclusion, as admitted by the European Commission in 2010, even considering the shift in policy of the last decade, Europe still lags behind other countries and the opportunities provided by procurement of innovation are still overlooked and its potential is used only limitedly.

Structure

We will analyze the different kinds of contest through which the procurer rewards the supplier and the possible outcomes for public procurement of innovation by taking a look at the Hommen matrix in chapter 2, we will see further what the stance on procurement of the European Commission is and what is the impact of the phenomenon in Europe with relation to other countries. We will briefly describe some of the rules that regulate the interactions between procurer and potential suppliers in chapter 3 and we will investigate on whether regulation limits or promotes the creation of innovation through the use of procurement.
We will take a look at a real case in chapter 4 and then we will draw the conclusions, offering with this work a first outlook on procurement, the tools to use it, their potential outcomes, the rules that regulate the process and finally a practical example of the phenomenon being used in a real life scenario.

2. Types of contests and of procurement

Since governmental large-scale purchases can be oriented toward goods with different R&D contents, governments must consider the effects of their procurement decisions on R&D investment in the private economy, given the large impact they can have on it. The appropriate design of procurement contests results in considerable gains in static efficiency in the short term, but its effects on technical progress can accumulate over time and can have greater consequences in the long run. We will consider these possibilities in this chapter, focusing in particular on how to induce potential suppliers to produce and sell innovative products. These cases apply to public procurement, even though some elements are also valid for private procurement. We will also make macroeconomic observations on how public procurement can be used to stimulate aggregate R&D expenditure and to incentivize the formation of human capital.

A peculiar kind of good is knowledge. Innovative knowledge can in principle be procured like any other good, but it has two main distinguishing characteristics. It is “non-rival”, that is, after it is produced, it can be consumed by several users simultaneously at almost no cost. This mainly applies to two common types of knowledge: an idea for a product and a process innovation. Once a new idea has been invented and successfully tested it can be applied to the production of an indefinite number of products. Innovative knowledge is also “non-excludable”, that is, it is hard or impossible to control who has or is using it in the absence of secrecy or legal protections, like intellectual property rights, which are used as artificial incentives to stimulate

research, where otherwise everyone would prepare to freeride knowledge produced by others. This means that knowledge tends to be what's called a public good in economics, which is not to say that it cannot be obtained through public procurement of innovation. We will take a look at the main tools used in public procurement projects and we will compare it to their main alternative, intellectual property rights. Through intellectual property rights or trade secrecy, authors and inventors obtain a temporary monopoly over the commercial use of the innovative knowledge they have created. The prospect of reaping monopoly rents, albeit for a limited time period, incentivizes them in engaging in innovative activities and opportunities that would otherwise be left untapped without the exploitation of limited monopolistic power. The alternative mechanism to foster innovation, which is the one mostly used in standard procurement, is the granting of monetary prizes to innovators. Knowledge, products and services invented by all contenders are then put in the public domain. Prizes can be defined as ex-ante or ex-post. Ex-ante prizes are announced before the contest takes place and can be claimed by the first to solve a problem defined by the organizer. In ex-post prizes, no problem is defined beforehand and a worthy discovery is awarded at the discretion of the organizer. Private firms on the other hand can procure knowledge by conducting research in-house, obtaining licenses from independent holders of intellectual property rights or trade secrets, and posting prizes.

Ex ante

Monetary prizes financed out of general fiscal revenue can and have been used to reward innovators. In particular, ex-ante prizes are posted in advance and can be claimed by anyone that satisfies the need expressed by the procurer. On the contrary, ex-post prizes are granted discretionally as a reward for achievements that could not be foreseen in advance. In both cases, the prospect of profit from winning the prize will elicit some research effort.

Ex-ante prizes are often impractical because many inventions cannot be easily described and it is hard to verify whether the desired invention has been achieved or not, since practices like clinical tests cannot be applied in many cases. Even when these conditions can be met, ex-ante prizes have other issues when compared to intellectual property, mainly:

1. Prizes financed out of general fiscal revenue cause an inaccurate distribution of the value of the innovation, since some individuals end up paying for something they do not use or value, or they pay disproportionately to the use they make of the innovation. With patents instead, no one pays more than he benefits from what he buys.
2. The burden of the prize funding must be divided proportionately among the countries involved, which requires international agreements to be stipulated. Even though the same problem is also possible with the use of patents, this problem has already been addressed and solved by various international treaties, like TRIPS.
3. "The reward conferred by patents depends upon the invention being found useful, and the greater the usefulness, the greater the reward."[1] While incomplete information isn't an issue in intellectual property, because the market naturally determines the value of the innovation, it is in the assignment of monetary prizes, since it is hard to correctly choose their size. The prize has to align the private incentive to invest with the social value of the innovation; consequently, this system is bound to over-incentivize certain innovations and under-incentivize others.

A prize system has also advantages over a patent system, mainly two. Firstly, generally the deadweight loss incurred from monopoly pricing of a new patented good is greater than the excess burden from optimally (and in most cases also from most existing non-optimally) designed tax systems. Monopoly prices cause not only monetary deadweight costs but also social costs from the exclusion of people from the patented good, e.g. ill people excluded from consumption of a new life saving drug. Secondly, the

1. Mill (1848)

private value of a patented innovation may fall short of its social value, for instance when a new drug would grant the supplier small profits but it would greatly increase the quality of life of many diseased people, and thus a patent system may result in insufficient incentives to invest in research, whereas the size of a monetary prize can be increased to match the social value of the innovation.

If we leave aside distributional concerns, assume that international agreements are easy to reach and that the optimal patent life is finite, the main point of comparison between patents and prizes is the distortion created by asymmetric information on one hand and those associated with monopoly pricing on the other. It must be noted that when potential innovators have incomplete information regarding the value of the innovation, the decision to invest in research is distorted also under a patent system. The extra cost of a prize system is due to the asymmetry of information between the prize setter and the contestants and not by the incompleteness of information. Information can in fact be incomplete but symmetric, causing no extra costs. Therefore, when information is symmetric, monetary prizes are the better reward for innovators. This conclusion applies whenever the cost of informational asymmetry is lower than the deadweight loss from the exercise of monopolistic power. The higher is the elasticity of demand, the higher is the social cost from monopolistic economic equilibrium. Likewise, when information is very asymmetric and the deadweight loss is smaller, patents are preferable to prizes. This could be the case also when demand is very inelastic, even though asymmetry of information isn't high. A solution in between are self-selection mechanisms that combine prizes and intellectual property. For instance, an optional patent system in which the supplier (who is generally better informed on the value of his innovation than the procurer) chooses discretionally between a patent and a monetary prize. The decision will be made based on the value of the innovation and the expected potential profits coming from it. The reward would be constant if the prize is chosen and will increase with the value of the innovation if the patent protection is preferred instead.

2. Dosi (1982); Utterback (1994)

Consequently, more valuable innovations will end up being patented, and less valuable innovations will be used to claim the monetary prize. The downside of such a solution are the informational rents that suppliers will inevitably hold, but even taking this into consideration, this system may in many cases be preferable to a pure patent or pure prize system.

In the scenarios we depicted we consider every innovation as independent of the others. However, innovation is cumulative in nature: typically, each innovation builds on the previous ones, and in turn constitutes the basis for subsequent developments. Using intellectual property rights with cumulative innovation is trickier than with standalone innovation, which makes ex-ante prizes a much more suitable solution for many procurement cases. The two main consequences of cumulative technical progress are:

- First, cumulative knowledge increases the social value of an innovation, because you have to take into account the option value of obtaining a subsequent innovation with further investments.
- Second, next-generation innovations usually kill the demand for the previous generation, hence suppliers producing the current innovation that are protected by patents would not only be unrewarded for creating the option value of subsequent improvements, but they would be punished for it as soon as these improvements come in existence, erasing the market for the current innovation.

To protect the interest and grant enough incentives to original innovators forward protection is needed, preventing future innovators to compete with previous generation products and keeping profits coming from them intact. This solution, though, inhibits the production of subsequent generations improvements, which entails a high social cost. On the other hand, a prize system is immune from this complications, since it can include the option value of basic innovations, granting enough reward for basic innovators and allowing future innovators to take advantage immediately of the new opportunities that have been generated, since the new knowledge produced is immediately put into the public domain.

Ex post

There are times when an innovation can't be easily or precisely described or when it can't even be conceived in advance, rendering setting an ex ante prize unfeasible. However, if the occurrence of the innovation is verifiable ex-post, in principle a procurer could commit to offer ex-post prizes to successful innovators. In an ex-post framework, describing the innovation is no longer at issue, the problem lies in guessing the value of the innovation and hence the appropriate size for the prize.

The two main issues for setting a prize ex-post are: the uncertainty over the value of the innovation, similarly to the issue of asymmetry of information described previously for ex-ante prizes, and the unobservability of the value of the innovation. To preserve a good reputation, the government usually has an incentive in keeping its promises and paying out a prize in a public procurement case. Simple reputation mechanisms are sufficient incentives with ex-ante prizes and the attribution of intellectual property rights, because it is easily observable whether the government rewarded the innovators appropriately or not. With ex-post prizes, discretion comes into play. The government didn't promise any specific size for the prize and it didn't describe the requirements to be met to win it, thus it has a lot of leeway in assigning the prize and deciding its magnitude. This means that reputation mechanisms are not effective when third parties aren't able to observe the value of the innovation. In these circumstances, the government is tempted to under-reward innovators, which in turn will be tempted to under-invest in research, expecting low returns from the procurer. Another problem caused by discretion is that the system is prone to corruption and innovators can engage in opportunistic behavior and lobbying with relative ease.

Kremer's mechanism

Kremer's mechanism is an attempted solution to the problems described above. Its main goal is that of leaving no discretion to the procurer. It works by

providing to suppliers the protection granted by intellectual property temporarily, then the government acquires the intellectual property rights it granted initially through a competitively designed buy-out, eliminating the monopolistic power shortly held by the suppliers. The buy-out happens through a standard first-price sealed-bid tendering process for the patent in which the winner almost never actually claims it, but instead it is the government that acquires the patent at the highest price bid. The highest bidder must still win sometimes, otherwise there would be no incentive in bidding correctly if the probability of being rewarded with the patent was null. This whole mechanism is based on the premise that even if the government is affected by asymmetric information and it doesn't know the value of the innovation, the supplier's competitors most likely do. Furthermore, if the government can abuse its discretionary power and under-reward innovators in standard ex-post prizes, it cannot under Kremer's mechanism because it is the bidders that set the price. Even though this solution solves the issues we stated before, it is still prone to collusion.

Research contests

A prize contest requires the occurrence of the innovation to be describable in advance or verifiable afterwards. When neither of the two are possible procurers can resort to research contests to generate innovation. In a research contest, the procurer sets both a prize and a time deadline, and pays the prize to whoever has made the largest progress when the deadline is reached. Contestants don't need to reach a target or to satisfy a predefined need, all that matters is that one of them is awarded the prize at the end of the research contest.

The number of participants in a contest can influence its result by altering the amount of effort exerted by contestants, which is proportional to their probability of winning the race. For this reason, the procurer may want to restrict access to the contest. On the other hand, if access is too restricted the best performers risk being cut out, a collateral damage that procurers want to avoid. Since in this kind of competition it is

the marginal value and not the total value of research that counts, it is important to include the best performers even though they cause the other contenders to exert little effort, because of their little chance of winning. This is not even always the case, since the weaker contestants would exert little effort only if they knew that they lag way behind the best performer. If they are being outclassed by a small margin, they may decide to increase their efforts and try to outdo their competitors.

In a race where marginal value is what matters it is often not beneficial to split the prize, since you risk disincentivizing the strongest contestants, but with few exceptions. There may be cases where the procurer wants to increase aggregate effort, even at the cost of marginal effort, or, more likely, it wants to keep high levels of competition in later stages during multi-stage contests.

Even if it seems counter-intuitive, it may be a good idea to handicap contestants, because they perform harder when they are neck-to-neck, while incentives could be low when there is a great disparity. Even in cases of disparity though, handicaps are not necessarily constructive, the tradeoff between decreased productivity and increased levelness of the competition may still worsen the outcome.

In addition to monetary prizes and intellectual property rights, innovators can be rewarded with procurement contracts. In cases where contracts are used as rewards the outcome of the contest can be improved with another instrument: the price of the good supplied. Now the competition has two stages, during the first one contestants work on the good or service to be produced and during the second one they set a price. Now the contender that produces the best innovation is not certain of winning the prize, since the winner is chosen on the base of another factor in addition to quality.

Indirect effects

Other than the immediate effects any procurement case has on a market, it also has some indirect effects

on innovative activity. Procurement can enlarge the market for new goods, change the market structure so as to make it more conducive to faster innovation and it can facilitate the adoption of new standards.

Procurement can help in creating new network effects and it can weaken pre-existing ones. Network effects cause the value of a good or service to increase when the number of its users increases. Networks can be physical or virtual alike. Strong network effects can lead to market failures which are hard to counter without public intervention. There are two main forms of market failures for innovative goods related to network effects: excess inertia and inefficient lock-in. Excess inertia happens when a new, superior technology fails to dethrone an older, inferior one because of its strong network. Inefficient lock-in refers to the situation when market dynamics lead to the adoption of an inferior technology or standard. Going back to excess inertia, the mechanism behind it is that users of the old technology are hesitant to switch because they don't value the new technology due to its weak existing network or because they fear they will be among the few to switch. Public administration can choose a new technology by purchasing considerable amounts of innovative goods and services, changing the outcome of the technology adoption process, creating demand for technologies that could have failed due to inertia or inefficient lock-in. The public administration can also adopt a new technology as a whole, eliminating fear of isolation by private adopters.

Hommen matrix

The Hommen matrix attempts to label and summarize the main different types of public procurement of innovation activities, defined in this model by two dimensions. The first dimension captures the mode of interaction from which the social need that motivates the procurement process has evolved. The other dimension captures the impact of the procurement in relation to the market. While on the social need dimension "distributed" procurement has been added, the market dimension has been extended with the element of destruction.

Role in Relation to Market / Type of Social Need	Initiation Development	Escalation Adaptation	Consolidation Standardization	Destruction Removal
Direct Needs intrinsic to public agencies	Direct Initiation	Direct Escalation	Direct Consolidation	Direct Destruction
Co-operative Congeneric, or shared needs	Co-operative Initiation	Co-operative Escalation	Co-operative Consolidation	Co-operative Destruction
Catalytic Extrinsic needs to public agencies	Catalytic Initiation	Catalytic Escalation	Catalytic Consolidation	Catalytic Destruction
Distributed Need identified and satisfied externally through exposed public opportunity	Distributed Initiation	Distributed Escalation	Distributed Consolidation	Distributed Destruction

Public procurement of innovation can take place with different degrees of bundling of demand. A public agency can execute procurement of innovation for intrinsic reasons, that is, to satisfy its own needs. This is a case of direct procurement. When the public procurer is still the potential user, but it also wants to promote market acceptance of a good, it is satisfying a need that is shared or congeneric. This is called collaborative procurement. When the procurer acts on behalf of other users, like the private consumers for instance, and not to satisfy an intrinsic need, we observe extrinsic or catalytic procurement. This may happen consciously but it may also be an unintended effect of a procurement project. A further form of extrinsic procurement is the fourth element on the social needs axis: distributed public procurement of innovation. In this case the public agency doesn't directly commit to procure anything, but it publishes some kind of opportunity that suppliers can explore and exploit for their own benefits. An example of such a case would be if the government published data and information related to a new unexplored technology that firms can transform into a new good or service. The other dimension in the Hommen matrix refers to the market effects rendered by the procurement and relies on the assertion that public procurement of innovation takes place at different stages of technological development, or phases in the technology life cycle.[2] It is widely known that public

2. Dosi (1982); Utterback (1994)

procurement of innovation can play a vital role in the emergence of new technologies, but the role that public demand can have in their diffusion by influencing private demand is not as well established. For this reason, in the Hommen matrix it is taken into account that innovation can occur at any stage of the technological life cycle. Public procurement can lead to market creation, and in that case we talk about market initiation. It can boost or escalate a pre-existing market. A fragmented market with many different products that needs to be harmonized or standardized can be consolidated. Public procurement can also cause the end of a technology's life cycle, in other words its destruction. Destruction is one neglected aspect of public procurement of innovation, which is a bit odd, as destruction is central to the Schumpeterian understanding of innovation (Schumpeter, 1976, p. 84). Combining the two dimensions described before and their elements we obtain 16 possible outcomes, all characterized by differences in the social and economic context. The matrix can be used by analysts as a framework to compare different instances of procurement projects and by policy makers as a tool for identifying different contexts of possible intervention. Direct/initiation procurement usually comes from technologies originally intended for military defense, which then found applications also in the civil market. Direct/consolidation procurement often takes place when the government wants an industry to adhere to certain environmental criteria, pressuring suppliers that don't meet the desired environmental requirements. Cooperative/initiation can occur when public agencies are forced to consider environmental and energy efficiency issues and end up creating innovation that is attractive to the private sector too. Cooperative/consolidation procurement comes from lists of "best practice" products, that create incentives for innovation in competing products that are currently underperforming. Catalytic/initiation procurement activities contribute to the creation of new markets, without entailing any direct benefit for the procurer. Finally, innovation is often associated with the destruction or replacement of what currently exists and is in use. Consolidation procurement can be destructive, in that it triggers innovation among

suppliers that don’t meet the required standards, while at the same time having a destructive effect on existing technology. In the same way initiation can be destructive, the creation of a new market can be the doom of an old one. Escalation can annihilate a market that was dominant before the escalating market expanded, reducing the demand for the previously dominant product. Destruction is not always a consequence of procurement but it could also be a precondition for the success of a new product or it could be the aim of a procurement project. Sometimes contract must be terminated and resources freed to make space for new opportunities, or existing goods must be removed from the market to avoid threats to public health, like harmful substances used for the production of a particular product.

3. Regulation for public procurement

Procurement law became a topic of great legal importance when the relevance of public procurement and interest in its role as a mean to stimulate innovation increased. We will now take a look at how the EC directives affect the capacity of public agencies to procure innovation. We will mainly ask whether these directives hinder innovation or not. The need to answer this question comes from the perceived tension of the interactive characteristics of PPI and the assumption that EC directives limit the possibilities presented to public agencies when faced with opportunities to procure.

Innovation and design theories

The basic argument here is that the interactive learning and user–producer interaction required for innovation could be inhibited by the rules. A few scholars warn that "the consequence of rigid procurement rules may be that procurement processes give rise to solutions that are price competitive, but do not spur innovation and the dynamic development for firms and society as a whole".[1] The EC directives on public procurement are transposed into national legislation among EU member states, but other, non-EU member states also comply with the same rules, through their participation in the EFTA agreement and membership in the European Economic Area. Member states have a limited amount of discretion on how they want to implement the regulations because of the subsidiarity principle. Sweden, for instance, integrated the directives with amendments to the old act on public procurement, while Denmark incorporated them without further adaptation to the text. This means that public procurement must be carried out in compliance with the public procurement directives within the institutional domain. Albeit with small variations at the national level, especially regarding procurement cases below certain threshold values the principles applied are the same in all the European area. One central element of the directives is the specification of procurement procedures a public procurer can apply to award a contract. The procedures specified in the old Utilities Directive 93/38 are the open procedure, the restricted procedure, the negotiated procedure and the design contest. Innovation and design are activities that by definition concern the creation of new products or services, which implies that the characteristics of the good to be procured are not known in advance, thus this type of procurement involves uncertainty and risk. Given this, innovation theory proceeds to assume that the interaction between the supplier and the procurer or other stakeholders reduces the uncertainty in PPI projects. Not

1. Nyholm et al, p. 264 (2001)

only that, but frequently, none of the actors involved in the project have enough information to design, develop and produce the good when taken individually, but they are able to do so thanks to the input provided by their counterparts. In PPI projects, often what makes innovation possible is the interaction that allows transfer of different kinds of knowledge and skills between procurer and supplier. “Public procurement of innovation can be seen as a special instance of innovation, characterized by learning and interaction (Dosi, 1988; Lundvall, 1992). With this interpretation in mind, PPI cannot be considered a linear process, but instead an event where interactive learning and user-producer interaction play a fundamental role. Even though the usefulness of interaction for the analysis of innovative activities is important, the direction in which the learning flows must not be neglected. In this respect, design theory adds a useful complementary perspective for further analysis of the interaction that took place between the procurer and the tenderers. Design theorists would understand public procurement of innovation as a learning process driven by a vision that provides the direction towards a solution (Stolterman, 1991). At first the designer’s ideals and thought figures determine the initial perception of the design. The vision is objectified and gives birth to an operative image. This process is the result of “negotiations” between the designer’s vision and his perception of the current design situation, mediated by the designer’s thought figures. The vision leads to the development of an operative image and is simultaneously affected by it. At some point in time the development of the operative image becomes established as the design suggestion, that is, as some kind of artefact (Arnheim, 1962; Rolfstam, 2001). It is a reflexive process where “the solution does not arise directly from the problem; the designers’ attention oscillates, or commutes, between the two, and an understanding of both gradually develops” (Cross, 1992, p. 49). The most relevant point to make in this discussion is that even though the outcome is unknown and not predetermined, the process is guided by needs and intentions that allow the developers and the procurers to determine when the outcome has been reached. Finally, the design process can be considered as uncertain but rational, since it develops from the agents’ rationalities. Putting together innovation theory and design theory we can establish that PPI is both an interaction between actors collaborating on a project and a design process that wants to realize a vision and reach a concrete goal. A procurement case can be generally divided in three phases: establishing the need; finding a supplier and satisfying the need. If we assume, like we have done in this chapter, that PPI requires interactive learning and user–producer interaction, the most relevant procedure for procuring innovation under the Utilities Directive would be the negotiated procedure. This procedure is the one that allows the greatest level of interaction and

2. Dosi (1988); Lundvall (1992)

negotiation among the agents, since the procurer "consults suppliers, contractors or service providers of its choice and negotiates the terms of the contract with one or more of them" (Directive 93/38, Article 1, para. 7c). There is no empirical evidence however that this procedure is more conducive to innovation, even though it seems to be the most fitting for the processes analyzed above.

The rules of the game

The directives can be interpreted as an exogenous limiting factor that determines what a procurer can and cannot do. As we already stated in chapter 1, the directives don't regulate directly the content of a procurement project, that is, the product that is procured, and they do not distinguish between procurement of regular goods and procurement of innovation, so the innovation is not explicitely inhibited by compliance with the law. The opposite, in fact, can be argued: compliance with the directives can increase the chances of reaching a successful outcome and to produce innovation. Typical obligations specified in the Utilities Directive are the requirement to publish a tender call in the Official Journal of the European Communities (Directive 93/38, Article 21). The contracting entity is also obliged to base the contract award on certain criteria (Directive 93/38, Article 34). The tender eventually chosen has to be the "most advantageous tender" or the offer with "the lowest price" (Directive 93/38, Article 34, para. 1). Non-discrimination is a central theme in the directives. "Contracting entities shall ensure that there is no discrimination between different suppliers, contractors or service providers" (Directive 93/38, Article 4, para. 2). A technical specification must be included in the tender documents (Directive 93/38, Article 1, para 8; Article 18). This last requirement may be seen as an issue because specification and innovation seem antithetical, with the argument being that if the procurer is required to know what should be procured, the outcome cannot be innovative, since an innovative item is something that does not exist yet at the time of the submission of the tender call.

Another 'problem' associated with this line of thinking was as follows. When dealing with (at least partly) unknown innovations, innovative projects may sometimes reveal new solutions to a problem as the project develops. If specifications cannot be changed as the project develops, it might not be possible to exploit the new solution, as tenderers that did not get the original contract might complain on the grounds that the innovation eventually delivered did not match the specifications made in the tender call. Although the use of functional specifications has been encouraged for quite some time now, for example in the context of green procurement (European Commission, 2004b), because "focusing on the outcome or functionality desired gives suppliers the opportunity to be

innovative" (Central Procurement Directorate, 1994, p. 12), it might still be problematic to propose radically and previously unproven solutions in an ongoing project. "innovation … cannot be explained sufficiently in terms of information processing or problem solving. Rather, innovation can be understood as a process in which the organization creates and defines problems and actively develops new knowledge to solve them" (Nonaka, 1994, p. 14). In principle, what Nonaka describes is a reflecting process, where knowledge is created through conversion between tacit and explicit knowledge. Viewed as such, the actual process of writing the specification for the system to be procured forces tacit knowledge to become explicit knowledge. This means that the writing of a specification per se may be understood as a learning opportunity in itself. Writing a specification requires the author to learn about the system to be specified and therefore it should be understood as part of the innovation process. In that sense, the requirement of a specification actually becomes something that stimulates innovation (Directive 93/38, Article 18, para. 1). One major critic of the current legislation on procurement is that it doesn't allow public agencies to act like private firms would in the same circumstances, and, if they could, everything would be fine. Current laws alter the way tender calls are managed, requiring the procurer, for instance, to publish certain information to all potential suppliers, adding a layer of burocracy to the process. Another point of argumentation supported by certain authors is the perception that the directives forbid long-term collaborations between the procurer and a so called "national champion". These two entities are defined together as a "development pair" (Fridlund, 1999). It is still possible for the champion to participate in a tender call like all of its competitors, but the informal possibilities of interaction and contribution that may arise in an unregulated environment are not possible under the law. Furthermore, the discretion that the procurer can apply in choosing the winner of a call is limited, since the tender selected is determined by its fit with the specified award criteria. This limitation on discretion is intentional and it has the goal of preventing nationalistic, protected and (therefore) inefficient procurement and instead promotes the creation of a common European market (Cox and Furlong, 1996). The aim of the legal framework on this matter is to balance the risk of corruption, favoritism of local champions and stimulation to competition. It also has positive effects on the level of innovation of the outcome obtained, since it prevents inferior domestic technology to be chosen over state of the art technology to satisfy political needs. The negative effect is the potential increase in the gap between domestic and foreign technology and the creation of a lock-in to inferior domestic technology.

The implication of innovation theory is that, to enable innovation, the procurement procedure must allow interaction between procurer and supplier to the greatest extent. The level of interaction varies among the different procedures defined in the directives. The negotiated procedure is held in high consideration by innovation scholars because it “seems to have been designed for highly innovative development projects” (Lundvall and Borrás, 1997, p.131; also Gavras et al., 2006). Public procurers are reluctant to use the negotiated procedure because of the risks it entails. The main concern risk averse procurers have is the need to remain competitive during the whole tender process, while scholars emphasize the interactive aspects of it and they focus less on the competitive selection of suppliers. Both aspects shouldn’t be neglected in the end, since interaction is important, but it depends on who is interacted with, which makes the selection of the most suitable supplier a fundamental step of the process.

4. Case study: e-government services in Greece

1. The context: e-government in Europe

E-government (electronic government) refers to the utilization of ICTs, and other web-based telecommunication technologies, to improve the efficiency and effectiveness of service delivery in the public sector.[1] E- government changes considerably the way public services are delivered and generally the way in which government interacts with citizens and businesses. Thus, it can be considered as a field that provides significant room for public procurement of innovation (PPI). The benefits resulting from an extensive realization of e-government concern a large variety of actors. First, e-government can enhance the public sector's productivity, increase transparency, hence leading to less corruption, cost reductions and increased public revenue. At the same time, it can result in better delivery of public services to citizens by ensuring time and cost savings and generally by upgrading their quality of life. Furthermore, e-government can improve the interactions of government with industry, strengthening in this way the private sector's productivity and competitiveness prospects. The EU's e-government services are becoming increasingly interactive and transactional, while the quality of service delivery has been significantly improved over time.[2] However, three key messages emerge from a recent e-government Benchmark Report.[3]

1. Citizens expect increasingly swift and easily accessible public electronic services.
2. Users are slow in adopting these new services, causing under-investment in the sector. This problem probably reflects the inefficiency with which European countries are introducing e-services to their citizens.
3. A shift to an "outside-in" approach is needed, that is, designing the product by looking at it through the eyes of its users.

2. The context: e-government in Greece

In Greece, the use of public procurement to stimulate demand is fragmented and confusing. The current economic and political

1. Jeong (2007)
2. European Commission (2013)
3. European Commission, p. 60 (2013)

environment cultivated several inhibitory factors like excessive bureaucracy, lack of trust, human resources, skills and organizational capabilities on the side of public agencies and, in general, disinterest by the government in increasing procurement activities. In the case of ICTs specifically, particular procedures are applied to ensure cost-effectiveness and compliance with the technological developments. Studies show that Greece is not an intelligent buyer of ICT and e-government solutions and that the usage of ICTs at all government levels lags behind that of other countries in the Union.

A large-scale survey (KEDE and NTUA, 2011) examined the situation of ICT utilization in Greece and the findings aren't promising. The majority of the surveyed municipalities not only have not developed an explicit ICT strategy, but they do not even have a formal IT unit, and those who do, still have an inadequate number of employees to effectively support their operation. Further problems observed in the study are: lack of skilled personnel, scarce use of internal and external consultation and poor organizational capabilities.

The project

In 2007 the Local Government Application Framework (LGAF) project was launched by the Central Union of Greek Municipalities (KEDE) for the development of ICT. The project was co-funded by the European Union and it had a budget of 1.6 million euros. The aim was to develop a platform that offered a modern high quality e-government service while still being compatible with the legacy applications used by local authorities. The process for the realization of the project could be divided in two stages:

1. The design and development of the software system itself and its delivery to KEDE.
2. The pilot delivery of the services offered by the new system, that is, the use by its end users.

The main incentive that brought KEDE to launch this project was an opportunity offered by the EU Cohesion Policy Fund to provide the capital needed for the delivery of value-added online services to citizens and local businesses; and a more efficient management of local authorities' resources and organizational processes. This aim was translated in more practical functional requirements for the tender call:

1. The development of a centralized platform that could be used by every agency, eliminating the need for a

2. fragment platform and the development of many e-government tools for each agency.
3. The adoption of open standards, to guarantee the interoperability and interconnection of the platform with legacy systems in use, to make it scalable and reusable for other potential applications.
4. The use of open source software (OSS) that makes the system flexible, free of licensing costs and easier to reallocate for different uses.

An open call including the requirements mentioned above was released, together with a list of suggested OSS packages that were already used by governments in other European countries. A large and well established Greek IT firm was selected and awarded the contract. It chose APLAWS as OSS, one of the solutions mentioned in the list of suggestions. APLAWS (Accessible and Personalized Local Authority Website System) was developed in the UK as a nationally funded scheme designed to develop technology that could be reused across the country. In 2007, KEDE and the contracted firm decided to redesign the project, using APLAWS as a base, and to create a more state of the art technology that was more fit to reach the goals established in the tender call. This decision was taken mainly because, even though APLAWS was a pioneering technology when it first launched, it fell behind with time, due to the quickly evolving landscape of web-service technologies, and it could not be easily adapted. Web-service technologies support very flexible system architectures like SOA. SOA is an enterprise wide IT architecture that enables the design of integrable and reusable applications assets from existing services, without the need of rebuilding them from scratch. Its main characteristic is its implementation of a service platform consisting of many services that signify elements of business processes that can be combined and recombined into different solutions and scenarios, as determined by the business need.[4] This capability provides organizations with the flexibility needed to respond quickly and effectively to new situations and requirements.[5] SOA is thus considered as the best underlying paradigm with which to begin to roll out cross- agency and cross- border e-government services and is proposed as an implementation of the building block approach of the European Interoperability Framework. To exploit the advantages offered by the use of SOA, KEDE and the contracted firm decided to build a new and complex platform made of several components. The advantages of this solution over the previous one are mainly three:

4. Biebertein et al. (2006)
5. UNDP (2007)

1. Higher level of interoperability with legacy systems
2. Increased reusability potential, adaptation and responsiveness
3. Possibility of interoperation with other systems in use by the public administration

This new path required hiring specialized providers capable of applying SOA. The project team changed to accommodate these subcontractors and became a nexus of specialized service providers that helped developing the components needed. A fundamental input was the feedback by the municipalities, which were the end users of the platform. However, only one of them actively contributed to the project, specifically the development of the business process management system (BPMS), by re-engineering and modelling the specific organizational processes that would underlie the delivered services. The implementation of the project required a high level technical management for the efficient coordination of the specialized providers and the integration of the components to be produced. The contracted firm, however, didn't have experience with such a division of innovative labor. This lack of expertise caused a situation where the project participants pushed towards different technical directions and started playing a non-cooperative bargaining game. The project was stalled for a long time and its completion was delayed considerably. A few of the contractors also withdrew due to inconsistencies in the financial flux or to their inability to meet the project's specifications. A firm of considerable size, approximately 40 employees, however, joined the project and provided invaluable input, helping to resolve the stall and accelerate the technical work and the completion of the first stage of the project, the development of the LGAF platform.

The results

Delays in the project were mainly due to endogenous and systemic obstacles in the delivery of the platform. In 2013, when the case study we are examining was made, the project was only half complete. The first stage: the development and delivery of the system to KEDE was finally ultimated in December 2011, but as of November 2013 the second stage was still a work in progress. The finished platform was a satisfying result anyhow, it was a centralized system that satisfied these three core design principles:

1. It was built once, but it could be used several times;
2. It was fully built with open source software and open standards;
3. It was based on service-oriented architecture.

The remaining requirements for the product to be fully usable were: the technical interoperability with the legacy systems used by municipalities and the redesigning and modelling of municipalities' internal processes directly.

KEDE didn't have the tools needed to successfully fulfill this project in terms of management and general procurement skills, like the ability to manage the bidding process, evaluate the bids, award contracts and manage them. KEDE also didn't take advantage of complementary tools that could have had a significant impact on the outcome of this PPI, like increasing the awareness of local government leaders and enhance the training of employees in ICTs to intensify the engagement of the municipalities involved. The limited knowledge, capacity and user skills of these players were a considerable downside and hindered the final result. One can argue that a more active involvement from the municipalities could be obtained if the selection criteria were different, since those selected were chosen by following the concept of representativeness present in the directives of the 3rd Community Support Framework on the basis of their geography and size, instead of more suitable criteria like interest in the project and capacity to constructively contribute to it. While these problems are on the demand side, the study also suggests that on the supply side path dependency in the way IT procurement projects are designed and carried out in Greece was a significant obstacle for the success of the project. IT firms in Greece mainly modify existing products and offer them to the procurer instead of getting involved in R&D efforts to provide actual innovative solutions. This traditional approach satisfies the specifications provided but doesn't generate any meaningful innovation.

Conclusions

In conclusion, the LGAF project was an attempt to address the issues of the current e-government services in Greece, increase their usage and be an upgrade for citizens and businesses alike, trying to achieve at the same time a more efficient management of resources and organizational processes and take advantage of economies of scale. It has aspects both of direct and of cooperative and catalytic procurement[6] as one central public authority (KEDE) organizes and coordinates the project

6. Edler and Georghiou (2007); Edquist and Zabala-Iturriagagoitia (2012)

whose product (platform) will be used mainly by other peripheral public authorities (municipalities). Even though the initial design principles were innovative by themselves, the major source of innovation in this PPI project was the use of SOA, that combined various state-of-the-art or beyond-state-of-the-art technologies for the creation of a new integrated system. Specialized developers (and their coordination) were needed to provide the individual components' enrichment and modifications required by the architecture. As a consequence, the LGAF project can be considered as an adaptive PPI[7] as it leads to a significant incremental innovation through the integration of various advanced technologies. It is important to note that as the ultimate objective of this procurement process was the delivery of product-based services[8] the created technological innovation can constitute the technical base for extensive organizational innovation. This part of the project required the harmonization of the municipalities' internal processes and would have led to the provision of high quality digital public services, but it was left incomplete. A significant positive side-effect of the LGAF project was that it created opportunities for knowledge intensive entrepreneurship[9]. Furthermore, the use of SOA and OSS, stimulated the participation of small software providers interested in the incentives to knowledge exploration provided by this software and its implication in the project. Thus, LGAF developed an environment where a knowledge network among small knowledge intensive organizations had the opportunity to flourish and it ultimately led to the development of the system.

As we already mentioned, this study dates back to 2013. As of today, we know that the second stage of the project was never completed. A few municipalities began testing of the platform, acting as end users and testers for the remaining development steps, namely the adaptation and harmonization of their internal processes, but this phase was never finalized. The system is very limitedly operational and only a handful of services has been released and can be used by the public.

7. Edquist and Zabala- Iturriagagoitia (2012)
8. Technopolis (2011)
9. Malerba and McKelvey (2010); Radosevic et al. (2010); Edquist et al. (2010); Timmermans and Zabala-Iturriagagoitia (2013)

5. Final remarks

In this work we have reviewed the tools that procurers can use for setting up and executing their projects, the advantages and the disadvantages they entail, the trade-off that must be considered when taking decisions that will affect the final outcome. We have seen that the main tools are:

- Prizes, either ex ante or ex post;
- Research contests
- Intellectual property rights
- Hybrid tools

We have examined the indirect effects that procurement can have on the market and we labelled the majority of the types of outcome possible with the help of the Hommen Matrix. PPI can lead to the initiation of a new technology or the destruction of and old one. It can satisfy intrinsic or extrinsic needs.

We took a look at the European Commission opinion and general stance on procurement, the economic relevance of the phenomenon here with respects to other countries where it is more widely exploited. We reviewed a bit the regulation on the matter, focusing on whether or not claims that it can or cannot spur innovation are correct, showing little reason to believe that EC directives have a clear inhibitory function.

We studied a real case in which the Greek public administration tried to build a platform to offer modern e-government services to the public. We have seen the positive sides, the creation of a system that brought up very relevant and highly innovative elements and generated a productive network of knowledge seekers, attracted by the implementation of open source software; and the negative sides, the inability of the procurer to manage the project properly, selecting the wrong suppliers and contractors, applying principles present in the EC directives inappropriately, resulting in the end in incompletion of the second and final stage of the project.

With this work I attempted to provide a brief but effective overview of the topic, with insights on some elements that are most relevant to the understanding of the phenomenon and the analysis of its application, as it gains more and more traction as a demand-side tools for governments and it is expected to play an important role in the pursuit of growth and innovation in the future.

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