# Opening Innovation Procurement:

# Roles for Standardization, Collaboration

# & Intermediation

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von der Fakultät VII – Wirtschaft und Management
der Technischen Universität Berlin
zur Erlangung des akademischen Grades

Doktor der Wirtschaftswissenschaften
– Dr. rer oec. –

genehmigte Dissertation

Promotionsausschuss:

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Tag der wissenschaftlichen Aussprache: 16. September 2016

Berlin 2016

*"Innovation cannot happen on an island"*

- *Menno Groen*

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# Publication, Presentation, and Submission Record

This dissertation is comprised of four independent yet complementary academic papers on innovation procurement. The first paper is sole-authored, entitled *Standards in Public Procurement - A Conceptual Framework for Enhancing Eco-Innovation*. It was presented at the Global Cleaner Production & Sustainable Consumption Conference 2015 in Sitges, Barcelona, Spain, and accepted at the European Academy of Management 2015 in Warsaw, Poland, and the European Academy for Standardization 2016 in Montpellier, France. It is currently undergoing the first round of edits for the Journal of Cleaner Production.

The second paper, also sole-authored, is entitled *From Whence the Knowledge Came: Heterogeneity of Innovation Procurement across Europe*. It was presented at the DRUID 2016 PhD Workshop in Bordeaux, France, and the FG Inno 2016 Wannsee Retreat in Berlin, Germany. It was accepted at the University of Cambridge R&D Management Conference 2016 in Cambridge, UK. It will also be presented at the 7th International Public Procurement Conference (IPPC) 2016, in Bali, Indonesia, and was selected by the IPPC7 Best Paper Award Committee for the second place award, from 96 papers. A publication is in press at the Journal of Public Procurement for inclusion in Volume 16, Issue 4 (Winter).

The third paper is co-authored by Dr. Rodrigo Lozano and Mr. Sjors Witjes at the University of Utrecht, the Netherlands. It is entitled *Stimulating Circular Economies through Intermediation - A Case Study of the Textile Pilot Project of the Dutch Ministry of Defense*, and was presented after invitation at the KPU-Soesterberg *Contract Signing - Milestone in CSR Target with Recycled Post-Consumer Textiles*, June 15, 2016 in Amersfoort, the Netherlands. As well, it was presented at the 22nd International Sustainable Development Research Society Conference 2016 in Lisbon, Portugal, and the ETHZurich PhD Academy on Sustainability and Technology 2016 in Appenzell, Switzerland.

The final paper is also co-authored, by Prof. Dr. Knut Blind, and entitled *Innovation and Standardization as Drivers of Companies' Success in Public Procurement – An Empirical Analysis*. It was presented at the Competition and Innovation Summer School 2015 in Turunç, Turkey, the European Academy for Standardization 2015 Conference in Copenhagen, Denmark, and the 5th European Conference on Corporate R&D and Innovation 2015 in Seville, Spain. It is currently undergoing the first round of edits for Research Policy.

# Acknowledgements

This dissertation would not have been possible without the support of so many individuals, opportunities, and assistance over the last two years. At the Chair of Innovation Economics, my supervisor and co-author Prof. Dr. Knut Blind provided excellent direction and mentorship. My colleagues at the Chair offered unconditional support and encouragement through openly sharing their experiences and providing research help – especially Sören Petersen, Anne-Marie Großmann, Annika Lorenz, Julius Rauber, Florian Ramel, Jo-Ann Müller, Jan Peuckert, Matti Große, Paul von Gruben, Simone Wurster, Martin Löhe, and Michael Nauruschat. I have to thank Menno, my mom Betty, Ellen Winter and Sam Groen, and the extended Groen family for bringing me into their family and keeping me sane through so many fun activities together. Annika Lorenz and Marcus Mohr, thank you for easing the transition to Germany and giving me and Cleo a place to live, and your kind offers of cat-sitting and coffee services, respectively.

This dissertation and the activities performed as a part of it are a direct result of generous funding provided by a research fellowship position from Climate KIC (Knowledge Innovation Community). Excellent research assistance from Thomas Hirth through the German Standardization Institute (Deutsches Institut für Normung, DIN) accelerated the project. Toward receiving my Climate KIC PhD Label, I am grateful for so many lifelong friends I made on the 5-week Summer School to London, Copenhagen, and Wrocław, and the 2-week PhD School in Frankfurt. The Climate KIC Mobility Research Program provided funding enabling me to conduct numerous in-person interviews in the Netherlands. This was supported by co-authors Rodrigo Lozano and Sjors Witjes through the European project REBus, and with invaluable assistance from Rob van Arnhem and Aletta Westra at the Dutch Ministry of Defense, and Emile Bruls and Joan Prummel at the Ministry of Infrastructure and Environment (Rijkswaterstaat). I have to thank each of the seventeen interviewees for their valuable time and patience provided over multiple months.

Finally, invaluable in-depth feedback was received from scholars George Licht and Bettina Peters during CISS 2015, Jan Peuckert during CIF 2015, Mette Knudsen during the DRUID Academy 2016, and Volker Hoffmann and Andrew Van de Ven during the ETH Zurich Academy 2016. I am also grateful for the feedback of student reviewers at these venues, and comments and anonymous reviews from the conferences attended.

# 1 Introduction - Innovation Procurement and Open Innovation

## 1.1 Policy Contexts

Interactions between government and industry shape innovations and markets. Public procurement, where the government purchases goods, services, and works from the market, is a key platform upon which public and private entities interact. Across Europe, public procurement accounts for more than 19% of GDP (ERAC, 2015). Certain sectors such as aerospace, defense, healthcare, and education are dominated by public spending – many of these are also critical areas for expanding knowledge horizons through research and development (R&D). By acting as an intelligent buyer, governments can demand public works, products and services in ways that help them improve their own services and reduce costs. Further benefits are possible when purchases help meet societal goals, such as market growth and sustainability improvements.

In leveraging its impact to support these primary and secondary policy objectives, respectively, public procurement plays a vital role in stimulating sustainable and inclusive European growth through innovation. While supporting the European Commission's Single Market Strategy in stimulating competition and trade, increasing efficiency and quality, and helping reduce prices, public procurement must balance fairness and competition aspects. The recent European Directive 2014/24/EU encourages public procurers to do so while inducing innovation in government services and private firms, supporting efficiency in public spending and societal goals (EC, 2014a) by offering greater flexibility in procurement type and design. Dedicated funding is intended to support this – the European Commission offers €130 million for such projects under Horizon 2020, and Member States are pushed to create dedicated budgets under the Europe 2020 Flagship Initiative toward an annual European market of €10 billion (EC, 2010). However, facing growing scrutiny and fiscal constraints, government agencies are increasing their focus on core competences, reducing internal capacity to conduct procurements with high impacts at a time when doing so is even more critical for cost-savings and growth. "Insufficient

information" (EC, 2008a, p. 4) is a primary culprit holding back the benefits that can be accrued through public procurement. The potential of this mechanism to improve public services has not yet been realized (EC, 2013), with low public R&D expenditures across Europe decreasing the adoption rate of innovative solutions (EC, n.d., p. 3) and the ability to compete internationally. This problem persists even for commercialized products and services - capturing innovation in procurement remains uncommon (Uyarra et al., 2014), and varies greatly across institutions and countries within Europe (ERAC, 2015).

The disconnect between policy drivers for innovation and real-life practices creates opportunities for introducing *open innovation* into public procurement. Open innovation paradigms can be used to define and accelerate innovation trajectories (Chesbrough, 2004; Dahlander & Gann, 2010), capturing the process of supplementing internal knowledge through external information sourcing. The practice of *innovation procurement* empowers public procurers to deploy open innovation processes by introducing changes to *procurement processes*, such as increasing knowledge sourcing activities, or to *tender designs*, such as strategically using voluntary standards and valuing innovation. *Knowledge sourcing* is defined by Gray and Meister (2006) as drawing upon the "expertise, experience, advice, and opinions" of others to "supplement" (p.142) the expertise of a public purchaser, such as on technology or market trends and supplier capability (EC, 2005). *Voluntary standards* (hereafter referred to as "standards") are those which set specifications above what is required by regulation (Breyer, 1982) through a process of *standardization*: the voluntary development of "technical specifications based on consensus amongst the interested parties," (EC, 2008b, p.2) including industry, relevant interest groups, and public authorities. By injecting such knowledge into the public procurement process, innovation procurement can expedite service efficiency and cost reduction at the agency level through better identification of needs and potential solutions. At the market level, innovation procurement can provide an initial market to a selected supplier, promote market uptake of innovative products and services through demand signalling, and increase their speed of diffusion through standards for compatibility.

Thus, through the strategic use of sourced knowledge, innovation procurement using open innovation processes can stimulate and support innovations that help meet social goals. The nature of these actions are partly determined by the degree of evolutionary change in the desired product or service that the procurement creates. These mechanisms

are conceptualized as the conduct of R&D through *pre-commercial procurement (PCP),* commercializing tailor-made products or services through *innovation partnerships*, or adapting/adopting existing market solutions through the *public procurement of innovation (PPI)* to meet the needs of the public purchaser. The introduction of innovation partnerships in the new Procurement Directive brings the purchase of R&D services under the directive for the first time (EC, 2014a), extending the modality of PCP into a demand-side mechanism through the commercialization of its outcomes. Each of these practices are defined and encouraged in the new European Procurement Directive, and introduced under Horizon 2020 as instruments to decrease time to market for innovations.

## 1.2 In the Literature

Given their renewed focus in policy, only recently has literature begun to study modalities of innovation procurement and their differences according to systems of innovation theory. Discussing this literature is facilitated by distinguishing between interactions at the organization level, and those at the product or service and market level (Aschhoff & Sofka, 2009; Edquist & Hommen, 2000; Hommen & Rolfstam, 2009). Hommen and Rolfstam (2009) were the first to differentiate these aspects in innovation procurement according to evolution of products and services and their markets, and the learning on behalf of organizations that coincides with the innovation process. The literature on innovation procurement is first discussed here in terms of evolutionary aspects, which have been the focus of greater study.

### 1.2.1 Overview of Evolutionary Aspects

Of the three mechanisms introduced in the previous section, PPI has received the most attention as a part of user-producer interaction in innovation theory, where Dalpé (1994) was the first to stress the necessary presence of (public) demand to pull innovations from the marketplace, and their vital role as client in shaping technologies. Edquist and Hommen (1999) introduced the novelty of studying PPI according to systems theories, including interactive learning theory and network analysis. In contrast, PCP has received limited study as a distinct concept, beginning with its differentiation by Edquist and

Zabala-Iturriagagoitia (2012) based on the character of its product or service outcomes, and further distinction as an instrument for demand-side R&D – or supply-side innovation (Edquist & Zabala-Iturriagagoitia, 2015).

Empirical research has focused on PPI, such as Uyarra et al. (2014) on barriers to innovation according to suppliers in the UK and Edler (2013) on its influence on firm innovation with respect to other demand-side mechanisms. Empirical study on PCP has been limited to the form of reports to inform policy, on expenditures (e.g., EC, 2014b), and impacts (e.g., Bedin et al., 2014). Such studies have often included the mechanism only as a part of wider analysis of innovation in the public sector (e.g., Gallup, 2011) rather than examining it as a central research concept. *Innovation partnerships* – in large part due to their novelty – have received only preliminary study, namely by Georghiou et al. (2014), who highlight its contribution to innovation policy framework conditions in allowing for greater flexibility in contracting for public purchasers. The implications of having government both direct R&D and finance commercialization for radical innovations developed using this mechanism are currently unknown – especially in its effects on market competition and innovation in the long-term.

### 1.2.2 Learning and Organizational Aspects

With intention to define and accelerate innovation trajectories (Chesbrough, 2004; Dahlander & Gann, 2010) across innovation procurement modalities, open innovation paradigms allow for analyzing *interactions* within innovation systems, which are at the heart of generating growth. Open innovation in innovation procurement is conducive to organizational and learning processes (Edquist & Hommen, 2000; Hommen & Rolfstam), which complement and drive evolutionary mechanisms. The European Research Area and Innovation Committee (ERAC) of the European Union identifies that the availability of European project funding for innovation procurement will stimulate open innovation processes, where "co-creation" of suppliers and purchasers (often referred to as "users") will be a "critical success factor" (ERAC, 2015). Market consultation is promoted in the new directive through consultation of potential suppliers in competitive dialogue procedures for purchasing innovations (EC, 2014a). Using this mechanism, suppliers can inform purchasers regarding the state-of-the-art and market potential, including price and

quality criteria that can feed into *tender specifications* and *award criteria*. Respectively, these tender components should be designed to support minimum quality and openness to innovation, built with price-quality ratios reflecting user needs under the Most Economically Advantageous Tender (MEAT) (EC, 2014a). Thus, both aspects of evolution and learning are important for using innovation procurement to drive European growth, and are intertwined in the process.

With the ambition to better understand the role of interactions within innovation systems, research on public procurement has moved beyond evolution-based classifications for products and services by introducing elements of learning. Edquist and Hommen (2000) were the first to investigate this area, distinguishing *direct* procurement as when purchases are intended to directly meet the needs of the procuring agency, from *catalytic* procurement when another end-user is intended and the purchase more directly stimulates markets. Hommen and Rolfstam (2009) build up these elements by using learning structures and contexts, demand structure, and needs addressed, and introduce *cooperative* procurement, where public agencies work together with other public agencies toward common goals. These definitions compliment Edquist and Zabala-Iturriagagoitia (2012)'s call for enhanced organizational skills required for better coordination when multiple actors are involved in PPI projects. With a wider lens, Edler and Yeow (2016) broaden the scope for studying PPI from that which results in an innovation (as that which *triggers* an innovation), to include public procurements which *respond* to an innovation already in the marketplace. This allows for the study of factors that promote or hinder the uptake of innovative solutions by a public agency, supporting the conceptualization of public procurement as a process which can be modified and improved to have greater impacts on the purchaser and the market.

Taken together, innovation procurement as a field of study has been significantly furthered in recent years, particularly as PPI. We now have a better understanding not only of its potential to produce significant social benefit, but also of the barriers that prevent it from adequately or effectively stimulating innovation. It is important to note that a lack of common terminology across this literature is a reminder of the nascency of the field, indicated by significant time and effort having been spent on clarification of typologies and classifications.

## 1.3 Supporting Openness in Innovation Procurement

Interacting within innovation procurement processes, open innovation processes for knowledge aggregation are a critical instrument to design better innovation procurement projects with higher impacts. Namely, this dissertation examines *standards and standardization, collaboration, and intermediation* as tools to help public agencies achieve these improvements in their processes. These mechanisms have complementary features of openness and connectivity that improve tender development and market influence. They can be strategically deployed (in the case of standards) and undertaken (in the case of standardization, consultation, and intermediation) to have particular effects in product and service development trajectories in a way that can improve public services and reduce costs, while also directing private sector developments. Their impact is on both tangible developments of product or service evolution, and intangible aspects of organizational learning.

Innovation procurement and standardization have commonalities and synergies that must be examined together. As is also true for innovation procurement, Edler et al. (2014) highlight standards as "major elements of demand-based policies" (p. 37), as they help to create demand and aide diffusion of innovations (OECD, 2009) by facilitating market entry and diffusion in cases of market failure (OECD, 2011). Introducing standards as technical specifications or award criteria in innovation procurement can embed market and innovation information that shapes the competitive environments of the public demand. To be used in public procurement, standards must be based on "scientific information using a procedure in which stakeholders, such as government bodies, consumers, manufacturers, distributors and environmental organizations can participate" (EC, 2004, p. 7). Applicable standards can help innovation procurements to include specifications or performance criteria beyond those which are required by regulation, with a high potential to support social welfare goals such as improving environmental or labour conditions. For promoting sustainability through innovation procurement, for example, the EU Eco-Innovation Action Plan states that the use of environmental criteria in procurement – supported by standards – can drive market demand for eco-innovations (EC, 2011) and "stimulate innovation" for eco-technologies (EC, 2008a, p. 4).

Only recently have academic endeavours been made to investigate the potential role for standards in public procurement. Koch and Jacobsen (2014) studies empirically the role of computerized information standards in promoting or hindering innovation in the public procurement of buildings, identifying benefits of costs savings and more accurate data that promoted a firm's competitiveness during tendering. Focusing instead on environmental criteria, Nissinen et al. (2009) found gradual increases in the inclusion of "green" criteria into tenders over time and between Nordic countries. Also examining green criteria but in the contexts of buildings, Simcoe and Toffel (2014) found the use of the Leadership in Energy and Environmental Design (LEED) standard in public procurement had spillover effects by its uptake increasing in private markets. Broader analyses – across countries and without focusing specifically on environmental standards – have been report-based in nature and have had a practitioner (e.g., Europe Innova, 2008) or policy (e.g., Edler et al., 2005) rather than an academic orientation.

Standards developing organizations (SDOs) are examples of organizations which instill credibility in the the development of standards (Rainville et al., 2015) to meet legitimacy criteria. They are themselves classified by Geels and Deuten (2006) as intermediary actors that aggregate knowledge. Engaging in standardization at an SDO is a company strategy to influence outcomes of standards developed (Weiss & Sirbu, 1990) by shaping trajectory of new products and services and increasing their advantages in (future) markets. Particular motives are identified by Blind and Mangelsdorf (2016) as addressing technical issues, knowledge seeking, influencing regulation, and facilitating market access. For public agencies, such involvement offers a platform to capture knowledge spillovers and further embed R&D findings from PCP projects, shaping future infrastructures through interactions with industry and relevant interest groups (EC, 2007). Thus, when deployed in innovation procurement, standardization can support the function of the single market by enhancing industry competitiveness, sustainability and innovation improvements.

However, the potential for standardization in public procurement does not often manifest. For example, an Innovation Union communication regards "slow standardization and ineffective use of public procurement" (EC, 2010, p. 2) as deterrents to innovation. Also problematic is the potential for member states to use standards and standardization can as a tool to promote national champions by excluding foreign competition while

building up domestic capacity; the same is possible for the new innovation partnerships modality, through state aid of commercialization. For this reason, European or International standards are favoured in the Procurement Directive, and only when no such standard exists may a national standard be used (EC, 2014a). As well, the European Commission has set threshold levels for opening tenders to competition from abroad that vary according to whether it is a work, product, or service procured, or in some instances according to sector (EC, 2015). While these measures may indeed prevent the use of public procurement to the detriment of other European countries, our understanding of ways to better develop and deploy standards for European growth through innovation procurement remains preliminary at best.

*Knowledge sourcing* activities by public agencies accelerate organizational learning through open innovation processes in innovation procurement. Information on product and service developmental trajectories from suppliers, tailored requests from users, and experiences from other governments who have conducted similar procurements can all be gathered through open innovation processes. Firms have incentive to participate in such consultation for similar reasons as in standardization activities – to improve their market position, often by influencing the outcome of the requirements that shape their competitiveness (Rainville et al., 2015). While engagement of small and medium-sized enterprises (SMEs) in standardization is often limited due to limited resources and absorptive capacity (Blind, 2006; Blind & Mangelsdorf 2013), these factors mean that such firms can particularly benefit from open innovation (Huizingh, 2011) through knowledge spillovers. Promoting engagement of SMEs through better access to tenders, such as sub-dividing contracts, and opening competitions can stimulate entrepreneurship, giving access to new markets stimulated or established by public demand in support of European growth through competitiveness and innovation.

Particularly, sourcing knowledge by consulting other government agencies, and partnering through cooperative and joint procurement as promoted in the new Procurement Directive (EC, 2014), can share process learnings and reduce project risks while helping to leverage funds to support innovation procurement. Consulting users helps inform public agencies of the desired characteristics of a product or service, enabling for performance-based specifications and resulting openness in tenders. Directly, these interactions feed into technical specifications and award criteria, helping the procuring

agency to better meet their own needs, and often at a lower cost due to greater openness to competition. Additionally, codifying information from these sources and embodying it in a tender has indirect effects on the market, as its publication communicates the direction of public purchasing and signals markets as to future demand.

While open innovation processes have high potential to support innovation procurement, their effective and efficient execution can be difficult given the complexity of innovation systems in which they operate. This introduces a role for systemic intermediaries that can act between industry, other government agencies, and users to push the impacts of innovation procurement on growth by supporting the "free movement of innovative ideas" in a way that is "genuinely open" (EC, 2010, p.18). As an important early analysis of intermediation in innovation systems, van Lente et al (2003) identify *systemic intermediaries* as being unique from other types by performing demand articulation. Their involvement in innovation procurement can facilitate learning and cooperation in the innovation process (van Lente et al., 2003) and support information translations and networks for increasing participation from a variety of sources.

Recognizing the need for better coordination between actors in innovation procurement projects, Edler and Yeow (2016) have been the first to focus on the enhancement of organizational capabilities of public procurers, through the role played by intermediation in innovation systems. This is part of an emerging area of literature that examines actors that facilitate *processes* by looking more specifically at the government as buyer. As explicated by Howells (2006), intermediaries can be organizations or individuals that act as brokers, third parties, and agencies that help support the innovation process. Geels and Deuten (2006) identify a key function of "intermediary actors" as the aggregation of knowledge, such as through standardization as codification of tacit knowledge, and industry associations stimulating technical knowledge production. As brokers of both technology and knowledge, intermediaries facilitate "learning and cooperation in the innovation process" to achieve "alignment and learning of the multi-actor network" (Klerkx and Leeuwis, 2009, p. 851). According to Clarke and Roome (1999), intermediaries link individuals within these networks together by the "flow of knowledge, information, and ideas" (p. 297). There is a strong potential to introduce open innovation processes to innovation procurement through the help of intermediaries,

thereby alleviating much of the pressure facing governments to increase the professionalization of public procurement (e.g., ERAC, 2015).

## 1.4 This Dissertation

This dissertation examines innovation procurement for how to optimize the interaction between public procurement, innovation, and standardization by using open innovation processes to push their impacts on growth. It covers periods of pre-procurement consultation prior to the purchase, the use of external knowledge and standards to inform specifications and criteria, and the effects on competition created through the resulting tenders. Across these activities, it conceptualizes procurement as a dynamic process situated within networks and systems, rather than a strictly linear and truncated affair beginning with tendering and ending with contracting.

In seeking to understand these phenomena, four questions were posed:

1. *How do conceptualizations of standardization fit with (eco)innovation procurement modalities?*
2. *How do public agency practices of innovation procurement differ across Europe?*
3. *How can intermediation in innovation procurement promote a more circular economy?*
4. *How do a firm's innovation and standardization practices affect their success in public procurement?*

Four independent yet complementary papers were written to answer each of these questions. They are presented in the next four chapters (Chapters 2 to 5). Figure 1.1, below, provides an overview of stages of open innovation processes in innovation procurement, according to the focus of each of the four papers. The first of these papers, in Chapter 2, conceptually investigates typologies of public procurement from a technology life cycle perspective, in conjunction with standards that act upon transitions within these life cycles and their strategic incorporation into calls for tenders. From this, an overview of interactions between demand-setting, effects and utilization of standards, and trajectories of environmental products and services procured is developed. The resulting *framework* is

intended to improve understanding and alignment of policies affecting environmental benefits through public procurement.

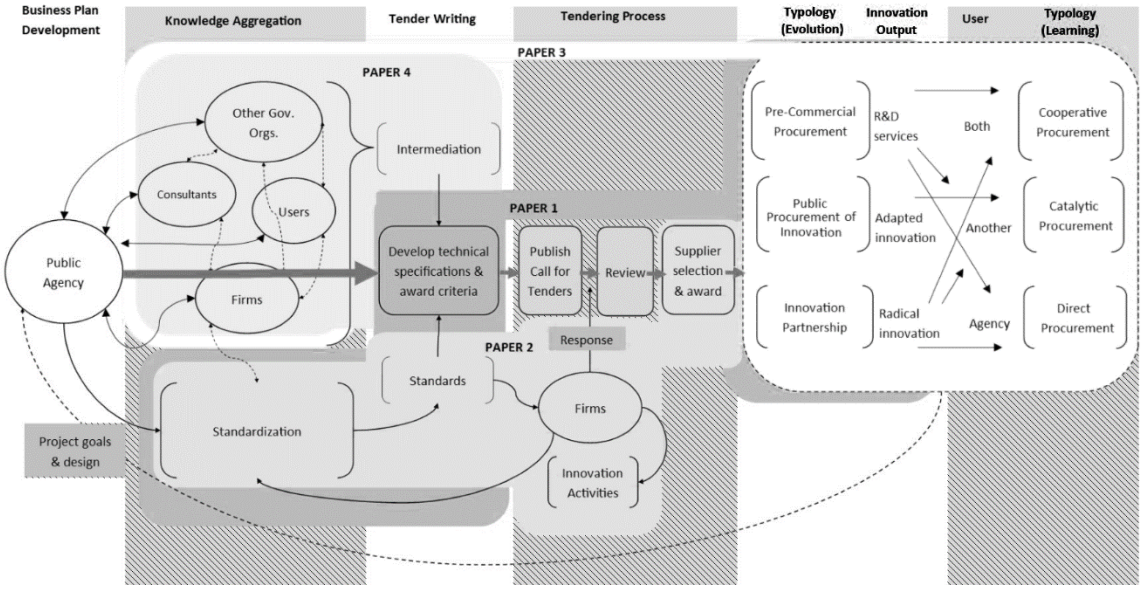


*Figure 1.1 – Overview of open innovation processes according to the stages of public procurement, and typologies according to innovation activities and end-users. The foci of the four papers of this dissertation are highlighted accordingly.*

Moving to the *process* of embedding knowledge into tenders, the second of these papers (Chapter 2) conducts an empirical study of consultation practices in innovation procurement processes to test and improve taxonomies. This paper presents the first European-wide, survey-based analysis of the extent to which different innovation procurement mechanisms are practiced according to knowledge sourcing activities at the agency level. It cross-examines learning and evolutionary aspects using cluster analysis techniques to identify heterogeneity across knowledge sourcing activities, procurement areas, and tender innovation outcomes for 1,505 public procurers from 2008-2010. The analysis provides an important snapshot of the state of innovation procurement prior to the recognition of the updated Procurement Directive by member states, in 2016.

Focusing in on *consultation practices*, the third paper in Chapter 4 examines how intermediation during the pre-procurement process can be used to promote a more circular economy. Based on a pilot project executed by the Dutch Ministry of Defense for

including recycled content into purchased textiles, it endeavours to determine the role of intermediation in the extensive knowledge gathering and translation activities conducted. It conducts an in-depth case study using seventeen interviews from 2016 totalling more than 25 hours of content, analyzed through a grounded theory approach. The investigation highlights the roles for intermediation in public procurement toward transitions to new economic models, such as more circular economies.

Turning to the *competitive environments* created through public procurement once tenders have been published, the last of these papers (Chapter 5) combines aspects of standardization and innovation. If the policy to open procurement to innovation is successful, then firms who engage in innovation and standardization should have a higher likelihood of receiving procurement contracts. This paper tests this hypothetical relationship using regression analyses based on a sample of 2114 German manufacturing firms from 2010-2013. By doing so, it is the first to examine such interactions, as effects of any innovation procurement practices on success in meeting public demand.

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# 2 Standards in Public Procurement – A Conceptual Framework for Enhancing Eco-Innovation

**Abstract**

Multiple European initiatives are attempting to leverage the market and environmental impacts of standards and public procurement, applying various mechanisms at different points of product and service life cycles. Throughout pre-commercial procurement, public procurement of innovation, and green public procurement, standards and standardization play a critical role in shaping the trajectories of eco-innovations. This paper presents a first attempt to conceptually investigate typologies of public procurement from a life cycle perspective, in conjunction with standards that act upon transitions between life cycle stages. It synthesizes relevant literature in these areas to develop an overview of interactions between demand-setting, effects of standards and standardization, and trajectories of procured environmental products and services. Insights on pre-commercial procurement include the importance of open standards for cost savings and information standards for future certification, as well as intermittent standardization (with government input) to shape future infrastructures. In public procurement of innovation, strategically applying measurement, testing, and interface standards supports openness in calls for tenders for more innovative solutions and eventual market capture. For green public procurement, information standards incorporate environmental criteria into purchases and support environmental life cycle costing, and alongside minimum quality standards to promote diffusion of eco-innovations. Further elaboration and application of the framework proposed here may contribute to a better understanding of how to leverage standards and standardization in procurement processes.

## 2.1 Introduction

Due to the significant size of government purchasing and its potential to affect markets through demand, multiple policy initiatives promote environmental outcomes of public procurement. These policies act at different points and by using various mechanisms during the life cycles of products and services procured, making the systemic effects of their implementation complex and effects on eco-innovation difficult to decipher. The parallel action of standards - as both used in and as developed from procurement activities - during each transition throughout life cycles shapes the trajectories of products and services and impacts the environmental benefits that can be leveraged through public procurement. This paper presents a first attempt to conceptually investigate typologies of public procurement from a life cycle perspective, in conjunction with standards that act upon transitions within these life cycles and their strategic incorporation into calls for tenders. It reviews and synthesizes literature on *pre-commercial procurement (PCP), public procurement of innovation (PPI),* and *green public procurement (GPP)* with that on standards to develop an overview of interactions between demand-setting, effects and utilization of standards, and trajectories of environmental products and services procured. Such an integrated analysis is necessary for improving understanding and alignment of policies affecting environmental benefits through public procurement.

### 2.1.1 Policy Relevance and Literary Gap

Public procurement is the acquisition of goods or services by public entities. Regular procurement, as the straightforward purchasing of off-the-shelf products or services, still constitutes the "vast majority" of public procurement across Europe and amounts to 19% of GDP in Europe (EC, 2010). By adding environmental criteria to regular procurement, the EU Eco-Innovation Action Plan states that GPP – along with standards – can drive market demand for eco-innovations (EC, 2011) and "stimulate innovation for eco-technologies" (EC, 2008a). Similarly, given its potential to shape markets, numerous European policy initiatives have been enacted to promote PPI, including the updated Public Procurement Directive (EC, 2014a), European Assistance on Innovation

Procurement through DG CONNECT, and discussions of a draft framework and targets for innovative procurement through the European Research Area and Innovation Committee (ERAC). Recently, ERAC has called for countries across Europe to "create a strategic framework for innovation procurement" and an action plan, to support procurers and promote innovation in purchasing (ERAC, 2015).

Together with PPI, PCP is introduced as an instrument in Horizon 2020 to decrease time to market for innovations, applying across all stages of research and innovation. Initiatives from 2014 have focused on quantifying PCP expenditures (EC, 2014b) and its impact (EC, 2014c) across Europe. These mechanisms are complementary and can be substitutable at different stages of development: combining PCP with GPP can have the same function as PPI for eco-innovations, whereas PPI can intervene at the point of commercialization after PCP is complete for an environmental development. Common academic themes between these are drivers and barriers in eco-innovation (Horbach et al., 2012; Kesidou & Demirel, 2012), innovation in public procurement (Uyarra et al., 2014), and the uptake of GPP (Günther & Scheibe, 2006), with emerging PCP literature beginning discussions regarding its theoretical disentanglement from PPI (Edquist & Zabala-Iturriagagoitia, 2015)

Despite these measures, the potential for different types of public procurement has not materialized. A comprehensive survey of progress in GPP uptake across all member states show that the uptake of environmental criteria has been slower than expected, uptake varies greatly between countries, and life cycle costing is still only used infrequently (in only 6% of cases) (Renda et al., 2012). "Insufficient information" contributes to a lack of benefits harnessed through public procurement (EC, 2008a, p. 4), and often the tender that is more economic in terms of upfront costs is selected instead of that with the lowest (environmental) life cycle costs (Blind, 2008, p. 44). Similarly, PPI is used infrequently – in Germany, it has been estimated that only 10% of all procurements are relevant to innovation (Wegweiser, TU Berlin, & Hölters & Elsing, 2009). European-funded pilot projects for PCP have been slow to take off, and compared with countries from outside of Europe, lower public R&D service expenditure in Europe "slows down the adoption rate of innovative solutions in the public sector" (EC, n.d., p. 3) and challenges its ability to compete with major players like the United States. Together, these challenges may be

particularly influential on eco-innovation through product and service development and diffusion, as public demand-setting for such innovations leverages impact toward incorporating environmental externalities and supports sustainability in ways that private markets will not (efficiently) accomplish through independent means.

Standards can drive market demand for eco-innovations (EC, 2011) and standardization can capture the knowledge spillovers from demand-side activities like public procurement. The role of standards in stimulating innovation in public procurement has been studied empirically (Koch & Jacobsen, 2014) and theoretically (Blind, 2007), with more comprehensive studies such as the European STEPPIN (STandards in European Public Procurement lead to INnovation) project having a practitioner rather than academic orientation (Europe Innova, 2008). A lack of consolidated study in the area has left room for yet unexplained paradoxes between the use of standards and the innovation aspects of public procurement. For example, while procuring organizations in Austria, the Netherlands, and Italy have above average use of standards (Blind, 2007), and are known for above-average strategic public procurement (Edler et al., 2005), procurement in the UK was found to have below average referencing of standards (Blind, 2007) despite leading in the modernization of PPI (Uyarra et al., 2014). Connecting theories on standards and public procurement is required for an improved understanding of how standards can best be deployed to produce greater environmental benefits and market impacts through eco-innovation.

## 2.2 Methods and Outline

This paper is a first attempt to review and synthesize research across a number of previously discreet areas that impact environmental outcomes of public procurement. Policies, literature, and prominent reports are reviewed, and core concepts related to public procurement, environmental improvement, innovation, and standards are extracted. Building upon foundational concepts for standards and technological trajectories set forth by Swann (2000), a conceptual framework situating standards and standardization as intermediaries, facilitators, and outcomes along technological trajectories according to PCP, PPI, and GPP is presented. Select examples are given to illustrate concepts drawn from literature in the context of this framework.

Further information on the process of framework development is given in each subsequent section. Section 2.3 analyses literature on public procurement to define relationships between PCP, PPI, and GPP according to their respective innovation outcomes, developing a framework for further analysis in which certain standards may be studied. Section 2.4 discusses effects of standards and standardization in life cycle transitions, then introduces standards inputs and standardization outputs at each transition stage within this procurement framework, highlighting the most relevant standards to consider at different points. The concluding Section 2.6 summarizes key aspects of standards in eco-innovation through public procurement and reiterates the need for further study to better harmonize policy drivers.

## 2.3 Public Procurement According to Life Cycles of (Eco) Innovation

### 2.3.1 Public Procurement of Innovation

Eco-innovations can be directly procured through PPI by integrating, customizing, or adapting existing solutions through to commercialization (EC, 2007). Public procurement of innovation is a demand-side measure (Edler et al., 2014; Edquist & Zabala-Iturriagagoitia, 2012; OECD, 2011b; Yi, 2011) as it creates immediate demand and can stimulate future demand (market pull). It seeks to modify the rate and/or direction of technological change (Dalpé, 1994; Edquist & Hommen, 2000; Geroski, 1990) by means of public intervention. In the public procurement of innovation, purchasers select criteria for products or processes that do not yet exist (Edquist & Zabala-Iturriagagoitia, 2012).

Considering the production of eco-innovations through PPI, eco-innovations are defined in the EU Eco-Innovation Action Plan as:

> *"Any form of innovation resulting in or aiming at significant and demonstrable progress towards the goal of sustainable development, through reducing impacts on the environment, enhancing resilience to environmental pressures, or achieving a more efficient and responsible use of natural resources." (EC, 2011, p.2)*

Based upon its Innovation Strategy, the OECD considers eco-innovation as products or processes that are new and have a positive effect on the environment, and can be radical/systemic or incremental (OECD, 2011a, p. 29). Neither the EC nor the OECD limit eco-innovations to (green) technologies – they may also encompass non-technological innovations. This conceptual framework is executed, for example, by Dong et al. (2014), who examine the prominence of organizational, process, and product eco-innovation in China. Organizational and process innovations are captured in literature on *innovative public procurement* (distinct from PPI), where the method of undertaking a procurement is modified in order to include more stakeholders in consultation, increase the efficiency of the process, etc. Edquist and Zabala-Iturriagagoitia (2015) separate two approaches to studying PPI as based on the procurement process – differentiating between direct and

catalytic procurement, depending on whether the end-user is the same as the procurer, as introduced by Rolfstam (2012) – or the outcome of the procurement, i.e., the product or process resulting from the procurement.

The classifications of an eco-innovation as based on its properties have also crossed over into procurement literature. Following the Oslo Manual definition of innovation (OECD, 2005), OECD (2011a) considers the novelty criterion for eco-innovation as being new to a country, intermediary jurisdiction, or firm. In contrast, Edquist and Zabala-Iturriagagoitia (2015) determine radical innovations through PPI to be those accomplished through "*developmental PPI*" and which are new to the world, whereas incremental innovations are deemed "*adaptive PPI*" and are new only to a particular jurisdiction. Others definitions, such as used by the EC, define radical innovation as products or services with characteristics that surpass those currently on the market (EC, 2007). Examining environmental performance and competitiveness at the firm level, Dong et al. (2014) limits the novelty of eco-innovation to that which is new to a firm. The innovativeness of the firm is the focus in much procurement literature as well: for example, according to Edquist and Zabala-Iturriagagoitia (2012), innovation in public procurement is undertaken on behalf of the supplier, rather than the procuring agency. Doing so allows them to focus on innovative goods or services produced by the firm. Others have taken an institutional approach to innovation in procurement, such as Rolfstam (2012) who focuses rather on the "user producer interaction" (p. 308) (von Hippel, 1988) in public procurement and the learning implicit in these interactions.

Public procurement helps to incentivize innovation by guaranteeing higher returns on investment from establishing early markets of sufficient size (Aho et al., 2006). This is particularly relevant in those industries characterized by heavy R&D requirements and substantial economies of scale in production (Porter, 1980), and for innovations with high entry costs (Blind, 2008). By providing an initial demand for new green products and stimulating diffusion of existing ones, GPP can to reduce uncertainty regarding resources, initial consumers and suppliers by specifying consumer preferences, providing external financial resources, and specifying desired timing, deliverables, quantities, and prices (Meijer et al., 2006).

### 2.3.2 Green Public Procurement

In GPP, public purchasers play a critical role in stimulating or impeding private sector innovation activities (Aho et al., 2006; Cabral et al., 2006) by expanding markets for off-the-shelf environmental products and services. With the addition of green criteria to regular procurement, GPP is a "tool to support market uptake of eco-innovations" (ECOPOL, 2014) through "clear and ambitious environmental criteria" to purchase existing products or services in the market that have better environmental performance than competing products (EC, 2008a). While subject to the EU Procurement Directive, it is also supported by numerous policies at the EU level as a driver for sustainable development (Testa et al., 2012). However, just as regular procurement does not directly affect innovation and is therefore not an innovation policy instrument (Edquist & Zabala-Iturriagagoitia, 2012), neither is GPP. GPP is capable of leveraging the significant proportion of procurement funds spent by public authorities to "shape production and consumption trends" and create demand that establishes or enlarges markets (EC, 2008a) p2 for green products or services. This, in turn, incentivizes eco-innovation (for example, the development of "environmental technologies" or "eco-technologies") by firms. As public purchasing power can be leveraged through GPP to influence markets, GPP can be considered as a form of "innovation oriented procurement" (Rothwell, 1984, p. 165), as that which stimulates supplier innovation. From the perspective of innovative public procurement, GPP has been considered as a "process" (EC, 2008a) whereby environmental life cycle costing supports the purchase of environmental products or services by incorporating environmental externalities as quality considerations.

The purchase of existing products on the market through GPP will be considered here to have eco-innovation impacts due to its assistance in diffusion of products either which meet core criteria or which lead the market in their environmental benefits for a given product category. There has been a lack of discussion on the diffusion of innovations subsequent to procurement (Rolfstam et al., 2011), although it is a key element to determining the impacts of GPP on eco-innovation, especially for the purchase of products already on the market. Also, applications of existing technologies to new markets such as through public procurement shows how its market pull effects can influence innovation on

the *supply-side* (Hommen & Rolfstam, 2009). In such an application, the degree of innovation coinciding with application of an existing product could be measured in terms of (competitors in) the new market (Kalvet & Lember, 2010) or in the learning required in new and different organizations (Rolfstam, 2014). GPP has been found to stimulate greater environmental awareness in the private sector (Brammer & Walker, 2011), suggesting associated systemic eco-innovation benefits that support the study of its diffusion.

### 2.3.3 Pre-Commercial Procurement

At earlier stages in product or service life cycles – and ceasing prior to commercialization – PCP serves to create demand for R&D services that may bring ideas as far as the prototyping and field testing stage (Edquist & Zabala-Iturriagagoitia, 2012; Izsak & Edler, 2011; Rigby et al., 2012). Also referred to as an "R&D service contract" (Edler & Georghiou, 2007), PCP can be used by European authorities to "steer the development of new technologically innovative solutions that can address their specific needs" (EC, 2006b, p. 2), stimulating and steering technological development so that supply and demand sides may meet (OECD, 2011b). PCP is often required for procurement of radical innovations (Tsipouri et al., 2010), although separate from PPI in that it does not necessarily entail any product development past a prototype (Edquist & Zabala-Iturriagagoitia, 2012).

Alone, PCP is not sufficient to be considered innovative procurement – in one of the only academic discussions on the subject, Edquist and Zabala-Iturriagagoitia (2015) deem it to be a supply-side instrument in relation to innovation, which may influence innovation (i.e., production of a new product or service) but only indirectly. As such, they see it as being better suited to separation from innovative procurement, and that it can be seen as a demand-side measure only in relation to R&D. Commercialization costs are financed by the developing firm rather than through a procurement contract – but demand-side with respect to R&D. The role of PCP in regular procurement can be to make available market-ready products that otherwise may not exist at all, or in a relevant time span (Edquist & Zabala-Iturriagagoitia, 2015). Due to the nascency of these discussions, this paper considers PCP to be a procurement mechanism, as it generates market competition for

public money for a product or service (albeit possibly one that has not been developed yet) toward public objectives, as advocated by (Rigby, 2013).

Rather than being subject to the EU Procurement Directive (EC, 2007), PCP initiatives are guided by EU treaty principles and EC Communication 799/2007, and can be complementary to other innovation activities such as regular procurement and standard-setting (Edquist & Zabala-Iturriagagoitia, 2015). The European Commission stresses that PCP activities are necessarily for R&D services, and must terminate prior to uptake or commercialization, and therefore exclude activities such as "integration, customization, incremental adaptation and improvements to existing products or processes" (EC, 2007, pp. 2-3). The procuring entity offers no agreement to purchase any prototypes, etc. developed from the PCP, nor is it allowed to by law wholly finance a commercialization (Edquist & Zabala-Iturriagagoitia, 2015). In addition, the any IP rights coming about as a consequence of the PCP remain with the firm. For the aforementioned reasons, Edquist and Zabala-Iturriagagoitia (2015) deem the effect of PCP on innovation to be "indirect and mediated" (p. 155), and therefore a supply-side innovation measure.

## 2.4 Standards and Standardization in Public Procurement

### 2.4.1 Setting the Stage – Standards in Developmental Trajectories

Standards are applicable to multiple stages of public procurement, including market consultation, specification development, risk management,[1] and linking PCP with PPI (Rigby et al., 2012). Environmental criteria in particular, such as those setting emissions efficiency or water use, can be used in multiple stages of the tendering process in procurement: technical specifications, assessing expertise, selecting award criteria, and

[1] Risk, as "measurable uncertainty of outcome" (Tsipouri et al., 2010, p. 22), can deter firm investment into eco-innovations and hinder markets for and diffusion of green products and services. Government can typically absorb a greater number of risks than industry – particularly catastrophic risks (Expert Group, 2005) – and by doing so can help drive environmentally beneficial purchases. With firms identifying poor risk management as a critical barrier to innovation through PPI (Uyarra et al., 2014), standards can contribute to significant environmental benefits by acting as risk mitigation mechanisms.

execution of the contract (Testa et al., 2012). This is also true for procurement at different stages of product and service development. It is not only environmental standards that can have an impact on eco-innovations: compatibility and measurement standards can play an important role in market success of innovations impacted by public procurement by generating network externalities and economics of scale. Even standards that do not focus on environmental aspects can have a major role in uncertainty reduction in the presence of network externalities or economies of scale (Vollebergh & Werf, 2014). They can reduce supplier liability (Europe Innova, 2008) in areas including financial inefficiency, environmental, health and safety (Blind, 2008).

A range of standards formed through different mechanisms are applicable in public procurement, including formal (*de jure*) voluntary standards from standard development organizations (SDOs), standards formed by companies, NGOs, or consortia, or informal (*de facto*) standards existing in the marketplace. Legitimacy – as a prerequisite for credibility (Suchman, 1995) – in standards is especially important for transnational standards in the absence of overarching regulation (Botzem & Dobusch, 2012), such as is the case for using public procurement to help reach sustainability goals. However, creation of formal standards at SDOs is a time-consuming process, in comparison with codifying knowledge into company or consortia standards. For PPI and GPP – under the EU Procurement Directive – a variety of types of standards, technical specifications, and eco-labels may be used provided that they are based on "scientific information using a procedure in which stakeholders, such as government bodies, consumers, manufacturers, distributors and environmental organizations can participate" (EC, 2014a). Such a science-based, multistakeholder process is undertaken at SDOs, which conveys legitimacy in formal voluntary standards (Cargill & Bolin, 2007).

Serving different purposes, standards can be applied at all stages of public procurement. Technical specifications and performance (functional) requirements embedded in international, European, or national standards used may be used in developing calls for tenders in PPI and GPP (EC, 2014a). They can include those for levels of environmental performance or quality, design and conformity, safety, and labeling, coinciding with a range of widely-accepted standards possible to use for this purpose. As part of these specifications, environmental characteristics may be included in determining

the "most economically advantageous tender" (EC, 2014a). This includes environmental criteria – as "obligatory technical specifications for the product or service" – used as award criteria, contained in the contract's definition, or presented in its clauses (Nissinen et al., 2009). Notably, environmental criteria in the form of eco-labels and product/service certification is considerable in both PCP and GPP.

Proper application of standards can reduce tender complexity and length while supporting openness to different solutions (DIN & INS, 2014). The current directive encourages procurers to allow variants by setting minimum quality requirements upon which companies can build innovative solutions, while awarding contracts "on the sole basis of the best quality-price ratio" (EC, 2014, p. 73). Using performance standards to define purchaser needs in specifications supports purchases that are based on functional specifications (EC, 2004) and increase the openness of the specification to alternative solutions while containing possible responses. When used properly, standards can "ensure the openness of the tender while at the same time providing clear criteria for evaluation" (DIN & INS, 2014). Establishing processes open to more suppliers with less specific requirements can help reduce technological uncertainty (Uyarra et al., 2014).

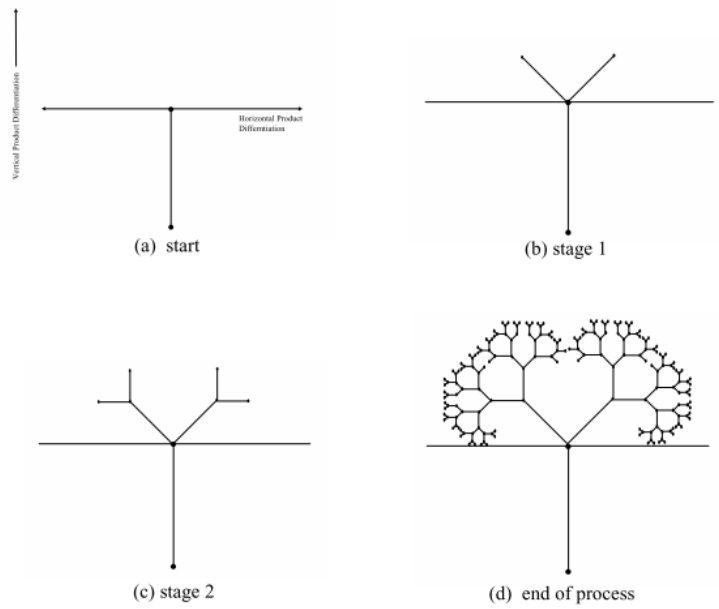



*Figure 2.1 – Product innovation with standardization. Horizontal axes depict horizontal product differentiation, and vertical axes vertical product differentiation. From Swann (2000, p. 25), Figure 2.*

Standards intervene to enable the transition between developmental stages. Referring to technologies, Swann (2000, p. 25) sees new formal standards formed at each node up to (c) in Figure 2.1 (above), the distance between nodes showing the degree of technological progress from what was formerly achievable. The major stems can simultaneously be conceptualized as standards. Component (d) shows a landscape where product differentiation has occurred in a mature market, where competition based on different technology characteristics has been built upon common (product) standards. Defining a space for innovation is a role where public procurement – as government intervention – can concentrate or shift the shape of product development and competition in a desired way (Swann, 2000). References to formal standards (at the Europe, or national level when no higher standard exists) in calls for tenders are possible, where it is the responsibility of the economic operator to prove equivalence of any alternatives presented to the standard (EC, 2014a, p. 74).

When standards are applied in early stages of procurement alongside stakeholder consultation, proprietary information from future tenderers is less likely to influence the direction of the procurement given the usual neutrality of standards (Europe Innova, 2008). Potential suppliers also benefit from additional knowledge from this consultation that reduces risks in carrying out contracts (Europe Innova, 2008) and knowledge on standards as part of a broad market and technical knowledge base that limits supplier risk (Tsipouri et al., 2010).

### 2.4.2 Standards in PPI and GPP – Under the EU Procurement Directive

To better visualize differences between and discuss procurement mechanisms – including with respect to the inclusion of standards through procurement – in the next two sub-sections, a diagram of their differences is presented in Figures 2.2 and 2.3. The types of standards most relevant for influencing trajectories between developmental stages is taken from Blind and Gauch (2009), who examine nanotechnology and standardization in Germany, and from Großman et al. (2015) who include standards inputs as well as standardization (formal, consortia, etc.) outputs within new product development. Building upon the economic classification of standards, Swann (2000) discusses effects of standards

on economics at different stages in the product life cycle, including rationales for government engagement in standardization at these stages. These same rationales can be used for strategic use of standards by public purchasers in procurements. Intermediate and ultimate economic effects of standards were derived from Swann (2010). Particularly for Figure 2.2, a Commission response outlining the role of standards in linking PCP to PPI was used to supplement these with actions for standardization that can come at the end of each phase in PCP (EC), where open standards and their formation are highly relevant (Apostol & Mair, 2012).

To delineate phases and their associated activities within PCP (Figure 2.2, below), Rigby (2013) was studied, who reviews PCP approaches and their effects on innovation by building upon the EC Communication on PCP (EC, 2007). The Frascati Manual of the OECD identifies R&D as applying to basic research, applied research and experimental development (OECD, 2002). Separating PCP and PPI, the differences between the two mechanisms and further differentiation of PPI based on the degree of novelty in their outcomes proposed by Edquist and Zabala-Iturriagagoitia (2015) was also applied, supported by OECD sub-classifications of eco-innovation according to degree of novelty (OECD, 2011a). Case studies from literature and Commission reports were applied as examples.

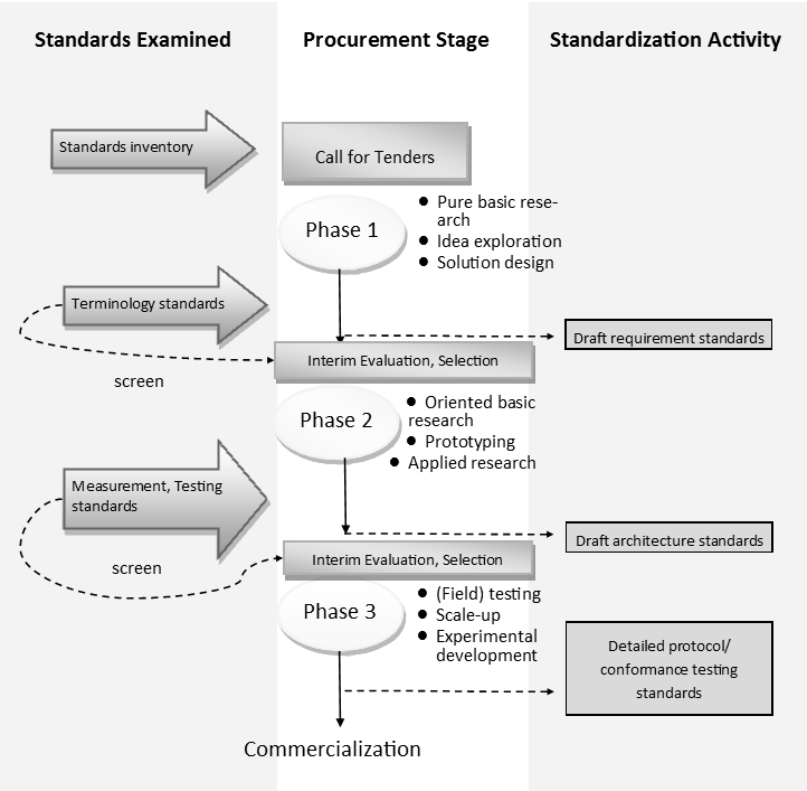
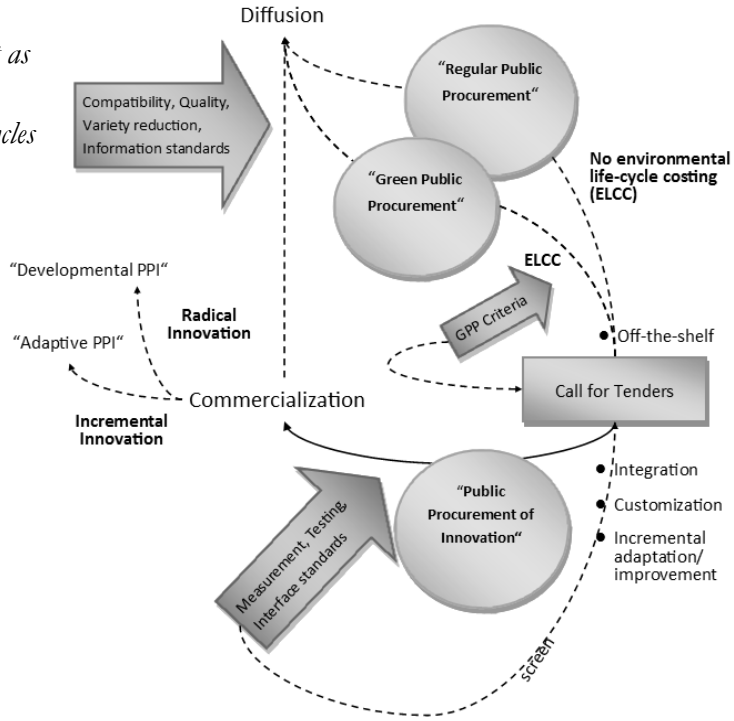



*Figure 2.3 – Pre-commercial procurement as "demand-side R&D": Phases according to life cycles post-commercialization; standards input and standardization outputs*

*Figure 2.2 – Public procurement as "demand-side innovation": Classifications according to life cycles pre-commercialization, and standards input.*



### *Public Procurement of Innovation*

Procurers require guidelines to aide in "specification development for high risk and innovative purchases" (Rigby et al., 2012, p. 33) typical of developmental PPI. To counter the increased risks in eco-innovations and incentivize supplier innovation, risk management is even more important in these earlier stages of development (Tsipouri et al., 2010). Within this context, standards can establish minimum functional or performance criteria to increase tender openness, which can help to identify those most capable of meeting the procurement need. By doing so, absorbing associated costs and risks with early adoption of innovations can payoff for public procurers by offering improved specificity of the innovation to their needs and greater associated benefits (Aho et al., 2006).

Standards that set clear and challenging functional specifications without specifying specific solutions incentivize innovation in public procurement (Georghiou, 2007). Nevertheless, specifications or requirements to enable this transition must remain "sufficiently precise" (EC, 2014a) such that their criteria can be used to clearly communicate to suppliers and for use in awarding contracts. The success of PPI requires "a radical change in specification development compared to the common practice in public procurement" (Rigby et al., 2012, p. 33). Referencing standards helps to simulate competition among suppliers to meet these standards, and doing so in more open calls for tenders allows room for a wider range of solutions resulting from this competition (Blind, 2008).

Calls for tenders in PPI are intended to stimulate integration, customization, or incremental adaptation or improvement to improve upon existing solutions (EC, 2007). Bringing new products or services from such late-stage development to commercialization requires consideration of **measurement, testing,** and **interface standards** (Blind & Gauch, 2009). Interface standards are most important in PPI, as they most directly affect the outcomes for a procurement bringing a novelty through commercialization. Also referred to as **compatibility standards** (Swann, 2000), interface standards support compatibility with infrastructure to reduce switching costs required for transitions to new solutions (Farrell & Shapiro, 1988) and generate network externalities (Farrell & Saloner, 1985; Katz & Shapiro, 1994) through the uptake of common interfaces within systems. In

procurement, standards can be used to test for and support compatibility of proposed solutions with existing infrastructure (Europe Innova, 2008), and by doing so reduce the "costs of finding adaptive solutions and prevents costs related to incompatible interfaces" (Blind, 2008, p. 45). Open standards are more desirable than informal standards to prevent monopolies (Swann, 2000). Interface standards help to establish scale economies to maintain price and productivity in markets (Swann, 2010), and where lock-in (Cowan et al., 2000) may reduce opportunities for an inferior environmental solution to remain embedded in markets, reducing risks of technological or system failure (Europe Innova, 2008). **Information standards** such as eco-labels may also be relevant, as they apply to the growth phase of life cycles to reduce perceptions of risk in larger markets (Swann, 2000).

Examples from Edquist and Zabala-Iturriagagoitia (2012) highlight instances of success and failure in PPI as influenced by standards used in the process. Swedish examples are for procurements taken under the 1988 Swedish Technology Procurement Program, which was intended to increase energy efficiency to reduce national electricity demand by 2000 (Neij, 2001). A successful procurement of energy-efficient lighting, including technical specifications based on those of previous purchases but minimum efficiency standards, saw a number of benefits for the successful bidder. The procurement employed life cycle costing estimation, development of testing methods, and informal standards-setting through consultation with key market influencers. Prices decreased drastically (economies of scale), market share grew to capture the majority of the market, and export to multiple countries was achieved (compatibility).

A second example examines the success of Swedish refrigerator procurement, where technical specifications were used in conjunction with performance requirements for a product 40-50% more efficient than those on the market at the time (Edquist & Zabala-Iturriagagoitia, 2012). Choosing, in a subsequent procurement stage, between two solutions with differing energy efficiency from a selected company, procurers selected the "more standard and established technology" (p. 1764) despite its lower efficiency. Successes were demonstrated in purchases in the domestic market and exports in a growing market, with forecasts for cumulative impacts of 1 TWh in annual savings by 2010 at a significantly low public cost.

### *Green Public Procurement*

The use of environmental criteria is what differentiates GPP from regular procurement, in which no environmental life cycle costing has been used (EC, 2008a). As defined earlier, the major impact of GPP for purchasing existing products or services is the diffusion of eco-innovations in the marketplace, which in turn stimulates market competition with subsequent environmental benefits. Examples of environmental criteria include eco-labels and standards for energy efficiency, emissions intensity, or noise thresholds (Nissinen et al., 2009). Environmental management system certification can also be used, as elaborated upon later.

Eco-labels are classified as **information standards** or **product description standards**, as they help to convey rich information about a product (or service) to the consumer. Information standards can have similar consequences as compatibility, quality, and variety reduction standards for "near-market measurements" that reduce risks to seller and buyer (Swann, 2000). According to Blind and Gauch (2009), they are relevant in the diffusion stages of innovation life cycles. Eco-labels that are public and for multiple criteria conform to requirements of ISO 14021 (Type 1 Ecolabels) (EC, 2008b). They are supported by life cycle assessments based on the ISO 14040 series and can be applied to communicate environmental characteristics in a clear and legitimate way. Examples of other eco-labels of the same type are the Blue Angel eco-label from Germany, Nordic Swan in Scandinavia, and Milieukeur in the Netherlands. They can also be for singular criteria, with pass/fail such as the energy star label for energy efficiency or a grading scale such as the EU energy label. Private labels such as those from the Forest Stewardship Council (FSC) may be appropriate depending whether their mechanism of development meets those of the Procurement Directive (EC, 2008b).

Both core ("green") and comprehensive criteria for indirect eco-innovation in GPP have been pre-determined at the EU level for twenty-three different classes of products including construction, transportation, and textiles to promote consistency and uptake of GPP across member states. Comprehensive criteria define more aspects of or greater degrees of environmental performance, going beyond minimum specifications in the core criteria to help identify leading environmental products available on the market (EC,

2008a). The success of using these criteria is dependent upon government ability to deploy specifications in tenders which set such higher standards than those in EU harmonized legislation (Kunzlik, 2013). Under the updated Sustainable Development Strategy, there is a goal at to have at least half of all tendering procedures meet core GPP criteria (Szuppinger, 2009). It is intended that, as member states begin to uptake GPP to greater extents, these specifications will be adapted in order to increase the stringency of the core green criteria, holding markets to higher standards (EC, 2008a).

From 2008, the goal set for GPP was to bring up level across all member states to best performing member states (Netherlands, Sweden, Denmark, and Belgium) by 2010 (EC, 2008a). Under this goal, half of all tendering procedures should be "green", i.e., compliant with endorsed common core GPP criteria, in terms of number and value of "green" contracts versus the total contracts in the sectors where core GPP has been identified (Renda et al., 2012). However, diffusion of environmentally beneficial products stimulated through purchase may be hindered by a fragmented public or private demand, as demand-side barriers to eco-innovation (Tsipouri et al., 2010). After purchase, there is an increased risk of technology lock-in coinciding with the extent of diffusion (Kalvet & Lember, 2010; Tsipouri et al., 2010). In general, standards support diffusion necessary for achieving larger environmental impact from GPP and promote diffusion by reflecting user needs (Europe Innova, 2008). Clear GPP criteria for distinct product groups is required for "benchmarking and target setting" and is developed as "minimum technical specifications" for compliance in bids, or as award criteria to "stimulate additional environmental performance without being mandatory" (EC, 2008a, p. 5). As part of GPP criteria referencing eco-labels in calls for tenders incorporates benefits of technical standards without directly referencing them (DIN & INS, 2014), demonstrating the flexibility of the equivalence clause in the procurement directive governing GPP. As competition can drive innovation in industries where leaders have larger market shares (Cabral et al., 2006), greater openness of tenders for existing products in GPP can support emerging producers with functionally equivalent yet more environmentally friendly products.

Multiple types of standards affect the *diffusion* from eco-innovations purchased through GPP, including **compatibility, quality,** and **variety reduction/reducing standards** (Blind & Gauch, 2009). While compatibility standards have been discussed for

PPI, the other are most relevant to GPP compared with other procurement mechanisms. **Minimum quality** (alongside safety) standards help ensure that higher quality products in the market are rewarded with higher prices. These transaction costs by reducing buyer uncertainty (Swann, 2000), and promote environmental benefits such as pollution reduction without penalizing markets (Baumol & Oates, 1971). While they do not have to be public to be effective, quality standards must at least be "cooperatively defined" (Swann, 2000). As GPP is used to purchase goods/services at the stage of maturity, information standards help to establish economies of scale when cost is also an important criterion (Swann, 2000).

The lack of uptake of GPP is in part caused by "limited established environmental criteria" or their insufficient publication (EC, 2008a, p. 4), as well as uncertainty regarding the legality of different methods of incorporating environmental criteria in calls for tenders (EC, 2008a), although Kunzlik (2013) found that the directives do not disinhibit the use of environmental standards. A lack of openness in calls for tenders is a central concept to many of the risks faced in GPP, as calls for tenders with too stringent requirements can deter potential suppliers (Tsipouri et al., 2010). Driven by greater regulatory openness than for regular procurement (Wilts et al., 2013), GPP in general can have greater uncertainties that increase risk. These include the chance of inefficiency due to more complex calls for tender or procurement processes due to introduction of environmental criteria, choosing products or services with inadequate criteria to meet purchase requirements, and the potential for unclear legal requirements (Wilts et al., 2013). An absence of knowledge and information hinder decision-making in GPP (Günther & Scheibe, 2006), adding to the risk that purchasing outcomes are not as intended. Acting before products and services reach market maturity, information standards can help to reduce perceptions of risk in larger markets (Swann, 2000).

**Environmental management systems** such as ISO 14001 are often used in procurement (Europe Innova, 2008). Certification in ISO 14001 can be for either purchasers or suppliers, and requires awareness and reduction of indirect environmental impacts associated with an organization rather than focusing on environmental attributes of one particular product or service. This may be requested by producers for contractor qualifications to signify environmental performance (EC, 2004), and can serve as pre-

qualification selecting for successful suppliers (DIN & INS, 2014). Environmental management systems have a positive impact on product innovation (Rehfeld et al., 2007) and process innovation (Wagner, 2008), and certification is expected to encourage green practices in procurement (Günther & Scheibe, 2006). Despite this, public organizations often consider GPP separately from standards such as ISO 14001, and certification was found in one study to have no link to the use of GPP (Testa et al., 2012). A better understanding of interactions between environmental management systems and procurement is needed if ISO 14001 is to be able to drive innovation.

In a study on the prominence of GPP in tenders for furniture in Sweden and Finland, Parikka-Alhola (2008) found that more than 60% of the environmental criteria were required technical specifications – i.e., material choices, chemical content, etc. Textile standards were in the form of eco-label criteria, such as Swann label or Öko-tex. Due to restrictions in procurement literature affecting the application of eco-label criteria in GPP, however, they deem the use of such criteria to have a low ability to influence the direction of eco-innovations. Authors conclude that the use of environmental criteria in GPP can be used to influence manufactures by creating demand where there is no requirement for environmental action, such as in purchasing furniture with recycled materials incorporated.

### *Standards in Pre-Commercial Procurement*

As outcomes of different phases of PCP, standardization plays an important role in the future success of procured R&D services. It generates externalities from R&D like knowledge leakage and positive spinoffs, supporting the "public good" aspects of innovation. Knowledge created in the development process can be codified in the form of standards (Blind & Gauch, 2009), serving as common methodologies to further pre-procurement. Specifically, the transition between each progressive phase in PCP supports the development of **open standards** (EC, 2007). Interoperability requirements in PCP allow procurers to create *de facto* standards and encourage adoption of open interfaces by key market providers, and in doing so can reduce lock-in to previous suppliers (EC, 2014c). In general, government involvement in standardization is particularly important in early stages of product and service life cycles, often regardless of the speed of development

(Swann, 2000). Especially for PCP, R&D results can be disseminated by public bodies through standardization (EC, 2007). Swann (2000) identifies roles for government in standardizing for variety reduction as focusing efforts, when looking at early stages of life cycles. Along with citing standards in requests for tenders, standardization in PCP promotes diffusion and implementation of standards, as well as further cost savings that can accrue from public procurement activities. These effects enable more resources for further investment into supplier R&D and an increased budget for procurers to purchase more innovative features (Blind, 2008). Helps ensure that developers will not have to put in additional standardization efforts in later stages of development.

Many of the benefits to engaging in PCP – for both procurer and supplier – stem from risk reduction. Risks, as are rights, are shared between purchaser and supplier in PCP "according to market conditions" (EC, 2007, p. 6), where results are disseminated not only through commercialization, but also standardization and publication. As critical for the uptake of novel platforms, standards may serve as common methodologies to further pre-procurement, reducing risks of technological or system failure and risks for suppliers to innovate (Europe Innova, 2008). Due to the firm risk reduction from receipt of guaranteed R&D funds for awarded researchers from PCP (Edquist & Zabala-Iturriagagoitia, 2015), firms may receive an advantage in attracting private investment (Bodewes et al., 2009).

Multiple EU programs fund PCP initiatives in an effort to further knowledge and opportunities to leverage its potential, including FP7 and Horizon 2020. At least 14 European countries have begun PCP pilot projects, including Germany, the Netherlands, UK, France, Sweden, and Denmark, including multiple cross-border collaborative projects. One current initiative is CHARM, a project led jointly by the Netherlands and England to improve traffic management centers for better safety and reliability, efficiency. Environmental requirements include materials, waste, and emissions reduction. By "moving away from proprietary towards open IT architectures" the first stages of the CHARM project suggested that a 20% cost savings (EC, 2014c, p. 5). In the United States and China, PCP activities have "significantly reduced" fuel cell cost stations, enabling the development of affordable fuel cell-powered busses for cities to purchase as part of their transportation fleet (EC, 2007).

Some initiatives make the labeling and compatibility considerations clear from the very beginning. With the receipt of European funding, Statoil and Gassanova in Norway began PCP projects in 2011 for carbon capture technology. In the former, the state has a majority share, and the latter is state-owned. Driven by increasing emissions reductions requirements, the government set out to develop the largest carbon capture facility in the world to stimulate innovation and competition while reducing adverse environmental effects of industrial operations (EC, n.d.-a). The purpose was to develop the "best technical solutions to meet the performance requirements" at the Mongstad combined heat and power plant, through a tailored "technology qualification program" including five potential technology vendors (EC, n.d.-a). Anticipating the need for certification for the success of their project from the start, Statoil identified relevant certification bodies in the calls for tenders required for certification at the end of Phase 3 of the PCP project, completed in 2013 (EC, n.d.-b). Communicating needs to suppliers in such a way assists in defining potential developmental trajectories – found by Edler and Yeow (2016) to help trigger innovation through public procurement.

## 2.5 Conclusions and Limitations

This paper has been a first attempt to conceptually investigate typologies of public procurement with respect to standards and standardization from a life cycle perspective. While distinct procurement mechanisms, PCP, PPI, and GPP all have potential to provide enhanced public and market benefit through eco-innovation. In purchasing R&D services, open standards especially can achieve cost-savings while anticipating information standards required can steer developers in similar paths. Standardization activities involving knowledge generated throughout the PCP process help shape developmental trajectories for successful eco-innovations, including major energy and transport infrastructure. In PPI, strategically applying measurement, testing, and interface standards supports openness in calls for tenders toward more innovative solutions and market capture of incremental or radical innovations, such as more efficient refrigerators and lighting. For GPP, using information standards incorporates environmental criteria into purchases and supports

environmental life cycle costing, and alongside minimum quality standards promotes diffusion of minimal to market-changing eco-innovations. Integrating comprehensive frameworks into European policy drivers, alongside improving capabilities for integrating standards in procurement, will improve long-term eco-innovation impacts of procurement and positively affect markets and the environment.

The framework and analysis proposed here face certain limitations. The nascency of public procurement as an area for studying innovation, environmental improvement, and standardization limits the body of literature available to draw upon for deeper insight into structures and interactions between these areas. Particularly, disagreement within this literature on classifications of innovation within public procurement remains, and is often a matter of practical legal requirements rather than theoretical investigation. Emerging research on the role of institutions in public procurement, such as Edler and Yeow (2016), help to increase study of procurement as a dynamic process situated within systems rather than a strictly linear one beginning with tendering and ending with contracting. Further elaboration and application of the framework proposed here may contribute to a better understanding of how to leverage standards and standardization in procurement processes toward improved environmental benefits.

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# 3 From Whence the Knowledge Came: Heterogeneity of Innovation Procurement Across Europe

**Abstract**

To induce innovation in the public sector, Directive 2014/24/EU encourages internal and external consultation during the procurement process. However, little is known regarding the prominence of these practices. Determining the extent of knowledge sourcing in innovation procurement across 29 European countries, this paper presents an institutional cluster analysis, examining heterogeneity across knowledge sourcing activities, procurement areas, and tender innovation outcomes for 1,505 public procurers from 2008-2010. Building upon existing taxonomies, three types of procuring agencies are identified: Large collaborative agencies practicing public procurement of innovation (31%); supplier-focused pre-commercial procurers (20%); and direct procurers at the municipal level (49%). Validation supports this heterogeneity, using innovation outcomes and policy drivers. At the country level, Spain and the United Kingdom, Italy, and Germany and Poland are most represented in respective clusters. Findings enable predictions regarding impacts on agencies and innovation from the new Public Procurement Directive's translation into national law by Member States.

## 3.1 Introduction

Directive 2014/24/EU encourages public procurers to induce innovation in government services and private firms, supporting efficiency in public spending and societal goals (European Commission (EC, 2014, p.65). Changes in the new directive promote interactions with other governments, potential suppliers, and users that can be achieved by using *innovation procurement*: an approach to improve purchasing through process management, which may "help the market uptake of innovative products and services" (European Research Area and Innovation Committee [ERAC], 2015, p. 2).

As used here, innovation procurement consists of public procurement of innovation (PPI), pre-commercial procurement (PCP) and innovation partnerships. Innovation procurement has received only limited study (e.g., Edler and Yeow, 2016; Uyarra et al., 2014), with many more studies instead concentrating on innovative criteria (EC, 2013; Nissinen, Parikka-Alhola, & Rita, 2009; Wegweiser, TU Berlin, & Hölters & Elsing, 2009). Although public purchasing across Europe amounts to 19% of GDP (ERAC, 2015), innovation procurement remains uncommon (Uyarra et al., 2014) and varies across institutions and countries (ERAC, 2015). The potential of innovation procurement to improve public services has not yet been realized (EC, 2013), and little is known regarding differences in practices.

A critical component of consultation in innovation procurement is *knowledge sourcing*: drawing upon the "expertise, experience, advice, and opinions" of others to "supplement" (Gray & Meister, 2006, p.142) the expertise of a public purchaser such as on technology or market trends and supplier capability (EC, 2005, p. 27). Examples of knowledge that can be gathered in procurement consultation are market information from potential suppliers, requests from users, learnings or tools from other procurers, and special advice from experts. Knowledge sourcing is an example of an instrument "to embed innovation procurement" in organizations, which can increase awareness of organizational innovation potential, strategy, and procurer skill (Georghiou, Edler, Uyarra, & Yeow, 2014). The *organizational learning* resulting from knowledge sourcing activities supports professionalization of public procurement, where better knowledge on behalf of procuring agencies increases efficiency (EC, 2014, p. 88). Knowledge sourcing can also affect *product or service and market evolution* when information shared is embedded into tenders that drive

innovation. As such, gathering information through consultation supports a number of innovation procurement measures, including tender openness, more innovative demands, and procurer capability (Uyarra et al., 2014). Wider demand-side influence of public procurement, such as market signaling (Rolfstam, 2014) can also be leveraged through enhanced market dialogue coinciding with consultation activities. Given this, there exists ample opportunity for a better understanding of knowledge sourcing within procurement to support innovation procurement.

Taxonomies can provide a platform from which to study these consultations in innovation procurement with respect to interactions at the 1) organizational and 2) product or service and market level[1] (Aschhoff & Sofka, 2009; Edquist & Hommen, 2000; Hommen & Rolfstam, 2009). Hommen and Rolfstam (2009) refer to these classifications as "learning" and "evolution," respectively. However, these concepts have not been tested using empirical data at the European level (i.e., beyond case studies and national surveys), and their applicability is limited in the face of novel policy distinctions between certain innovation procurement mechanisms. Most notably, Hommen and Rolfstam (2009) provide a taxonomy relevant to discussions of consultation, including "modes of interaction." With the exception of Edquist and Zabala-Iturriagagoitia (2015), no academic efforts have differentiated between emerging concepts of public procurement of innovation (PPI), pre-commercial procurement (PCP), and innovation partnerships, which are distinct in terms of learning and evolution. As such, there is a need for empirical study of consultation practices in innovation procurement processes to test and improve taxonomies.

In addressing this research gap, this paper presents the first European-wide, survey-based analysis of the extent to which different innovation procurement mechanisms are practiced according to knowledge sourcing activities at the agency level. To uncover the prominence of these practices, this paper tests innovation procurement taxonomies by conducting a cluster analysis at the organizational level. Cluster analyses can be used as a tool to classify organizations into groups according to degrees of similarity across variables. Here, cluster analysis identifies heterogeneity across knowledge sourcing practices (consultation of potential suppliers, users, other procurers, and experts), procurement areas (purchasing innovations or R&D services), and organizational characteristics of public

agencies. Clusters are validated using tender innovation outcomes (service innovation or reduced service costs), national policy frameworks, and countries.

The findings identify three distinct types of public agency with respect to different knowledge sourcing in innovation procurement: Large collaborative organizations practicing public procurement of innovation (31%), supplier-focused pre-commercial procurers (20%), and direct procurers at the municipal level (49%). Validation supports this heterogeneity, using innovation outcomes and policy drivers. At the country level, Spain and the United Kingdom, Italy, and Germany and Poland are most represented in respective clusters. The new directive is predicted to impact these three types of agencies and their innovation differently, often stimulating interactions between them.

## 3.2 Literature Review

Taxonomies can be used as identification schemes to identify heterogeneity within groups. Applied to the study of innovations and institutions, taxonomies have been used successfully to support studies of technological regimes (Nelson, 1977) as a reflection of technical competency (Pavitt, 1984), and for mapping rates, sources, and types of innovation within organizations (de Jong & Marsili, 2006). However, in comparison with private sector innovation, public sector innovation has received little analysis, both generally and regarding classifications. While similarities with private functions exist, such as cost reduction drivers, differences like profit seeking versus policy or socioeconomic growth means that innovation taxonomies for public institutions cannot readily draw parallels with literature on the private sector. In terms of innovation capacities, separation of innovation within the two spheres have evolved from the organizational theory period of the 1960's to the turn of the century, during which time the two were viewed similarly (Kattel et al., 2014). With respect to impacts of public procurement on markets, however, the European Commission Expert Group on Public Sector Innovation still deems the public sector as a "Schumpeterian Innovator" (EC, 2013, p. 12) for its creation of new (and temporary) markets for private sector innovation. This latter perspective is reflected in studies of innovation procurement amongst demand-side measures and its interactions with markets. For example, Edler (2013) situates public procurement within a typology of such measures as having the most direct connection to market stimulation, and Aschhoff

and Sofka (2009) find it to be equally as influential as university knowledge spillovers. While market impact is indeed an effect of successful innovation procurement, better understanding knowledge sourcing within procurement processes requires a focus on procurer practices.

Innovation procurement taxonomies capture features of public purchases according to organizational learning and product or service and market evolution. The concept of learning is marked by "interactive learning" in non-anonymous market interactions (Lundvall, 1992, pp. 8-10). Public intervention is necessary for stimulating innovation in cases of perfect market competition (Edquist & Hommen, 2000), as is typical of innovation procurement, where knowledge and information additional to price and quantities is gathered (Edquist & Hommen, 1999). Viewing innovation procurement as that which introduces novelty to the purchasing organization, Edler and Yeow (2016) focus on the enhancement of organizational capabilities of public procurers – including the abilities to establish linkages between internal and external actors "in the process of defining needs, exploring solutions, conducting the procurement and adopting and using innovations" (p. 415). It is this view which underpins the use of innovation procurement in this paper – to capture a new method or process in procurement by public agencies. Whether this novelty results in an innovation, and whether this innovation is introduced to the public buyer, depends in part on the modality of the procurement.

Three modalities characterize innovation procurement, distinguished first by evolution: public procurement of innovation (PPI), pre-commercial procurement (PCP), and innovation partnerships. *Public procurement of innovation* is a demand-side measure which seeks to modify the rate and/or direction of technological change (i.e., innovation) (Dalpé, 1994; Edquist & Hommen, 2000; Geroski, 1990) through public intervention. In this modality, purchasers select criteria for innovations that require at least some degree of novelty – in this paper, underpinned by trends to more broadly conceptualize innovation, PPI is not limited to technological change. At earlier stages in product or service life cycles – and ceasing prior to commercialization – PCP creates demand for R&D services that may bring ideas as far as the prototyping and field testing stage (Edquist & Zabala-Iturriagagoitia, 2012; Izsak & Edler, 2011; Rigby et al., 2012). Pre-commercial procurement is often required for procurement of radical innovations (Tsipouri, Edler, Rolfstam, & Uyarra, 2010), although separate from PPI in that it does not necessarily entail any product

development past a prototype (Edquist & Zabala-Iturriagagoitia, 2012). In an *innovation partnership*, a buyer works together with a single supplier over a multi-year period toward the purchase of a product or service at the point of commercialization (Georghiou et al., 2014).

A number of classifications further differentiate these innovation procurement modalities. Regarding the degree of technological change induced by a procurement, Edquist and Hommen (2000) define *developmental* and *adaptive* procurement, where the former is new to the world and the latter is only new to a country, requiring only small modifications to fit local conditions. This terminology will not be applied here, however, as while they are attractive concepts they are incompatible with the modern procurement modalities outlined in the previous paragraph. In a more process-oriented definition, Edler and Yeow (2016) distinguish between innovation procurements where tendering *triggers* development of a new innovation (e.g., PCP/innovation partnerships), and those where the tendering *responds to* some innovation already in the market (e.g., PPI).

Other classifications are based on who is the end user. In *direct* procurement, purchases are intended to directly meet the needs of the procuring agency, whereas in *catalytic* procurement another end-user is intended and the purchase more directly stimulates markets (Edquist & Hommen, 2000). Building upon these elements in terms of learning structures and contexts, demand structure, and needs addressed, Hommen and Rolfstam (2009) introduce *cooperative* procurement, where public agencies work together with other public agencies toward common goals. Further classifications specific to knowledge sourcing (learning) and innovation (evolution) within each of these are given in the descriptions of clustering variables.

## 3.3 Data and Variables

### 3.3.1 Data

Data for public procuring organizations across Europe were obtained from Innobarometer 2010 (Gallup, 2011). The survey was conducted jointly by UNU-MERIT, the European Commission and Gallup Europe. The Innobarometer 2010 provides the most comprehensive international dataset available to date that includes details regarding public procurement, and has been used for analyses published in highly reputed journals (e.g., Arundel, Casali, & Hollanders, 2015). While dedicated datasets on public procurement allow for better tailoring of questions, these are either national-level (e.g., Uyarra et al, 2014) or case studies (e.g., Edler and Yeow, 2016). The Innobarometer 2010 provides a cross-section of public procurement and associated innovation to gain insight into activities across and within European countries.

Covering a three-year period, 4,063 public agencies were interviewed for the Innobarometer 2010 to measure innovation strategies at the level of their organization from 2008-2010 inclusive, obtaining 3699 valid responses.[2] A random sample of 27 EU Member States, Switzerland, and Norway was selected from organizations at each country level. The number of responses obtained from each country was partially influenced by country size and the number of institutions available through the sampling bodies. Organizations served local, regional, and national geographic areas, and ranged from 10 employees to over a thousand. Interviews were conducted via telephone, and respondents were general managers or strategic directors, answering for their immediate institutions (Gallup, 2011).

To conduct the analysis in this paper, a number of steps were taken to gather a valid sample from the total responses. First, to better focus on public agencies in this paper, not-for-profit or private sector organizations were removed from the sample, leaving respondents representing either a government organization, or one owned by the government. Next, responses with missing information or no response to questions associated with any of the fourteen focus variables (presented in Table 3.1, below) were removed. These variables were selected from the survey based on literature for use in clustering based on knowledge sourcing,

*Table 3.1 – Variables of knowledge sourcing, tendering area, and organizational information used to develop the clusters*

| Variable | Description | Interpretation |
|---|---|---|
| Knowledge sourcing | | |
| devl_indep | Process/organization innovations developed **independently** | Yes=1; No=0 |
| devl_supp | Process/organization innovations developed in **collaboration with private business** | Yes=1; No=0 |
| Info_supp | Importance of information from enterprises (as suppliers) in developing innovations<br>- Dummy variable created by combining categories of "somewhat important" with "very important" | Somewhat /Very important=1<br>Not important=0 |
| consul_supp | Consult potential **suppliers**/contractors before tendering | Yes=1; No=0 |
| consul_user | Consult **service users** before tendering | Yes=1; No=0 |
| consul_gov | Consult **other organizations** conducting similar procurements | Yes=1; No=0 |
| inno_imp | Innovation is at least as important as cost for an applicant to be successful in winning a tender from their organization.<br>- Dummy variable created by combining categories of "innovation is more important than cost" with "innovation and cost are equally important" | Innovation>= cost=1<br>Cost>innovation=0 |
| Tendering areas (goods or services) | | |
| tender_ict | ICT equipment/ systems | Yes=1; No=0 |
| tender_tech | Other types of technology | Yes=1; No=0 |
| tender_serv | Provide one or more user services | Yes=1; No=0 |
| tender_servinno | Consulting to recommend/design/pilot test service innovations | Yes=1; No=0 |
| tender_rd | R&D for new technologies and services | Yes=1; No=0 |
| Organizational information | | |
| org_empl | Employee number<br>- Dummy variable created by combining categories of 10-49, 50-99, 100-249, 250-400 to make one category, and 500-999 with 1000 or more to make the other category | >=500=1<br>10-499=0 |
| org_geo | Geographic area served by organization<br>- Dummy variable created by combining regional and national | Regional/ National=1<br>Local=0 |

tendering areas, and organizational information. This left a sample consisting only of public agencies who procured goods or services from private businesses between 2008-2010, in areas of ICT, technologies, service consulting, and R&D, as these were the organizations whom were further questioned regarding consultation practices. A dummy variable to test for the presence of a domestic innovation policy framework was introduced from a list of updated innovation procurement initiatives around Europe (EC, 2015), as further detailed in the later discussion on variables used for validation. One notable limitation of the dataset is the comparability between countries. This is due to the small representation of countries in certain subgroups, as well as country-specific factors such as the degree of public agency autonomy (Gallup, 2011). Due to these attributes, the results are not suitable for comparisons between countries, but rather "across broad institutional segments" (Gallup, 2011, p. 7). For this reason, while a number of countries are used in validating the model presented in this paper, these are not used for cluster development, and weightings across clusters are only compared within countries rather than across countries. A second limitation is that, while information on the sectors in which these public entities were purchasing would have provided greater insight, the ability for respondents to choose up to three sectors of operation made doing so impossible. Instead, the area in which they tender provides some insight into their areas of operation.

### 3.3.2 Clustering Variables

Building upon the literature on taxonomies of innovation procurers, fourteen variables were selected to test for clusters within the data. The following explains these variables and contextualizes them in relevant literature.

#### *Knowledge Sourcing*

Knowledge sourcing variables measured consultation in terms of collaboration, information sourcing, consultation practices, and innovative criteria among public agencies. These were chosen to identify the learning activities of public agencies in their purchasing. Knowledge sourcing activities fall under interactive learning, as a mode of interaction that builds social capital (Hommen & Rolfstam, 2009). In innovation procurement, public sector organizations face difficulties in connecting the right actors with complementary

skills and interests at an intra and interorganizational level (Edler & Yeow, 2016, p. 415), reflecting upon knowledge sourcing capabilities.

*Collaboration*

Collaboration is a public sector strategy which supports public sector innovation (Arundel, Casali, & Hollanders, 2015), where interfaces between public organizations and external actors in innovation procurement "shape the innovation process" (Bloch, 2011, p. 18). Institutional proximity is a common theme in public agency collaboration. Both knowledge flows between actors in innovation procurement and capacities for collaboration (Huxham & Vangen, 2005) are facilitated by common institutional environments (Hommen & Rolfstam, 2009). Greater "institutional closeness" (EC, 2012, p. 37) between public agencies and others helps "maximise learning and often minimise risks" (Bason, 2010, p. 240).

However, while "the majority" of ideas from the public sector are externally sourced, most of the ideas generated in this manner are not often turned into innovations, as found by Hughes, Moore, and Kataria (2011). This supports the definition of innovation procurement used here, where innovation outcomes are not mandatory but possible, such as in the modality of PPI. The variable *devl_supp* measured external orientation as collaboration of public agencies with private businesses in developing process or organizational innovations, supported by the importance of supplier information (*info_supp*). Literature on supplier consultation is presented in the following section. In contrast, *devl_indep* measured the internal orientation and independence of public agencies in developing such innovations. Extensive internal collaboration can help to identify solutions (Corbin, Corwin, & Mittelmark, 2012), with innovation success influenced by internal diffusion methods (Hughes, Moore, & Kataria, 2011).

*Consultation Practices*

Regarding knowledge sourcing in the development of tenders specifically, variables tested for the prominence of consultation as a common practice with potential suppliers *(consul_supp)*, service users *(consul_user)*, and other government organizations *(consul_gov)*. Consultation of other organizations offering special advice *(consul_spec)* was used as a validation variable, and is discussed in the corresponding section. The relevant question in the survey was phrased as whether respondents "usually consulted" each particular party prior to tendering (Gallup, 2011, p. 195), which is interpreted here as meaning that, in most instances and as a common practice, procuring organizations sought information from the specified source.

*Consultation Practices - Potential Suppliers*

Sharing information with potential suppliers – particularly at early stages of procuring a radical innovation (such as in the modality of PCP) – is a form of market signaling that enables planning of capacity and "innovation investment to react to public sector needs" (Tsipouri et al., 2010, p. 41). Currently, suppliers identify a lack of opportunity to present unsolicited ideas as an area for concern (Uyarra et al., 2014), underscoring communication barriers between suppliers and purchasers. Improving the efficiency and use of procurement consultation through dialogue with potential suppliers has been an issue of recent national focus, such as in the UK in improving the design and delivery of procurement processes (HM Treasury, 2013). For suppliers, procurement market consultation is increasingly preferred to competitive dialogues once tenders are open (Uyarra et al., 2014) where the process is becoming more efficient (HM Treasury, 2013). In France, procurers have begun networking with potential suppliers at events since 2014 to connect with high-potential industry partners and to better find small and medium-sized enterprises (SMEs) (ERAC, 2015). As well, the type of innovation procurement in general should influence the sourcing of information. For purchasing new technologies, for example, intensified dialogue between the public sector and firms active in R&D is widely perceived to influence public sector innovation (Wegweiser et al., 2009).

Consultation and collaboration are a prerequisite for public-private innovation partnerships, which can be used under the new directive instead of multi-stage tendering with multiple companies in PCP. Public-private partnerships in procurement are a form of

cooperation under the New Public Management paradigm (Essig, 2005), where government works more closely external organizations (Walker & Preiss, 2008). In an innovation partnership, which specifically refers to partnership with a private firm, a buyer works together with a single supplier over a multi-year period to purchase the product or service at the point of commercialization (Georghiou et al., 2014). In the new Procurement Directive, procurers are advised to establish innovation partnerships with companies through procurement mechanisms, particularly for long-term activities in developing new products or services (EC, 2014). Such public-private innovation partnerships are "extremely important" for identifying innovations for significant cost-savings and "improved service quality and accessibility" (EC, 2012, p. 59). Examining partnerships in smart city initiatives, EC (2012) found them to be more common in "either federal or highly decentralized institutional settings" (p. 44) of the UK, Germany, Netherlands, Italy, and Spain.

*Consultation Practices - Service Users*

Users are a driving force in public sector innovation (Bloch, 2011), and user-supplier interaction and co-production are mechanisms by which procurement helps to induce or diffuse innovations (Edler, 2013). In innovation procurement literature focusing on communication with the supply side, the procurer is seen as the user (Edler & Yeow, 2016, p. 418). However, particularly when public procurement is seen as first a mechanism to serve the public rather than to stimulate innovation (Edler & Yeow, 2016; Edquist & Hommen, 2000), it is not sufficient to only examine suppliers as a source of knowledge. In examining innovation procurement, users should be clearly distinguished from suppliers, and much about their role in driving public sector innovation remains unknown (Bloch, 2011). Extending evaluation to include users of public services requires recognition of internal processes at public institutions. From the perspective of the public agency, Bloch (2011) identifies potential users as enterprises, other public organizations (with the exception of universities and public research institutions) and citizens (p.18). Importantly, even within public organizations, public purchasers and public users rarely would be the same entities – especially at agencies serving a larger geographic area, where internal departments exist for buying to concentrate expertise, tasks, and often demand.

The dataset used in this analysis captures this important difference, by including purchaser consultation with service users. Public purchasers consulting with service users in procurement discussions act as critical connections between users and producers, accumulating knowledge on both market potential and user needs. Given this, literature to user-producer interaction in innovation procurement can still be applied with clarifications, based on theoretical agreement that user-producer interactions support innovation through learning (von Hippel, 1988).

In *catalytic* procurement, the end-user is a third-party (i.e., not the public agency who conducted the purchase) and the government buys a product or service to stimulate a (new) market in a desired way (Edler, 2013; Hommen & Rolfstam, 2009). In procuring for R&D services through the modality of PCP, user consultation is critical at such early stages of innovation. Such market intervention is deemed by Hommen and Rolfstam (2009) as "user-led innovation" (p. 30), where the user is referred to as the purchaser. Associations with solely suppliers during procurement in PCP would help to direct R&D toward meeting what the market identifies as user needs, without consulting users directly. Particularly in such a purchase, the potential for lack of uptake of procured innovations presents societal risk, challenging the core goal of innovation procurement. A dialogue process with potential users "helps improve the acceptability of the marketplace and thus reduce market risks" (Tsipouri et al., 2010, pp. 41-42), whether it be users of new applications, private lead users. User satisfaction (not limited to the procuring agency) is a common objective in Nordic procuring institutions (Bloch, 2011), such as Denmark, which promotes market dialogue and identification of user needs in innovation procurement (ERAC, 2015).

*Consultation Practices - Other Innovation Procurers*

The variable measuring consultation of other organizations conducting similar procurement before tendering complemented other consultation mechanisms. In certain types of procurement, such as *cooperative* procurement, collaboration is mandatory as procurers work with other public entities to organize the purchase and specify needs together (Hommen & Rolfstam, 2009). In this paper, cooperative procurement includes when multiple agencies are contracting authorities, as well as "joint" procurement (ERAC, 2015), where multiple agencies have control over provider decision-making and objectives. Cooperative procurement indicates organizational innovation practices, as found by Bloch (2011) in the external cooperation of public administration institutes in Nordic countries. However, Member States lack coordination and cooperation across Europe, despite this being a prerequisite for innovation procurement (ERAC, 2015). To support this collaboration, governments across Europe are beginning to stimulate connections between procurers. For example, there is a growing number of examples of cooperative procurements and those involving networks for consultation, with European backing like by EAFIP (*European Assistance for Innovation Procurement*).

Cooperative procurement concentrates demand, which can enable the purchase of more innovative products at a lower price. Knowledge sharing is an important element in achieving these benefits, which can be accomplished with or without internal restructuring. In the Netherlands, Category Managers assigned to each purchasing sector are tasked with external consultation and communicating knowledge gained to procuring agencies. In contrast, without establishing a new entity, Austria has developed a clear governance structure across its three ministries cooperating in PCP and PPI to share knowledge, knowhow, and experience between purchasers (EC, 2015). Regardless of the structure, collaborations remain a prerequisite for innovative public finance such as networking grants (Baliey et al., 2010) that can help remove financial barriers to innovation procurement. However, the efficiency of cooperative procurement initiatives is not guaranteed: Metze and Levelt (2012) identified cooperative procurement across Dutch municipalities, finding that best interests or innovation expectations were not always met with by parties.

### *Importance of Innovation*

The variable *inno_imp* indicates whether innovation was at least as important as cost for a supplier to win a tender from a public agency. The question is interpreted here as referring to the innovativeness of a potential supplier and/or the presence of innovative criteria in a tender. Importantly, the results of knowledge sourcing in innovation procurement should be codified in tenders, with public agencies recognizing and selecting for product or service characteristics with novelty in mind. Supporting tender openness (Wegweiser et al., 2009), innovative criteria can be placed either in calls for tenders (as technical specifications/requirements, also referred to as selection criteria) or award criteria (Nissinen, Parikka-Alhola, & Rita, 2009). Notably, it is assumed that respondents did not just consider innovation in award criteria, but more broadly in innovative calls for tenders. This decision is supported by Nissinen, Parikka-Alhola, and Rita (2009), who found that a number of requirements set in award criteria, such as specific environmental management measures and policies, are in reality selection (knock-out) criteria that should be presented in the tender body.

### *Tendering Area to Private Suppliers (Goods or Services)*

As they reflect upon learning and evolution, examining tendering areas provided insight into which innovation procurement modality respondents undertook. Variables were included for whether agencies purchased particular goods or services in the last three years. These are for ICT equipment/ systems *(tender_ict),* other types of technology *(tender_tech)*, and providing one or more user services *(tender_serv),* and consulting to recommend/design/pilot test service innovations *(tender_servinno). Tender_tech* captured whether respondents tendered technologies that they considered primarily related to neither ICT nor those which improved environmental or energy performance. These variables are analogous to those used by Bloch (2011) in a survey of innovative procurement practices in the Nordic countries. As they all refer to the purchase of an innovation, they are indicative of the practice of PPI. Another variable introduced for tendering area was for the conduct of R&D for new technologies and services *(tender_rd).* This is analogous to PCP, as the procurement of R&D services, and differentiated from PPI as no innovation is necessarily purchased. If the survey data was for a time period

where the new directive applied, this variable might also reflect developmental stages within innovation partnerships. Such an interpretation would be akin to Bloch's (2011) "public private partnerships" question as an indicator of innovation procurement. However, as the mechanism was not included in the previous directive (Georghiou et al., 2014), the data in this paper is not interpreted with respect to innovation procurement practices.

### *Organizational Information*

Organizations at similar hierarchical levels may conduct innovation procurement similarly due to similar institutional drivers. As well, organizations with more staff may be those better equipped to conduct enhanced knowledge sourcing activities coinciding with innovative procurement. To find commonalities regarding organizational characteristics of the sample, variables for number of employees (*org_empl*) and the geographic area served by the organization (*org_geo*) are used here.

A number of findings have supported relationships between these factors and the degree of innovation in public sectors, although not with respect to innovation procurement. Institutional structure influences the actions of public sector innovators (EC, 2012). According to Arundel, Casali, and Hollanders (2015), the likelihood of service innovation increases with the size of the public institution, where smaller organizations have less external information sourcing compared with larger organizations. Other findings corroborate this, such as Gow (2014), who found larger Canadian institutions were more innovative in terms of adopting novel processes or organizations. With respect to applying the results of procurements, Bloch (2011) found central (i.e., national) government to use their ICT procurements more often to promote innovation in suppliers.

### 3.3.3 Variables Used for Validation

A number of additional variables were used to validate the cluster analysis. These are displayed in Table 3.2 and described in greater detail in the following sections.

#### *Consultation Practices: Special Advice*

As access to skills is a critical enabling factor of public sector innovation (Hughes, Moore, & Kataria, 2011), consulting external organizations for special advice may be more highly associated with innovation procurement. For example, special skills can help risk-averse organizations begin innovation procurement in the face of complex criteria decisions (EC, 2013). The variable *consul_spec* captures whether procuring agencies usually consulted external organizations that offered special advice in this manner.

*Table 3.2 – Variables for special advice consultation, tender innovation outcomes, and country criteria used to test the clusters*

| Variable | Description | Interpretation |
|---|---|---|
| consul_spec | Consult other organizations offering **special advice** prior to tendering | Yes=1; No=0 |
| outcome_inno | Tender resulted in **service innovation** | Yes=1; No=0 |
| outcome_cost | Tender resulted in reduced service provision costs | Yes=1; No=0 |
| count_inno | Whether country has developed **frameworks** for innovation procurement | Yes=1; No=0 |
| countnord | Whether country is Finland, Denmark, Sweden, or Norway | Yes=1; No=0 |
| (Multiple – according to two-letter EU abbreviations) | 27 EU Member States, Switzerland, and Norway – one dummy variable per country used | Yes=1; No=0 |

#### *Tender Innovation Outcomes*

Innovation outcomes from tenders measured whether at least one tender during the 3-year timeframe of the study resulted in service innovation (a "new or significantly improved service provided by or for your organization") *(outcome_inno)* or reduced costs of service provision *(outcome_cost)*. Whether public purchasers offer entrance to lead markets, or act as experimental or lead users, the use of innovations is necessary for their diffusion

(Edler, 2013). If public bodies adopt procured innovations themselves, they act as a first user and help establish demand in new markets, while benefiting in their own cost reductions or improved services. Acting as an early user of procured innovations can support the diffusion of cost-effective technology and services, supporting product improvement and speeding up cost reductions (Aschhoff & Sofka, 2009). Also associated with increasing service quality and cost-effectiveness, tendering for one or more user services indicates outsourcing (EC, 2012) and a better focus on core government mandates. The presence of positive innovation outcomes from tendering is interpreted as indicating PPI and *direct* innovation procurement, where the purchasing entity implements its purchase. Innovation partnerships may also be practiced, although due to its long timelines and multiple phases, this can be concluded with less certainty. In line with innovation procurement goals of societal assistance defined by Edler (2016) and Edquist and Zabala-Iturriagagoitia (2012), service improvement from tendering supports "improved responsiveness" to clients or citizens of public institutions – a critical metric for measuring public sector innovation outcomes (EC, 2012).

Not all tenders from an innovation procurement must result in an innovation, which is complicated by frequent confusion of PCP, PPI, and innovation partnerships (Edquist & Zabala-Iturriagagoitia, 2015). When tenders do not result in innovations benefiting the public agency, modalities of PCP may be practiced instead. Pre-commercial procurement is more likely to be based on longer-term and explorative contracts (EC, 2012), such that it is not inevitable that these contracts result in innovations. The European Commission stresses that PCP activities are necessarily for R&D services and must terminate prior to uptake or commercialization, and therefore exclude activities such as "integration, customization, incremental adaptation and improvements to existing products or processes" (EC, 2007, pp. 2-3). As such, public organizations are not allowed to purchase innovative solutions that have been developed through PCP mechanisms, as this would be covering the costs of commercialization, in contrast to innovation partnerships where doing so is permitted. As well, if the purchase is *catalytic*, the government is not the end user and thus would not implement any innovations that were purchased. Similarly, the implementation of a purchased innovation through *cooperative* purchasing with other public agencies is not guaranteed.

Introducing innovations to public agencies is associated with learning and evolution. Regarding the former, the extent of internal change required for a public organization to adopt a tendered innovation was found by Edler and Yeow (2016) to influence learning and adaptation costs, as well as intermediation needs. With respect to evolution, Bedin, Decarolis, and Iossa (2014) found that many public R&D initiatives did not require significant effort, and also resulted in organizational innovations and "incremental applied research" (p. 12), such that innovation outcomes from innovation procurement may be quite high. However, Hughes, Moore, and Kataria (2011) identified the quality of ICT infrastructure as a critical organizational enabler of innovation, such that improving infrastructure through the purchase of ICT should be associated with positive outcomes at the public agency level.

### *Policy Drivers*

The policy environment of the public agency was measured by testing whether respondents belonged to a country which had developed frameworks for innovation procurement or not (*count_inno*). In developing this variable, countries who have ongoing or completed PCP projects (the rightmost section in Figure 3.1) were said to be "innovative," as they have moved through the stages from exploration, to framework development, to identification and pilot preparation (EC, 2015). This was used as an indicator of whether the countries conducted PPI as well – i.e., not procuring R&D services but purchasing a new innovative product or service. As the dataset surveys organizations from 2008-2010, those who are innovative in 2014 would have been in earlier stages of developing policies for this in prior years, and those who in 2014 had not yet begun projects would have been farther behind given the longer timelines for PCP compared with PPI. While remembering that PCP is not the same as the PPI, this was the best approximator for a policy environment conducive to innovation procurement given the lack of comprehensive study in this area. Although the vast majority (94%) of OECD countries policies or strategies to support innovative goods and services, green public procurement, or SMEs (OECD, 2015), there is currently no data on specifically innovative procurement among European countries. The 2014 Procurement Directive must be translated by Member States into national law by January 2016, when national legislation will vary across countries dependent upon domestic institutions (Rolfstam, 2014).


*Figure 3.1 – Implementation of pre-commercial procurement projects across Europe. Source: EC (2015).*

Edquist and Hommen (2000) differentiate between *direct* and *indirect* policies for innovation procurement. The latter sets framework conditions and institutional contexts (such as the EU Procurement Directive), which is recognized by all Member States in the sample. In contrast, direct policies directly intervene in active technology development (Edquist et al., 1998). Both of these policies must be aligned at national levels in order to both increase domestic capacities while meeting social needs (Edquist & Hommen, 2000), as key features of innovation procurement (Edler & Yeow, 2016). The presence or absence of a national framework for innovation procurement tests for such policy alignment. National frameworks uphold "innovation networks" and "knowledge generation" by public entities (Edquist & Hommen, 2000, p. 3). These concepts are being recognized in practice: The European Research Area and Innovation Committee (ERAC) recently recognized the need for countries across Europe to "create a strategic framework for innovation procurement" (ERAC, 2015).

For innovation procurement, policy motivation is a top-down innovation method (EC, 2012). Innovation at the organizational level is often driven by policy (Petkovšek & Cankar, 2013, p. 1331). Arundel, Casali, and Hollanders (2015) found new laws and regulations to be the most important driver of innovation in the public sector, while Hughes, Moore, and Kataria (2011) found organizations with innovation strategies to have better innovation measures. However, only recently have "dedicated innovation policy approaches" been targeting demand-side measures (Edler, 2013, p. 5). Policies prompting innovation in public procurement are an "example of public sector innovation that combines institutional and administrative aspects (e.g. how bids are evaluated) and technological skills and innovations in the private sector" (EC, 2013, p. 15). These policies

go beyond primary policy objectives of public procurement of efficiency and cost effectiveness (OECD, 2015, p. 138).

### *Countries*

To investigate how the cluster analysis mapped according to countries – given variation in innovation procurement practices – one variable for each of the 27 EU Member States, Switzerland, and Norway was introduced during validation. As the Nordic countries have been active in innovation procurement initiatives, including surveying (Bloch, 2011) and academically (e.g., Edquist & Zabala-Iturriagagoitia, 2015; Hommen & Rolfstam, 2009), a dummy variable (*countnord*) was also introduced to test for whether a public agency belonged to Finland, Denmark, Sweden, or Norway. Country variables were weighted by their general population size, as provided by Gallup (2011).

## 3.4 Methods

Focusing on 1505 government organizations, a three-stage exploratory analysis was undertaken to examine similarities within subgroups, following the approach of de Jong and Marsili (2006) and Leiponen (2008). While one drawback of cluster analysis is its subjectivity across different data sets and theoretical lenses, its rigour can be enhanced by identifying commonalities between broad categories and clusters in prior analyses. This is intended through comparison with taxonomies of innovation procurement.

### 3.4.1 Principal Component Analysis

First, a principal component analysis (PCA) was performed to reduce the number of variables to be used in the cluster analysis. Of eighteen potential variables of interest, four variables were removed due to a low individual Kaiser-Meyer-Olkin measure of sampling adequacy score, and later used for validation. With the remaining variables combined, the KMO score was 0.75, and for each individual variable was above the minimum required of 0.60 (Table 3.5, Appendix). An extraction technique with varimax rotation was used, and the latent root criterion required that eigenvalues be greater than one. The six components with an eigenvalue greater than one explained a cumulative 42.7% of the variance in the dataset, and a three-dimensional solution explained 33.4% of variance. There was no indication of issues from high multicollinearity, with all values below 0.3634. The determinant for the correlations was 0.3613, which was greater than the necessary 0.00001 (Arundel, Casali, & Hollanders, 2015).

### 3.4.2 Cluster Analysis

Using the clustering variables, the cluster analysis was performed. While cluster analysis is sensitive to outliers, all variables had standard deviations much lower than the acceptable limit of between 2 and 3, according to Hair et al. (1998). When considering the number of potential clusters, between three and six were considered to be desirable *a priori*, with fewer than three offering little explanatory power and more than six requiring greater literary basis than is available for explanation. Hierarchical and non-hierarchical techniques

were combined to define centroids for a k-means cluster analysis based on Ward's Euclidian distances (de Jong & Marsili, 2006; Punj & Stewart, 1983; Singh, 1990).

For the *hierarchical component*, and following Singh (1990) until kappa validation stage, a Ward's linkage with Euclidian distances – as a continuous dissimilarity measure - was generated. Using this, a dendrogram was developed for visual inspection of an appropriate number of clusters to test. Due to the high number of observations, the dendrogram was limited to the top 15 branches (Figure 3.3, Appendix). From here, 2-5 clusters were seen to be feasible. A three-cluster centroid was then developed using the Ward's linkage.

For the *partitional component,* this three-cluster centroid was used as a starting point in performing a k-means cluster analysis with three clusters. Focus variables were then displayed according to this new k-means cluster solution, then kappa was calculated between the cluster analysis solution and the initial hierarchical solution. Kappa tests for randomness in agreement, and calculates the chance correlated coefficient of agreement. This process was repeated for solutions of 4 and 5 clusters, and the percent agreement compared between the three solutions. The three-cluster solution had the highest agreement at 77.54% and a kappa of .6199 (Table 3.3), greater than those for either the 4 or 5 cluster solution (with agreements of 70.96% and 61.53%, respectively).

*Table 3.3 – Kappa for 3-cluster solution*

| Agreement | Expected Agreement | Kappa | Standard Error | Z | Prob>Z |
|---|---|---|---|---|---|
| 77.54% | 40.92% | .6199 | .0191 | 32.55 | 0.0000 |

## 3.5 Results

### 3.5.1 Descriptive Statistics

For a three-cluster solution, Column 5 in Table 3.4, below, presents the means for each variable used in the cluster analysis and validation. On average, more agencies develop innovations independently (72%) than with suppliers (46%), while more than half value information from suppliers in developing innovations, and consult them for developing tenders. In comparison, consulting other governments conducting similar procurements was more common, and users least common.

More than three-quarters of agencies believe innovation is at least as important as cost for a company to win one of their tenders. Before a dummy variable was constructed for this indicator (*inno_imp*), only 21% (N=316) of organizations said cost was more important than innovation in winning a tender, while 65% (N=983) saw them as equally important and 14% (N=206) as more important.

A higher proportion, on average, conduct PPI, which varies according to what is purchased: it is most common in tendering for ICT (78%) services (68%), and other technology (57%), whereas half tender for consulting to recommend, design or pilot test new or improved services. Only one-third of the agencies conduct PCP (*tender_rd*), in tendering for R&D for new technologies and services. As may be expected, this indicates that solutions which are readily implementable are procured by most, meeting organizational requirements, followed by those which are near to commercialization but may provide a more innovative solution tailored to the organization (indicated by *tender_servinno*). Tenders for earlier-stage R&D, requiring greater risk and potentially longer-term investment, are expectedly least common.

Regarding organizational characteristics, the majority (78%) of organizations were at the local level, with fewer at the regional (16%, N=240) and national (6%, N=92). The latter two categories were combined such that a total of 331 organizations served regional or national geographic areas. Employee numbers are also quite low: only 19% (N=287) had more than 500 employees. Before a dummy variable for employee number was created, the most common size category was 1-49 employees, at 44% (N=655) of the total sample, supporting the small geographic area served by the many local organizations.

Between the validation variables, means did not vary as greatly, as was expected by their lower KMO scores. Almost three-quarters of organizations had a tender result in a new service innovation, whereas more than half had at least one resulting in significantly reduced costs of providing existing services. Three-quarters were from countries deemed to have policy frameworks for innovation procurement.

Due to the aforementioned challenges in comparing between countries using this dataset (Gallup, 2011), country means were not compared with each other, but rather within countries across clusters. The shorter list of countries displayed in Table 3.4, below, was chosen due to their higher means and significant variance from the mean (F-Value); the full list is displayed in the Appendix (Section 8, Table 3.6). The most represented countries are Spain (N=232), Germany (217), and Italy (214). The UK (181), Poland (127) and France (100) are also more highly represented. With the exception of the Netherlands (51) and Romania (54), the other countries have under 50 responses in the sample.

### 3.5.2 Cluster Analysis

The results of the cluster analysis are presented in Table 3.4. Cluster 2 is discussed first due to the explanatory power derived from its high scores on most variables. Cluster 3 is discussed next, to focus on the many similarities with Cluster 2 and then point to significant divergences. Finally, Cluster 1 is presented, with the lowest performance in most variables across the clusters.

#### *Cluster 2: Collaborative Innovation Procurers*

Public agencies in this cluster have the highest score on almost all variables compared with the other two clusters. They comprise 31.4% (N=473) of the sample. Almost half of these organizations have 500 or more employees, making them much larger than the other two clusters. Their geographic area served also reflects this, as they are more regional and national than the others. Overall, for knowledge sourcing for both public procurement and innovation, they rank highest, with the exception of consulting enterprises (as suppliers) in developing innovations when compared with Cluster 3.

Their knowledge sourcing is a common practice and sources are varied. An equal proportion consult potential suppliers and service users (81% and 83% of organizations, respectively) when developing calls for tenders. Similarly, they consult private businesses when developing processes or organizational method innovations (77%), while at other times relying solely on internal knowledge. This suggests an external orientation and significant knowledge seeking practices from multiple sources. Strikingly, nearly all usually consult other organizations conducting similar procurements, at 97%, in particularly sharp contrast to those in Cluster 3, as detailed below. This strongly signifies cooperative procurement.

Most agencies in this cluster procure ICT equipment or systems (90%), supported by tenders for the provision of user service (88%). In this profile, they are nearly identical to Cluster 3. However, these in in Cluster 2 rank much higher in procuring other types of technology. Notably, across all clusters there are more agencies in Cluster 2 who are active in consulting to recommend, design, or pilot test service innovations, and they also have a more purchasing other types of technologies. In combination with high importance of innovation in winning tenders, this underscores the modality of PPI.

*Table 3.4 – Cluster analysis and validation for a three-cluster solution*

| | Cluster | | | Mean | F-Value |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | | |
| N | 736 | 473 | 296 | 1505 | - |
| Percent | 48.9% | 31.4% | 19.7% | 100% | - |
| Knowledge sourcing | | | | | |
| devl_indep | 0.65 | 0.84 | 0.70 | 0.72 | 27.29*** |
| devl_supp | 0.25 | 0.77 | 0.48 | 0.46 | 192.67*** |
| info_supp | 0.49 | 0.76 | 0.82 | 0.64 | 80.71*** |
| consul_supp | 0.47 | 0.81 | 0.65 | 0.61 | 80.21*** |
| consul_user | 0.50 | 0.83 | 0.32 | 0.57 | 125.16*** |
| consul_gov | 0.69 | 0.97 | 0.20 | 0.68 | 364.39*** |
| inno_imp | 0.73 | 0.87 | 0.81 | 0.79 | 17.96*** |
| Tendering area | | | | | |
| tender_ict | 0.65 | 0.90 | 0.90 | 0.78 | 74.38*** |
| tender_tech | 0.37 | 0.83 | 0.67 | 0.57 | 154.00*** |
| tender_serv | 0.49 | 0.88 | 0.86 | 0.68 | 156.43*** |
| tender_servinno | 0.19 | 0.83 | 0.76 | 0.51 | 453.90*** |
| tender_rd | 0.05 | 0.54 | 0.70 | 0.33 | 405.26*** |
| Organizational information | | | | | |
| org_empl | 0.06 | 0.47 | 0.07 | 0.19 | 212.33*** |
| org_geo | 0.14 | 0.37 | 0.21 | 0.22 | 50.40*** |
| Validation variables | | | | | |
| consul_spec | 0.53 | 0.74 | 0.75 | 0.64 | 41.83*** |
| outcome_inno | 0.65 | 0.84 | 0.71 | 0.72 | 25.50*** |
| outcome_cost | 0.48 | 0.70 | 0.53 | 0.55 | 29.88*** |
| count_inno | 0.68 | 0.92 | 0.82 | 0.78 | 50.26*** |
| countnord | 0.07 | 0.11 | 0.03 | 0.23 | 9.18*** |
| ES | 0.05 | 0.30 | 0.16 | 0.15 | 86.03*** |
| UK | 0.08 | 0.23 | 0.03 | 0.12 | 38.55*** |
| DE | 0.21 | 0.11 | 0.02 | 0.14 | 19.40*** |
| NL | 0.03 | 0.06 | 0.01 | 0.03 | 5.13** |
| IT | 0.13 | 0.05 | 0.31 | 0.14 | 46.70*** |
| FR | 0.07 | 0.04 | 0.10 | 0.07 | 5.04** |
| SE | 0.02 | 0.03 | 0.00 | 0.02 | 6.63** |
| PL | 0.13 | 0.02 | 0.07 | 0.08 | 38.19*** |
| RO | 0.05 | 0.01 | 0.05 | 0.04 | 4.61** |
| EL | 0.02 | 0.02 | 0.04 | 0.02 | 2.84* |
| BE | 0.02 | 0.01 | 0.02 | 0.02 | 0.48 |
| PT | 0.02 | 0.01 | 0.06 | 0.02 | 10.98*** |
| IE | 0.01 | 0.01 | 0.01 | 0.01 | 0.30 |

* A significance level of 10%
** A significance level of 5%
*** A significance level of 1%

### *Cluster 3: Pre-Commercial Procurers, Supplier-Focused, Outsourcers*

In developing innovations, the 19.7% (N=296) of organizations in Cluster 3 see enterprises (suppliers) as more important than the other clusters, but relatively fewer contact them in comparison when developing tenders. They are particularly different from organizations in Cluster 2 in not consulting service users or especially other organizations conducting similar procurements, at only 32% and 20%, respectively. In these, they rank lowest across the three clusters, which underscores low knowledge souring. This also reinforces the external orientation of Cluster 2, who outsource service provision but still contact users, coinciding with PPI. In contrast, in conducting PCP, user consultation is not important to these agencies. Tendering for service provision to users was nearly as common as in Cluster 2, at 86% of organizations.

Most organizations procured R&D services for new technologies or services, ranking them significantly first among the clusters. The large differences between this and other clusters (at only 54% in Cluster 2 and 5% in Cluster 1) highlights agencies in Cluster 3 as focusing heavily on PCP. As they also engage in a certain degree of tendering in other areas, they also practice a certain degree of PPI. These organizations have small employee numbers (almost identical to Cluster 1), but a higher proportion serve regional or national areas than do those in Cluster 1.

### *Cluster 1: Direct Procurers*

Agencies in Cluster 1, comprising nearly half of the total sample, rank below those in Clusters 2 and 3 in all variables except consulting potential suppliers and others conducting similar procurements prior to tendering. Even though fewer agencies publish tenders across all tendering areas, a higher proportion consult with service users (50%) and others conducting similar procurements (69%) prior to tendering. Only a small proportion consults to recommend, design, or pilot test new or improved services, and almost none (only 5%) conduct PCP, by tendering R&D services. They are primarily local governments, with 94% having less than 500 employees.

### 3.5.3 Validation

A validation analysis was done to test for significant differences between the identified clusters, following the method of de Jong and Marsili (2006) by performing a MANOVA test and then applying to additional variables not included in the PCA to the clusters. Validation variables were those excluded due to lower KMO scores, but they were also predicted to vary across clusters. Identifying significance between variables used, a MANOVA test for all variables (Pillai's Trace is 1.2231, F-value = 86.11 (approximately distributed) and $p < 0.001$ [Table 3.4]) indicated a difference between the 32-dimension mean vectors (32 dependent variables, including short country list) of the three clusters, allowing for the null hypothesis that the mean vectors are the same for the three clusters to be rejected. Findings were confirmed by multivariate regressions for one-way analyses for each variable (Table 3.4, Column 6).

F-values are highest for variables differentiating between cooperative procurement (*consul_gov*), PPI (including *tender_ servinno*) and PCP (*tender_rd*). Also prominent is the F-value for employee number, whose clear distinction across clusters suggests that innovation procurement requires significant internal capacity.

#### *Cluster 2: Collaborative Innovation Procurers*

The validation variables mapped across clusters as expected according to their interpretation. With more tendering and pre-tender consultation by agencies conducting PPI, Cluster 2 also had more innovation resulting from its tenders, and three-quarters of its agencies consult external organizations with special advice. Overall, their tenders have more innovative outcomes than the other clusters, and a higher percentage (92%) of their countries have innovation procurement policies in place to stimulate knowledge sourcing.

Nordic countries were most concentrated here, supported by Bloch (2011) who identified innovation practices in Nordic countries through external cooperation, and supplier and user consultation. As well, there have been more recent cooperative procurement initiatives specifically between the Nordic countries (EC, 2015). At the individual country level, Spain and the United Kingdom are most represented. Both countries are active in conducting cooperative PPI and PCP in a variety of sectors at the municipal to national level, as well as with other Member States (EC, 2015). The UK

succeeded in procurement consultation initiatives in leveraging knowledge gained from supplier dialogue toward more efficient procurement processes with market influence (HM Treasury, 2013). Spain has now embedded PPI and PCP into its research and innovation strategy, providing spending targets for innovation procurement and cross-institutional financial incentives (EC, 2015).

### *Cluster 3: Pre-Commercial Procurers, Supplier-Focused, Outsourcers*

Similar to Cluster 2, three-quarters of agencies in Cluster 3 consulted external organizations with special advice, suggesting its equal importance in purchasing R&D services and innovations. A PCP and outsourcing approach is supported in this cluster given fewer innovation outcomes for the organization from tendering, as well as lower user consultation (32%) in combination with more tendering for user service provision (86%). Italy is the most represented country, where current initiatives still focus predominantly on PCP, as the country has integrated PCP within its research and innovation framework and provided designated funds for large projects (EC, 2015).

### *Cluster 1: Direct Procurers*

For Cluster 1, all validation variables consistently ranked third across the clusters. As innovation outcomes are on par with the prominence of tendering for innovations, the purchase of their innovations may be more effective than either those in Clusters 2 or 3, or at least targeted more toward improvement attributed to the purchaser's own institution. This indicates direct procurement practices. The most represented countries are Germany – identified as an innovation procurement laggard, especially respect to PCP (Wegweiser et al., 2009) – and Poland, with only scarce contemporary examples of innovation procurement (EC, 2015).

## 3.6 Conclusions and Policy Relevance

From this exploratory analysis, there appears a significant difference between public agencies practicing modalities of PPI and PCP in terms of knowledge sourcing, tendering areas, and organizational characteristics. Comparing findings with taxonomies in literature, three different types of agency practicing innovation procurement across Europe are suggested (Figure 3.2), before discussing how they may be impacted by changes in the new directive.

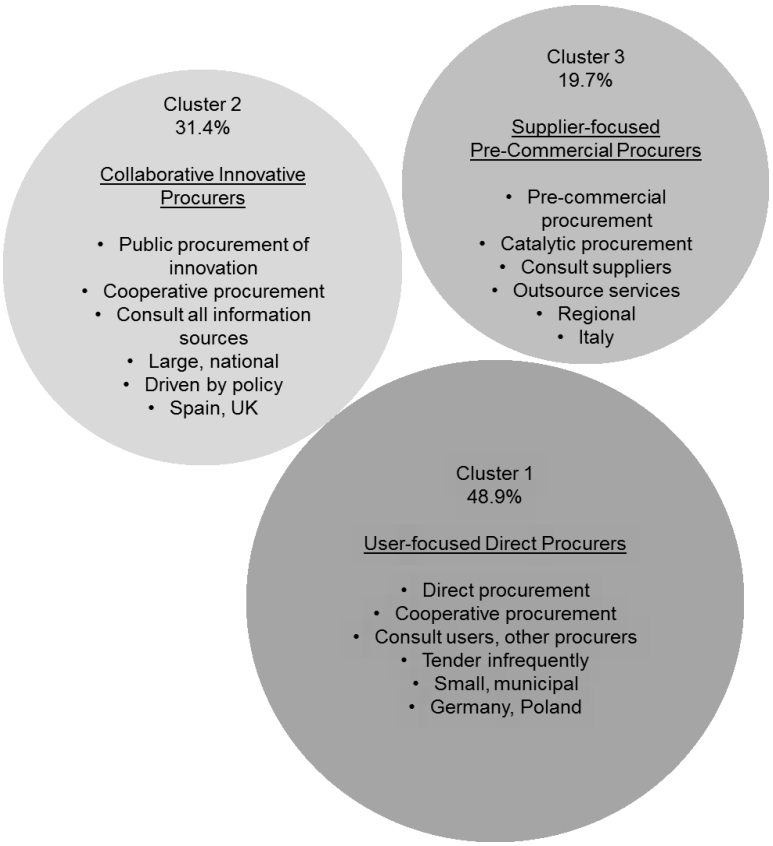


*Figure 3.2 – Visual summary of results of cluster analysis, validation, and interpretation*

Larger, national public agencies focusing on *PPI* (Cluster 2) consult readily with other procurers with expertise, users, and suppliers to inform their innovation procurements. They conduct *cooperative* procurement, and may have diversified procurement portfolios that include a smaller number of PCP, with tendered innovations benefiting from private markets in providing enhanced service provision at a lower cost. In contrast, regional agencies focusing on *PCP* (Cluster 3) do not cooperate with other procurers or consult users in tendering for R&D services. They strongly value innovation from suppliers in developing innovations. What new service innovations are implemented do not reduce service provision costs, as they are new-to-the market and have yet to reach economies of scale. Finally, the majority of public agencies are municipal agencies conducting *direct* procurement (Cluster 1), incorporating knowledge from other procurers and users, and benefiting from cost reductions by adopting innovations from the market. They lack supplier consultation and purchase more "off the shelf" goods and services.

These findings both support and challenge changes to procurement law seen in the updated European Procurement Directive 2014/24/EU. The Directive sets procedural rules for contracts over threshold levels which are not exempt. Compared with the previous Directive 2004/18/EC, it gives agencies more options of procurement type and design, most notably through cooperative procurement with other governments, consultation of potential suppliers in PPI and innovation partnerships, and the tailoring of award criteria to user needs. Other parts of the directive will influence what is purchased, such as the requirement for digitalization of public procurement. The following predicts the effects of changes to the directive given the three types of agencies identified in this paper.

Increases in the importance of innovation for potential suppliers to win tenders, and in user consultation to better define needs, are predicted for all types of agencies based on new recommendations for award criteria development. Procurers can now use the Most Economically Advantageous Tender (MEAT) to develop price-quality ratios, supporting the purchase of high-quality products and services "optimally suited to their needs" (EC 2014, p. 82). Agencies are encouraged to "allow variants as often as possible" (EC 2014, p. 72) due to the importance of innovation. Consulting potential suppliers regarding information to inform pricing and performance options, or other government agencies to assist with methods such as life cycle costing, is also expected.

More cooperative procurement is predicted, particularly between municipal and regional agencies (Clusters 1 and 3), and central agencies across member states (Cluster 2). Agencies are exempt from the new directive if they exercise joint control over a provider with other authorities or have multiple agencies serving as contracting authorities (EC 2014, p. 70).[3] Municipal and regional agencies also have the new option to use a simplified tender publication system, publishing an information notice rather than a European-wide contract notice (EC 2014, Article 48). As such, enhanced cooperation between agencies in Clusters 1 and 3 can be expected, where the user consultation of the former and the stronger R&D and innovation focus of the latter may help improve innovation procurement in these smaller agencies. For national agencies, the new directive presents clear rules for "cross-border joint public procurement" to support a European single market and drive innovation through demand aggregation and risk sharing. While almost all of the central agencies in Cluster 2 already source knowledge from other governments, the greater clarity regarding cross-border cooperative procurement may increase collaborations between leading countries in innovation procurement such as the UK and Spain with those with room for improvement in PPI, such as agencies in Italy and smaller agencies (Cluster 3). However, the directive provides no direct measures to induce innovation in municipal and regional agencies, rather providing measures to increase efficiency such as in utilities provision and the purchase of "off-the-shelf" goods and services by municipal and regional agencies. Centralized national coordinating services to promote innovation in purchasing, as recommended by the European Research Area and Innovation Committee (ERAC) (ERAC, 2015), may help to connect larger organizations successful in PPI with these municipal agencies so that the latter can learn how to efficiently consult potential suppliers.

Consultation of potential suppliers is expected to increase particularly along with PPI, given broader grounds and greater accessibility to apply competitive dialogue and the new competitive procedure with negotiation (EC 2014, Article 29). These are relevant for cases requiring innovation, design, or adaptation, and can be used when agencies are unable to define means of meeting their needs or assessing market offers, such as in complex projects, and enables pre-market engagement. Provided that direct procurers such as in Cluster 1 have the resources and support to engage in these dialogues, this new addition may increase the innovation procurement in municipal agencies especially. For slightly larger agencies such as in Cluster 3, these rules may help them expand their focus from PCP.

The effects of the new innovation partnership rules are not as predictable. The process can now be used when no market solutions exist and when R&D is required to provide a solution to meet an agency's needs (EC 2014, Article 31). Suppliers can be one or multiple parties, who proceed through a multi-stage elimination process or with a group purchase at the point of commercialization. The process applies the directive for the first time to R&D services. The agency must select all potential partners and define maximum price and minimum performance at the outset, which must be adhered to in decisions to purchase the fruits of R&D efforts. Due to these restrictions, recent commentary such as Bennett (2015) has questioned whether its impacts will differ from processes using competitive procedures with negotiation. As highlighted by Corvers, Apostol, Mair, and Pantilimon (n.d.), the inability to open the competition to other suppliers once the initiative has begun locks in chosen supplier(s), and for purchases from national agencies especially may exclude competition from abroad. These issues may be exacerbated by the longer timelines and larger contracts coinciding with the purchasing of R&D services and their innovations. Given the findings of this paper, innovative national agencies (Cluster 2) and those leading in PCP (Cluster 3) may be those most likely to pursue innovation partnerships. This modality may be simple to implement, as Bedin, Decarolis, and Iossa (2014) found that many PCP initiatives involved only a single supplier without significant R&D effort. As the innovation partnership applies to direct rather than catalytic procurement (Corvers et al., n.d.), municipal agencies may find it an attractive mechanism for purchasing tailored innovations to meet particular needs rather than cooperative procurement. Whether they have the resources or capacities necessary to do so remains to be seen.

Finally, the directive's requirements for digitalization are expected to impact tendering in certain areas, most notably through an increase in tendering for ICT, and subsequently service innovation and cost-saving results of these tenders. For the first time, all contracting authorities must implement E-procurement – the electronic notification and submission of offers – through a step-wise process, with the penultimate deadline in 2018. Small municipal agencies (Cluster 1) may face particular difficulties in achieving the required digitalization as ICT tendering is more uncommon in comparison with its ubiquitous presence in Clusters 2 and 3. Once implemented, such digitalization will lead to service efficiency improvements, but with initial learning costs – likely anticipated in the multiple deadlines set for Member States. The deadline for national agencies (like those in

Cluster 2) to implement fully digital communication a full year before municipal and regional agencies is, given this evidence, well-founded. As well, the directive simplifies systems and roles for "off-the-shelf" products and services through electronic Dynamic Purchasing Systems (EC 2014, p. 76; Article 34), which frees up resources to support innovation procurement.

In summary, the translation of changes to Directive 2014/24/EU by Member States may increase agency sourcing of knowledge from potential suppliers and other governments especially, providing incentives and greater resources to dedicate to innovation procurement. Its recognition of diversity across agency types according to level of government served begins to acknowledge their heterogeneity, although measures to directly stimulate innovation are not directed to municipal and regional agencies. The recommendation of ERAC for the European Commission to establish a "knowledge-sharing service on innovation procurement" to encourage "mutual learning" (ERAC, 2015, p. 3) is certainly well-founded given the findings in this paper. Improving consultation by public agencies will drive evolutionary aspects of purchases, improving the tailoring of new products and services to needs. In conclusion, this paper calls for 1) an updated taxonomy that encompasses innovation procurement practices, inclusive of new modalities, and learning and evolutionary characteristics; and 2) application of this taxonomy to develop dedicated surveys to monitor innovation procurement practices across Europe.

This research addressed practices of innovative procurement in public agencies by focusing on their learning and evolutionary characteristics. Due to the nascency of this research area and the explorative approach, it did not focus internal dynamics (EC, 2012; Gow, 2014; Hughes, Moore, & Kataria, 2011) or degree of institutional autonomy (Arundel, Casali, & Hollanders, 2015). An improved dataset and indicators dedicated to capturing innovation procurement practices is crucial to providing a baseline upon which to monitor the effectiveness of the new Procurement Directive. A first step in doing so is to examine new national translations of the directive across Europe.

## Notes

1. While previously referred to as technological change, terminology regarding innovation procurement has widened to include innovation more generally (Edquist & Zabala-Iturriagagoitia, 2015).
2. The Innobarometer survey measured innovation in public administration (service innovation), developing innovations (regulatory, financial drivers; information sources; intraorganizational dynamics) and effects of innovations (improved user access to information, improved user satisfaction, more targeted services, faster service delivery; administration simplification, working condition improvement, employee satisfaction, service delivery speed, cost reductions). Other measures were human resources supporting innovation (workforce education, development teams, training courses) and public procurement (consultation, tendering practices in innovation-related areas, and administrative benefits from resulting innovations).
3. Agencies are also exempt if the supplier provides at least 80% of its activities for the contracting authorities.

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## 3.8 Appendix

*Table 3.5 – Kaiser-Meyer-Olkin measure of sampling adequacy*

| Variable | kmo |
|---|---|
| devl_indep | 0.7279 |
| devl_supp | 0.7891 |
| info_supp | 0.7714 |
| consul_supp | 0.6966 |
| consul_user | 0.6401 |
| consul_gov | 0.6296 |
| inno_imp | 0.6374 |
| tender_ict | 0.7728 |
| tender_tech | 0.7971 |
| tender_serv | 0.799 |
| tender_servinno | 0.7687 |
| tender_rd | 0.7282 |
| org_empl | 0.7566 |
| org_geo | 0.7357 |
| Overall | 0.7494 |

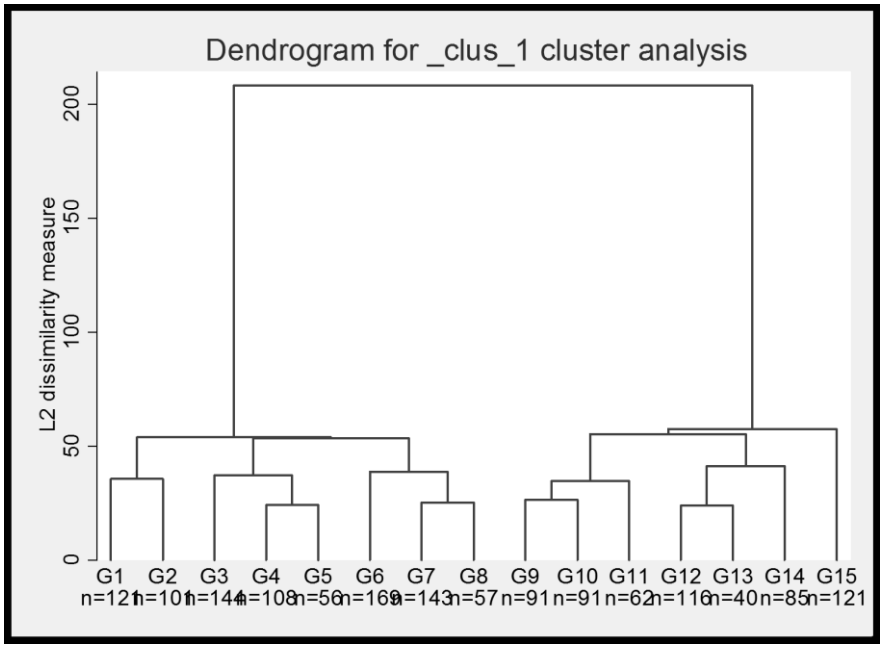


*Figure 3.3 – Dendrogram for a cluster solution based on Ward's Linkages, truncated to show only 15 groups*

*Table 3.6 – Countries applied to cluster centroids, displayed alphabetically*

| Country Code | Country | N | Cluster 1 | Cluster 2 | Cluster 3 | Mean |
|---|---|---|---|---|---|---|
| AT | Austria | 21 | 0.016 | 0.014 | 0.007 | 0.014 |
| BE | Belgium | 28 | 0.019 | 0.014 | 0.023 | 0.018 |
| BG | Bulgaria | 15 | 0.013 | 0.005 | 0.008 | 0.010 |
| CH | Switzerland | 26 | 0.013 | 0.024 | 0.016 | 0.017 |
| CY | Cyprus | 3 | 0.003 | 0.003 | 0.000 | 0.002 |
| CZ | Czechoslovakia | 28 | 0.027 | 0.003 | 0.019 | 0.018 |
| DE | Germany | 217 | 0.211 | 0.107 | 0.023 | 0.141 |
| DK | Denmark | 7 | 0.006 | 0.005 | 0.000 | 0.005 |
| EE | Estonia | 5 | 0.005 | 0.002 | 0.002 | 0.003 |
| EL | Greece | 35 | 0.021 | 0.015 | 0.040 | 0.023 |
| ES | Spain | 232 | 0.053 | 0.299 | 0.158 | 0.151 |
| FI | Finland | 23 | 0.014 | 0.018 | 0.011 | 0.015 |
| FR | France | 100 | 0.070 | 0.036 | 0.099 | 0.065 |
| HU | Hungary | 13 | 0.018 | 0.000 | 0.000 | 0.009 |
| IE | Ireland | 15 | 0.010 | 0.011 | 0.007 | 0.010 |
| IT | Italy | 214 | 0.127 | 0.049 | 0.315 | 0.139 |
| LT | Lithuania | 8 | 0.007 | 0.002 | 0.006 | 0.005 |
| LU | Luxembourg | 2 | 0.002 | 0.000 | 0.003 | 0.001 |
| LV | Latvia | 10 | 0.007 | 0.007 | 0.006 | 0.007 |
| MT | Slovenia | 1 | 0.000 | 0.001 | 0.000 | 0.000 |
| NL | Netherlands | 51 | 0.026 | 0.057 | 0.013 | 0.033 |
| NO | Norway | 9 | 0.005 | 0.012 | 0.000 | 0.006 |
| PL | Poland | 127 | 0.132 | 0.016 | 0.066 | 0.083 |
| PT | Portugal | 36 | 0.017 | 0.013 | 0.057 | 0.024 |
| RO | Romania | 54 | 0.049 | 0.007 | 0.046 | 0.035 |
| SE | Sweden | 28 | 0.016 | 0.032 | 0.002 | 0.018 |
| SI | Slovenia | 4 | 0.004 | 0.000 | 0.002 | 0.002 |
| SK | Slovakia | 12 | 0.010 | 0.001 | 0.013 | 0.008 |
| UK | UK | 181 | 0.081 | 0.230 | 0.028 | 0.117 |

# 4 Stimulating Circular Economies Through Intermediation - The Textile Pilot of the Dutch Ministry of Defense

**Abstract**

Public procurement offers a unique opportunity to transition towards a more circular economy by providing initial markets valuing resource efficiency. However, interactions between public buyers and potential suppliers in defining this value are still not fully understood. Intermediation in demand articulation can facilitate these interactions, sourcing and translating knowledge into tender specifications. To address the question of *How can intermediation promote a more Circular Economy?*, this paper examines a pilot project led by the Dutch Ministry of Defense to incorporate post-consumer recycled content in textiles, through extensive consultation activities. Seventeen in-depth interviews were conducted with those directly involved in the pilot, and analyzed using a grounded theory approach based on literature on intermediation and collaboration within buyer-supplier and network relationships. Intermediaries were found to play a critical role in such processes by 1) coordinating government and industry through aligning project goals, 2) facilitating cooperation of industry players to stimulate new business relationships, and 3) collaborating with the buyer to push for higher post-consumer recycled material in the final tender. With respect to demand articulation, greater insight is needed to discover how to best combine buyers' motivations for cost savings, sellers' motivations of increased returns, and the sustainability requirements often imposed by third parties. These dynamics may prove to be hallmarks of transitions toward circularity as more projects arise, carving a more permanent role for intermediation.

## 4.1 Introduction

Buyer demands can influence sustainability in supplier business models, as changing requirements or preferences of the former shape the value that can be gathered by the latter. While pressure facing suppliers to innovate can include meeting new demand through new products or services, it can also stimulate the development of new business strategies to capture this value through new processes. Both of these technical and non-technical changes are needed to promote a more *circular economy*: improving resource efficiency by prolonging the value of products or services within supply changes (EC, 2014a). Such resource efficiency improvements can be driven by innovations within the value chain that connect production and consumption to add value to waste materials (Witjes & Lozano, 2016). However, difficulties face transitions to more circular economies, in that the model has not been proven in many sectors, requires innovation across value chains and in business models, and agreement between players *before* products are on the market.

As a major purchaser – amounting to 19% of GDP across Europe (ERAC, 2015) – government agencies occupy a unique position from which they can promote the incorporation of sustainability in business models and drive sustainable development (Testa et al., 2012). Products or services that are part of a circular economy are attractive to buyers, as they provide new revenue streams while reducing costs (EC, 2014a). Government agencies are no exception, and will soon experience policy drivers to further the resource efficiency agenda (EC, 2014b). In the meantime, interactions between procurers and suppliers are often negotiations of specifications and price (Kiiver and Kodym, 2014), which due to their linear nature (Uyarra et al., 2014) do not incorporate discussions of raw materials or material wastes associated with the product or service delivered.

Alternatively designing procurement competitions can mitigate some of these challenges, by stimulating supplier awareness of areas for resource efficiency improvements along the supply chain (Preuss, 2009). However, challenges with transitioning to more circular economies will exacerbate issues facing changes in procurement processes intended to promote circularity. For public procurement to stimulate market transitions, government agencies much consistently applying tender specifications or criteria that reward

sustainability and communicate long-term circularity ambitions. To do so, public purchasers must integrate market knowledge and information on technological readiness into calls for tenders and their purchasing plans. While public agencies being increasingly limited in their internal knowledge and lacking knowledge-sourcing capabilities, intermediation in public procurement can help facilitate processes (Edler & Yeow, 2016).

Providing support for "systemic functions in innovation systems" (Edler & Yeow, 2016, p. 416), intermediaries act beyond the role of information broker and across institutional boundaries needed to promote more circular economies through demand setting. Literature has increasingly investigated the role of intermediaries and interactions in facilitating projects. For example, Grandia (2015) examines change agents as individuals promoting sustainable procurement pilot projects, through an overview of six cases. Building upon the roles for intermediaries in innovation systems (Bessant & Rush, 1995; Howells, 2006; Klerkx & Leeuwis, 2009), Edler and Yeow (2016) investigate as two case studies the role of multiple intermediaries in the public procurement of innovation, highlighting the importance of roles, internal coordination, and access to knowledge for project success. Others have investigated relationships between actors in projects, including partnership building (Eriksson & Pesamaa, 2013; Erridge & Greer, 2002; Essig & Batran, 2005) and process facilitation through coordination, cooperation, and collaboration (Dietrich et al., 2010), applied to sustainability transitions (Fadeeva, 2005; Geels & Deuten, 2006; Lozano, 2008). According to Dietrich et al. (2010), coordination is a quality indicator of collaboration for "shared understanding" (p. 67) of goals, activities, and contributions, or defined by Lozano (2008) as the performance of activities to make individuals "compatable with a common purpose or result" (p. 502). Cooperation is the mutual engagement and alignment of the "multi-actor network" (Klerkx and Leeuwis, 2009, p. 891) through which participants learn from eachother and share experiences (Lozano, 2007), and can mitigate problems such as disagreements and project productivity lags (Dietrich et al., 2010). Finally, collaboration is a "recursive process where people or organizations work together in an intersection of common goals by sharing knowledge, learning, and building consensus" (Dietrich et al., 2010, p. 60).

Despite these recent advancements in understanding, a major question remains: *How can intermediation promote a more circular economy?* To answer this question from the perspective of public demand articulation, this paper develops a case study on the interactions of

intermediaries leading up to the publication of a tender in a pilot project led by the Dutch Ministry of Defense. In a multiplicity of ways, intermediaries in the project determined the potential for suppliers to incorporate post-consumer recycled content in textiles and translated findings to design a tender that would stimulate new business models. In-depth interviews were conducted and constant comparative analysis applied to identify and ascertain the roles and activities of intermediaries in this process, and divergence from literary concepts highlighted to further the understanding of intermediation in demand articulation and in promoting circular economies more generally. Section 4.2 presents the conceptual background and literature review on collaboration and intermediation used to ground the analysis; Section 4.3 presents methods, case selection, data collection, and analysis. Section 4.4 presents the analysis according to stages, and Section 4.5 the discussion. Conclusions in Section 4.6 complete the paper and highlight relevance for policy, practitioners, and to the scientific community.

## 4.2 Conceptual Background

With the recognition that new approaches are required to affect change, public procurement has undergone a shift toward "relationship contracting" that includes "collaboration, networks, strategic alliances, [and] partnerships" (Lawther, 2005, p. 213). Collaboration in pre-procurement initiatives to inform demand can serve as a modern form of competition (Hartman et al., 1999) to bring in market information to procurement processes. Edquist and Zabala-Iturriagagoitia (2012) advocate that the knowledge benefits of stakeholder engagement may make them an even *more* effective tool in public procurement than conventional competition aspects. Highlighting their simultaneous importance for sustainable growth, Lozano et al. (2013) underscore that competition and collaboration are *both* required, for efficiency increases and industry-wide transitions. The transition to circular economies, which entails aspects of sustainable supply chain management (SCM), includes both of these aspects as actors collect and disseminate information along the supply chain, and seek to "influence the performance of supply chain members" (Preuss, 2009, p. 215). Public procurement to promote circularity is expected to require extensive collaboration for tender development, while stimulating and capitalizing upon aspects of market competition.

Collaboration is a form of "strategic bridging" which enables interorganizational knowledge exchange (Westley & Vredenburg, 1991), and enhances knowledge-integration capacity for projects (Dietrich et al., 2010) in which "organizational pre-conditions and interpersonal capabilities" are important for mutual learning (Clarke & Roome, 1999, p. 307). These benefits accrue from divergent "perspectives, knowledge and approaches, and problem solving" that are encountered in collaboration (Lozano et al., 2013, p. 138-139). In public procurement, interactions between buyers and suppliers transfer information across institutional boundaries to further learning (Rolfstam, 2012), which in turn is associated with higher project performance (Henderson & Cockburn, 1994). Also regarding such bilateral relations, Hollos (2012) found that strategic orientation in purchasing and supply management increases "green" practices through co-operation with suppliers. Focusing on organizational representatives, Sharma and Kearins (2011) found that bilateral collaboration can improve relationships and responsiveness to sustainability pressures. Broadening the scope of analysis to include multiparty interactions, Fadeeva (2005) argues that collaboration can introduce organizations in sustainability networks to emerging issues, while working towards goal congruence enables new partnerships that penetrate organizational boundaries (Eriksson & Pesamaa, 2013). To be successful, collaboration must be driven by a common strategy or vision (Gray, 1989; Hollos, 2012). Due to its conduction over time, collaboration is examined here as a process by which to promote a more circular economy, through demand-setting.

An emerging area of literature examines actors that facilitate collaboration processes by looking more specifically at the government as buyer, in public procurement projects. Contributions from across disciplines can be used to support understanding of this multidimensional area. Viewing public procurement initiatives as projects entails coordinated activities, by one or a team, toward particular goals and within time, performance, and budgetary restrictions (Yeow & Edler, 2012) and can create demands for collaboration (Dietrich et al., 2010). Edler and Yeow (2016) are the first to study intermediation in the public procurement of innovation, as that which improves connections between actors with complementary skills or common interests toward the development and diffusion of an innovation. As explicated by Howells (2006), intermediaries can be organizations serving as brokers, third parties, and agencies that help support the innovation process. Through a socio-cognitive perspective, Geels and Deuten (2006) see a key function of "intermediary actors" as the aggregation of knowledge, such as

through standardization, through codification of tacit knowledge. Examples are standardization institutes, industry associations stimulating technical knowledge production, and firms who are involved across multiple "local practices" (Geels & Deuten, 2006). In developing a tender, government agencies can use these intermediary actors to themselves codify tacit knowledge in the form of technical specifications and award criteria.

As separate from a diffusion and technology transfer perspective, Hargadon and Sutton (1997) examine intermediaries in innovation management studies for their role as technology and knowledge brokers. Here, intermediation facilitates "learning and cooperation in the innovation process" to achieve "alignment and learning of the multi-actor network" (Klerkx and Leeuwis, 2009, p. 851). Social network theory supports that these brokers benefit from negotiation in creating relationships to fill structural holes (Burt, 1992) which create knowledge gaps between individuals, organizations, and sectors to transform information (Hargadon & Sutton, 1997), by acting within "multi-party, learning-action networks" (Clarke & Roome, 1999, p. 296). Clarke and Roome (1999) discuss these networks as based on relationships that "lay over and compliment formal organizational structures linking individuals together by the flow of knowledge, information, and ideas" (p. 297).

Similarly, from a systems of innovation perspective, Meulen and Rip (1998) expand the role for intermediary institutions between the operational and policy level, in ecologies where institutes coordinate horizontally. Dietrich et al. (2010) also found collaboration to enable more horizontal rather than hierarchical structures, facilitating "knowledge competence and teamwork" (p. 68). Grounded in organizational change literature, Grandia (2015) studies "change agents" in sustainable public procurement for their role in catalyzing sustainability initiatives. Change agents are defined according to Caldwell (2003) as "an internal or external individual or team responsible for initiating, sponsoring, directing, managing or implementing a specific change initiative, project or complete change programme" (pp. 139-140). Parallels between Grandia's (2015) "stages" of resistance, exploration, and commitment, and "phases" of unmoving, moving, and freezing can be drawn with degrees of openness (Dietrich et al., 2010), formalization and codification (Geels & Deuten, 2006), linking them with theoretical constructs from literature on project collaboration and intermediation. Taken together, this diverse literature provides the conceptual foundations for studying intermediation, which can

occur via one or multiple intermediaries who are individuals or institutions, and which act within networks influenced by institutions and structures to further projects.

### 4.2.1 Intermediary Roles in Projects

The ways in which intermediaries help to further projects depends on their roles and activities. Intermediaries can serve sustainability transitions through taking a systemic role in acting multilaterally within networks (van Lente et al., 2003), moving beyond the role of information broker between buyer and supplier. From an innovations systems perspective, Edler and Yeow (2016) define three types of intermediation: demand articulation, actor and linkage formation, and innovation process management. Van lent et al. (2003) differentiate between three types of intermedia*ries* in such systems, depending on roles: 1) *hard* intermediaries, articulating technical possibilities; 2) *soft* intermediaries, articulating business and innovation strategies; and 3) *systemic* intermediaries, articulating demand and strategy development. While all three of the latter include activities of articulation, alignment, and learning, *systemic* intermediaries have additional roles of "Identifying, mobilizing and involving relevant actors; Organizing discourse, alignment, and consensus; [and] Management of complex, long-term innovative projects" (van Lente et al., 2003, p.11). They also create conditions enabling the creation of knowledge gained through experience (van Lente et al., 2003), summarized by Howells (2006) as "knowledge processing, generation, and (re) combination" (p. 721). In empirically testing these roles, Edler and Yeow (2016) identify four roles for intermediaries in public procurement particularly: 1) *performers* of the project or purchase, 2) *brokers* linking externally to markets and internally within organizations, 3) *content experts* with technology, market, and diagnostic expertise, and 4) *trainers* building up buyer capacity for future projects. Their roles are further shaped by the market effect of the procurement, distinguished by those which trigger or respond to an innovation.

Transferring this knowledge is a key function of intermediaries, as they develop and disseminate particular information collected to actors (van Lente et al., 2003). Edler and Yeow (2016) see the information provision role as driven by the creation of "awareness and transparency" by intermediates, supporting the creation of "market enabling communication and trust between the parties" (p. 416). In this way, social capital is a key

component of intermediation, as it can improve linkages between government, market, and non-profit actors (Erridge & Greer, 2002).

### 4.2.2 Intermediation and Collaboration in Public Procurement

Under the New Public Management paradigm, government works more closely with businesses, social enterprises and NGOs (Walker, 2008), and cooperation with these actors can generate knowledge to be incorporated in public procurement (Essig, 2005). Early engagement of stakeholders is particularly important to innovation procurement, providing greater opportunities for interactive learning (Rolfstam, 2013). Intermediation in public procurement connects actors between supply and demand sides to improve the innovation of government purchases (Edler & Yeow, 2016). The process facilitates these relationships by introducing a third party to what is typically otherwise two-way negotiation occurring before and after single-stage contracting (Uyarra et al., 2014), and rarely prior to the official procurement (Gallup, 2011).

Intermediation in public procurement literature has been examined almost exclusively with respect to public procurement partnerships (e.g., Erridge & Greer, 2002; Essig, 2005; Lawther, 2005; Walker, 2008), which neglects the multilateral network activities of systemic intermediaries. In such partnerships, trust "facilitates action" in the same way as authority (for governments) and prices (for markets) (Lawther, 2005). It builds social capital (Essig, 2005) and can improve connectivity between public, private, and non-profit actors (Erridge & Greer, 2002). Partnerships with suppliers and the trust those are based on are "paramount" to including social and environmental factors in the purchasing process (Walker, 2008, p. 1605). Introducing the study of intermediaries to pre-procurement stages enables the analysis of broader and more complex interactions between intermediaries and firms, governments, and NGOs.

Certain aspects of collaboration may affect participation and hinder projects must be considered in intermediation. For example, collaboration may not affect cost reduction or operational performance (Hollos, 2012), and firms may also capitalize upon collaborative initiatives to preserve or enhance their organization's interests (Sharma & Kearins, 2011) or as a platform to promote them through legitimacy instilled (Fadeeva, 2005). The propensity for organizations to be engaged to further their own agendas is particularly important to

recognize when industry collaborates with government (Lozano, 2007) – an important consideration when examined in the context of public procurement. Supplier opportunism can be reduced by selecting the right suppliers before collaboration occurs and by creating environments that reward desired behaviors to motivate supplier performance (Eriksson & Pesamaa, 2013; Gadde & Snehota, 2000). As partnership goals in public procurement can be separated from project goals (Lawther, 2005), and potential for learning, innovations and collaboration from project success (Dietrich et al., 2010), intermediation prior to procurement can be disentangled from the procurement itself to be studied as an important mechanism with the potential to influence business models.

## 4.3 Data and Methods

To answer the research question posed, a qualitative case study method was applied with a grounded theory approach. While case studies provide a snapshot in time rather than longitudinal data, rich details can emerge using such a method that provide deep insight into a unique case (Yin, 1984). As well, a grounded theory approach enables linking with previous research while supporting the development of broader implications (Strauss & Corbin, 1967; 1990). Empirical data were collected through multiple interviews, and transcribed and iteratively coded by using constant comparative analysis. Findings were then reported according to constructs that emerged from this process. The following subsections present the case selection, and further detail methods for data collection and analysis.

### 4.3.1 Case Selection

Sectors, such as the textile industry, with international supply chains face particular challenges to sustainability, especially when under strong price and time competition. There is a high potential to affect market change through by leveraging public demand in the European textile sector toward circular business models. The sector generates approximately 3% of Europe's value-added industry, with a €166 million turnover in 2013 from 185,000 firms (EC, 2016). Significant environmental impacts are associated with textile production, especially for traditional fibers as cotton, which have high life cycle

impacts across categories of energy and water use, greenhouse gases, waste water production, and direct land use (EC, 2011). With governments across Europe purchasing large quantities of cotton textiles for workwear, some are recognizing environmental responsibilities to purchase textiles with lower environmental impacts. The Dutch government is one of these, recently pursuing cost-saving sustainability improvements to the purchase and recycling of the €21.9 million of workwear they procure annually (Saltzmann, 2015). Signalling markets with these aspirations can promote innovation in recycling technologies and supply chains toward circular business models, and leverage the €9 billion of annual production by Dutch textile companies (Saltzmann, 2015) toward long-term cost reductions for recycling and reusing fibres.

Dialogue and multi-stakeholder collaboration is increasingly recognized as being important in driving these changes, such as seen in recent European grants to support procurer networks (Bedin et al., 2014). For the Netherlands in particular, market consultation has often been sufficient to find new solutions (Putten, 2015). However, the contribution of Dutch public procurement to sustainable development had been limited by the absence of specific long-term ambitions and a systems perspective (Melissen, 2012) that underpin transitions to circular economies. In light of these shortcomings, the country has assigned product Category Managers at the federal level to lead sustainability initiatives in in their respective categories through public purchases. These individuals act as intermediaries between buyers and external actors (including suppliers, other government departments, and NGOs) toward long-term goals of accessing more sustainable and affordable market offers.

The project examined in this paper is the pilot project for purchasing textiles with post-consumer recycled content by the Dutch Ministry of Defense (MOD). The project intended to demonstrate the feasibility of a procurement mechanism for helping the public sector to meet their ambitions regarding circular procurement and impact the textile market. The pilot was one of five public procurement pilots overseen by the Ministry of Infrastructure and Environment (RWS) as a part of REBus (Resource Efficient Business models), a €3.1 million European demonstration project (2013-16) focused on reducing reliance on conventional resource models relying on new materials and disposal.

While the technology for recycling polyester was well-established, the process was more difficult for cotton fibers due to the shortening of fiber length leading to lower

quality. Scaling up cotton recycling typified a "chicken or the egg" problem, where the beginning of the circle was unclear: companies along supply chains were waiting for a first mover as it was too early for private investment, while the public sector had missed opportunities to trigger markets through initial demand. At the time of the pilot, one company in the Netherlands claimed to have the only technology to recycle cotton textiles, for a small market with low percentages of recycled content voluntarily pursued by a select group of Dutch fashion companies. A retail market for products with recycled cotton would be necessary for the survival of companies who did produce these products. Private demand was insufficient to motivate the sector, where many struggled with low margins to maintain their market positions even in established markets, and firms lacked a sustainability ambition. Prices for quality post-consumer recycled cotton were high, particularly from Western Europe, and small quantities were expensive to produce, while technical issues faced large-scale, high quality production. Fragmented supply chains created anonymity between buyers and sellers, supporting transactions based solely on price, and sub-contracting and corruption in auditing challenged the verification of sources. As it is only the thread in producing recycled textiles differs from regular textiles, incorporating recycled content into products required other firms along the supply chain (weavers, manufacturers, stitchers, etc.) to find new partners with access to cost-effective recycled yarns.

The Defense Materials Organization (DMO) of the MOD had already created a revenue stream from used materials and reduced incineration costs through contracting a textile collection facility prior to the pilot. Responsible for the DMO's logistics, KPU Bedfijf[2] (the buyer) had a long-term strategy to reuse or recycle every material used, which included items such as clothing, helmets, combat vests, and sleeping bags. Of the annual €35 million clothing budget of the MOD, this facility already saved €12 million in returned goods yearly by sorting military clothing for re-use. However, materials were not yet recycled within this system to make new clothing, which created opportunities to generate revenue streams from recycling cotton garments. The pilot project was a first step toward capturing this value, by asking suppliers for materials containing post-consumer recycled cotton, while supporting the sustainability aspirations of the Dutch government. Through

[2] Kleding- en Persoonsgebonden Uitrusting Bedrijf – Clothing- and Personal Equipment- Enterprise

these interactions, it resulted in a tender valued over €1 million for towels, coveralls, and scarves with a percentage of post-consumer recycled cotton, that met technical specifications such as for quality, durability, absorbency, and comfort.

### 4.3.2 Data Collection

For this study, data were collected from interviews as well as evidence in official publications and reports, including the Workwear Category Plan (Saltzmann, 2015), workshop report (Bruls, 2015), request for information, call for tender, and official questions and answers (DMO, 2015), and relevant policy documents (e.g., IenM, 2014).

Seventeen semi-structured interviews were conducted for this study. Participants were 1) government employees involved in the pilot project; 2) consultants, a national textiles sector consortium, and a NGO invited by government to contribute to the pilot; and 3) firms who participated in activities under the pilot project. Figure 4.1, below, presents a visual summary of these participants. To identify interviewees, government employees involved in the project were shared by contacts at the Dutch Ministry of Internal Affairs, as were representatives of the NGO and industry consortium. Industry contacts were identified through responses to the Request for Information disseminated to the market in October 2014.

To all potential respondents, official requests for interviews were sent individually via email, with a brief follow-up email one week after if no response was received. The interviews took place beginning in Fall 2015, when the call for tender was published at the European level. Interviews occurred primarily in person, with a few over the phone due to distance restrictions. All interviews with non-governmental employees were completed first, so that no internal information could be unintentionally shared with external parties during the tendering phase. Respondent names were anonymized to encourage greater openness in responses.

Using a semi-structured interview, questions were open-ended to solicit a multiplicity of responses from respondents (see the full list of questions in Appendix, 4.8.1). Sub-questions were asked depending on the depth and content of interviewee response. The questions helped to capture aspects of interactions, including their nature and frequency,

drivers for change, barriers to change, facilitators, and suggestions for improvement. Interviews lasted an average of ninety minutes, totaling more than 25 hours of interviews.

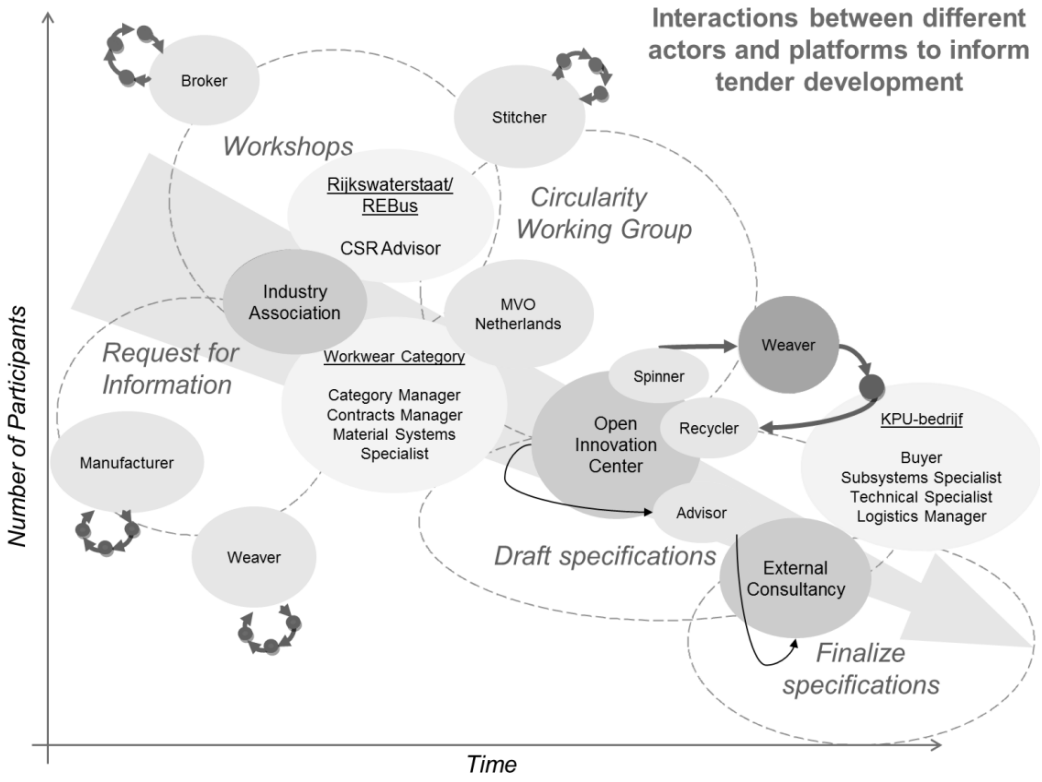


*Figure 4.1 – Interviewees according to their organization name (if a government organization, NGO, or consultancy) or position in the textile supply chain (if a company). Stages where interactions occurred underlay the actors; the first stage is excluded for simplicity. Cycles beside firms represent new relationships with other firms in their (circular) supply chains.*

### 4.3.3 Data Analysis

Data were coded and analysis was done using constant comparative analysis. The initial set of codes (Appendix, Section 4.8.2) was created from concepts in the following literature, organized by subject. Regarding roles for intermediation, codes were formed from concepts on intermediary roles (van Lente et al., 2003), intermediary functions (Howells, 2006), and intermediation in technology (innovation) purchasing (Bessant & Rush, 1995). Regarding collaboration, initial coding was based on level of interaction according to organizations (Lozano, 2008b), antecedents, benefits, and factors influencing mediation in collaboration (Dietrich et al., 2010), requirements for joint action between buyers and sellers (Eriksson & Pesamaa, 2013), quality of interactions (Dietrich et al., 2010), extent/degree of collaboration (Hartman et al., 1999; Lozano, 2007), and particular disincentives or determents to collaborate (Fadeeva, 2005; Gadde & Snehota, 2000; Hollos, 2012; Maspons, 2015; Sharma & Kearins, 2011). Literature spanned public-private partnerships, buyer-supplier relationships, and project collaboration in general.

Once responses were transcribed, they were coded on these constructs using the software NVivo 11. Examples of key first order codes are shown in the left column of Figure 4.2, below. Codes were also created to identify project stages (right column, Figure 4.2), according to when and where interactions took place. New constructs were created when none from literature were suitable. Once all interviews had been coded initially, the codes were reviewed based on their prominence within and across interviews. Nodes that were small were either combined within larger nodes, or created as a subset for finer granulation. On the other hand, large nodes were re-examined and broken down where appropriate. Following this, all nodes were reviewed systematically and iteratively using matrices to ensure that codes were consistently applied, particularly where codes were expected to overlap, and modified accordingly. While a number of constructs in the literature were found in the data, constructs that were unique from those in literature also emerged. These are summarized as second order codes and aggregate dimensions, presented in Figure 4.2.

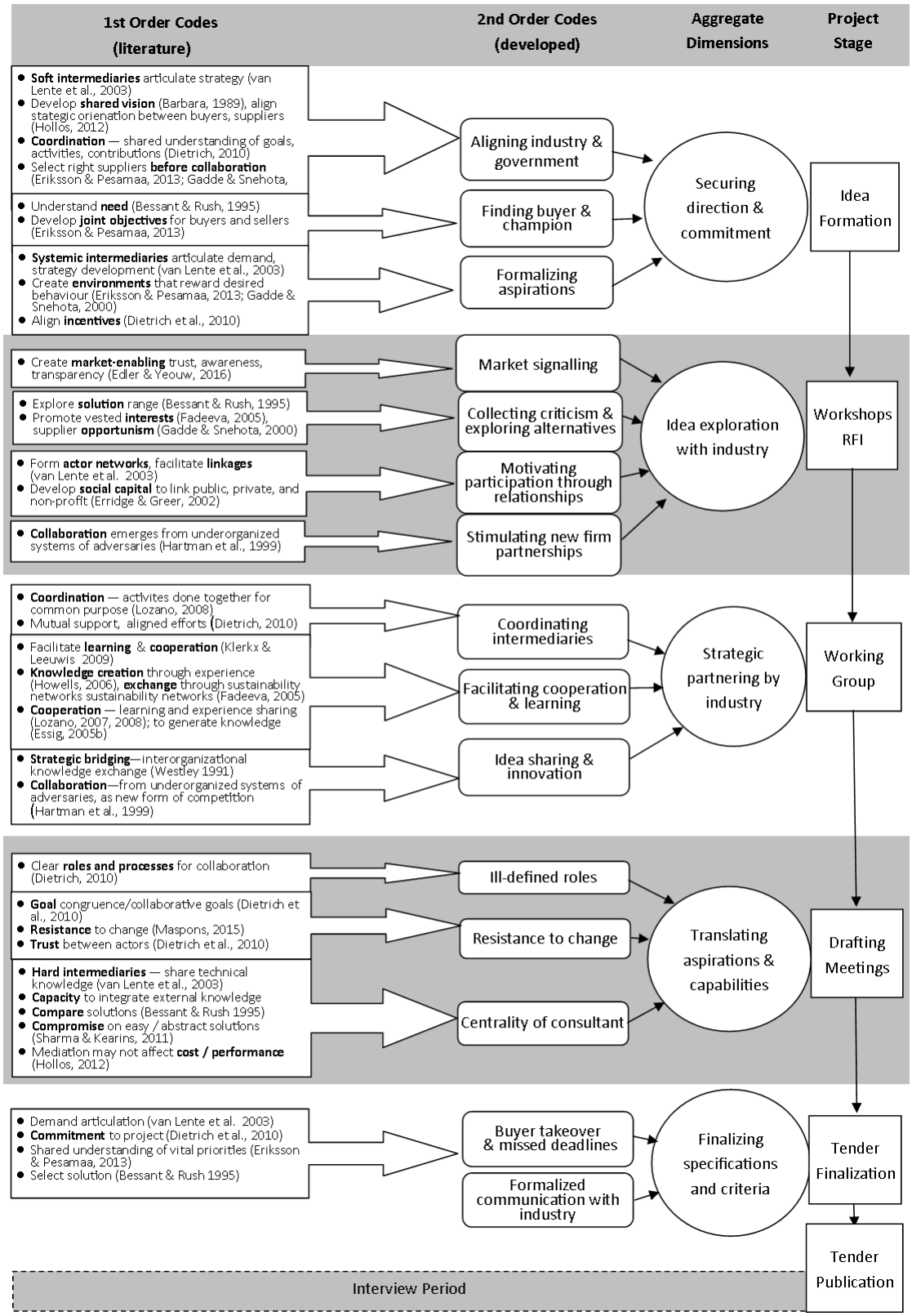


*Figure 4.2 – Summary of key codes from literature (first order codes), secondary codes developed using a grounded theory approach, and aggregate dimensions. These are presented according to project stages.*

## 4.4 Analysis

Intermediation during the pilot contributed to a circular economy by motivating and enabling key actors to create new connections and exchange knowledge, which furthered systemic learning across project stages. As was the intention, the pilot resulted in a tender that required suppliers to include a minimum percentage of post-consumer recycled content, and rewarded higher percentages. Enabling factors were the abilities of *multiple* intermediaries to conduct complementary activities, obtain the private sector's interest and commitment, stimulate new market relationships, support the transfer of market/technology aspirations and capabilities to the buyer, and improve their translation into an official tender. Project inertia and resistance to change emerged in the final project stages as gathered information became increasingly codified. The findings are summarized in Figure 4.2, and are presented in subsections according to aggregate dimensions and second order codes.

Throughout the analysis, intermediaries are underlined at key points.

### 4.4.1 Securing Direction and Commitment

**Aligning industry & government.** Before the start of the pilot, a circular economy for textiles did not exist, and the market faced anonymity in fragmented supply chains valuing price alone. A publicly-commissioned study in 2010 (Vreede & Sevenster, 2010) had identified significant potential to reduce life cycle impacts of cotton textiles through waste management. Focusing on resource efficiency through cotton reuse, the *Green Deal on Circular Procurement* was joined by more than twenty public and private parties in 2011 to create a demand for recycled textiles to support a circular economy, developed with contributions from Ministry of Internal Affairs, the Ministry of Infrastructure and Environment (RWS)[3] and MVO Netherlands[4] - a non-governmental organization (NGO) helping interested firms to further their sustainability performance in support of long-term industry transitions. Advisors from RWS worked on national policy for waste management,

[3] RWS

[4] Maatschappelijk Verantwoord Ondernemen Nederlands – Corporate Social Responsibility Netherlands

including using circular economies to close material loops. From this involvement, intermediaries emerged, as one very prominent CSR Advisor from RWS, and as MVO Netherlands itself. In 2013, as part of the *Green Deal*, the Ministry of Internal Affairs and RWS created the pilot project that is the focus of this paper as a way to understand how to use the public sector to create demand for cotton textile recycling.

Industry was involved in developing the pilot project under the *Green Deal* both indirectly, through the NGO, and directly, by organizations promoting market interests. A national textiles Industry Association was a central member of the pilot project, with a vision to bring all member firms to higher sustainability performance through self-regulation. An Open Innovation Center was also invited, whose main goal was "to build consortia with partners to make developments go faster," and who led the market in textile recycling. The Industry Association had a long-term reciprocal relationship with the Open Innovation Center regarding assistance with the pilot, as well as other projects toward circularity goals, and stated that their sustainability ambitions "fully fit" within one another. These partners became involved due to what they saw as inadequacies of public demand-setting in promoting circular economies for textiles, to "challenge the Ministry." The Industry Association expressed unhappiness with the formulation of previous criteria in tenders, viewing them as:

> *"Too broad in range in issues, and too strict on the criteria for each issue, so you get competition between different aspects….and never know in advance what the specific aspect [to be rewarded] is."*

In this initial stage, the CSR Advisor, MVO Netherlands, and the Industry Association all acted as *soft intermediaries* as they helped to articulate strategy (van Lente et al., 2003) for the new pilot project, based on commonalities between their own organizational goals and interests. While the Open Innovation Center would later display attributes of a hard intermediary, with a central relation to technical knowledge (van Lente et al., 2003), in these alignment stages they displayed competencies in sharing sustainability visions that lent themselves to strategy articulation. Activities were focused on coordination, as creating a shared understanding of goals, activities, contributions (Dietrich et al., 2010) for the pilot project. These "coordination actions" (Hollos, 2012), which hinged upon the development of this project strategy, and were expected to be a necessary prerequisite for eventual cooperation toward more sustainable supply, as initiated by a

buyer. Developing the shared vision – of creating demand-pull to promote circular economies in textiles – laid the first step of a collaboration (Gray, 1989). While not exactly selecting the right suppliers prior to collaboration, as stressed by Eriksson and Pesamaa (2013) and Gadde and Snehota (2000), the invitation of the Open Innovation Center introduced an individual firm to the early stages of goal and strategy articulation, one with strong sustainability ambitions, technical capabilities, and knowledge.

**Finding buyer and champion.** In early 2014, the Contract Manager of the Defense Materials Organization, under the MOD, agreed to serve as the buyer for the pilot project at their Clothing- and Personal Equipment Enterprise[5], during a meeting with seventeen other customers of the Workwear Category. They were convinced by the intermediary who would in 2015 become the Category Manager for Workwear, assigned to the Ministry of Internal Affairs. Under the new centralized purchasing system for national government agencies, the Workwear Category was incepted in 2015 as a team that included the Category Manager, Contracts Manager and a Material System Specialist. According to their purchasing calendar, the Workwear Category would contact clients such as the MOD, who provided them with information on upcoming needs. In turn, the Category provided information on technical possibilities and markets, trying to "inch the needs of others into [their] own since there is a huge overlap and [the Category's] specifications are usually the most complete."

As did the Industry Association, the Contract Manager at the MOD also acknowledged challenges facing the use of tenders in changing markets, stating that "people usually perceive a tender as a lottery because it takes so much time and effort and only one can win." To help rectify these issues, a central goal of the project became to open up the process of information sourcing for tender development to industry, to increase transparency, specificity, and opportunities for fair competition. With respect to the buyer, the role of the Category Manager was to "personally motivate" and stimulate the buyer, since the buyer did not have the "market mentality" and did not fully see the benefit of moving toward a more circular economy. The Category Manager stated the following:

[5] KPU Bedrijf - Kleding- en Persoonsgebonden Uitrusting Bedrijf – Clothing- and Personal Equipment Enterprise

> *"At this time, the most important factor of procurement is the price and my vision - one of the visions that I have - is that the sustainability is more important than the price, and also it's my role to be a good example for the market and to create more enthusiasm."*

As an intermediary, the Category Manager played a critical role in not only helping the MOD identify their needs (Bessant & Rush, 1995), but in aligning these needs with those of the emerging pilot project. This activity aided in the identification of a buyer willing to participate in the pilot. Also focusing on the buyer, at this stage their objective in joining the pilot project – particularly for long-term cost savings – was made clear.

**Formalizing aspirations.** Following the commitment of the buyer, the Workwear Category combined their sustainability vision with the logistics requirements of the buyer to develop its Category Plan Workwear in April 2015 (Saltzmann, 2015). The Category Manager invited the CSR Advisor to jointly author the document, which and served two purposes: supporting operational planning (logistics) for its clients, and communicating purchasing plans to the market. Together, they developed a vision to use the pilot as a stepping stone toward achieving additional revenue streams in the future for the MOD, when textiles could be recycled and purchased once again. The latter aspiration formed a second project for a new contract on recycling collected textiles, to begin in 2017. The signing of this document by the Category Manager authorized his responsibilities, and communication of the plan two years prior to tendering was intended to help companies reconsider their investment plans and calculate profit timelines in preparation for the tender. As the final step in the first stage, the Category Plan published joint objectives between the buyer and potential suppliers of the pilot that had been created through earlier discussions between government, industry, and NGO groups.

As per Eriksson and Pesamaa (2013), these joint objectives were necessary for project partners to understand priorities and collective goals, and set the groundwork for creating environments promoting favourable industry responses (Eriksson & Pesamaa, 2013; Gadde & Snehota, 2000) where incentives become aligned (Dietrich et al., 2010). At this point, the Category Manager began to emerge as a systemic intermediary, as one who *articulates* strategy development and demand through the consultation of others (van Lente et al., 2003). In these early stages, participation was between representatives of government and industry, rather than between buyer and supplier. The buyer became involved after the pilot project goal was established, with the facilitation of soft intermediaries. Strategies for

executing the pilot project were captured by the systemic intermediary, to be communicated to the market in the subsequent stage.

### 4.4.2 Idea Exploration with Industry

**Market signalling.** After the pilot project goals were formalized and commitment secured, intermediaries shared the pilot aspirations with the market and gathered ideas. Both of these aspects were central to the implementation of the Category Plan, stated as "transparency about the vision and objectives" alongside "collaboration with interested market parties" (Saltzmann, 2015, p. 4). The Category Manager did not see it as sufficient to only inform the market about their vision, as doing so would result in in them asking for business, which had to be offered in the form of public demand. A key feature of signalling was that it was intended to give suppliers ample time to prepare. One respondent saw the Category Manager as successful in this regard, by opening up tenders which are usually "a secret" by "inviting everyone…. Making it more open and transparent, [and] then leaving it up to producers and manufacturers to do it." These actions directly align with the role of intermediaries in creating *market-enabling trust, awareness,* and *transparency* (Edler & Yeow, 2016). Importantly, in this case they were additionally coupled with the provision of a guaranteed demand – secured through earlier agreements with the buyer – as a critical component of effective market signalling.

**Collecting criticism and exploring alternatives.** Together with the CSR Advisor and Industry Association, the Category Manager facilitated two supplier workshops in 2014: one to generate ideas for logistics and planning for the buyer, and the next to gather information regarding the feasibility and cost-effectiveness of including recycled content in products. These were attended by "every workwear producer," with approximately forty participants whose interest was piqued by the size of the Category Manager's purchases. Workshop leaders collected information on the current state-of-the-art, possibilities, and barriers regarding the ability to provide different degrees of recyclable content in textiles (Bruls, 2015). Later that year, the Defense Materials Organization sought the same information by publishing an electronic Request for Information on the electronic procurement platform TenderNED (DMO, 2014), and requested that the Industry Association send invitations for participation for both, to ensure fairness through a wide reach.

A key complaint heard by firms in these workshops was that prior to the pilot, the government communicated the desire to become greener, and then circular, but had continued to only look at prices in tendering instead of acting and setting an example. This had been identified earlier by the Category Manager and was central to developing his vision for the pilot project. Discussing technical possibilities, participants took issue with the sustainability losses of focusing on recycled cotton instead of polyester, questioned the validity of microscopic testing methods and the ability to conduct product controls, and were against the lack of transparency required and the potential to "cheat" through alternative sourcing or sub-contracting of recycled materials that would reduce prices. Alternative methods to tender the recycled material directly and then conduct a second tender for its manufacturing were suggested by one firm. In contrast, another firm believed that the co-creation process (used in the subsequent working group stage) was necessary for circular business models needed to win the tender, and that these could improve tracking and tracing along the value chain.

This criticism and exploration stage coincides with the role of intermediaries in helping organizations to accomplish early-stage activities such as identifying requirements to solve the problem (as the goals set in the preliminary stage), and exploring the range of available solutions that may be acquired (Bessant & Rush, 1995). Particularly in the exploration stage, intermediation enabled the identification of competing solutions. This market consultation collected a range of potential solutions and alternatives to help ensure that no single supplier could unduly influence the tender to further their own interests, although a higher change of winning an eventual tender was indeed what motivated many firms' participation, as also identified by Fadeeva (2005).

**Motivating participation through relationships.** During these workshops, and to a lesser extent during the subsequent working group stage, respondents believed the Category Manager acted as a "system-" or "macro-level" player who promoted the project by "kneading" and convincing audiences, and spreading enthusiasm. This coincided with the stated vision of the Category Manager, and was consciously performed. In addition to the workshops, firms who had existing contacts with the MOD often preferred to use these relationships as a means to solicit information. On such firm viewed the Category Manager as a middleman who was better equipped to deal with salespeople and could not fully appreciate new information on technical innovations that the firm had to offer. They

believed that approaching technical specialists with the Category or the buyer was seen as the best way to understand user needs and promote new advancements. Another firm preferred to bring innovative ideas directly to the MOD. In fact, for similar reasons, many firms were keen to develop relationships with the MOD to achieve better access to their competitions; they had a long-term perspective, and recognized fluctuations in priorities over time based on relationships with previous suppliers, international events, and policy shifts. Firms interviewed ranged from proactive firms leading the market and looking for cost reduction benefits of circularity, or those struggling for market survival – their participation in the pilot at this stage was to understand and influence future ambitions affecting a major buyer. They were curious about the project and its outcomes, and many were motivated by personal beliefs and a stated sense of responsibility for sustainability. The relationships that were identified or created as a cause of the pilot project were enabled by the assistance of the Category Manager, especially in developing social capital (Erridge & Greer, 2002).

**Stimulating new firm partnerships.** Stimulating new partnerships along supply chains in the textile sector was a central goal of the pilot project, as necessary for circular economies. According to Erridge and Greer (2002), developing social capital is conducive to linking public, private, and non-profit actors. In this pilot, focusing on private linkages as motivated by public intermediation, the personal motivation of the Category Manager facilitated linkages and helped develop actor networks van Lente et al. (2003) by stimulating new firm partnerships. *All* respondents interested in applying for the tender sought new partners. The Open Innovation Center itself developed and led a Dutch-Belgium consortium of companies, in which one member described them as "the glue between everyone saying things are possible." One firm described new business relationships stimulated by the pilot as "the worst type of networking that you can have, since you are not sure that you will get [the tender], but you need to have the partners." These findings align with those of Hartman et al. (1999), where proactive firms coordinate and collaborate, emerging from previous systems of disorganization and competition. This networking represented investment into transitions by identifying what one respondent referred to as the "right players, solutions, and innovations," which another respondent said could be catalyzed only by initial public funds, given the state of the market and technology at the time of the pilot project. Engagement of firms in this networking often first required internal approval and budgeting based on future forecasts, highlighting the top-down

approach within organizations responsible for permitting the exploration of new partnerships.

### 4.4.3 Strategic Partnering with Industry

**Coordinating intermediaries.** A select group of industry members was invited by the Industry Association to participate in more frequent, in-depth, and technical discussions jointly chaired and facilitated by intermediaries. The forum for these interactions was the bimonthly Circularity Working Group hosted at MVO Netherlands, formed under the Industry Association's National Action Plan. Meetings were jointly directed by the Sector Manager at MVO Netherlands, the CSR Advisor from RWS and the Category Manager. These actors took turns being the core facilitator of the meetings, along with the Open Innovation Center. Here, intermediaries *coordinated* activities toward a common purpose– however, differing from the definition of Lozano (2008b), these were not done together in the sense of simultaneously, but rather in a manner that made their involvement more efficient and contributions in terms of different knowledge and approaches complementary. This indicates mutual support and aligned efforts, as identified by Dietrich et al. (2010) as prerequisites for and quality indicators of collaboration.

**Facilitating cooperation and learning.** Intermediation was expected to facilitate cooperation and learning (Klerkx & Leeuwis, 2009), extending to knowledge creation through experience and exchange through sustainability networks (Fadeeva, 2005). Working group interactions marked the first cooperation in the project – with the exception of those between interested firms and their new partnerships that occurred outside of official project activities. As cooperation, these interactions directly indicated learning and experience sharing (Lozano, 2008), as well as knowledge generation (Essig, 2005). Again, while Essig (2005) finds the latter in partnerships between one private and one public entity, the concept appears to also fit well in cases of coordination prior to supplier selection, as examined in this case. Examples of knowledge creation through experience (Howells, 2006), as a role for intermediaries, were found for instance when the Category Manager visited the weavers, manufacturers, and shredders of this consortium, who had invited him to demonstrate their circuit of production based on information he had shared with them. By providing a platform for learning, intermediaries also facilitated learning through interactions, which as defined by van Lente et al. (2003) contributes "to

the added value of the whole system" (p. 9) This stage coincides with findings of Edler and Yeow (2016) where intermediation enabled "joint learning" (p. 422) in need specification through inviting market actors to help define needs for supplier signalling, as that which would come through the publication of the tender.

**Idea sharing and innovation.** Narrowing in from the market information in the form of sales pitches during formalized activities during the idea exploration stage, in the working group members exchanged more technical information about innovation possibilities and opportunities. Firms who were involved in the Circularity Working Group saw benefits in the sharing of such information – as stated by one firm:

> *"It is just building up your knowledge about the whole team, and that is what we are learning in the groups. It is a network with different companies, and is also an information gathering place."*

Upon this platform, ideas and knowledge were shared within a more informal context. In this way, the working group allowed for interorganizational knowledge exchange (Westley & Vredenburg, 1991), particularly through the efforts of intermediaries that created strategic bridges between participants. As it was still a pre-commercial market, firms in the working group network shared goals and knowledge on technology advancements in chemical and mechanical recycling without seeing each other as competition, supporting the view of collaboration as a new form of competition (Hartman et al., 1999). They learned from each other and could "add up their knowledge in the new product" that would be specified by the call for tenders in the pilot. The Category Manager valued the opportunity to use this working group to speak informally, which was "normally not possible." The discussions during the working group helped firms involved to develop more innovative solutions to respond to the tender once it was published. One firm saw it as a "responsibility" to demonstrate that what they claim is possible can be done, and:

> *"if not then why not, so that if the fabric will not pass the test, then at least we can say to the military and to the working group that look, we tried and that the test requirements are too high."*

This suggests that the firms involved felt a mutual responsibility to the government, stemming from the trust, awareness, and transparency facilitated by intermediaries in the project.

Participants appreciated the working group interactions for how they overcame barriers from talking without acting, which was said to have high time costs and low benefit – a futile exercise when no investment is available. While the potential prize was high, no single firm participating was guaranteed to win it, leading to other firms stating that if they did not win they would not partake so heavily in future initiatives due to the resources required to explore R&D required and new partnerships. On behalf of the government, the effort put into the pilot showed a "practice what you preach" mentality and "set an example," and manifested "real things" when implementing circularity within the government's operational management. In the absence of public demand, it is therefore uncertain as to whether cooperation would have occurred as readily. If the market wasn't prepared yet, the Category Manager intended to repeat the pilot in the next contracting phase – likely unaware of firms' threats to not cooperate in the future.

### 4.4.4 Translating Aspirations and Capabilities

Information generated during the pilot was translated into a draft tender during four meetings, which were chaired by an External Consultant hired by the Category Manager, and attended by the CSR Advisor, Category Manager, and Material System Specialist for the Category, as well as actors internal to the MOD – including the buyer and a Subsystems Specialist. The External Consultant also hired an Advisor from the Open Innovation Center to help develop requirements, sampling provision, timelines, and evaluation. The Category Manager was also invited to modify the purchasing team at the buyer's organization that would be in charge of the tender, and added a new Technical Specialist, choosing to keep the rest of the team the same for the sake of continuity.

**Ill-defined roles.** Once industry consultation had taken place, the buyer became responsible for drafting the tender. Unlike the Category's other clients – for whom the Category acted themselves as the buyer – the buyer maintained a procurement team of nine employees that specialized in purchasing articles of higher importance for defense capabilities. In previous procurements, the role of the Category had made it difficult to intermediate between suppliers and buyers when user requests were not clearly communicated by account managers. This pilot was more simplified, as it purposefully chose low-risk and non-complex articles, as towels, to support project success. The problems which arose instead pertained to a failure to clearly designate roles and

responsibilities. With the initial impression that the external intermediaries would design the tender, it was not until after the third of four such meetings that the buyer's procurement team understood that they were the ones who would have to do so. This confusion was reflected by the Category Manager's statement that that the buyer's organization had difficulties understanding his role, calling himself "only a guest in this house." Most significantly, the roles of the Category (Manager) and the External Consultant during these meetings were not well defined, which caused some confusion regarding the transfer of information. This underscores the importance of clear roles and processes for enhancing the quality of collaboration (Dietrich et al., 2010). As an "outsider," the Category Manager experienced success in organizing meetings at earlier stages of the project, "until the moment it was a formal procurement."

**Resistance to change.** Despite the MOD's initial agreement to serve as buyer for the project, when it came time to translate the findings into tender specifications, intermediaries were met with resistance. The Category was tasked with convincing their customers of the benefits of, and providing training for, "greening" their procurement, which was difficult when advocating for unproven innovations and markets:

> *"You have to convince your customer that he wants something else, but there's no intrinsic need for the customer to be more green or more aware…. It's just so unpredictable at the moment that we can't really give them the advantages; it is hard for a customer to see the advantage of what they're buying."*

This directly aligns with findings of Edler and Yeow (2016) in which intermediation is critical in communicating benefits of an innovation, alongside assurance regarding quality and long term advantages. Both the Category and the procurement team were careful to respect competition rules, to the point that the Category viewed the buyer as "following the rules but not more" such as the sustainability aspirations envisioned in the Category Plan. This suggests that the goals between the buyer and the pilot were not congruent, as a prerequisite for successful collaboration (Dietrich et al., 2010). Trust was also an important factor (Dietrich et al., 2010), as this underscored the careful nature by which the new Category approached dealings with the buyer, with their focus in the preliminary stages after reorganization in 2015 being on first securing client trust through continuity. Similar to findings of Maspons (2015) for other public procurement projects, the pilot experienced resistance to change during tender development, largely in part due to what some

participants perceived as rigid mindsets. As the buyer gradually realized responsibility of drafting the tender, they had to keep requirements open enough to adhere to European procurement law for fair competition. This exercise depended on the "creativity of the tender writer," where suppliers would be "invited to look for the degrees of freedom" in the tender that the consultant pushed for.

**Centrality of consultant.** The External Consultant was included in a fourth meeting together with the buyer and their procurement team, and helped to *compare* potential solutions, in accordance with the third step in intermediation in technology purchasing of Bessant and Rush (1995). In drafting the tender specifications, the functional requirements and limitations began to take priority over recycled content, as the procurement team believed external actors were not as familiar with their markets and users. According to the Subsystems Specialist, "it was good to think and speak about, it but it was not like they had the best ideas and we didn't know it." Two participants interviewed perceived this resistance to change due to historical precedence and numerous authorizations required by organizational hierarchies. Based on its value alone, the procurement would already require review and authorization at a higher level once a supplier was chosen. Adding sustainability criteria created extra burden for the tender writers.

In efforts to overcome this resistance, the External Consultant assisted the other intermediaries in *advocating for* proportionately rewarding higher amounts of recycled cotton content in award criteria and changing the colour of the hand towels – modifications which were perceived by actors internal to the buyer organization as possible for "regular users" but not feasible for products for military purposes. The External Consultant pushed for performance-based standards, developed by using a systems understanding of the functional requirements of the textiles. The resulting specification, after several discussions, was "a kind of compromise," seen from the buyer's perspective as underpinned by the tendering strategy to maintain high quality by maintaining certain requirements. This does not quite fit with the findings of Sharma and Kearins (2011) on the compromise on easy or abstract solutions in interorganizational collaborations for sustainability, as the tender appeared to satisfy price, quality, and circularity demands of all the actors. These actions clearly identify the External Consultant as a *hard* intermediary, in sharing technical knowledge (van Lente et al., 2003). While this study did not include the post-tendering

phase, the effects of intermediation on cost or *criteria* in the tender are evident – rather than reducing technology cost or promoting performance (Hollos, 2012), intermediaries pushed for creating value for non-cost criteria of environmental benefit while not compromising on quality aspects. In this way, the External Consultant moved beyond comparing solutions (Bessant & Rush, 1995) to a role of advocacy similar to that of the Category Manager during the workshops and working group sessions.

### 4.4.5 Finalizing Specifications and Criteria

Towards tender publication, the involvement of intermediaries ceased, as the procurement team finalized the tender to finally articulate demand. This diverges from van Lente et al. (2003), where intermediaries were also involved in selecting the final solution. The buyer became responsible for the project and for communication with industry, which was then formalized. At this point, the process was undertaken according to standard procurement procedures. Finally, once the tender was published, it was the role of the buyer instead of any intermediaries (as found by Bessant & Rush, 1995) to select a solution.

**Missed deadlines.** Despite the visibility of the Category Manager's message and the "huge impact and priority the pilot should have had," delays in internal staffing and the delayed publishing of the tender proved to be problematic. The internal change from the restructuring of purchases into categories that occurred during the pilot created staffing delays for both the Category and the buyer, which played a role in missed deadlines. Both a supplier and the Contract Manager saw that staffing changes and outsourcing knowledge to the market had led to what the latter described as a "huge drain of information in the departments themselves," where it was difficult to get information from the government when it was held by their supplier. In part, this drove the earlier stages of market consultation. Including for the Category Manager, who appeared to be spearheading the project, the time dedicated to the pilot (including associated workshops and the working group) was relatively low and did not comprise the majority of roles of any respondents. Prioritization of procurements from the MOD – which were admittedly "more important than a couple of towels" – also pushed back deadlines. To quote one respondent: "Deadline after deadline was skipped because of this and that." The Category Manager had no authority to prioritize the pilot project within the KPU, but could only stimulate progress through personal motivation. This makes the degree of the buyer's commitment

to the project questionable, a factor that decreases the quality of collaboration (Diedtrich et al., 2003). Once the tender was initially published, the keywords did not include those used throughout the earlier project stages that the industry was expecting, such as "workwear, corporate clothing, or uniform" that one firm relied on their search alert to pick up. The Category Manager was blamed by the firm for this, when publishing responsibilities were those of the buyer. The formal complaints lodged by this supplier likely led to the extension of the tender deadline by another month. This supported the Category Manager as a project figurehead, built upon their visibility and repeated interactions with industry.

## 4.5 Discussion

The goal of the pilot was to promote a more circular economy in the textile sector by creating demand. Setting this demand, the final tender called for high-quality products, containing recycled cotton, at a reasonable price. Meeting these requirements and outperforming competitors would require interested firms to scale up recycling technology from demonstration stages. In creating this demand, intermediation was a central tool. Consisting of both individuals and organizations, intermediaries coordinated activities, facilitated cooperation with and amongst firms, and collaborated with the buyer especially. Their actions stimulated knowledge generation, sharing, and learning, which they then used to support demand articulation by the buyer. As such, the pilot was itself an exercise in *demand articulation*, which intermediaries contributed to via *actor linkage formation* and *innovation process management* (or, process innovation management), in contrast to the distinction of these three types of intermediation by van Lente et al. (2003). Fluidity of network structures (Clarke & Roome, 1999) was found in overlapping networks, movement of intermediaries between them, and by their evolving roles over time.

The pilot "created a lot of change" amongst a new backdrop of reorganized institutional purchasing structures. In the face of this reorganization, the Category proceeded carefully while inducing sustainability pressures, focusing foremost on continuity to increase the buyer's trust. In contrast to the case examined by Edler and Yeow (2016) where internal change was an *outcome of* introducing intermediation in procurement, this paper identified challenges facing intermediation that were *caused by* internal change – which was, ironically, intended to increase efficiency. Within this dynamic environment, the pilot

provided different *platforms* upon which where knowledge was collected and shared by multiple parties, according to the project stage. The degree of formalization of these platforms was a critical aspect to the interactions that happened upon them, and findings reinforce the three phases of project-level change applied by Grandia (2015) in change agents for sustainable procurement. Aligning with the *mobilizing* phase, the project became most open to informal interactions during the working group stage, where collaboration occurred with select market participants regarding developing new ideas for potential solutions. This also suggests systemic *effects* of intermediation, in which intermediaries can also have a more indirect influence by playing "enabling and supporting roles" (Edler & Yeow, 2016, p. 416), such as in stimulating firms toward new partnerships, in addition to linking actors and facilitating their interactions. Suppliers and often intermediaries preferred such informal discussions, where they could gather more concrete information about performance demands for which they could specify/develop technical solutions.

During the initial and final stages, information became codified – during Idea Formation, in the form of aspirations in the Category Plan, and during Tender Finalization, in the form of the official tender. The former aligns with *unfreezing* phase, including vision development and planning, and the latter with *freezing* phase including refinement and institutionalization. Importantly, the findings of this study add depth to these phases by highlighting the activities of different actors according to platforms. Early interactions, within the unfreezing phase, were marked by joint activities and industry representatives, whereas those in the mobilization phases were between the buyer and (potential) suppliers. In the freezing stage, the buyer finalized demand that compromised between these sustainability aspirations and their own interests in price and quality.

While activities at a general level corresponded with previous definitions according to formalization, the findings suggest that there is a need to reconceptualise roles for intermediation in this process. The findings both support and challenge roles for intermediation defined by Edler and Yeow (2016) (*performer, broker, content expert,* and *trainer*),[6] based upon distinctions including by van Lente et al. (2003) (*hard, soft,* and *systemic*).

[6] It should be noted that, while Edler and Yeow (2016) distinguished two cases by triggering an innovation, or responding to an innovation already in the marketplace, the case study examined in this paper had features of both of these purchase types, as the pilot was intended to create a larger market to help the market for incorporating recycled material scale up. As such, their findings according to both of these cases are drawn upon for comparison purposes.

While intermediaries did not serve as a *performer* of procurement, they performed certain functions associated with the purchase, including project management while taking ownership of the project during the middle stages. Systemic intermediaries functioned as *brokers,* performing brokering activities with *external market* actors (searching for solutions and potential providers, signalling suppliers) and *internal government* employees (need definition and translation into the tender). The abilities of systemic intermediaries – and especially the Category Manager – to personally motivate markets and government actors alike contributed to this brokering activity.

Roles for intermediaries as *content experts* (Edler & Yeow, 2016) were identified in this study, and differentiated according to soft and hard intermediaries (van Lente et al., 2003). While Edler and Yeow (2016) couple technology expertise with market knowledge within the same role, this study identified that capabilities of intermediaries were specialized in one or the other, although there was some crossover of expertise as hard intermediaries were also involved in idea formation, and soft intermediaries in drafting meetings. Importantly, intermediaries did not have any role as *trainer* (Edler & Yeow, 2016). Instead, the creation of categories, and use of Category Managers as systemic intermediaries, required that many of the capabilities of the buyer – such as staff and purchasing responsibilities – were transferred to the Category. This may have been a contributing factor to the resistance of the buyer during the Drafting stage, who may have felt their team's positions were being made redundant through shifting knowledge to the Category, and in the interests of their own organization then pushed for more emphasis on user needs rather than sustainability. Returning to the activity of project management in *performance,* the intermediaries built up product and market knowledge themselves and together in the working groups before translating it (but not capabilities) to the buyer. Thus, capabilities remained with the intermediaries, who faced a continuing challenge to convince buyers of sustainability benefits without the market being developed enough to share a sound business case with them.

With respect to project phases, soft and hard intermediaries were most active in the initial and final stages, respectively; the unique contribution of the systemic intermediaries was during the idea exploration and strategic partnering activities during the workshop and working group stages. Systemic intermediation played a critical role in translating market information (from communication with sales people on innovation and markets) and

technical information (from working group discussions) into tender specifications with the help of specialists. The systemic intermediary was seen as a market interface, and the figurehead of the project during its execution stages. The personal motivation by systemic intermediaries appeared to be an attempt to compensate for lack of authority to further the project, once the buyer assumed leadership in the later stages. This conceptualization of intermediaries as individuals rather than organizations lends itself to the study of their role in building social capital to further projects.

Actors, platform exclusivity, and content exchanged varied throughout the course of the project. As such, activities of coordination, cooperation, and collaboration were performed at different stages and with facilitation by different intermediaries. Collaboration provided strategic bridges enabling the exchange of knowledge between organizations, towards solving problems that no party could address unilaterally (Westley & Vredenburg, 1991). Support was found for the importance of both collaboration and competition (Lozano et al., 2013) as actors – including potential suppliers, systemic intermediaries, and the buyer – "challenged eachother all the time" while searching for ways to "interconnect and work together" to shape the demand articulation toward their own goal. These activities were driven by different objectives of participating firms, of the buyer (to maintain quality and reasonable pricing), and the intermediaries (to increase the content of post-consumer recycled material).

## 4.6 Conclusions

This paper addresses the question of *How can intermediation promote a more Circular Economy?* To do so, it first draws from literature on intermediation and collaboration within buyer-supplier and network relationships, across theories of systems of innovation, social network, and organizational change. These concepts are then applied to examine interactions during a process of demand articulation for a high-profile public procurement pilot project. By developing a qualitative case study using a grounded theory approach, it presents evidence supporting the centrality of systemic intermediation in initiatives promoting a more circular economy, and provides a unique contribution to the understanding of collaboration in demand articulation. Intermediaries were found to play a critical role in such processes by 1) coordinating government and industry through aligning project goals, 2) facilitating cooperation of industry players to stimulate new business relationships, and 3) collaborating with the buyer to push for higher post-consumer recycled material in the final tender. The coordination of multiple intermediaries facilitated often unilateral action toward a common goal. This increased the efficiency of their involvement while enabling for their complementary capabilities as soft, hard, or systemic expertise to be put to best use depending on the project stage, across which actors and degrees of formality varied. Interorganizational relationships, structures, and hierarchies emerged as critically important, affecting processes across project stages.

Future projects involving intermediation should consider the coordination of multiple intermediaries with specialized knowledge according to these features. The question arises of how to anticipate or adapt to organizational changes affecting intermediation within projects. With respect to demand articulation, greater insight is needed to discover how to best combine buyers' motivations for cost savings, sellers' motivations of increased returns, and the sustainability requirements often imposed by third parties. These dynamics may prove to be hallmarks of transitions toward circularity as more projects arise, carving a more permanent role for intermediation. To achieve commitment and willing collaboration by buyers, sustainability incentives must first be bundled with cost-savings. This may be especially true for public agencies, who are typically risk-averse but upon whose demand-setting circularity transitions may depend. This paper provides support for leveraging intermediation in accomplishing such demand articulation.

This study has certain limitations that create opportunities for further research. Notably, intermediation in public procurement has unique features that differentiate it from that in typical buyer-supplier relationships. While the former includes additional dimensions such as policy drivers, parallels can be drawn in more simplified private demand articulation with respect to consulting potential suppliers. While it does not identify commonalities between cases, a major benefit of the case study method is the deep insight it provided into a complex project involving networks of actors working toward goals that drive successful circular economies: sustainability, quality, and cost-savings. As well, while process outcomes can indeed be studied separately from project outcomes, a second study examining the outcomes of this pilot project could evidence any causality between intermediation efforts and materialized economic changes post-contracting. Based on the findings of this study, intermediation to promote a more circular economy appears to be particularly beneficial when used for collaborative initiatives to support public demand articulation, which helps to solve the "chicken or the egg" conundrum holding back sustainability transitions.

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## 4.8 Appendix

### 4.8.1 Interview Questions

1. What is your role in your organization?
2. Could you tell about your organisation's vision on sustainability?
    a. On Circular economy?
3. How were you involved in the Dutch pilot project for public procurement of textiles with recycled material (hereafter referred to as "the project")?
    a. What is/was your role in this project?
4. How did you become involved in the project?
    a. Who invited you and by what means?
    b. Could you expand upon / clarify your relationship?
5. Why did you decide to become involved in this project?
    a. If involvement was mandatory, how does this fit into your role at your organization?
6. Which individuals or organizations did you interact with during the project?
    a. What type of interactions did you have?
    b. How often did these occur?
    c. How did you communicate with them?
    d. What type of information did you exchange?
    e. Could you provide some examples of such interactions?
    f. Were these interactions facilitated? If yes, how?
7. What resources (time, money) were required for your involvement in the project?
    a. Was this according to your expectations?
8. What benefits did you obtain from the interaction? Your organization?
9. In your opinion, what were drivers to the interaction?
10. Were there any particular barriers?
    a. Were these barriers overcome? If so, how?
11. Do you see a link between this interaction and the project goals?
12. If this project were to be re-done, what would you do differently?
13. If there was another sustainable public procurement project with unlimited resources, with whom would you interact, and why?
    a. With whom would you not interact, and why?
14. Could you recommend anyone else involved in the project to contact for an interview?

### 4.8.2 First Order Codes Derived from Literature for Coding

- Intermediation
  - Areas for intermediation in technology purchasing functions: (Bessant and Rush, 1995)
    - Recognize need, technology requirements
    - Explore range of solutions
    - Compare solutions
    - Select a solution
  - Functions of innovation intermediation (Howells, 2006) -
    - Support technology transfer, diffusion
    - Enable innovation through organizational management
    - Provide bridging infrastructure
    - Enable systems and network functions
  - Intermediaries in demand-side transitions (van Lente et al., 2003)
    - Articulate demand
    - Form actor networks, facilitate linkages between possible partners for cooperation
      - Scan
      - Scope
      - Filter
      - Match-making
    - Process management
      - Facilitate learning and cooperation (Klerkx and Leeuwis, 2009)
  - Collaboration
    - Level of interactions (Lozano, 2008)
      - Interpersonal – between two or more people
      - Intergroup – between two or more groups of people
      - Interorganizational – between two or more organizations
        - Strategic bridging (Westley & Vredenburg, 1991)
        - Strategic orientation – influences cooperation with suppliers (Hollos, 2012)
        - Organizational pre-conditions (Clarke & Roome, 1999)
        - Interpersonal capabilities (Clarke & Roome, 1999)
  - Factors influencing collaboration
    - Antecedents: for collaboration mediation (Dietrich, Eskerod, Dalcher, & Sandhawalia, 2010)
      - Roles and process for collaboration,
      - Trust between actors,
      - Physical and cultural proximity,
      - Alignment of incentives,
      - Commitment to project,
      - Goal congruence, collaborative goals,
        - Drivers for interactions toward circularity
          - Cost reduction
          - Environmental impact reduction
          - Social improvement
        - Shared vision (Gray, 1989)
        - Shared understanding of vital priorities (Eriksson & Pesamaa, 2013)
      - Conflict resolution
      - Expectations fulfillment

- Requirements: for joint action between buyers and sellers (Eriksson & Pesamaa, 2013)
  - Develop joint objectives,
  - Perform teambuilding activities, and
  - Adopt conflict resolution
- Quality of collaboration: dependent upon (Dietrich et al., 2010b)
  - Quality of communication
  - Coordination
  - Mutual support
  - Aligned efforts
  - Cohesion
  - Presence of tools for collaboration (Eriksson & Pesamaa, 2013)
- Components of collaboration
  - Communication
  - Collaboration
  - Coordination, "activities performed by different individuals to make them compatible with a common purpose or result" (Lozano, 2007)
  - Cooperation, "engaging in work on monitoring and evaluation, learning from each other and sharing experiences' (Lozano, 2007)

- Drawbacks/Detriments to collaboration
  - "Resistance to change"
    - Mind-set (Maspons, 2015)
  - No guarantee to reduce costs of improve performance (Hollos, 2012)
  - Promote vested interests through legitimacy it can instill (Fadeeva, 2005)
    - Supplier opportunism (Gadde & Snehota, 2000)
      - Enhance one organization's interests (Sharma & Kearins, 2011)
      - Influence policy (Lozano, 2007)
  - Compromise on easy or abstract solutions (Sharma & Kearins, 2011)

# 5 Innovation and Standardization as Drivers of Companies' Success in Public Procurement

**Abstract**

There is a significant potential to improve the benefits from public procurement through a better understanding of drivers in company success at the micro-level, an area which has received little study to date. To increase these impacts on innovation and markets, policy makers have opened procurement to innovation, including the strategic incorporation of formal standards in calls for tenders. Consequently, companies offering innovative solutions should have higher chances to be successful in public tenders. In addition, companies who engage in standardization activities at standards development organizations (SDOs) may have a competitive advantage in submitting tenders. Examining the case of Germany, this paper empirically investigates the effects of German manufacturing companies' innovation activities and their engagement in national standardization on the receipt of contracts from procurement competitions, both within Germany and from abroad. The results of logit regressions based on German companies surveyed within the framework of the Community Innovation Survey show that being successful in product innovation and being engaged in standardization are significant positive predictors of companies' success in public procurement within Germany. With implications for policy-makers, this suggests that public procurement is indeed open for both innovative and standardized solutions.

## 5.1 Introduction

Public procurement has a strong potential to drive innovation and market growth by reducing suppliers' risk and stimulating demand. Policy makers have opened public procurement to innovation (EC, 2014) in an attempt to increase the impacts of public purchasing on innovation, both at the firm level and a macro level. Leveraging purchasing power through strategic procurement will "improve the efficiency and quality of public services" while wider societal benefits through the generation of new ideas and their translation into innovations (EC, 2014, p. 72). In addition, the strategic incorporation of standards in calls for tenders can increase these innovation impacts (EC, 2008; Blind 2008; Koch & Jacobsen, 2014). Due to the increasing prominence of standards in calls for tenders (Europe Innova, 2008), a company's competitive advantage in receiving such contracts and reaping associated benefits will be partially dependent on their awareness of and ability to deploy standards. As such, standardizing companies have additional benefits to this engagement, receiving competitive benefits from procurement contexts. This may compound the challenges of receiving such contracts especially for small and less innovative companies, who face particular barriers to public procurement (Uyarra, Edler, Garcia-Estevez, Georghiou, & Yeow, 2014) and who are less likely to be engaged in standardization activities (Blind 2006; Blind & Mangelsdorf 2013; Blind et al. 2015). If the policy to open procurement to innovation is successful, then firms with more engagement in innovation and standardization may have a higher likelihood of receiving procurement contracts. Examining the case of Germany, this paper investigates the effects of company engagement in national standardization and innovation activities the receipt of contracts from procurement competitions.

Despite the growing importance of using standards in public procurement, no research has looked both at the innovativeness of companies and their involvement in standardization as a potential success factor in the receipt of contracts. Timing and openness in standardization are critical for it to effectively support innovation through public procurement (Dale & Bryson, 2012). Standards are "major elements of demand-based policies" (Edler, Georghiou, Blind, & Uyarra, 2014, p. 37), which help to create demand and aide diffusion of innovations (OECD, 2009). Along with public procurement, standardization can serve to "facilitate market entry or facilitate the diffusion of

innovations in the case of market failure" (OECD, 2011, p. 11), and both are an integral part of Germany's high-tech strategy for promoting diffusion of innovations (BMBF 2006, 2010, 2014). However, this potential does not often manifest. For example, an Innovation Union Communication regards "slow standardisation and ineffective use of public procurement" (EC, 2010, p. 2) as deterrents to innovation.

Recent literature has touched upon the standardization of procurement processes and calls for common tenders across instances and institutions (for example, Loader 2013, 2015; Malara & Mazurkiewicz 2012), which would help to address the fragmentation across European markets (Edler et al., 2014) and firms who execute contracts (EC, 2014). Such market change would support the ability for entities to consult others who have developed performance-based specifications in order to glean information on good design (Rigby et al., 2012). For procurements that are open to firms from abroad, standards such as those for quality and the environment should be chosen through administrative cooperation across borders (EC, 2014). In Germany, standardization across the country's procurement landscape has been called for in terms of central procurement platform and for harmonizing procurement law (Wegweiser, TU Berlin, & Hölters & Elsing, 2009). Simultaneously analyzing companies' engagement in standardization at standards developing organizations (SDOs), which create many standards that are also relevant to public procurement, and companies' innovation activities is required to provide additional insights into how to optimize the interaction between innovation, standardization and public procurement in order to push their impacts on growth. This paper provides a first attempt to do so.

## 5.2 Literature Review and Derivation of Hypotheses

Public purchasers often apply cost and innovation criteria together towards determining the Most Economically Advantageous Tender (MEAT). In designing and awarding calls for tenders, public purchasers use standards in program requirements to guarantee minimum quality and support low costs. Innovation can be introduced in either program requirements or award criteria in different ways, such that potential suppliers who can provide a desired innovation at a low cost are more competitive. The following provides background to the dimensions of innovation, standardization, complemented by additional company characteristics used in this analysis, based on review of relevant literature. Based on these, two hypotheses are developed.

### 5.2.1 Innovation

Literature has supported the effects of public procurement on company and market innovations, while scant attention has been paid to the effects of company innovation on receiving public procurement contracts. For instance, public procurement contracts can help support innovation within companies for which resources are limited, reducing risk and expense and potentially being more effective than direct public support (Aschhoff & Sofka, 2009). Lember, Kalvet, and Kattel (2011) found public procurement to influence radical innovation through the creation of new markets. Measured by market turnover from her products, Aschhoff and Sofka (2009) identified a positive and significant effect on innovation success from procurement in "more conventional branches" such as those for administrative requirements, rather than for higher knowledge sectors such as defense or security sectors. Georghiou, Edler, Uyarra, and Yeow (2014) found that approximately half of companies engaged in procurement increased their R&D expenditures in association, and 67% noted that doing so influenced their innovation activities. In addition, 56% "reported that they won a public sector contract in the last three years because of innovation" (p. 7).

There have been a limited number of studies on the influence of a company's innovation activities on public procurement. Uyarra et al. (2014) revealed that R&D-intensive companies found specifications that were too prescriptive, and contracts that

were too small, to be a major barrier to innovation benefits from public procurement. Others found that the importance of increasing R&D spending for small and medium-sized enterprises (SMEs) was significant only for procurement outside of the local public sector, e.g. government agencies, EU central government, etc. (Pickernell et al., 2011). While these findings are somewhat contradictory, it may be the case that higher R&D intensity has a small positive influence on the receipt of domestic procurement contracts. The size of the effect may be dampened as the greater barriers perceived by these more innovative companies may prevent them from pursuing public procurement contracts.

Similarly, there exist slightly contradictory findings regarding the effect of a company receiving R&D subsidies on public procurement. For stimulating innovation within industries, public procurement has potential to be more effective than public R&D subsidies (Geroski, 1990), as the receipt of public contracts can reduce demands for direct public funding (Loader, 2015). This would suggest that those companies which receive R&D subsidies are less likely to seek public procurement contracts, as their success is less likely to depend on the receipt of such guaranteed public funds. However, Pickernell et al. (2011) identified public financing as positively and significantly associated with receipt of local public procurement contracts for SMEs, while not significant for public agencies at a higher level. Extrapolating from this, it may be true that for procurement at the domestic level, receipt of subsidies has a small positive effect on the likelihood of receiving procurement contracts.

Based on the above, the following hypothesis is derived:

*H1: Greater research intensities and the performance of innovation activities will increase a company's likelihood of receiving public procurement contracts.*

### 5.2.2 Standardization

Standardization is the voluntary development of "technical specifications based on consensus amongst the interested parties," including industry, relevant interest groups, and public authorities (EC, 2008, p. 2). It results in the publication of voluntary standards, available to the public (for free or for a cost). Engagement in standardization, while itself dependent upon the availability of a company's resources, is highly influential in a company's ability to understand the benefits of standards and to be able to deploy them in

strategic applications that influence competitiveness. While also beneficial for cost-competitiveness in markets, the use of standards in public procurement competitions helps purchasers in particular to meet requirements of low cost. By guaranteeing a minimum quality, the risk-reducing effects of standards support risk-averse attitudes of public purchasers. As such, use of and benefits from standards in public procurement should be amplified when compared with private markets.

In public procurement, agencies may use a variety of types of standards, technical specifications, or eco-labels provided that they are based on "scientific information using a procedure in which stakeholders, such as government bodies, consumers, manufacturers, distributors and environmental organizations can participate" (EC, 2004, p. 7). The updated Directive cites national standards transposing European standards as the most preferable for technical specifications, for application "without prejudice to mandatory national technical rules" (EC, 2014, p. 121). Procurers have the option to express these instead as performance or functional requirements, to follow the same rules regarding standard origin as the technical specifications. Including of appropriate standards supports openness in calls for tenders (DIN & INS, 2014), enabling fairer competition that is open to more bidders and innovative solutions (EC, 2004). Including performance or functional requirements as minimum standards – rather than very narrowly defined technical specifications – is encouraged as it ensures this openness (EC, 2014). Regarding tenders received, procurers should not discriminate between submitted tenders that meet minimum requirements based on equivalent domestic, European, or international standards so long as these specifications address the requirements stated in the call for tenders (EC, 2014). Similar to how awareness of rules and regulations can be a factor for a successful public procurement (Tabish & Jha, 2011), awareness of existing voluntary standards cited in calls for tenders can improve the likelihood of receiving public procurement contracts.

References to standards in calls for tenders enable purchasers to select less expensive products due to global competition that relies on cost-saving standards (Blind, 2008). With 41% of calls for tenders citing formal open standards (Europe Innova, 2008), engagement in standardization may increase the competitiveness of suppliers submitting tenders. As mentioned earlier, the relationship between standardization and public procurement has not been examined comprehensively. It has been touched upon for the products of public procurement, and Rigby et al. (2012) calls for further investigation into standards

development for the eventual end-user of the product that is procured. Referenced standards should be at the domestic level if no European standard is available (EC, 2014).

Regarding standard type, Blind et al. (2010) found standards published by formal standardization bodies to have the strongest positive effects when compared to informal consortia or proprietary standards.[7] For the ICT sector, such standards had the greatest impacts on 1) development, procurement, and combination of products/services; 2) global industry structures/markets; and 3) economic impacts (mostly cost and price-related) at the firm and industry level (Blind et al. 2010). As such, the required openness and non-proprietary character of formal standards can maximize the potential of public procurement for promoting innovation, especially for those at the international level (Blind, 2008). Engagement at standards developing organizations (SDO) that produce such formal standards can instill greater credibility than other standards setting process that are closed or proprietary (Rainville, Hawkins, & Bergerson, 2014), and may have the proportionately large impacts on public procurement outcomes that is worthy of study.

Engagement in standardization can be predicted by a number of factors, including a company's size, export intensity, and economic sector. An inverted U-shape characterizes relationships between standardization and company size – i.e., companies who are engaged in standardization tend to be those within a middle range and not on the large or small ends of the spectrum (Blind, 2006). Very small companies may lack resources and absorptive capacity to benefit from knowledge spillovers associated with standardization, and very large companies may not sufficiently benefit from knowledge-sharing activities to increase already large market shares (Blind, 2006; Blind & Mangelsdorf 2013; Wakke et al. 2015). Recently, Wakke et al. (2016) show that German companies' involvement in standardization increases their productivity and performance. The extent to which this factor can predict success in public procurement may also depend on the type of procurement, such as those which have higher likelihoods of using standards as references. These are namely procurements of a greater number of products, with higher financial values, longer product life-cycles, and/or with a greater frequency of similar/identical procurement processes (Blind, 2007).

[7] For a discussion of the limitation of referencing consortia standards in public procurement, see EC (2011).

In theory, R&D results from pre-commercial procurement could be disseminated by public bodies through standardization (EC, 2007b), but this has only been realized in exceptional cases. Co-operation of procuring institutions with standardization bodies in Germany is neither common nor intensive, with 25% of organizations surveyed by Wegweiser et al., (2009) reporting some degree of engagement and only 3% of this being intensive or very intensive. For DIN SPECS - suitable for intercompany standards required relatively quickly, such as in the early stages of innovation – this percentage decreases to 2% (DIN, 2013). In contrast, engagement with other departments, the users of the product or service to be procured, and other procurement offices are much higher, at over 80%. Thus, the potential for reverse causality in our analysis with respect to standardization is relatively low.

Interaction of public procurers with companies – in the form of joint purchasing, public-private procurement partnerships, and pre-commercial procurement – is much less common, with less than half of public institutions reporting any degree of this engagement (Wegweiser et al., 2009). As such, while firms submitting tenders to public procurement contracts may not meet those from the public agencies making direct purchasing decisions, they have opportunities to meet other potential stakeholders from whom they could glean useful information into how to increase their competitiveness in public purchases.

Based on the previous arguments, engagement in standardization is not only enhancing companies performance (Wakke et al. 2016), but expected to increase the likelihood of success in domestic-level public procurement, because companies who do so are more likely to a) use standards referenced by calls for tenders already (i.e., independently or prior to the call) and b) have been partly influential in the content of those standards that are referenced, as involvement in standardization is a company strategy to influence its outcome (Weiss & Sirbu, 1990); and c) companies may meet public procurers in standardization processes, the dialogue from which may assist companies in competing in calls for tenders (Uyarra et al., 2014).

Based on the above, the following hypothesis is derived:

*H2: Engagement in standardization will increase the likelihood that a company receives public procurement contract(s).*

### 5.2.3 Company Characteristics

In addition to innovation and standardization factors that may influence the receipt of procurement contracts, a number of company characteristics are of interest for their ability to influence successes in a similar manner.

#### *Company Size*

Company size is the most commonly cited factor for success in public procurement, and is typically used to justify the need to increase the competitiveness of smaller companies. Especially for SMEs, public procurement is important to effectively leveraging procurement capabilities (Geroski, 1990), and procurements "should be adapted to the needs of SMEs" (EC, 2014, p. 79). SMEs are only half as likely to be successful in public contracts than private contracts, leading to a reduced interest among SMEs in submitting tenders (Freshminds, 2008). A quantitative study of SMEs in the UK found that company size was positively associated and equally influential for domestic public procurement at all levels and abroad (Pickernell, Kay, Packham, & Miller, 2011), suggesting that company size is proportional to the likelihood of receiving procurement contracts. Karjalainen and Kemppainen (2008) associate the lower engagement of SMEs in public procurement with insufficient resources, especially towards legal expertise and administration. Critical barriers to this involvement include overly prescriptive requirements and qualification criteria, along with increasing requirements for SMEs to supply through a third party (Loader, 2015).

Other studies have found that there is a trend toward longer contracts (Procurement Innovation Group, 2009), and that contracts that are too large pose a barrier for small companies (Uyarra et al., 2014). Loader (2011) suggests that shorter contracts or the proposal of the Procurement Innovation Group (2009) of subdividing larger contracts would help increase the competitiveness of SMEs in public procurement. Additionally, while there exists consensus on the positive relationship between a company's size and their propensity to export (e.g., Bonaccorsi, 1992), the same cannot be said for export intensity. Verwaal and Donkers (2002) found that exports of manufacturing companies have a positive relationship with company size up to a certain point, after which a neutral and eventually negative relationship is seen. Based on this, it might be expected that company size should have a linear and positive effect on the receipt of procurement

contracts to a certain extend. As well, it may be true that company size will have a more significant effect for foreign contracts, as larger companies with greater resource availability are expected to be those who are most interested and competitive in procurement competitions open to suppliers from multiple countries.

To date, no literature has analyzed the relation between a company's export intensity and their success in public procurement. Most research in the area has focused on the potential for positive impacts of public procurement on exports. There is also literature on the positive relationship between innovation and export performance, e.g., public procurement can help expand export markets by stimulating domestic markets through product development (Vecchiato & Roveda, 2014). Particularly, public procurement of innovation has the goal of "improving the export potential of innovative companies' through improving domestic markets for these companies, in addition to improving the efficiency and effectiveness of providing goods and services to public authorities (Putten, 2012, p. 2291). In the UK, a lack of demand-side pressure to innovate has been supported by export markets that do not demand innovative products or services, where the domestic market can also be seen as a "less demanding buyer than consumers in many other nations" (Georghiou, 2007, p. 6). In addition, calls for tenders that are too prescriptive or limited to a certain (idiosyncratic) design can reduce the chances of success in export markets (Edquist & Zabala-Iturriagagoitia, 2012). Therefore, if it is assumed that companies with greater export intensity are more focused on export markets, and that they would desire to expand their shares in these markets or the size of the markets, they may see engagement in public procurement as one way to do so and thus be more likely to receive public procurement contracts.

### *Company Sector*

Since the number of public procurement contracts and their volume depend very much on the sector a company is active in, we must control for company sector. For example, both in the construction and information technology (IT) sectors, the public sector has a high demand such as for buildings and regular updates of IT infrastructure. Certain sectors exist first and foremost for government purchasing, such as manufacture of weapons and spacecraft, and companies operating in sectors in which government activity

is concentrated are more likely to benefit from receipt of contracts (Aschhoff & Sofka, 2009). However, while there are some sectors in which public procurement is more common, this does not necessarily equate to the size of the demand (Shingal, 2015), for contracts may be smaller of less value. In sectors with greater public demand compared to domestic output, a propensity for the public sector to select domestic firms can reduce trade between countries, particularly if these sectors are characterized by monopolies and returns to scale (Trionfetti, 2000). The sector in which a procurement is taking place may also influence the selection criteria used – for instance, for those within the energy sector, cost-effectiveness may extend to life cycle costs to consider potential savings over the longer term (Wegweiser et al., 2009). In Germany, the sectors with the greatest estimated procurement expenditures are property and land leases and rent (near 20% of expenditure), and building work (22.4%). In terms of number of contracts awarded, volume is distributed fairly evenly, with education and research, and transport and communications, each receiving 16%, social security receiving 13%, defense approximately 10%. Less common procurements are for policies and centralized management, security and order, and health and environmental (Lorenz et al., 2009).

### *Company Strategy*

Public procurement is capable of establishing the demand necessary to create new markets for innovation-intensive products (Kok et al., 2004), particularly in areas where there is high investment required and where companies are risk-averse. Involvement in public procurement at the domestic level for German companies opens up access to markets at the federal, state, and local level (BMBF, 2006; Lorenz et al, 2009), estimated at 247 billion (Wegweiser et al., 2009). As such, the desire to expand markets may predict receipt of public procurement contracts at the domestic level. These effects may be also valid for procurement contracts outside of the country as well.

The purpose of calls for tenders in public (and private) procurement is to stimulate competition so that the public entity can receive goods or services at sufficient quality at the right price. Due to this goal, there is an emphasis on price as the most important criteria in awarding procurement contracts. Erridge and Nondi (1994) found that a number of procurers surveyed indicated that emphasis on price does not allow for enough

consideration for quality to decide between tenders and potential suppliers, and that negotiation (i.e., tendering with multiple stages) can assist in price reductions and achieving greater value for money. This was especially noted by procurers who were advocates of partnership-based rather than competitive procurements, and partially explained by certification according to minimum quality standards (Erridge & Nondi, 1994). The current directive on public procurement encourages procurers to allow variants by setting minimum quality requirements upon which companies can build innovative solutions, while awarding contracts "on the sole basis of the best quality-price ratio" (EC, 2014, p. 73) where appropriate. Due to this emphasis on costs, it can be expected that companies who have improving the quality of existing products as a strategy will be less likely to receive procurement contracts.

### *Competitive Landscape*

The degree to which a company's products are easily replaced by competitors may influence their success in procurement, for in straightforward calls for tenders (i.e. less complex, open, or innovative) other potential suppliers may readily meet the requirements of the procurer. As only 10% of procurement contracts in Germany are estimated to be related to innovation (Wegweiser et al., 2009), it is expected that companies engaged in procurement will often compete on prices for interchangeable goods. Current procurement rules have an "overarching focus on maximizing competition" (Thai, 2009, p. 2) that will help secure competitive prices for public purchasers (Rolfstam, 2014), generating variety in more open calls and increasing the efficiency of the selection process (Georghiou, 2007, p. 11). However, if too much competition is generated then many companies may be disadvantaged. For example, competition on pricing is especially an obstacle to small companies seeking to obtain procurement contracts (Michaelis, McGuire, & Ferguson, 2003). If it is assumed here that if there are fewer innovative procurements, then companies which have products that are easier to be replaced by competitors will be more likely to obtain contracts, as these products have a larger public procurement market.

Companies facing higher threats of market position through the entry of new competitors may also influence success in public procurement. The entry of new competitors is associated with greater product variety and differentiation possible through

public procurement, particularly in markets driven by innovation and competition (Edler et al., 2014). However, public procurement law may hinder competition by promoting risk-aversion on behalf of procurers developing calls for tenders (Knutsson & Thomasson, 2014). If it is assumed that more calls for tenders do not sufficiently stimulate competition, then it may follow that those companies whose market position is more threatened by new entrants will be less likely to receive procurement contracts.

The degree of competition from foreign providers has a potential effect on procurement success. Many of these calls for tenders are closed to suppliers from abroad, with values below set thresholds that would otherwise require disclosure and opening to companies from abroad (EC, 2015). Germany has the largest proportion of tenders for works below tender value threshold levels across all EU counties, at 95% of all domestic work contracts (London Economics et al., 2011). For supplies are services contracts, however, only 10% for central agencies and 14% for sub-central agencies are below the threshold. Thus, it is expected that there will be a positive effect of increased competition from foreign providers on companies who receive contracts, as there are many contracts available at the domestic level that will be open to foreign competition as well.

Differences in procurement patterns have been identified based on vertical and/or horizontal hierarchy, and as influenced by geography. A number of studies have discussed these according to the level of the procuring institution (i.e., local, regional, or national), such as Blind (2007) and Pickernell et al. (2011). Cabaras (2011) examined public procurement in a remote region in the UK, finding it to be characterized by greater competition that could disadvantage local suppliers. In contrast, Vecchiato and Roveda (2014) identified potential spillover effects of improving services for local community and increasing economic competitiveness of local R&D activities for regional public procurement in Italy. Similar findings by Aschhoff and Sofka (2009) for regional areas in Germany suggest that public procurement can assist smaller companies and help to alleviate economic stress. Company age has also been used to gauge success in public procurement, where it was found to have a positive significant relationship on SME involvement with public procurement by local national authorities (Pickernell et al., 2011). While differences in company geography are available, it is not included as at this stage as a primary focus to maintain attention to a limited number of variables.

## 5.3 Empirical Analysis

### 5.3.1 Data

The data for this analysis is from the Mannheim Innovation Panel's 2013 Innovation Survey, with company-level data from innovation activities of German companies from 2010 to 2012 inclusive. This survey is conducted annually by the Centre for European Economic Research (ZEW) on behalf of the German Federal Ministry of Education and Research. The methodology and questionnaire is harmonized with the Community Innovation Survey (CIS) conducted at the European level. The 2013 survey included questions regarding the receipt of public procurement contracts from 2010 to 2012, as well as innovation undertaken either directly or in association with any contracts received. This data was matched with data on company engagement in standardization at the Deutsches Institut für Normung (DIN) over the same time period. Companies in the service sector are omitted from our analysis, which instead focuses on manufacturing companies. Of the 8740 total responses, 2114 are considered to be valid - include no missing information for any of the variables selected for inclusion in the analysis. Germany currently has no method of measuring results of its procurement strategies (OECD, 2015), and as such a database of more detailed information regarding procurement is not available.

A binary logistic regression is performed to test our two hypotheses, controlling for further company characteristics. We focus on the receipt of one or more procurement contract(s) from public entities within Germany, but compare these results with the success factors in public procurement competition abroad as a form of robustness check.

### 5.3.2 Variables

We conceptualize success in public procurement as the receipt of public procurement contract(s) within the timespan of analysis. Success in procurement serves as the dependent variable in in two separate regressions, the first for receipt of contracts in Germany and the second for abroad. Multiple variables were introduced in order to control for additional factors from the focus variables that may influence a company's success in receiving public procurement contracts.

To test H1, we introduce four variables were included regarding innovation activities and expenditures. First is the implementation of new or significantly improved products to the company, accounting for product innovation of goods (pdpp) or manufacturing processes (pzfv). Internal R&D expenditure intensity – expenditure as a share of turnover (iafuent) – was selected rather than external intensity to coincide with activities within the company. Receipt of any public funding from any source was also used, where the funding organization could be the federal states, the Federal Ministries, the EU Research Framework Programme, or other public institutions (oefall). All of these variables were included in the main models. The risk of reverse causality to lead to endogeneity in this paper is small: an additional regression with a subset of companies who performed innovation as a consequence of procurement (either directly required by a procurement contract, or not) remained constant overall.

Formal standardization organizations exist at the national, European, and international level. However, the engagement at the national level is in general the requirement for supranational activities. To test H2, we introduce variables regarding national standardization and standards stocks at national and higher levels. The key variable is engagement in standardization, or more specifically involvement at the national SDO DIN (stand) with DIN at least between 2010 and 2012. However, companies' participation in standardization is in general a long-term engagement, i.e. that the companies have already been active before 2010. Involvement at DIN was an indicator for firms that both helped to set standards and implemented standards, whereas those who were not engaged were only able to implement standards and thus may have reduced competitiveness due to higher adaption costs. Additional data was gathered from the PERINORM standards database to develop an indicator for the total stock of standards recognized in Germany, including those at the German (DIN standards), European (i.e., EN standards) and international (ISO) level (denoted by variable stand_isic). This effectively controlled for sectors with a high number of standards and the possibility that procurements may be more likely to draw upon standards in calls for tenders in a particular sector. To harmonize this dataset with the CIS data, ISIC codes were converted to NACE codes. The base for stand_isic at all levels was set to the wood, paper, paper products, printing and publishing industry (ISIC3 numbers 20-22). To test for any interaction effect, the variable stand_stock was made to depict both engagement in standardization and the number of standards in the company's sector. Additional testing according to Norton, Wang, and Ai (2004) was

used via the inteff function in Stata, as the z-statistic from the logit regression output cannot be used to determine the significance of interaction effects.

A number of controls were introduced to the models. For company characteristics, company size (as the log number of employees – variable logbges) and exports as a share of total sales (expint) were used. As the number of employees has a large distribution – the log was used instead to control for this skewed distribution. Company strategies of developing new markets outside of Germany (newmkts), improving the quality of existing products or services (qualimprv), and forming alliances or partnerships with other companies or organizations (partnshp) were also introduced. For competitive landscape, the degree to which products were readily replaceable by competitors (prodreplc), the extent of the threat of new market entrants to the company's market position (mktthreat), and the degree of competition from foreign providers (forgncomp) were incorporated. Responses for company strategy and competitive landscape are coded from 0 (does not apply) to 3 (strongly agree).

Only those companies belonging to the manufacturing sector were included, due to the presence of a greater number of standards relevant to manufacturing than for services a higher proportion of companies who are active in standardization – in our sample, more than three-quarters of firms active in standardization belong to the manufacturing sector. As the number of public procurement contracts available differ according to sector (Aschhoff & Sofka, 2009), dummy variables controlling for sector effects are introduced by using three-digit NACE codes (see list under economic sector within the manufacturing industry, Table 5.1). Those companies in the manufacture of weapons and ammunition (NACE 25.4) and of military fighting vehicles (NACE 30.4) are omitted because they predicted success perfectly (i.e., every company active in the area had received public procurement contracts). The base for these sector controls was made to be NACE 10.0-18.2 (manufacture of food products, beverages, tobacco products, textiles, wearing apparel, leather and related products, wood and of products of wood, paper and paper products, printing and reproduction of recorded media), as the largest category with 27% of the companies sampled.

A number of measures were taken to test the correlation matrices for receipt of domestic (Table 5.8, Appendix) and foreign (Table 5.9, Appendix) procurement contracts. These suggest a low potential for collinearity problems. Hosmer-Lemeshow chi2 tests –

more appropriate than Pearson chi2 in this case, as the number of covariate patterns equals the number of observations – indicate a value of 11.45, with a p value of 0.1775, and as a smaller chi2 combined with large p value suggest a good logistic regression model fit. Classification tables indicate a specificity of 98.79%, there is a low rate of type I errors (incorrect rejection of a true null hypothesis), and sensitivity of 5.35%, indicating a higher degree of error through false negatives.

*Table 5.1 – Variable abbreviations and descriptions*

| Variable Abbreviation | Variable Description |
|---|---|
| Innovation and standardization-related factors | |
| pdpp | Product innovation of goods (yes or no) |
| pzfv | Process innovations of manufacturing processes (yes or no) |
| iafueint | Internal R&D expenditure as a share of total sales (ratio) |
| oefall | Received public funding for R&D or innovation projects a public institution (yes or no) |
| stand | Engagement in standardization activities (yes or no) |
| stand_isic | Number of standards at the German, European, and International level in the company's sector |
| stand_stock | Interaction effect for engagement in standardization, and number of standards in the company's sector |
| Company Characteristics, Strategy and Competitive Landscape | |
| logbges | Company size (log number of employees) |
| expint | Exports as a share of total sales (ratio) |
| newmkts | Development of new markets outside of Germany (0 to 3) |
| qualimprv | Improve the quality of existing products or services (0 to 3) |
| partnshp | Formation of alliances or partnerships with other companies / organizations (0 to 3) |
| prodreplc | Products are easy to replace by competitors (0 to 3) |
| mktthreat | High threat to market position through the entry of new competitors (0 to 3) |
| forgncomp | Strong competition from foreign providers (0 to 3) |
| Economic Sector within the Manufacturing Industry | |
| Ref. petrol, coke | NACE 19.0 - Coke and refined petroleum products (yes or no) |
| Chemicals | NACE 20.0 - Chemicals and chemical products (yes or no) |
| Pharmaceutical | NACE 21.0 - Basic pharmaceutical products and pharmaceutical preparations (yes or no) |
| Rubber, plastic, metal | NACE 22.0-24.0 - Rubber and plastic products, other non-metallic mineral products. basic metals (yes or no) |
| Fabr. metal | NACE 25.0 - Fabricated metal products. except machinery and equipment (yes or no) |
| Comp., elec., optic. | NACE 26.0 - Computer, electronic and optical products (yes or no) |
| Elec., mach., vehic. | NACE 27.0-29.0 - Electrical equipment, machinery and equipment n.e.c., motor vehicles, trailers and semi-trailers (yes or no) |
| Wtr., rail., spce trnsp. | NACE 30.1-30.9 - Building of ships and boats; Manufacture of railway locomotives and rolling stock; Air and spacecraft and related machinery; Other transport equipment (yes or no) |
| Furniture | NACE 31.0 - Furniture (yes or no) |
| Other manuf. | NACE 32.0 - Other manufacturing excluding medical and dental instruments and supplies (yes or no) |
| Medical, dental | NACE 32.5 - Medical and dental instruments and supplies (yes or no) |
| Mach. repair, instlln. | NACE 33.0 - Repair and installation of machinery and equipment (yes or no) |

### 5.3.3 Descriptive Statistics

Twenty-two percent of companies in the sample received domestic public procurement contracts. Those who do have a higher propensity to introduce product or process innovations at the company level (Table 5.2, below). The average number of companies undertaking product innovation, particularly, is significantly greater for those with contracts than for without, at 58% compared to 41%. For those firms who receive procurement contracts, there is also a higher proportion of firms who receive public funding for R&D or innovation activities. Engagement in standardization is almost twice as common in firms who receive contracts, at 14% compared to 8%.

More than half of all the companies engaged in procurement were SMEs, comprising 59% of the sample.[8] This finding contradicts the concerns referenced in literature citing the disadvantage of SMEs in public procurement, where larger companies are often seen as being more likely to receive contracts. Given this, the variance at the mean for size was not significant, nor was it for export intensity. Companies receiving contracts are less likely to be interested in developing new markets outside of Germany, and face less market competition. In contrast, they are more active in forming alliances and have products that are more easily replaced by competitors than firms who do not receive procurement contracts. Notably, the values for these variables for both those who receive contracts and those who do not are relatively low, where answers fall in the middle of the spectrum and signify a relative degree.

On average, there are half as many firms manufacturing rubber, plastic, or non-complex metal products with procurement contracts. In contrast, there are twice as many firms in the repair and installation of machinery and equipment (NACE 33.0) (included in manufacturing) with contracts. Similarly, there is more than twice the number of firms with contracts in manufacturers of computer, electronic and optical products (NACE 26.0), as well as those in the furniture manufacturing industry (NACE 31.0). For ships, railway transport, and air and spacecraft manufacturing (NACE 30.1 to 30.9), there are four times

[8] SMEs were defined according to limitations on employee numbers and turnover size as the EU definitions in OECD (2005) OECD SME and Entrepreneurship Outlook: 2005, OECD Paris, page 17 from http://stats.oecd.org/glossary/detail.asp?ID=3123.

as many firms with procurement contracts than without. The differences between means for the remaining sectors are not significant.

*Table 5.2 – Descriptive statistics: sample means and shares (standard deviation)*

| Variable | Companies with domestic contracts (N=374) | Companies without domestic contracts (N=1740) |
|---|---|---|
| Innovation and standardization-related factors | | |
| pdpp | 0.58 (0.49)*** | 0.41 (0.49)*** |
| pzfv | 0.33 (0.47)** | 0.27 (0.44)** |
| iafueint | 0.04 (0.16) | 0.02 (0.07) |
| oefall | 0.34 (0.48)*** | 0.24 (0.43)*** |
| stand | 0.14 (0.35)*** | 0.08 (0.28)*** |
| Company Characteristics, Strategy and Competitive Landscape | | |
| logbges | 3.75 (1.96) | 3.76 (1.58) |
| expint | 0.67 (0.81) | 0.66 (1.01) |
| newmkts | 1.50 (1.16)* | 1.67 (1.06)* |
| qualimprv | 2.48 (0.75) | 2.43 (0.80) |
| partnshp | 1.09 (0.99)** | 0.92 (0.92)** |
| prodreplc | 1.67 (0.96)** | 1.74 (0.90)** |
| mktthreat | 1.38 (0.81)** | 1.52 (0.80)** |
| forgncomp | 1.48 (0.97) | 1.55 (0.98) |
| Economic Sector within the Manufacturing Industry | | |
| Edbls, primary, med. | 0.18 (0.38) | 0.29 (0.45) |
| Ref. petrol, coke | 0.00 (0.05) | 0.01 (0.08) |
| Chemicals | 0.04 (0.19) | 0.06 (0.23) |
| Pharmaceutical | 0.02 (0.13) | 0.02 (0.15) |
| Rubber, plastic, metal | 0.07 (0.26)*** | 0.14 (0.35)*** |
| Fabr. metal | 0.10 (0.30) | 0.12 (0.33) |
| Comp., elec., optic. | 0.18 (0.39)*** | 0.07 (0.25)*** |
| Elec., mach., vehic. | 0.18 (0.38) | 0.18 (0.38) |
| Wtr., rail., spce trnsp. | 0.04 (0.20)*** | 0.01 (0.10)*** |
| Furniture | 0.05 (0.21)** | 0.02 (0.14)** |
| Other manuf. | 0.02 (0.13) | 0.01 (0.11) |
| Medical, dental | 0.03 (0.17) | 0.03 (0.17) |
| Mach. repair, instlln. | 0.10 (0.30)*** | 0.05 (0.21)*** |

*A significance level of 10%
** A significance level of 5%
*** A significance level of 1%

## 5.4 Regression Results

Table 5.3, below, depicts the results of the binary logistic regression. The results of the model for predicting success in receiving contracts from abroad is located in Table 5.6 in the Appendix. The odds ratios for models for domestic and foreign procurement are located in Table 5.5 in the Appendix, at high, low, and 95% confidence intervals. In the same location, Table 5.7 depicts the correlations of independent variables with both dependent variables investigated.

The results partially support H1, in that product innovation of goods significantly predicts receipt of both domestic and foreign contracts (Table 5.3).[9] Performing such innovation makes receiving domestic procurement contracts twice as likely, and contracts from abroad 3.5 times more likely. Obviously, such innovation activity gives companies seeking procurement from abroad a greater competitive advantage. This is the only innovation factor analyzed that has a similar influence in models for domestic as well as foreign procurement. These findings are similar to those in the case of the UK by Georghiou et al. (2014), where more than half of firms won a public contract due to innovation of some sort, and Uyarra et al. (2014) who reported that less innovative companies face particular barriers to procurement.

In contrast, conduct of manufacturing process innovations was not a significant predictor, nor was internal R&D expenditure intensity. The latter was especially surprising, given that previous studies have identified a positive relationship between engagement in procurement and increases in R&D expenditures, but may support other findings where more innovative companies are more likely to perceive barriers to public procurement and thus not pursue such contracts. The receipt of public subsidies had no impact on the likelihood of company success, for either level of procurement, and as such did not support the hypothesis in this regard. However, when each of the other three innovation variables were included independently through separate models, each was found to significantly and positively influence the likelihood of receiving contracts.

[9] An additional regression was performed without the 71 companies who performed innovation as a consequence of procurement (either directly required by a procurement contract, or not). The results of the regression are stable, with the significance and coefficients of the variables remaining very close. The two exceptions were size (logbges), which became significant at a level of 10%, and foreign competition (ustrat9), which lost its significance.

*Table 5.3 – Regression results of logit estimations to explain success in domestic public procurement - Coefficients with standard errors in parentheses*

| Explained Variables: Receipt of procurement contracts | Receipt of domestic contracts |
|---|---|
| Innovation and standardization-related factors | |
| Pdpp | 0.66 (0.15)*** |
| Pzfv | 0.12 (0.14) |
| iafueint | 0.76 (0.56) |
| oefall | 0.03 (0.15) |
| stand | 0.57 (0.20)** |
| Company Characteristics, Strategy and Competitive Landscape | |
| logbges | -0.06 (0.04) |
| expint | -0.02 (0.08)*** |
| newmkts | -0.26 (0.08)*** |
| qualimprv | 0.05 (0.08) |
| partnshp | 0.13 (0.07)** |
| prodreplc | 0.15 (0.08)** |
| mktthreat | -0.21 (0.08)** |
| forgncomp | -0.05 (0.07) |
| Economic Sector within the Manufacturing Industry | |
| Ref. petrol, coke | -0.74 (0.88) |
| Chemicals | -0.72 (0.29)** |
| Pharmaceutical | -0.46 (0.42) |
| Rubber, plastic, metal | -0.86 (0.22)*** |
| Fabr. metal | -0.38 (0.21)** |
| Comp., elec., optic. | 0.67 (0.20)*** |
| Elec., mach., vehic. | -0.33 (0.18)** |
| Wtr., rail., spce trnsp. | 1.20 (0.35)*** |
| Furniture | 0.65 (0.31)** |
| Other manuf. | 0.17 (0.45) |
| Medical, dental | -0.41 (0.33) |
| Mach. repair, instlln. | 0.49 (0.23)** |
| Other | |
| Constant | -1.26 (0.29)*** |
| Pseudo $R^2$ | 0.082 |
| Log-Likelihood | -905.28 |
| Number of observations | 2114 |

* A significance level of 10%
** A significance level of 5%
*** A significance level of 1%

The results support H2, in that company engagement in standardization significantly predicts the receipt of domestic contracts by German companies. Those who standardize are 1.8 times more likely to receive these contracts. For comparison, there was no significant effect on the receipt of foreign procurement contracts. This may suggest that companies engaged in standardization activities only improve their chances for success in national, but not international public procurement. While standardization activity at the European or international level is not available in a database, approximately half of German companies who are involved in national standardization are active in these higher levels (Blind, Rauber, & Müller, 2014). Additionally, firms are highly unlikely to meet public procurers in standardization at higher levels, despite their potential presence at national discussions.

The line of argument that companies active in standardization are in a better position to deal with the standards referenced in tender documents is obviously not completely true. Obviously, public procurers abroad prefer to reference national standards, which are different from German standards – including European or international standards – and which may not be used in Germany. In addition, the involvement in standardization provides companies with knowledge relevant for the success in public procurement including contacts to public procurers involved in standardization and possible partners for common procurement activities. This explanation is supported by the positive effect of the strategy to form external alliances or partnerships on the likelihood of receiving domestic public procurement contracts, which increases the likelihood by 1.2 but which has also no significant effect for procurement from abroad.

Introducing the stock of standards as a variable in the model depicted in Table 5.4, below, did not alter the outcome of the other variables. It is evident that the stock of standards describing the sector's standards intensity has a strong influence on their companies' success in public procurement. High numbers of standards are characterizing on the one hand network industries, like electrotechnology, or sectors with a strong government influence, because in Europe and particularly in Germany, the regulators rely in the sense of self-regulation on formal standards.

*Table 5.4 – Logit results of receipt of domestic procurement contracts, including variable for standards stock per sector*

| Explained Variables: Receipt of procurement contracts | Including with standards stock | Including interaction effect variable for engagement in standardization and standards stock |
|---|---|---|
| Innovation and standardization-related factors | | |
| pdpp | 0.65 (0.14)*** | 0.65 (0.14)*** |
| pzfv | 0.06 (0.14) | 0.06 (0.14) |
| iafueint | 0.86 (0.56) | 0.86 (0.56) |
| oefall | 0.18 (0.15) | 0.18 (0.15) |
| stand | 0.59 (0.20)** | 0.50 (0.35) |
| stand_isic | 0.00 (0.00)*** | 0.00 (0.00)*** |
| stand_stock | N/A | 0.00 (0.00) |
| Company Characteristics, Strategy and Competitive Landscape | | |
| logbges | -0.07 (0.04)* | -0.07 (0.04)* |
| expint | -0.02 (0.09) | -0.02 (0.09) |
| newmkts | -0.21 (0.07)** | -0.21 (0.07)** |
| qualimprv | 0.05 (0.08) | 0.05 (0.08) |
| partnshp | 0.15 (0.07)** | 0.15 (0.07)** |
| prodreplc | 0.05 (0.07) | 0.05 (0.07) |
| mktthreat | -0.19 (0.08)** | -0.19 (0.08)** |
| forgncomp | -0.04 (0.07) | -0.04 (0.07) |
| Other | | |
| Constant | -1.71 (0.27)*** | -1.71 (0.27)*** |
| Pseudo $R^2$ | 0.0443 | 0.0444 |
| Log-Likelihood | -942.8601 | -942.8036 |
| Number of observations | 2114 | 2114 |

* A significance level of 10%
** A significance level of 5%
*** A significance level of 1%

In this context, the firm size in this model becomes significant, where smaller firms are actually more likely to receive domestic contracts. Obviously, larger companies are more successful in the sectors with higher stocks of standards, e.g. electrotechnology. In addition, the replicability of products by competitors lost its significance. The stability of other outputs, including standardization, strategies, and the other foreign competition variables supports robustness of the model. With the interaction effect introduced, standardization becomes insignificant, suggesting that companies active in standardizing in the sectors with a high stock of standards are not more successful in public procurement.

Regarding the company's competitive landscape, most variables are influential for either domestic or external contracts. Findings suggest that those who receive domestic contracts operate in an environment with relatively low competition, produce products that are easy to replicate, and/or are also much more innovative. Companies producing products more replaceable by competitors are 1.2 times more likely to be successful, which may be influenced by the existence of a greater number of calls for tenders for the provision of relatively commonplace goods by those companies in the manufacturing industry, as compared to more innovative procurement. In Germany, multiple federal ministries collaborate toward greater consideration of innovative solutions in public procurement, which contributes to over 10% of Germany's GDP in 2006 (Wegweiser et al., 2009). Lower threats to market position also significantly impact the receipt of procurement contracts, which may limit the openness and competition stimulated by public procurement, as well as the market and innovation benefits that procurement can leverage. For procurement from abroad (Table 5.5, Appendix), German companies which face stronger competition from foreign providers are 1.6 times more likely to receive contracts.

Many strategies also significantly influence company success in either domestic or foreign public procurement (but not both). Companies who receive domestic contracts are only 0.8 times as likely to seek development of new markets outside of Germany (in Europe, or abroad). This remains somewhat counterintuitive, as procurement is expected to be able to open new markets or offer greater market foothold for companies. It may be the case that companies who procure at the domestic level are only more likely to be interested in entering new markets in Germany. In comparison, the pursuit of new markets outside of Germany significantly increased the likelihood that firms received foreign procurement contracts (Table 5.7, Appendix), which does align with predictions.

Improving the quality of existing products as a company strategy does not predict success in either domestic or external procurement, which also supported the hypothesis. Although as public procurement (and particularly public procurement of innovation) is said to be important to driving market improvements, along with stimulating competition, this finding supports that cost is a primary consideration. The test whether the relationship between contract receipt and quality follows is an inverted-U shape reveals no significant result.

These findings coincide with the greater likelihood of having replaceable products by competitors as influential on the receipt of public procurement contracts, which support previous findings that 90% of contracts in Germany are for non-innovative products or services (Wegweiser et al., 2009). In addition, companies facing lower threats from new market entrants are more likely to receive contracts. Only for foreign contracts did the presence of greater foreign competition influence the likelihood of receiving procurements, which is logical as foreign contracts would be open to firms located in that country as well, which would constitute foreign competition to the German tenderer.

A number of interesting results were noticed for the control variables. For domestic contracts, neither company size nor export intensity increase the likelihood of receiving procurements. However, for those from abroad, company size increases the likelihood of receiving such contracts, as does export intensity. Companies with more employees are 1.2 times more likely to receive contracts from abroad, and companies with greater export intensities are only slightly more likely (1.1 times) to receive such contracts. Firms manufacturing water, railway, and space transport goods are 3 times as likely to receive contracts from domestic procurers, and those in the computer, electrical, and optics goods, furniture, and machine repair and installation sectors are also more likely. In contrast, procurement in the chemical manufacturing sector is less likely – for both domestic and foreign procurement – as it is for manufacture of rubber, plastic, and metal.

## 5.5 Conclusions

There is a significant potential to improve the benefits from public procurement through a better understanding of drivers in company success at the micro-level. This paper serves as an empirical investigation into the effects of innovation activities and standardization on the receipt of public procurement contracts by German companies in the manufacturing sector. It contributes to knowledge on the factors going into procurement at the micro-level rather the impacts of procurement on companies and markets, an area which has received little study to date. Findings have both company-level and policy implications. For companies, they support that engagement in strategic alliances, including standardization activities, as well as undertaking product innovation at the company increase the likelihood of receiving German procurement contracts. For policy-makers, they support that public procurement is indeed open for innovation.

We conclude that the conduct of product innovation and the engagement of companies in standardization are significant and positive predictors of success in procurement within Germany. As the effects of national standardization on receipt of foreign contracts are not significant, we suggest that involvement in such standardization activities is not beneficial for success in foreign procurement competitions, where calls for tenders at this level would reference non-German standards, and domestic companies do not have the chance to meet foreign public procurers in their national standardization processes. When examined simultaneously, introduction of product innovation at the firm level is a much stronger indication of success in procurement than other innovation variables such as internal R&D expenditure and the receipt of public subsidies for innovation projects. Engagement in strategic alliances – alongside involvement in standardization activities – increases the likelihood of company success, supporting that companies who are open to open innovation by sharing and sourcing information from these interactions are more likely to receive contracts.

A few limitations to this analysis should be noted. First, and possibly most significantly, there is a potential for endogeneity as it may be true that the receipt of procurement contracts within the period of analysis had an impact on companies rather than the reverse. These effects may also be seen if companies who received procurement contracts during the time period covered by the questionnaire had also received them in

the past. This leads to questions regarding causality on the results of the economic regression. However, involvement in standardization is very stable and certainly not influenced by public procurement, and excluding the 18% of companies who innovated from procurement does not alter main results. In addition, uncertainty is introduced to the models from not knowing the success rate of companies submitting calls for tenders – companies could only answer if they did, or did not, receive procurement contracts, at either the domestic level or from abroad. It may be the case that companies did were not successful in receiving contracts over this time period although they had submitted calls for tenders.

Additional limitations have to do with procurement characteristics. We are not able to control for different types of tendering in terms of procurement processes or stages (e.g., competitive dialogue) or the product or process being procured, including the extent to which the purchase was intended to stimulate innovation either directly or indirectly (Rolfstam, 2014). However, it may be safely assumed that companies would supply goods and services to public organizations in the sector in which they operate – i.e., companies belonging to the manufacturing sector would not provide services through public procurement contracts. Due to this it is assumed that the limitations of the sample to the manufacturing sector also limit the procurement contracts received to solely those for products and processes that companies in the manufacturing sector can supply. Finally, certain limitations exist for using the CIS dataset. For instance, as the survey is self-reported, responses represent a subjective assessment from the perspective of individual companies. However, the data is representative and has been used for analyses published in highly reputed journals, and is the only dataset that may provide insight into the innovation characteristics for German companies, particularly for engagement in public procurement.

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## 5.7 Appendix

*Table 5.5 – Odds ratio at 95% confidence interval*

| Explained variable: receipt of public procurement contracts | Procurement contracts within Germany | | | Procurement contracts outside of Germany | | |
|---|---|---|---|---|---|---|
| | Low | Odds Ratio | High | Low | Odds Ratio | High |
| Innovation and standardization-related factors | | | | | | |
| pdpp | 1.45 | 1.94 (0.29)*** | 2.60 | 1.76 | 3.51 (1.23)*** | 6.99 |
| pzfv | 0.86 | 1.13 (0.16) | 1.49 | 0.63 | 1.01 (0.24) | 1.63 |
| iafueint | 0.71 | 2.13 (1.19) | 6.36 | 0.02 | 0.39 (0.64) | 9.95 |
| oefall | 0.76 | 1.03 (0.16) | 1.40 | 0.83 | 1.37 (0.35) | 2.28 |
| stand | 1.18 | 1.77 (0.36)** | 2.63 | 0.86 | 1.47 (0.41) | 2.52 |
| Company Characteristics, Strategy and Competitive Landscape | | | | | | |
| logbges | 0.86 | 0.94 (0.04) | 1.03 | 1.06 | 1.22 (0.09)** | 1.40 |
| expint | 0.84 | 0.98 (0.08) | 1.14 | 0.98 | 1.13 (0.08)** | 1.30 |
| newmkts | 0.67 | 0.77 (0.06)*** | 0.90 | 0.96 | 1.30 (0.20)** | 1.75 |
| qualimprv | 0.89 | 1.05 (0.08) | 1.23 | 0.72 | 1.00 (0.17) | 1.39 |
| partnshp | 1.00 | 1.14 (0.08)** | 1.30 | 0.89 | 1.14 (0.15) | 1.47 |
| prodreplc | 1.00 | 1.16 (0.09)** | 1.35 | 0.66 | 0.88 (0.13) | 1.18 |
| mktthreat | 0.69 | 0.81 (0.07)** | 0.96 | 0.60 | 0.82 (0.13) | 1.13 |
| forgncomp | 0.83 | 0.95 (0.07) | 1.09 | 1.25 | 1.67 (0.25)*** | 2.25 |
| Sector of the manufacturing industry to which the company belongs | | | | | | |
| Ref. petrol, coke | 0.09 | 0.48 (0.42) | 2.67 | 0.18 | 1.15 (1.08) | 7.29 |
| Chemicals | 0.27 | 0.49 (0.14)** | 0.86 | 0.19 | 0.46 (0.21)** | 1.11 |
| Pharmaceutical | 0.28 | 0.63 (0.27) | 1.44 | 0.34 | 1.02 (0.58) | 3.10 |
| Rubber, plastic, metal | 0.27 | 0.42 (0.09)*** | 0.66 | 0.12 | 0.29 (0.13)** | 0.70 |
| Fabr. metal | 0.45 | 0.69 (0.15)** | 1.04 | 0.02 | 0.11 (0.10)** | 0.62 |
| Comp., elec., optic. | 1.33 | 1.95 (0.38)*** | 2.87 | 1.22 | 2.16 (0.63)** | 3.83 |
| Elec., mach., vehic. | 0.51 | 0.72 (0.13)** | 1.03 | 0.40 | 0.69 (0.19) | 1.20 |
| Wtr., rail., spce trnsp. | 1.67 | 3.32 (1.16)*** | 6.60 | 0.60 | 1.58 (0.77) | 4.12 |
| Furniture | 1.05 | 1.91 (0.58)** | 3.48 | 0.46 | 1.48 (0.88) | 4.75 |
| Other manuf. | 0.49 | 1.18 (0.53) | 2.85 | 0.77 | 3.14 (2.25) | 12.82 |
| Medical, dental | 0.35 | 0.66 (0.22) | 1.27 | 0.63 | 1.81 (0.98) | 5.23 |
| Mach. repair, instlln. | 1.04 | 1.63 (0.37)** | 2.56 | 0.36 | 0.96 (0.49) | 2.59 |
| Other | | | | | | |
| Constant | 0.16 | 0.28 (0.08)*** | 0.50 | 0.00 | 0.00 (0.00)*** | 0.01 |
| Pseudo $R^2$ | | 0.082 | | | 0.265 | |
| Log-Likelihood | | -905.28 | | | -302.67 | |
| Number of observations | | 2114 | | | 2114 | |

* A significance level of 10%
** A significance level of 5%
*** A significance level of 1%

*Table 5.6 – Regression results of logit estimations to explain success in domestic and foreign public procurement - Coefficients with standard errors in parentheses*

| Explained Variables: Receipt of procurement contracts | Receipt of Domestic contracts | Receipt of Foreign contracts |
|---|---|---|
| Innovation and standardization-related factors | | |
| pdpp | 0.66 (0.15)*** | 1.26 (0.35)*** |
| pzfv | 0.12 (0.14) | 0.01 (0.24) |
| iafueint | 0.76 (0.56) | -0.94 (1.65) |
| oefall | 0.03 (0.15) | 0.32 (0.26) |
| stand | 0.57 (0.20)** | 0.38 (0.28) |
| Company Characteristics, Strategy and Competitive Landscape | | |
| logbges | -0.06 (0.04) | 0.19 (0.07)** |
| expint | -0.02 (0.08) | 0.12 (0.07)* |
| newmkts | -0.26 (0.08)*** | 0.26 (0.15)* |
| qualimprv | 0.05 (0.08) | 0.00 (0.17) |
| partnshp | 0.13 (0.07)** | 0.13 (0.13) |
| prodreplc | 0.15 (0.08)** | -0.12 (0.15) |
| mktthreat | -0.21 (0.08)** | -0.19 (0.16) |
| forgncomp | -0.05 (0.07) | 0.52 (0.15)*** |
| Sector of the manufacturing industry to which the company belongs | | |
| Ref. petrol, coke | -0.74 (0.88) | 0.14 (0.94) |
| Chemicals | -0.72 (0.29)** | -0.77 (0.45)* |
| Pharmaceutical | -0.46 (0.42) | 0.02 (0.57) |
| Rubber, plastic, metal | -0.86 (0.22)*** | -1.25 (0.46)** |
| Fabr. metal | -0.38 (0.21)** | -2.18 (0.87)** |
| Comp., elec., optic. | 0.67 (0.20)*** | 0.77 (0.29)** |
| Elec., mach., vehic. | -0.33 (0.18)** | -0.37 (0.28) |
| Wtr., rail., spce trnsp. | 1.20 (0.35)*** | 0.46 (0.49) |
| Furniture | 0.65 (0.31)** | 0.39 (0.59) |
| Other manuf. | 0.17 (0.45) | 1.15 (0.72) |
| Medical, dental | -0.41 (0.33) | 0.59 (0.54) |
| Mach. repair, instlln. | 0.49 (0.23)** | -0.04 (0.51) |
| Other | | |
| Constant | -1.26 (0.29)*** | -5.77 (0.68)*** |
| Pseudo $R^2$ | 0.082 | 0.276 |
| Log-Likelihood | -905.28 | -298.30 |
| Number of observations | 2114 | 2114 |

* A significance level of 10%
** A significance level of 5%
*** A significance level of 1%

*Table 5.7 – Logit results of receipt of foreign procurement contracts, including variable for standards stock per sector*

| Explained Variables: Receipt of procurement contracts | Including with standards stock | Including interaction effect variable for engagement in standardization and standards stock |
|---|---|---|
| Innovation and standardization-related factors | | |
| pdpp | 1.29 (0.34)*** | 1.28 (0.34)*** |
| pzfv | 0.00 (0.23) | -0.01 (0.23) |
| iafueint | 0.14 (0.90) | 0.14 (0.90) |
| oefall | 0.52 (0.24)** | 0.52 (0.24)** |
| stand | 0.44 (0.27) | 0.21 (0.50) |
| stand_isic | 0.00 (0.00)*** | 0.00 (0.00)** |
| stand_stock | N/A | 0.00 (0.00) |
| Company Characteristics, Strategy and Competitive Landscape | | |
| logbges | 0.14 (0.07)** | 0.15 (0.07)** |
| expint | 0.16 (0.07)** | 0.16 (0.07)** |
| newmkts | 0.31 (0.15)** | 0.32 (0.15)** |
| qualimprv | 0.00 (0.16) | 0.00 (0.16) |
| partnshp | 0.15 (0.12) | 0.15 (0.12) |
| prodreplc | -0.26 (0.14)* | -0.26 (0.14)* |
| mktthreat | -0.16 (0.16) | -0.16 (0.16) |
| forgncomp | 0.50 (0.15)*** | 0.50 (0.15)*** |
| Other | | |
| Constant | -6.45 (0.66)*** | -6.42 (0.66)*** |
| Pseudo $R^2$ | 0.224 | 0.224 |
| Log-Likelihood | -319.61 | -319.47 |
| Number of observations | 2114 | 2114 |

* A significance level of 10%
** A significance level of 5%
*** A significance level of 1%

*Table 5.8 – Correlation matrix for domestic procurement success*

| | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | | | | | NACE | | | | | | | |
| | | baaus | pdpp | pzfv | iafueint | oefall | stand | logbges | expint | ustrat12 | ustrat5 | ustrat9 | wett3 | wett4 | wett7 | 10,0-18,2 | 19 | 20 | 21 | 22,0-24,0 | 25 | 26 | 27,0-29,0 | 30,1-30,9 | 31 | 32 | 32,5 | 33 |
| | baaus | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | pdpp | 0.1985 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | |
| | pzfv | 0.1136 | 0.3523 | 1 | | | | | | | | | | | | | | | | | | | | | | | | |
| | iafueint | 0.0613 | 0.2134 | 0.0575 | 1 | | | | | | | | | | | | | | | | | | | | | | | |
| | oefall | 0.1824 | 0.4400 | 0.2529 | 0.2844 | 1 | | | | | | | | | | | | | | | | | | | | | | |
| | stand | 0.1671 | 0.1964 | 0.1048 | 0.0025 | 0.1670 | 1 | | | | | | | | | | | | | | | | | | | | | |
| | logbges | 0.1953 | 0.2735 | 0.2681 | -0.0172 | 0.1902 | 0.3811 | 1 | | | | | | | | | | | | | | | | | | | | |
| | expint | 0.1817 | 0.2652 | 0.1682 | 0.1129 | 0.1875 | 0.2313 | 0.3780 | 1 | | | | | | | | | | | | | | | | | | | |
| | ustrat12 | 0.1802 | 0.4292 | 0.2374 | 0.1791 | 0.3302 | 0.2443 | 0.3777 | 0.4642 | 1 | | | | | | | | | | | | | | | | | | |
| | ustrat5 | 0.0332 | 0.1151 | 0.1153 | 0.0282 | 0.0925 | 0.0030 | 0.1416 | 0.0445 | 0.1774 | 1 | | | | | | | | | | | | | | | | | |
| | ustrat9 | 0.0971 | 0.2010 | 0.1732 | 0.1357 | 0.2638 | 0.0750 | 0.1223 | 0.0782 | 0.2533 | 0.1877 | 1 | | | | | | | | | | | | | | | | |
| | wett3 | -0.0812 | -0.1250 | -0.0472 | -0.0708 | -0.1502 | -0.0604 | 0.0041 | -0.1294 | -0.1564 | -0.0376 | -0.0472 | 1 | | | | | | | | | | | | | | | |
| | wett4 | -0.0330 | -0.0862 | -0.0304 | -0.0238 | -0.0595 | -0.0846 | -0.0709 | -0.0748 | -0.0589 | 0.0238 | 0.0198 | 0.3833 | 1 | | | | | | | | | | | | | | |
| | wett7 | 0.1144 | 0.0907 | 0.0915 | 0.0472 | 0.0755 | 0.1075 | 0.1999 | 0.2191 | 0.2910 | 0.0699 | 0.0744 | 0.1645 | 0.2518 | 1 | | | | | | | | | | | | | |
| | 10,0-18,2 | -0.1065 | -0.1831 | -0.1082 | -0.1228 | -0.2094 | -0.1618 | -0.1331 | -0.1934 | -0.2576 | -0.0750 | -0.0706 | 0.2233 | 0.0937 | -0.1250 | 1 | | | | | | | | | | | | |
| | 19 | 0.0121 | 0.0094 | 0.0371 | -0.0125 | 0.0272 | 0.0186 | 0.0321 | 0.0406 | 0.0591 | -0.0339 | 0.0244 | 0.0503 | 0.0394 | 0.0231 | -0.0455 | 1 | | | | | | | | | | | |
| | 20 | 0.0058 | 0.1296 | 0.0377 | 0.1067 | 0.0691 | 0.0254 | 0.0761 | 0.1176 | 0.1473 | -0.0257 | 0.0607 | -0.0431 | -0.0475 | 0.0187 | -0.1418 | -0.0178 | 1 | | | | | | | | | | |
| | 21 | 0.0275 | 0.0282 | 0.0396 | 0.1311 | 0.0850 | 0.0195 | 0.0179 | 0.0808 | 0.1020 | -0.0444 | 0.0327 | -0.0239 | 0.0393 | 0.0299 | -0.0889 | -0.0111 | -0.0347 | 1 | | | | | | | | | |
| | 22,0-24,0 | -0.0560 | -0.0331 | 0.0458 | -0.0611 | -0.0206 | 0.0215 | 0.0504 | 0.0306 | 0.0202 | 0.0433 | -0.0439 | 0.0181 | 0.0139 | 0.0631 | -0.2354 | -0.0295 | -0.0920 | -0.0576 | 1 | | | | | | | | |
| N | 25 | -0.0751 | -0.1294 | -0.0576 | -0.0563 | -0.0722 | -0.0463 | -0.0525 | -0.1013 | -0.0986 | 0.0221 | -0.0257 | 0.0068 | 0.0521 | 0.0180 | -0.2181 | -0.0274 | -0.0852 | -0.0534 | -0.1415 | 1 | | | | | | | |
| A | 26 | 0.1718 | 0.1837 | 0.0582 | 0.1672 | 0.2237 | 0.0722 | -0.0368 | 0.1149 | 0.1807 | 0.0520 | 0.0871 | -0.1958 | -0.0776 | 0.0301 | -0.1860 | -0.0233 | -0.0727 | -0.0455 | -0.1206 | -0.1118 | 1 | | | | | | |
| C | 27,0-29,0 | 0.0435 | 0.1623 | 0.0614 | 0.0369 | 0.1048 | 0.1444 | 0.1707 | 0.1216 | 0.1574 | 0.0416 | 0.0088 | -0.1005 | -0.0911 | 0.0553 | -0.2811 | -0.0353 | -0.1098 | -0.0688 | -0.1823 | -0.1689 | -0.1441 | 1 | | | | | |
| E | 30,1-30,9 | 0.0956 | 0.0733 | 0.0406 | 0.0008 | 0.0824 | 0.0636 | 0.1050 | 0.0488 | 0.0954 | -0.0021 | 0.0519 | -0.0290 | 0.0124 | 0.0443 | -0.0759 | -0.0095 | -0.0296 | -0.0186 | -0.0492 | -0.0456 | -0.0389 | -0.0588 | 1 | | | | |
| | 31 | 0.0074 | -0.0209 | -0.0018 | -0.0240 | -0.0577 | -0.0192 | -0.0145 | -0.0447 | -0.0441 | 0.0144 | -0.0275 | 0.0675 | 0.0218 | 0.0590 | -0.0947 | -0.0119 | -0.0370 | -0.0232 | -0.0614 | -0.0569 | -0.0485 | -0.0734 | -0.0198 | 1 | | | |
| | 32 | 0.0146 | -0.0035 | -0.0408 | -0.0180 | -0.0463 | -0.0214 | -0.0576 | -0.0121 | 0.0056 | -0.0455 | -0.0443 | -0.0182 | -0.0420 | -0.0567 | -0.0672 | -0.0084 | -0.0263 | -0.0165 | -0.0436 | -0.0404 | -0.0345 | -0.0521 | -0.0141 | -0.0175 | 1 | | |
| | 32,5 | 0.0113 | -0.0059 | 0.0253 | 0.0083 | -0.0287 | -0.0100 | -0.0913 | -0.0342 | -0.0815 | -0.0070 | -0.0138 | 0.0198 | 0.0179 | -0.0063 | -0.1065 | -0.0134 | -0.0416 | -0.0261 | -0.0690 | -0.0640 | -0.0546 | -0.0824 | -0.0223 | -0.0278 | -0.0197 | 1 | |
| | 33 | -0.0076 | -0.0793 | -0.0470 | -0.0243 | -0.0037 | -0.0299 | -0.0288 | -0.0271 | -0.0775 | -0.0054 | 0.0509 | -0.0503 | -0.0306 | -0.0854 | -0.1471 | -0.0185 | -0.0575 | -0.0360 | -0.0954 | -0.0884 | -0.0754 | -0.1140 | -0.0308 | -0.0384 | -0.0273 | -0.0432 | 1 |

*Table 5.9 – Correlation matrix for foreign procurement success*

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | | | | | | | NACE | | | | | | |
| | | bade | pdpp | pzfv | iafueint | oefall | stand | logbges | expint | ustrat12 | ustrat5 | ustrat9 | wett3 | wett4 | wett7 | 10,0-18,2 | 19 | 20 | 21 | 22,0-24,0 | 25 | 26 | 27,0-29,0 | 30,1-30,9 | 31 | 32 | 32,5 | 33 |
| | bade | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | pdpp | 0.1299 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | |
| | pzfv | 0.0509 | 0.3523 | 1 | | | | | | | | | | | | | | | | | | | | | | | | |
| | iafueint | 0.0711 | 0.2134 | 0.0575 | 1 | | | | | | | | | | | | | | | | | | | | | | | |
| | oefall | 0.0912 | 0.44 | 0.2529 | 0.2844 | 1 | | | | | | | | | | | | | | | | | | | | | | |
| | stand | 0.0746 | 0.1964 | 0.1048 | 0.0025 | 0.167 | 1 | | | | | | | | | | | | | | | | | | | | | |
| | logbges | -0.0024 | 0.2735 | 0.2681 | -0.0172 | 0.1902 | 0.3811 | 1 | | | | | | | | | | | | | | | | | | | | |
| | expint | 0.0071 | 0.2652 | 0.1682 | 0.1129 | 0.1875 | 0.2313 | 0.378 | 1 | | | | | | | | | | | | | | | | | | | |
| | ustrat12 | 0.0049 | 0.4292 | 0.2374 | 0.1791 | 0.3302 | 0.2443 | 0.3777 | 0.4642 | 1 | | | | | | | | | | | | | | | | | | |
| | ustrat5 | 0.0225 | 0.1151 | 0.1153 | 0.0282 | 0.0925 | 0.003 | 0.1416 | 0.0445 | 0.1774 | 1 | | | | | | | | | | | | | | | | | |
| | ustrat9 | 0.0722 | 0.201 | 0.1732 | 0.1357 | 0.2638 | 0.075 | 0.1223 | 0.0782 | 0.2533 | 0.1877 | 1 | | | | | | | | | | | | | | | | |
| | wett3 | -0.0291 | -0.125 | -0.0472 | -0.0708 | -0.1502 | -0.0604 | 0.0041 | -0.1294 | -0.1564 | -0.0376 | -0.0472 | 1 | | | | | | | | | | | | | | | |
| | wett4 | -0.067 | -0.0862 | -0.0304 | -0.0238 | -0.0595 | -0.0846 | -0.0709 | -0.0748 | -0.0589 | 0.0238 | 0.0198 | 0.3833 | 1 | | | | | | | | | | | | | | |
| | wett7 | -0.0267 | 0.0907 | 0.0915 | 0.0472 | 0.0755 | 0.1075 | 0.1999 | 0.2191 | 0.291 | 0.0699 | 0.0744 | 0.1645 | 0.2518 | 1 | | | | | | | | | | | | | |
| | 10,0-18,2 | -0.0914 | -0.1831 | -0.1082 | -0.1228 | -0.2094 | -0.1618 | -0.1331 | -0.1934 | -0.2576 | -0.075 | -0.0706 | 0.2233 | 0.0937 | -0.125 | 1 | | | | | | | | | | | | |
| | 19 | -0.094 | -0.1803 | -0.1013 | -0.1241 | -0.2034 | -0.1576 | -0.1268 | -0.1852 | -0.2459 | -0.0802 | -0.066 | 0.2303 | 0.0997 | -0.1203 | 0.9857 | 1 | | | | | | | | | | | |
| | 20 | -0.1017 | -0.1116 | -0.0847 | -0.0655 | -0.1655 | -0.1414 | -0.0898 | -0.1271 | -0.1739 | -0.0834 | -0.0379 | 0.1912 | 0.0661 | -0.1097 | 0.8806 | 0.8661 | 1 | | | | | | | | | | |
| | 21 | -0.0947 | -0.1698 | -0.0931 | -0.0782 | -0.1773 | -0.1518 | -0.1243 | -0.1631 | -0.219 | -0.0874 | -0.0585 | 0.2105 | 0.104 | -0.1126 | 0.9482 | 0.9338 | 0.8278 | 1 | | | | | | | | | |
| | 22,0-24,0 | -0.1371 | -0.1882 | -0.066 | -0.1532 | -0.2032 | -0.1312 | -0.0853 | -0.1533 | -0.2186 | -0.0378 | -0.0941 | 0.2141 | 0.0942 | -0.0692 | 0.7398 | 0.7245 | 0.6099 | 0.6841 | 1 | | | | | | | | |
| N | 25 | -0.1019 | -0.2517 | -0.1364 | -0.1488 | -0.238 | -0.1778 | -0.1557 | -0.2426 | -0.2993 | -0.0537 | -0.0811 | 0.2077 | 0.1195 | -0.1019 | 0.766 | 0.7509 | 0.6379 | 0.711 | 0.4787 | 1 | | | | | | | |
| A | 26 | 0.0074 | -0.061 | -0.0658 | -0.015 | -0.0617 | -0.1071 | -0.1448 | -0.1111 | -0.1316 | -0.0387 | -0.0139 | 0.091 | 0.0409 | -0.0978 | 0.815 | 0.8002 | 0.6898 | 0.7612 | 0.5358 | 0.5651 | 1 | | | | | | |
| C | 27,0-29,0 | -0.0835 | -0.0377 | -0.0489 | -0.0808 | -0.1054 | -0.0326 | 0.0132 | -0.0782 | -0.1077 | -0.0346 | -0.056 | 0.1212 | 0.013 | -0.0686 | 0.6727 | 0.6568 | 0.5371 | 0.6148 | 0.365 | 0.3983 | 0.459 | 1 | | | | | |
| E | 30,1-30,9 | -0.0646 | -0.1596 | -0.0952 | -0.1204 | -0.183 | -0.1415 | -0.1019 | -0.1765 | -0.2268 | -0.0743 | -0.0551 | 0.2114 | 0.0954 | -0.1106 | 0.9615 | 0.9471 | 0.8414 | 0.9095 | 0.6985 | 0.7252 | 0.7751 | 0.6298 | 1 | | | | |
| | 31 | -0.0672 | -0.1853 | -0.106 | -0.1277 | -0.2234 | -0.1641 | -0.1345 | -0.2034 | -0.2658 | -0.0682 | -0.078 | 0.2403 | 0.0986 | -0.1018 | 0.9417 | 0.9273 | 0.8211 | 0.8895 | 0.6771 | 0.704 | 0.7543 | 0.6074 | 0.903 | 1 | | | |
| | 32 | -0.0863 | -0.1813 | -0.1168 | -0.1255 | -0.2178 | -0.1648 | -0.1454 | -0.1936 | -0.2526 | -0.0851 | -0.0805 | 0.2157 | 0.082 | -0.1372 | 0.9695 | 0.9551 | 0.8495 | 0.9175 | 0.7071 | 0.7337 | 0.7833 | 0.6387 | 0.9309 | 0.9109 | 1 | | |
| | 32,5 | -0.0894 | -0.1794 | -0.0953 | -0.1158 | -0.2134 | -0.1604 | -0.1631 | -0.2 | -0.2799 | -0.0752 | -0.0735 | 0.2236 | 0.0974 | -0.1234 | 0.9278 | 0.9134 | 0.8069 | 0.8755 | 0.662 | 0.6892 | 0.7398 | 0.5916 | 0.889 | 0.8689 | 0.897 | 1 | |
| | 33 | -0.0468 | -0.2122 | -0.1255 | -0.1281 | -0.1998 | -0.1678 | -0.1401 | -0.1962 | -0.2818 | -0.0736 | -0.0417 | 0.1864 | 0.0735 | -0.1603 | 0.873 | 0.8584 | 0.7503 | 0.8201 | 0.6015 | 0.6296 | 0.6817 | 0.5282 | 0.8337 | 0.8134 | 0.8419 | 0.7991 | 1 |

# 6 Conclusions – Innovation Procurement and Open Innovation

Innovation procurement introduces open innovation processes to public procurement, leveraging standardization, collaboration, and intermediation to meet primary and secondary policy objectives. Both standardization and collaboration are processes of consensus-building: formal standards resulting from standardization – as well as information gathered through collaboration – combine technical, market, and tacit knowledge in a specific area. The knowledge outcomes of both of these processes can be strategically input into tenders, creating public procurement competitions that are more open – and to more potential suppliers – and which allow for more innovative proposals. Intermediation can facilitate these processes by strategic bridging, facilitating knowledge generation improving the source, type, direction, and speed of knowledge transferred, and signalling markets.

Despite this potential, four critical challenges limit our understanding of and ability to better use standardization, collaboration, and intermediation in innovation procurement. Policy drivers for these mechanisms are siloed, little is known about their prominence, few examples of practice have been gathered, and their influence on industry strategy remains unclear. This dissertation addresses these challenges to investigate how to better use public procurement in promoting sustainable and inclusive European growth through innovation, by focusing on inputs to the public procurement process which may improve the rate and extent of this growth. The first three papers in this dissertation examine these mechanisms for their contribution to open design process for public procurement competitions, and the last tests the effect of firms' open innovation strategies on winning such competitions.

## 6.1 Integrating Demand-Side Processes

The first paper, in Chapter 2, provides an integrated analysis of how two demand-side policy mechanisms (standardization and public procurement) can be applied simultaneously to enhance environmental benefits through public purchasing. It does so by

building a framework to mutually conceptualize standardization in pre-commercial procurement (PCP), the public procurement of innovation (PPI), and green public procurement (GPP). Through a comprehensive literature review and synthesis, it highlights a role for standardization in research and development (R&D) services particularly, for helping to shape future infrastructures through public works such as major energy and transport infrastructure. Horizon 2020 projects which fund joint PCP projects between procuring agencies may also stimulate engagement in standardization by these parties, as new cooperations create interconnections between stakeholders interested in shaping future infrastructures in a certain way.

When incremental changes are required to an existing product, standards (the products of standardization) for measurement, testing, and compatibility are important. Interface standards, particularly, are necessary to embed into technical specifications to ensure that the resulting innovation fits. Combining these standards with minimum requirements in award criteria can help open tenders to innovation. This was found in the third paper (Chapter 4), where a minimum 10% of post-consumer recycled content was required, and where International Organization for Standardization (ISO) standards were applied in technical specifications to ensure quality aspects including durability, absorption, and colourfastness. Due to the nascency of using recycled cellulosic material in textiles, testing standards were also underdeveloped in this case, and procurers chose not to use emerging standards in the area as they saw them as premature, rather waiting for a better standard to emerge.

For products already on the market – the focus of GPP initiatives – information standards can help to incorporate environmental criteria and support environmental life cycle costing, while minimum quality standards promote diffusion of environmental products and services. Given the high proportion of public agencies procuring such readily-available products, as identified in the second paper (Chapter 3), the development of GPP criteria at the European level for procurers to use is likely to benefit both purchasers and the market for environmental products and services. These initiatives are not extended to products and services that undergo development through innovation procurement, however, and common criteria for these varied developments under PCP and innovation partnerships would be difficult to establish. Perhaps a more efficient means of

promoting eco-innovation for PCP and PPI is to train procuring agencies to scan, apply, and help build standards, enabling them to adapt to varying needs in different projects.

## 6.2 Benchmarking Open Innovation Processes

Despite the potential benefits of capturing external knowledge in innovation procurement, the ability of public agencies to do so varies greatly. Through a cluster analysis investigating the heterogeneity of knowledge sourcing activities, the second paper (Chapter 3) found that half of public agencies sampled across Europe are limiting their consultation to users and other government organizations, for purchasing products and services already on the market, and with cost reduction in mind. The off-the-shelf nature of these products and services reflects their developmental maturity, which procurers desire to meet user needs. It suggests that the learnings of other, possibly larger, procuring agencies are being applied to these smaller agencies at the municipal level. Returning to the promotion of standards such as through GPP criteria (Chapter 2), targeting off-the-shelf products and services would affect the purchasing of half the procuring agencies across Europe, supporting the benefits of information standards and connection to user needs.

In procuring R&D services through PCP, other agencies which are larger and serve more regional territories readily consult potential suppliers, and also work together with them in developing innovations. Drawing from the findings of the first paper (Chapter 2), such procurers are the ones who should be first targeted to promote engagement in standardization after each successive R&D phase, as doing so would build upon their existing competences in PCP. Their knowledge of standards inventories and potential for application is critical in shaping future innovation trajectories, particularly with new possibilities to purchase the outcomes of PCP through an innovation partnership mechanism.

National agencies – found to conduct primarily PPI along with a fair number of PCP activities – consult users, suppliers, other governments, and specialists, and purchase and implement innovations. Their practices have parallels for standards development institutes, who conduct consensus processes with varied stakeholders to develop a set of specifications in a document. Their external orientation, consultation abilities, and

innovation outcomes of their purchasing suggest that national procuring agencies may also be more knowledgeable of and better able to deploy standards in their purchases, and their purchased innovations also lead to cost-savings. Further research is required to determine the use of standards (and standardization practices) of such public agencies, and the relationship between this and their collaboration activities.

## 6.3 Uncovering Intermediary Roles

While the second paper (Chapter 3) shows that public agencies are indeed consulting varied sources of knowledge, albeit to different degrees and with different innovation outcomes, the question remained of how this collaboration might be facilitated. To address this, the third paper (Chapter 4) examines extensive intermediation in a pilot project used to input knowledge and standards into a final tender. The project typified a cooperative procurement, initiated and furthered by multiple government agencies. It found that multiple intermediaries with complementary business, technical, and systems-level skillsets coordinated amongst themselves to generate, gather, and input knowledge from suppliers. Intermediaries actively coordinated the alignment of project goals across government and industry institutions, and facilitated cooperation of industry members in sharing information and stimulating new partnerships in supply chains. Their collaborative activities with the buyer during tender drafting pushed toward a common goal of increasing value for recycled material – for market and sustainability benefits. These interactions in the final stages were marked with dissent due to the buyer's prioritization of user needs and desire to constrain costs. Involvement of intermediaries proved to be necessary to push sustainability criteria in tender development. An invited specialist was central to helping the buyer reconfigure the formal standards used in the tender, suggesting that even large procuring agencies face difficulties in applying standards when purchasing an innovation.

These findings reinforce those of the second paper (Chapter 3) regarding the prominence of open innovation practices by large, national-level agencies. From the government participation side, an issue of *internal governance* is the delegation of authority to an organization lower in the hierarchy to perform tasks to reach the goal, at the level where purchasing would actually take place, such as a dedicated procurement department. An

alternative to this delegation is the use of centralized procuring agencies, such as the Category Management in the Netherlands, if they themselves serve as buyers for clients across Ministries. Importantly, by providing deep insight into a successful open innovation process by such an organization, this paper (Chapter 4) identifies challenges beyond the organizational capacities of the procuring agency that influence demand setting. In highlighting the importance of the *relationships between* organizations collaborating in public demand setting, it concludes that intermediation plays a critical role in knowledge creation and translation.

The circular economy focus of the pilot project provided an opportunity to study the complex dynamics of intermediation in balancing cost, quality, and sustainability, as influenced by multiple parties driven by different objectives. Its findings suggest that – although it can facilitate more sustainable criteria in tenders – cost savings garnered through centralizing demand may compromise the consideration of user needs. This raises questions on the ability for innovation procurement to meet both primary policy objectives of needs fulfillment and cost reduction, particularly for complex projects involving numerous stakeholders and potential innovation trajectories. As secondary policy objectives may be imposed by third-party government agencies, perhaps these parties should have the responsibility of facilitating intermediation. This would enable such agencies to further cooperative or catalytic procurement, by interjecting secondary objectives between the buyer's motivation of cost savings, the user's of performance, and the supplier's of profit.

## 6.4 Comparing Open Innovation Strategies

Once tenders are finalized and published, the success of innovation procurement also depends on the abilities of industry to meet specifications and present innovative solutions. In this dissertation's final paper (Chapter 5), firm strategies that lend themselves to success in public procurement competitions are empirically tested through multiple regression analyses. German manufacturing firms were analyzed, with respect to winning both domestic and foreign public procurement competitions. Product innovation, followed closely by standardization, are the two most influential factors in increasing a firm's likelihood to win a domestic contract – by almost twofold. When examined independently,

all innovation indicators (product innovation, process innovation, external R&D expenditure, and public funding for R&D or innovation projects) increase their likelihood as well. Engagement in strategic alliances is also an important factor, supporting that companies who are open to open innovation by sharing and sourcing information benefit from this in receiving public contracts.

In this sense, parallels can be drawn between benefits of open innovation processes for innovation for public agencies (Chapter 3) and private firms, in that greater openness positively influences results for each. These findings also suggest that standards are being applied in at least late-stage PCP activities, for which more product rather than process innovations are developed. As successful firms face threats of product replicability by competitors without facing market threats, innovation procurement in Germany may seek to stimulate incremental innovations, as tailoring available products or services to user needs. That firms in the ICT sector are more likely to be successful supports the high prominence of tendering for ICT innovations also found in the second paper (Chapter 3), and underscores the relevance of Horizon 2020 funding initiatives supporting studies of standardization for ICT in public procurement. Similarly, the strongest sector indicator of water, railway, and space transport reinforce the need to consider standardization according to procurement of major infrastructure projects in the first paper (Chapter 2). Directive 2004/17/EC promotes openness through tender design and standards used for procurement in these areas specifically, due to the multiple ways that national agencies can influence firm behavior and the "closed nature" of these markets (EC, 2004, p.1). It is a positive sign for innovation that firm size did not influence success, where SMEs face a more even playing field. The new directive encourages procurement to sub-divide large to increase accessibility of their tenders to smaller firms (EC, 2014), although this may also result in closing-off of competition if doing so lowers contract values to below European publishing thresholds.

The strong concentration of German procuring agencies in the least innovative cluster in the previous paper (Chapter 4) raises interesting questions. The finding is supported by the even stronger advantages of innovation for German firms in winning foreign rather than domestic contracts, where innovation was not as important. As well, the cluster with Germany in Chapter 4 had the least supplier consultation, such that advantages to winning companies is more likely to come from standardization rather than any

consultation with procuring agencies. As an alternative interpretation to the openness of public procurement in Germany to innovation, it may be that published tenders value either standards *or* innovation, rather than both, although this is unlikely. In comparison with suppliers of the Dutch government interviewed, German companies successful in domestic procurement were not focused on developing new markets from abroad. This finding underscores that the size of a particular procurement market is one indicator of the degree of innovation that can be attained through the number of eligible firms it can attract.

A seemingly unique role of intermediation that includes hard, soft, and systemic intermediaries is the successful combination of both standardization (standards) and collaboration mechanisms, bringing together both technical and market knowledge. However, in instances where there are insufficient resources required to fully assist with both mechanisms, which should be prioritized? And if procuring agencies were to have increased engagement in standardization, would the need for such specialist help decrease? Further research in this regard should also be undertaken to investigate the use of non-formal standards, such as consortia or *de facto* industry standards, as informally applied in tenders and used by firms that are successful in procurement competitions. Progress on innovation procurement will provide a stronger foundation from which to study these more intangible aspects.

## 6.5 Enhancing Innovation and a Single European Market

Taken together, the results of this dissertation suggest a high degree of heterogeneity in practices of innovation procurement by governments across Europe. Spain, the United Kingdom, and the Netherlands are successful in collaborating to source knowledge – learnings which can be shared with countries such as Germany, Poland, and Romania, who already value cooperation with other governments to inform their procurements. High-performing governments have the opportunity to partner with those who require assistance in conducting public procurements – both domestically and abroad – as supported by funding under Horizon 2020. Governments are beginning to discuss procurement mechanisms with national agencies from other countries, such as between the Ministries of Defense of the Netherlands and Germany, France, and Belgium.

Germany does appear to be rewarding product innovation through its public procurement, although innovative German firms are even more successful in competitions from abroad because of this. As well, public procurements within the country are leveraging the cost-saving effects of standards by rewarding companies who participate in standardization activities. However, as national standardization activities only give a competitive advantage to domestic procurement competitions, the openness of German procurement competitions to foreign competition is questionable. Large differences between the proportion of *work contracts*, and *services and supplies contracts*, over thresholds for publishing at the European level (EC, 2015; London Economics et al., 2011) suggest that the latter is much more open to foreign competition – especially for national procuring agencies – and may attract more innovation because of that.

Also affecting cross-border supplier considerations, innovation procurement processes can stimulate new supply chain partnerships between countries as suppliers are prompted to develop relationships that enable the capture of new value from public demand. Textile suppliers interviewed indicated they also pursued contracts with the Ministries of Defense for the French, Belgium, and German governments. However, for German manufacturing firms, strategic alliances are only a predicting factor for domestic competitions, suggesting that successful partnerships are more often from within the same country. Engagement in standardization activities at the domestic level does not predict success in competitions from abroad, where standards referenced may be rather those from the country of tender origin. Interviewees who supplied the Dutch government noted that German procurers – whom they also supplied – relied more heavily on standards as evidence of meeting criteria in their procurement competitions.

### 6.5.1 Consequences and Predictions for Innovation Partnerships

The novel mechanism of innovation partnerships introduced in the new European Procurement Directive has implications for open innovation practices. The innovation partnership is now possible for when no market solution exists, and when R&D is required to provide a solution to meet an agency's needs. The mechanism has potential implications for collaborative practices of procuring agencies, openness of innovation procurement competitions to suppliers from abroad, the degree of novelty and the systemic effects of

innovations procured using this mechanism. Allowing for contracting with multiple suppliers, supplier consultation may increase through the uptake of innovation partnership practices. As firms compete in successive competitions for R&D services, the degree of innovation in the final product or process would be expected to increase. Innovation partnerships may increase participation in standardization by public agencies after each of these R&D contracting stages, as underlying the selection of the mechanism is a conscious awareness of the impact of public procurement on shaping innovation. For municipal agencies, the innovation partnership mechanism may provide a way to work with suppliers to develop innovations based on the user needs they are familiar with. This prediction is made cautiously, as the second paper (Chapter 3) of this dissertation identified that the Procurement Directive will not directly stimulate innovation in municipal and regional agencies, rather assisting them in cost-savings in purchasing off-the-shelf products to meet user needs.

With the innovation partnership mechanism, procuring agencies must adhere to pre-defined performance and costs set before any contracts are signed (EC, 2014). This effectively limits the openness of the mechanism to new ideas. As well, as procuring agencies may decide to work with only a single supplier through all stages of R&D, the innovation partnership mechanism may also limit openness to competition. This limit can extend to competition from abroad, if procuring agencies award a single domestic supplier, and be conducive to the development of national champions – to the detriment of inclusive European growth. With long timelines required for developing entirely new products or services, this limitation could persist for years, compounded by potential time overruns as suppliers face no competition to accelerate development or pressure to exceed expectations. Enhancing knowledge of standards inventories and potential application by agencies conducting PCP will increase the success rate of innovation partnerships, which require performance requirements to be set before initiation of the first contract; even for radical innovations with many unknowns. Engagement of purchasing agencies in standardization could help draft requirements, architecture, and more detailed protocol or conformance testing standards throughout an innovation partnership to help shape innovations in desired directions, more quickly.

## 6.6 Final Remarks

This dissertation provides a contribution to the field of innovation procurement by delving deeply into open innovation processes. Mechanisms of standards, collaboration, and intermediation that can be leveraged to promote European growth through innovation procurement are inherently processes of consensus. This dynamic process is shaped by the motives, knowledge, and skillsets of participants shared through interactions, and structured by organizations and institutions. Research on these interactions complements legal analyses of innovation procurement, as it provides deep insight into policy alignment for innovation, capabilities of procuring agencies, functions for facilitating collaboration, and the strategies of firms. Outside of academia, results provide insights for policy, industry, and practitioners of innovation procurement.

Regarding implications for policy, findings establish that open innovation as the free movement of knowledge – the "fifth freedom" (EC, 2010, p. 15) – is being practiced within Europe to support innovation procurement. While many public agencies are obtaining knowledge from a variety of sources, many more require assistance to understand market potential and technical opportunities in a target procurement area. Balancing between collaborative initiatives in which such knowledge is generated and shared, and setting demands for novel goods and services developed using this information, is critical. Intermediation should be promoted due to the clear benefit it can have in facilitating these processes, and may provide a cost-efficient alternative to building up capacity within each individual procuring agency. An innovation procurement framework at the European level (as recommended by e.g. ERAC, 2015) and for the OECD countries (Appelt & Galindo-Rueda, 2016) is indeed necessary. Such a framework would help capture the good practices of many leading member states and transfer them across Europe more systemically than would individual cooperative initiatives between countries. In addition to the "definitions, goals and indicators, tools and activities, … roles and responsibilities" recommended by ERAC (2015, p.5), this should include a new taxonomy, roles and application methods for standards and standardization (particularly in PCP and innovation partnerships), recommended knowledge sourcing activities, and roles for intermediators. Upon this framework, a European action plan (ERAC, 2015) can be built, and should give strong consideration to the various policy initiatives of countries promoting innovation procurement (Appelt & Galindo-Rueda, 2016).

For industry, engaging in open innovation processes increases a firm's competitiveness in public procurement and influence on markets and technology trajectories. Involvement in national standardization activities and strategic alliances increases the likelihood that firms will win a tender in a domestic competition. Through discussions and cooperation in working groups, firms can receive important information about upcoming purchases and indirectly influence a tender's content to increase their advantages in the long-term. Firms offering R&D services have a stronger ability to influence PCP competitions, and may better tailor their developments by considering user needs, which may be overlooked by agencies conducting such purchases. Individuals or entire firms may act as intermediaries in helping government bring in market and technical knowledge to their purchases, also benefiting the firm by enabling input into the final tender.

Public procurement practitioners should achieve a greater awareness of the importance of and potential to support secondary policy objectives in their purchasing. While professionalization of the procurement process (e.g., EC, 2015) may be the most efficient means of pursuing these goals in already top-performing national agencies, smaller and more dispersed municipal agencies may benefit most from the sharing of knowledge and methods in particular purchasing areas by larger organizations. Thus, a key component of improving innovation procurement through practitioners will be increased involvement with other procuring agencies, through cooperative or catalytic procurement. Using these mechanisms, objectives can be aligned, funds pooled, and knowledge and practical resources shared (in the case of cooperative) or deployed (in the case of catalytic) to promote secondary goals. Capturing new opportunities for such integration should be considered in any organizational rearrangements intended to promote innovation procurement, to mitigate structural hindrances.

In light of the contributions of this dissertation, questions in innovation procurement still remain. To better conceptualize innovation procurement, an updated taxonomy that encompasses innovation procurement practices, inclusive of new modalities, and learning and evolutionary characteristics is needed. For benchmarking progress, this taxonomy should be applied in developing a dedicated dataset and indicators for capturing innovation procurement practices across Europe. This will be crucial to providing a baseline upon which to monitor the effectiveness of the new Procurement Directive. To

date, there are no causal studies on how decisions made in procurement design processes influence the market, in large part due to the lack of coordinated information gathering by procuring agencies. As well, despite recommendations made in this dissertation for broader and improved application of intermediation in innovation procurement projects, academic study on this phenomenon is in its nascency. With respect to demand articulation, greater insight is needed to discover how to best combine buyers' motivations of cost savings, users' of performance, and suppliers' of profit, with the secondary policy objectives often imposed by third parties. This is especially important when pursuing goals that significantly alter the way business is done, such as in promoting more circular economies.

Given the findings of this dissertation, we must acknowledge the complementarity of standards and collaboration in innovation procurement while recognizing a degree of fungibility, as they each may provide common technical and nascent market knowledge. Thus, can the strategic use of standards compensate for a lack of supplier consultation, or collaboration processes replace an over-reliance on formal standards in tenders? Any balance struck between these two mechanisms should depend in part on the type of procurement being conducted – when standards more relevant to PCP and PPI have been built with high input from suppliers, standards for regular products through direct procurement are designed for communicating information to users. The translations of Directive 2014/24/EU by member states this year provides a crucial opportunity to begin studying the next phase of open innovation practices using standardization, collaboration, and intermediation for sustainable and inclusive European growth.

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