Communauté
UNIVERSITÉ Grenoble Alpes

THÈSE

Pour obtenir le grade de

DOCTEUR DE LA COMMUNAUTÉ UNIVERSITÉ GRENOBLE ALPES

Spécialité : **Sciences économiques**

Arrêté ministériel : 25 mai 2016

Présentée par

Julien CHICOT

Thèse dirigée par **Mireille MATT**

préparée au sein du **Laboratoire d'économie appliquée de Grenoble**
dans **l'École doctorale de sciences économiques**

Strategic use of public procurement for innovation: Rationales, instruments and practices

Thèse soutenue publiquement le **18 juillet 2017**, devant le jury composé de :

M. Uwe CANTNER
Professeur, Friedrich Schiller University Jena, Rapporteur

M. Jakob EDLER
Professeur, The University of Manchester, Rapporteur

M. Dominique GUELLEC
Chef de division, OCDE, Invité

Mme. Nathalie LAZARIC
Directrice de recherche, CNRS, Présidente du jury

Mme. Nadine MASSARD
Professeure, Université Grenoble Alpes, Examinatrice

Mme. Mireille MATT
Directrice de recherche, INRA, Directrice de thèse

M. Nicholas VONORTAS
Professeur, The George Washington University, Examinateur

L’Université Grenoble Alpes n’entend donner aucune approbation ni improbation aux opinions émises dans cette thèse. Celles-ci doivent être considérées comme propres à leur auteur.

Table of content

List of tables

List of figures

Acknowledgment

Before enrolling for my PhD, I was warned several times that this endeavour would be intellectually stimulating but would entail loneliness. After almost four years, I would contend that only one of these statements holds true. Indeed, I have never learned so much, but always with the strong support of my supervisor, my colleagues, friends and family. They all deserve my most sincere acknowledgement.

I wish to thank first and foremost my supervisor, Mireille Matt. I am highly grateful to her. Even though we did not know each other and I did not have the most relevant university background to do a PhD in economics, she considered my application, significantly assisted me in preparing my research proposal, and then welcome me in Grenoble. During the following almost four years, she has demonstrated exceptionally strong commitment to my supervision, shared her wide knowledge, and provided me with wise pieces of advice for my research and professional career. She has been an even greater PhD supervisor, as she did so with patience, enthusiasm, honesty, good mood and the optimism that I may sometimes lack. Most importantly, she found the right balance between a professional and effective supervision and a friendly support. Even though I am glad to finally defend my PhD, I feel sad as it means that our collaboration is about to end. However, I am eager to find new projects on which we will collaborate again.

Two of the chapters of this dissertation are the result of equally fruitful and friendly collaborations.

Mercedes Bleda was first the author of an article that caught my attention. I met her in Manchester, thanks to Jakob Edler, and we rapidly agreed that we should collaborate. This was the start of a series of long afternoon discussions in her office and then via Skype. Of course, these meetings would have been shorter if we had not also chatted between two serious talks. They are nevertheless good memories! I have learned a lot about evolutionary economics with her. This has not helped me fit in the academic economic community afterwards though, but I have no regret. I wish to thank her for all

these reasons, and for her high and honest involvement in our collaboration despite her ‘hectic’ (I have learned this word from her) schedule.

My third co-author is Marie-Anne le Dain. We were from different academic fields, from different schools, and from different parts of Grenoble city. We were introduced to each other by Daniel Llerena to make an interdisciplinary research proposal. We got the funding and started a collaboration, which has demonstrated all the importance of promoting further interdisciplinarity. Her enthusiasm, humour, frankness were a major asset to our project, which also benefitted from her highly valuable inputs and insights. As a researcher in an engineering school, she taught me a few techniques to represent processes. That was enough to wake up my nerdy self. She would deserve an acknowledgement in all projects in which I inserted a blueprint! For all these reasons, I am highly grateful to her.

I wish to thank Uwe Cantner, Jakob Edler, Dominique Guellec, Nathalie Lazaric, Nadine Massard, and Nicholas Vonortas for having accepted to be part of my PhD committee. It is a great honour to discuss my doctoral research with them.

This work would have not been possible without the daily support of the researchers, and research and administrative assistants of the Grenoble Applied Economic Laboratory, to whom I am sincerely grateful. Among them, I wish to express my special thanks to Janine Barba, Edwige Charbonnier, Sylvie Charlot, Gwennaël Clément, Brigitte Colomb, Frédéric Corolleur, Marie Cronfaldt, Paolo Crosetto, Mariane Damois, Rokhaya Dieye, Adélaïde Fadhuile, Aline Fugeray-Scarbel, Alexis Garapin, Ariane Gaunand, Adrien Hervouet, Anne Lacroix, Cédric Lanu, Stéphane Lemarié, Aurélie Level, Daniel Llerena, Nadine Massard, Béatrice Roussillon, Paolo Saviotti, Sabrina Teyssier, Agnès Vertier, and Valérie Wallet. I cannot forget my fellow PhD students, especially my pals Penelope ‘Penny’ Buckley and Nicolas Pasquier, my officemates Joël Aka and Bilel Rahali, and Ibrahima Barry, Germán Bersalli, Hélène Bouscasse, Rania Mabrouk, Miléna Marquet, and Sébastien Parenty. A special thank also to Elena Tea from the LIDILEM laboratory of Univ. Grenoble Alpes, who offered me delightful Italian-speaking break during my research, to Mariane Damois for her fast transcription of interviews, and to Cynthia Little for the rapid and high-quality editing of several parts of this dissertation.

I acknowledge Université Grenoble Alpes and, more specifically, INNOVACS and its directors, Daniel Llerena and Dominique Rieu, for having given me the opportunity to pursue my doctoral research. I also benefitted from the financial support of the Rhône-Alpes Regional Council, the Foundation for Industrial Innovation of Grenoble INP, the Grenoble Applied Ecoonmics Laboratory, and Canada's Social Sciences and Humanities Research Council.

With the financial support of the Rhône-Alpes Regional Council, I had the opportunity to do a six-month research visit at the Manchester Institute of Innovation Research of the University of Manchester. I am highly grateful to Jakob Edler for his welcome, his efforts to put me in contact with the right persons to advance my research, and then to have supported me since then. I additionally acknowledge Michaël Benaim, Lisa Dale-Clough, Siobhan Drugan, Dimitri Gagliardi, Kieron Flanagan, Philippe Larédo, Yanchao Li, John Rigby, and Elvira Uyarra. I had a great time in Manchester thanks to my fellow PhD visitors including Magdalena Bielawska, Xiaoyong Dai, Marisela Rodriguez Salvador, Ruyi Shi, and Jian-Hang Wang. My stay in Manchester is unforgettable due to the awesome time that I shared with my 'Mancunian family'. I wish to express my most sincere gratitude to Joanna Dowey and her family: the little Maddox Johnston, Janet Mugg, Anthony Walls, and Beatrice and Mary Williams.

During the last months of finalisation of this dissertation, I got the support of my colleagues of the Joint Institute for Innovation Policy. They all deserve to figure in this list of acknowledgements: Jacqueline Allan, Iker Barrondo Sáez, Lia Federici, Robbert Fisher, Daniel Gehrt, Milica Misojcic, and Luca Alessandro Remotti.

My family had a key role in my doctoral research that I need to acknowledge. My mother, Marie-Christine Chicot, showed an extreme patience and has been the most supportive person whom I have ever had. My brother, David Chicot, was the only person allowed to make jokes about my advancement. He might not know how helpful he was during my "PhD writing retreat" at the University of Caen. My incredible grandmother, Carmelle Catteau, is my model of commitment to *res publica*. My father, Paul-Albert Chicot, offered the necessary retreats back to the French Riviera. I am grateful to my aunt, Marie-Valérie Barthélémy, for her harassment to know the date of the defence to

be sure to be able to attend it. Finally, I wish I could have thanked my grandfather, Marcel Chicot, before he left.

In addition to my family, the following friends have always been here to change my mind and help me forget about public procurement of innovation for a while, especially Julien Baglio, Maria-Chiara Baldaccini, Nadège Bernard, Alice Boulleaux, Katarina Cirodde, Julien Deschamps, Laura Dufaut, Marine Fahy, Cynthia Lavison, Céline Mazars, and Tomomi Watanabe.

Finally, I want to thank two OECD persons, without whom this PhD would not have happened, namely Dominique Guellec, who encouraged me to enrol, and Sandrine Kergroach, who gave me my first job and trained me in innovation policy analysis.

Résumé en français

Contexte de la thèse

Dans la directive 2014/24/EU du 26 février 2014 sur la passation des marchés publics, le Parlement et le Conseil européens rappellent, au considérant 95, que « les marchés publics sont essentiels pour promouvoir l'innovation, qui est très importante pour la croissance future en Europe. » Ils contribuent ainsi à une tendance observable au niveau tant international que national de promotion de l'utilisation des achats publics en soutien à l'innovation.

Dès 2003, la Commission européenne a considéré qu'une utilisation appropriée des achats publics pouvait aider à atteindre l'objectif de dépenses en recherche et développement (R&D) fixé par le Conseil européen à Barcelone, c'est-à-dire 3% du PIB d'ici 2010 (European Commission, 2003). En 2006, le rapport du groupe d'experts dit d'Aho a remis son rapport '*Créer une Europe innovante*' dans lequel il préconise de mobiliser les achats publics pour créer un environnement favorable à l'innovation (Aho et al., 2006). Plus récemment, le Comité de l'Espace européen de la recherche et de l'innovation (CEER) a appelé à faciliter et soutenir les achats publics d'innovation (API) (ERAC, 2015). La Commission européenne n'a néanmoins pas attendu cet appel pour commencer à réformer le cadre juridique des achats publics en ce sens. La directive 2004/18/EC du 31 mars 2004 a introduit la procédure de dialogue compétitif pour faciliter la passation des contrats publics complexes, c'est-à-dire les achats publics au cours desquels les organisations publiques doivent interagir en amont avec de potentiels fournisseurs pour déterminer les spécifications des solutions qu'ils s'apprêtent à acquérir. Enfin, comme mentionné plus haut, la Directive 2014/24/EU a été adoptée, dix ans plus tard, notamment en réponse à l'appel de la Commission européenne pour une plus grande utilisation des achats publics en direction d'objectifs sociétaux dont l'innovation.

L'Organisation de coopération et de développement économiques (OCDE) a pareillement formulé des recommandations pour utiliser les achats publics en soutien à l'innovation (OECD, 2011a), conformément à sa Stratégie d'innovation de 2010 (OECD, 2010). En 2015, son Conseil a reconnu officiellement que les achats publics pouvaient poursuivre des objectifs secondaires tels que l'innovation. Cependant, il est important que la raison d'être de ces achats reste d'aider « l'exécution des missions des pouvoirs publics en temps opportun, au moindre coût et avec efficience » (OECD, 2015a, p. 6).

Ces appels d'organisations internationales ont, semble-t-il, été suivis d'effets. Un nombre croissant de pays de l'OCDE a, en effet, adopté ces dernières années des mesures pour faciliter l'utilisation des achats publics en soutien à l'innovation. En 2014, ils étaient 28 à encourager une telle pratique par le biais soit de mesures nationales soit de stratégies adoptées par des organismes d'achat public (OECD, 2015b). D'après les Perspectives de la science, de la technologie et de l'innovation de l'OCDE de 2016, les mesures facilitant les achats publics d'innovation sont parmi les politiques de science, technologie et innovation qui ont connu le plus de changements (en termes d'adoption, révision, abrogation) (OECD, 2016b). Ces tendances ne sont pas circonscrites à l'OCDE, mais également observables en Chine (Li, 2013) et dans les pays d'Amérique latine et des Caraïbes (Ribeiro and Furtado, 2014; Uyarra and Moñux, 2016).

La France illustre également cette tendance émergente dans les politiques d'innovation. Alors que les achats publics ont joué un rôle important dans le développement des télécommunications, du train à grande vitesse (TGV) et de l'énergie nucléaire dans les années 1980 et 1990 (Terrasse, 1992), une priorité moyenne-basse était encore accordée aux politiques de la demande pour l'innovation en 2010 (OECD, 2011b). L'année suivante, un rapport pour la Commission européenne confirmait que la France n'avait pensé aucune stratégie en la matière (Zaparucha and Muths, 2011). Des initiatives, telles que le programme Passerelle lancé en 2007 et le Small Business Act à la française de la loi de modernisation de l'économie (LME) de 2008, existaient néanmoins. Elles encourageaient alors l'achat à des petites et moyennes entreprises (PME) innovantes (OECD, 2014a). Le tournant en la matière est l'adoption en 2012 du Pacte national pour la croissance, la compétitivité et l'emploi. La mesure n°36 est le soutien à la croissance des PME innovantes par la mobilisation de l'achat public en leur faveur. D'ici 2020, 2% du volume total des marchés de l'État, de ses établissements publics et des hôpitaux (soit près de 1,4 milliards d'euros) devront être attribués à ces entreprises. Le gouvernement a pris des mesures pour atteindre cet objectif. Par exemple, les ministères de l'Économie et des finances et du Redressement productif ont élaboré en 2013 le *Guide pratique de l'achat public innovant*. Une plateforme en ligne dédiée à ces achats a également été ouverte pour faciliter les interactions des ministères et de leurs établissements publics avec les PME innovantes. Une mesure importante est enfin la mise en place en 2014 d'une unité Innovation au sein de l'Union des groupements d'achat public (UGAP) (OECD, 2016a). Elle a pour mission de promouvoir les API au sein des collectivités locales et de les faciliter en mettant à son catalogue des innovations qu'elle aura identifiées et évaluées (notamment au regard du besoin de ces mêmes collectivités).

Même dans une France centralisée, près de 60% du volume des achats publics étaient le fait de collectivités locales en 2013 (OECD, 2015b). Cette configuration pourrait limiter la mise en œuvre d'une politique nationale encourageant l'utilisation des achats publics en soutien à l'innovation. Cependant, elle a connu un certain écho au niveau local. Par exemple, dans sa Stratégie régionale d'innovation et de spécialisation intelligente de 2013, l'ancienne région Rhône-Alpes a identifié les achats publics innovants comme un instrument pour « explorer et développer les nouveaux champs de l'innovation et répondre aux défis sociétaux ». En réponse à cette stratégie, l'Agence régionale de développement et d'innovation (ARDI) lance des appels à manifestation d'intérêt pour financer des études de faisabilité de collectivités en vue d'achats publics d'innovation.

Avant même que les mesures en faveur de l'utilisation des achats publics en soutien à l'innovation ne connaissent un tel essor, le monde de la recherche s'est emparé du sujet. Quelques articles académiques ont été publiés sur le sujet dans les années 1980 et 1990, mais l'essentiel des travaux a suivi la parution du livre '*Public Technology Procurement and Innovation*'[1] d'Edquist, Hommen et Tsipouri en 2000, et celle de l'article d'Edler et Georghiou en 2007 '*Public Procurement and Innovation – Resurrecting the Demand Side*'[2].

La recherche s'est dernièrement beaucoup intéressée aux facteurs accélérant ou freinant l'innovation dans les procédures d'achat public. Leur objectif est d'expliquer le fossé observé entre les discours politiques promouvant les API et leur mise en œuvre effective (Rolfstam, 2015). Plusieurs études de cas ont été, par exemple, menées pour comprendre le déroulement des initiatives d'API au niveau local (Dale-Clough, 2015; Knutsson and Thomasson, 2014; Lember et al., 2007; Uyarra, 2010). D'autres se sont intéressés à des facteurs spécifiques de leur mise en œuvre, tels que le rôle des institutions (Rolfstam, 2009), les capacités des organisations publiques (Valovirta, 2015), la gestion des risques (European Commission, 2010a), et la centralisation des achats publics (Albano and Sparro, 2010; Uyarra, 2010). Uyarra et collab. (2014) ont interrogé des fournisseurs du secteur public britannique sur ce qui faisait obstacle à l'innovation dans les achats publics d'après eux. À partir des résultats de cette enquête, ils ont jugé la pertinence des mesures déjà en place pour encourager les API. D'autres chercheurs, enfin, se sont intéressés à certains instruments de politique en faveur des API, tels que le 'Forward Commitment Procurement'[3] au Royaume-Uni (Whyles et al., 2015), les

[1] Les achats publics de technologie et l'innovation.
[2] Achat public et Innovation – le retour de la demande.
[3] Acquisition des engagements par anticipation.

catalogues de solutions innovantes (Li and Georghiou, 2016), ou les exercices de prospective (Vecchiato and Roveda, 2013).

Ambition de la thèse

Les résultats des travaux de recherche mentionnés ci-dessus peuvent contribuer à l'élaboration de mesures pour encourager les API. Selon le principe de l'intelligence stratégique ('strategic intelligence'), toute intervention politique doit s'appuyer sur des informations ainsi que sur des outils et indicateurs analytiques (Kuhlmann, 2002). Une information de première importance à cet égard est l'objectif poursuivi par l'intervention publique concernée. En d'autres termes, le choix et la mise en œuvre d'instruments de politique doivent dépendre de la nature des problèmes qu'ils cherchent à résoudre.

Les instruments de politique renvoient à un concept intangible dont l'acceptation change selon le temps, le lieu et les acteurs (Flanagan et al., 2011). Nous les définissons ici comme l'ensemble des techniques soutenant l'intervention publique, mobilisant des ressources publiques, et orientées vers l'atteinte d'objectifs politiques identifiés (Howlett, 1991; Kergroach, 2017; Martin, 2016). L'élaboration des instruments d'API pose deux défis. D'abord, ils doivent permettre d'atteindre des objectifs en termes d'innovation sans renier la raison d'être des achats publics, qui est de fournir aux administrations publiques les biens et services dont elles ont besoin pour mener à bien leurs missions de service public. Ensuite, la sélection et la mise en œuvre de ces instruments doivent être adaptées à la nature particulière des API. Ils sont, en effet, polymorphes, ont de multiples objectifs, impliquent plusieurs types d'acteurs, visent des biens et services divers sur des marchés différents, et cherchent à satisfaire une grande diversité de besoins.

Dans ces conditions, **l'objectif de notre thèse est de soutenir l'élaboration des initiatives d'API en identifiant les défaillances économiques qu'elles doivent résoudre, et les instruments les plus appropriés pour maximiser leur impact sur l'innovation.**

Pour ce faire, nous devons répondre à trois questions de recherche. Il nous faut d'abord déterminer dans quelles circonstances les API peuvent soutenir des politiques orientées vers de grands défis (question de recherche n°1). Pour stimuler l'innovation, les API doivent lever les obstacles qui pèsent sur la création et le développement de marché. Nous nous interrogeons donc sur la manière par laquelle les API peuvent remplir cette fonction (question de recherche n°2). Nous définissons la création de marché comme une procédure dynamique reposant sur différentes formes de

coordination de connaissances et sur des interactions appropriées entre utilisateurs et producteurs. Les pratiques dans l'achat public peuvent néanmoins contraindre les collaborations entre ces deux acteurs, et sont dès lors sources de défaillances que les API doivent résoudre ou empêcher pour stimuler l'innovation. Par notre travail de recherche, nous nous interrogeons sur ces pratiques afin de mieux les définir et caractériser (question de recherche n°3).

Définition des achats publics d'innovation

Avant de répondre à ces questions, nous devons définir ce que sont les API. Les achats publics sont l'acquisition par des organisations publiques de biens ou de services auprès d'entités externes (Arrowsmith, 2005; Rolfstam, 2013). Bien qu'ils soient primordialement motivés par le soutien aux missions de service public (Georghiou et al., 2014; OECD, 2015a), ils ont historiquement accompagné les différentes politiques constitutives de l'État-providence (McCrudden, 2004). Ces dernières années, comme nous l'avons souligné plus haut, ces achats publics ont fait leur entrée dans les politiques de soutien à l'innovation.

Malgré ce nouvel intérêt pour les API, leur définition reste l'objet de débats parmi les chercheurs qui utilisent d'ailleurs une variété d'appellations pour les désigner : achat public d'innovation, achat public pour l'innovation, achat public innovant, achat public orienté vers l'innovation ou achat public de technologie.[4] Cette dernière n'est désormais guère utilisée, mais sa définition est toujours employée. S'opposant aux achats publics réguliers, les achats publics de technologie surviennent lorsque des organisations publiques achètent ou passent commande de produits ou systèmes qui n'existent pas encore, mais qui pourraient être développés dans un laps de temps raisonnable (Edquist et al., 2000).

Uyarra et Flanagan (2010) affirment que cette définition est trop restrictive et qu'elle ignore les impacts que les achats publics peuvent avoir sur l'innovation au-delà de l'acte d'achat stricto sensu. L'innovation y est, en effet, définie exclusivement en référence à ce qui est acheté, et est comprise comme quelque chose qui n'existe pas encore. Une telle définition ne désigne que les innovations radicales et ignore l'innovation par la recombinaison de biens et services existants, l'innovation dans la conduite de services, et l'innovation dans les procédés. Dès lors, il est possible d'affirmer que le concept originel d'achat public de technologie est peu en accord avec la définition suivante

[4] En anglais : public procurement of innovation, public procurement for innovation, innovative public procurement, innovation-oriented public procurement, public technology procurement.

d'innovation proposée par Schumpeter (1934) et aujourd'hui largement acceptée : introduction de nouveaux produits et de nouveaux procédés de fabrication, ouverture de nouveaux marchés, acquisition de nouvelles sources de matières premières et de biens de consommation intermédiaires, et mise en œuvre de nouvelles organisations industrielles.

Dès lors, la définition d'achat public d'innovation que nous retenons est celle proposée par Rolfstam (2013) : les API sont l'ensemble des décisions d'achats des organisations publiques aboutissant à n'importe quel type d'innovation schumpétérienne (Uyarra, 2016).

Cette définition comprend les achats publics ouverts à l'innovation dans la mesure où ils mènent effectivement à l'acquisition d'une innovation. Les achats pré-commerciaux (ACP), qui correspondent à l'achat public de services de R&D pour encourager l'innovation (Rigby, 2016), sont pour la même raison considérés comme des API. Nous reconnaissons néanmoins que les ACP peuvent être définis comme des instruments de politique de l'offre pour l'innovation puisqu'ils encouragent les investissements en R&D des entreprises (Edquist and Zabala-Iturriagagoitia, 2012, 2015). Néanmoins, cela ne saurait justifier leur exclusion de notre définition, puisque nous considérons les décisions d'achats (ce que sont les ACP) aboutissant à une innovation (ce que peuvent faire les ACP). Enfin, notre définition comprend aussi bien les API encourageant le développement d'innovations que les API en réponse à des innovations. Dès lors, nous considérons les API comme un éventail de situations d'achat public allant des ACP aux achats publics ouverts à l'innovation en passant par les achats publics stimulant délibérément l'innovation (Edler and Uyarra, 2013).

Construire une typologie unifiée des API : Quelles défaillances résolvent-ils pour encourager l'innovation ? Quelle est leur contribution aux grands défis ?

En parallèle de ces discussions sur la définition des API, plusieurs typologies en ont été élaborées dans la littérature. Parce qu'elles se basent sur des variables différentes, elles soulignent l'hétérogénéité des API.

Edler et collab. (2005) définissent des catégories d'API selon le besoin qu'ils cherchent à satisfaire (propre ou extérieur aux organisations publiques, ou partagé avec des utilisateurs privés) et leurs effets sur le développement des marchés des biens et services concernés (développement, adaptation ou standardisation). Hommen et Rolfstam (2009) suggèrent d'ajouter une troisième dimension à cette typologie, à savoir

les modalités d'élaboration des initiatives d'API (relations entre utilisateurs publics et privés, justifications de l'intervention publique, types d'innovation et formes de l'intervention). Enfin, Rolfstam (2013) propose de compléter la typologie originelle en y ajoutant les cas de destruction des marchés (dimension effet sur les marchés) et d'achat public distribué ('distributed public procurement') (dimension besoin à satisfaire).

Uyarra et Flanagan (2010) critiquent cette approche lui reprochant de ne pas prendre en considération la diversité des biens et services achetés. Leur typologie se fonde sur les deux dimensions suivantes : le niveau de spécialisation de ces biens et services (sont-ils élaborés par des spécialistes ou non ?) et le degré d'uniformité des besoins de leurs utilisateurs (s'agit-il d'un marché de niche ou non ?).

Edler et Georghiou (2007) n'élaborent pas une typologie proprement dite, mais font la distinction entre les API généraux où l'innovation est un critère parmi d'autres dans le cahier des charges, et les API stratégiques qui visent des produits et services spécifiques et identifiés.

Parce qu'il est difficile de distinguer les API des achats publics réguliers et d'en mesurer le volume, les preuves de leur l'impact, quelle qu'en soit la forme, manquent (Uyarra, 2016). De plus, l'innovation dans les API ne correspond pas exactement à la définition retenue dans le Manuel d'Oslo (OECD and Eurostat, 2005) et utilisée pour la collecte de données statistiques (Appelt and Gualindo-Rueda, 2016). Aschhoff et Sofka (2009), et Guerzoni et Raiteri (2015) sont, par conséquent, les rares chercheurs à avoir conduit une analyse quantitative de l'impact (relatif) des achats publics sur l'innovation. Ils confirment la conclusion de Geroski (1990) selon laquelle les achats publics offrent un soutien bien plus efficient à l'innovation que le grand nombre de subventions à la R&D qui sont pourtant fréquemment utilisées.

Malgré le manque d'éléments de preuve quantitatifs, les recherches menées sur les API insistent sur son impact positif sur l'innovation (Uyarra and Flanagan, 2010). Ils seraient en mesure d'accélérer la modernisation du secteur public et d'en améliorer la qualité des services tout en en réduisant le coût (OECD, 2014b). Pour sa part, Dalpé (1994) met en avant les effets positifs des API sur l'industrie, d'autant plus lorsque les organisations publiques agissent, à cette occasion, comme des primo-adoptants (Dalpé et al., 1992). Ils contribueraient également au développement d'économies régionales à forte intensité de connaissance (Rothwell, 1984) et à la transformation des systèmes existants (Gee and Uyarra, 2013). En effet, les API peuvent accompagner le changement dans les habitudes de consommation et ainsi accélérer la diffusion de certains biens ou services nouveaux (Morgan and Sonnino, 2007; Phillips et al., 2007),

ainsi qu'encourager la transition des entreprises vers de nouvelles activités identifiées par les décideurs politiques telles que l'approvisionnement des cantines scolaires en produits frais, locaux et issus de l'agriculture biologique (Sonnino, 2009). Pour cette raison, Edquist et Zabala-Iturriagagoitia (2012) affirment que les 'achats publics pour l'innovation' participent à la résolution de grands défis ('grand challenges') et qu'ils sont dès lors des instruments appropriés de politiques tournées vers des missions. Cependant, il apparaît que les API diffèrent selon qu'ils visent la résolution de tels défis sociétaux ou participent à des missions traditionnelles tels que le programme Apollo pour envoyer un homme sur la Lune (Soete and Arundel, 1993). Les grands défis sont des problèmes complexes qui ont récemment gagné une place prépondérante dans l'agenda politique. Ils appellent à repenser la justification des politiques d'innovation, parmi lesquelles figurent celles de la demande, ainsi que leurs modalités de mise en œuvre (Boon and Edler, 2017).

Partant du constat d'une grande hétérogénéité des initiatives d'API, nous nous posons la question suivante (question de recherche n°1) : **Dans quelles conditions les API peuvent-ils être raisonnablement considérés comme des instruments appropriés pour la résolution de grands défis ?**

Pour répondre à cette question, nous devons identifier les obstacles à l'innovation que les API doivent résoudre ainsi que les instruments dont ils ont besoin pour atteindre cet objectif.

Expliquer le rôle des achats publics d'innovation dans la création de marché

Les API soutiennent l'innovation en aidant la création de marché (Box, 2009; Edler and Georghiou, 2007; Edler and Uyarra, 2013; Rothwell, 1984). De manière générale, les achats publics peuvent agir sur les marchés de trois manières : ils augmentent la demande pour des biens et services innovants, en facilitent l'adoption au moyen de nouveaux standards, et changent la structure et l'organisation de ces marchés de manière à ce qu'ils soient plus favorables à l'innovation (Cabral et al., 2006). Au cours des initiatives d'API, les organisations publiques jouent parfois le rôle d'utilisateurs précoces ('lead users'), c'est-à-dire d'utilisateurs avec une moindre aversion au risque, plus enclins à adopter des innovations, et dont les besoins présents deviendront génériques dans les mois ou années à venir (von Hippel, 1986). Les utilisateurs précoces créent un environnement plus favorable à l'innovation en apportant aux innovateurs les informations dont ils ont besoin pour mener à bien leurs activités. De plus, ils sont prêts à payer un supplément pour acquérir des biens ou services nouveaux.

Du fait de ces caractéristiques, les utilisateurs précoces participent à l'émergence de marchés 'porteurs' (lead market), c'est-à-dire des marchés locaux dont les attributs augmentent la probabilité que le choix de consommation qu'y sont observés se diffusent rapidement à une plus grande échelle (Beise and Cleff, 2004). En résumé, le secteur public peut tenir le rôle d'utilisateur précoce, au travers d'initiatives d'API, et ainsi stimuler la création de marchés porteurs. Enfin, Neij (2001) prouve que les API soutiennent la transformation des marchés en accélérant la commercialisation et l'introduction de technologies jusque-là guère utilisées.

La création et le développement de marché sont une des fonctions clefs que les systèmes d'innovation doivent garantir pour effectivement encourager l'innovation (Bergek et al., 2008). Ces mécanismes reposent sur la génération et la coordination de connaissances et d'informations (Potts, 2000). Tout facteur les affectant justifie l'intervention publique (Bleda and del Río, 2013).

Notre deuxième question de recherche est, par conséquent, la suivante : **Comment les API peuvent-ils soutenir, tout au long de la procédure d'achat public, la création et coordination de connaissances pour la création de marché d'innovation ?**

Pour répondre à cette question, nous devons prendre en considération les capacités de tous les acteurs et leurs interactions, ainsi que l'influence des API à toutes les étapes du processus dynamique de création de marché.

Étudier les collaborations entre acheteurs publics et fournisseurs

À l'image de Rolftsam (2009) affirmant que les API sont des cas particuliers d'interactions utilisateur-fournisseur, des chercheurs ont adopté une approche de niveau micro pour étudier les effets des achats publics sur les relations entre ces deux catégories d'acteurs et, plus précisément, entre les acheteurs publics et leurs fournisseurs. Par exemple, Edler et Yeow (2016) identifient les différentes fonctions d'intermédiations des API entre offre et demande, et Uyarra et collab. (2017) examinent l'ancrage local des interactions sociales que les API entretiennent.

À l'inverse des achats publics réguliers, au cours desquels chaque partie essaie de tirer profit des faiblesses de l'autre, les API reposent sur la collaboration entre acheteurs publics et fournisseurs (Edler et al., 2005). Chacun détient des éléments de connaissance nécessaires à l'élaboration et au développement d'une solution innovante et appropriée. Il est nécessaire que ces connaissances portées par les acheteurs publics

et les fournisseurs se coordonnent pour permettre la création et le développement de marché (Bleda and del Río, 2013; Dopfer and Potts, 2008). L'absence de ces interactions dès lors cruciales entre utilisateurs et producteurs ou entre acheteurs publics et fournisseurs peut expliquer la faible mise en œuvre des API.

Dans ces circonstances, nous nous posons la question suivante (question de recherche n°3) : **Quels sont les facteurs freinant les collaborations entre acheteurs publics et fournisseurs pour le développement de nouveaux produits et services ?**

Le chapitre 3 identifie ces facteurs et les instruments pour les résoudre ou en atténuer les effets négatifs. Si nous parvenons à améliorer ces interactions entre acheteurs publics et fournisseurs, elles seront davantage susceptibles d'accélérer la création et le développement de marché, d'apporter une solution aux obstacles à l'innovation, et pourront même contribuer à répondre à de grands défis sociétaux. Les interactions entre utilisateurs et producteurs sont un concept clef que nous définissons et caractérisons selon différents approches tout au long de cette thèse.

La mobilisation de trois concepts théoriques

Nous avons recours à trois concepts pour répondre à nos trois questions de recherche, à savoir les défaillances, l'élaboration de politique et les pratiques. Selon l'approche économique, la justification d'une politique d'innovation réside dans les défaillances affectant la transformation des systèmes, les processus d'innovation dont la création de marché, et les interactions entre utilisateurs et producteurs. Identifier ces défaillances nous aide à déterminer comment les initiatives d'API devraient être élaborées, c'est-à-dire les instruments pour les accompagner et leurs modalités d'intervention. Cependant, les pratiques des acheteurs publics et des fournisseurs ont une influence sur ces instruments et la manière dont ils produisent leurs effets, et peuvent donc affecter les activités d'innovation. Par conséquent, nous devons étudier également les pratiques d'achats publics qui ont un effet sur la mise en œuvre des API.

Trois niveaux de défaillances

La littérature justifie les politiques d'innovation au moyen de plusieurs types de défaillances. Bien que leurs hypothèses ne soient guères compatibles, il n'est pas difficile de remarquer que les décideurs politiques, pour motiver leurs interventions, piochent parmi elles sans se soucier de ces considérations (Laranja et al., 2008). De la

même manière, il apparaît que les bénéficiaires de mesures politiques saisissent à peine ce qui les justifie (Bach et al., 2014). Dès lors, nous pouvons affirmer que notre contribution serait affaiblie par le choix de ne se concentrer que sur certaines défaillances et d'ignorer les autres.

Nous reconnaissons cependant que l'économie évolutionniste et l'approche systémique de l'innovation qui en découle permettent de mieux comprendre les API. Elles soulignent, en effet, l'importance de la coordination de connaissances et de l'apprentissage interactif pour les API. Cependant, il ne peut pas être ignoré que les défaillances de marché ('market failure') sont toujours prégnantes dans les discours politiques. Dès lors, nous ne pouvons pas les ignorer. Suivant les recommandations de Bach et Matt (2005), nous mettons donc en avant, dans cette thèse, plutôt la complémentarité entre ces approches que leur antagonisme.

Notre approche macro-méso-micro définit trois niveaux de justifications des politiques. D'abord, au niveau macro, les décideurs politiques choisissent l'orientation de leurs interventions pour atteindre les objectifs de grande envergure qu'ils se sont donnés (Mazzucato, 2016; Mazzucato and Perez, 2015). Ils doivent alors mettre en place des politiques verticales, à un niveau méso, et s'assurer de leurs bonnes interactions dans ce qui est appelé le 'dosage des mesures' ('policy mix') (Flanagan et al., 2011). Bien que nous reconnaissions que ces interactions sont cruciales, nous nous intéressons, dans cette thèse, à la justification de chacune de ces politiques verticales, c'est-à-dire aux défaillances qu'elles doivent individuellement résoudre au niveau des marchés ou des systèmes pour permettre l'innovation. Enfin, les décideurs politiques doivent décider des modalités de leurs interventions à un niveau micro de telles sortes qu'elles encouragent les bonnes pratiques pour encourager la collaboration entre acheteurs publics et fournisseurs pour le développement de nouveaux produits.

Défaillances de niveau macro : Soutenir la transformation des systèmes

Les agendas politiques accordent une place croissante aux grands défis, qui se définissent comme des problèmes sociétaux complexes (Nelson, 2011) tels que la dégradation de l'environnement et le vieillissement de la population. Les concepts de défaillances des marchés et des systèmes ne suffisent plus à justifier, dans ces circonstances, l'intervention politique.

Selon l'approche néo-classique, les politiques doivent résoudre les obstacles à l'allocation optimale des ressources et donc à l'innovation sur un marché concurrentiel

(défaillances de marché). L'économie évolutionniste considère plutôt que les interventions publiques doivent répondre à des interactions déficientes entre les acteurs complémentaires d'un système, et aux facteurs affectant la génération, coordination et diffusion de connaissances. Ces deux approches définissent les politiques comme des solutions à des défaillances de marché ou de système, c'est-à-dire à quelque chose qui ne fonctionne pas comme il le devrait (il est sous-optimal ou pourrait mieux fonctionner) et qui, en conséquence, ralentit ou empêche l'innovation. Les théories économiques néo-classique et évolutionniste se sont peu intéressées à la transformation des systèmes, aux facteurs qui l'influencent, et aux interventions publiques qui, par ce biais, visent à résoudre de grands défis.

Mazzucato (2013) défend l'idée d'un État entrepreneurial ('Entrepreneurial State'), dont les missions seraient d'identifier la direction de ces transformations et d'orienter les marchés et systèmes d'innovation pour répondre à ces problèmes sociétaux d'envergure. De la même façon, Weber et Rohracher (2012) affirment que les grands défis requièrent des configurations nouvelles d'acteurs, d'institutions et de pratiques qui permettront aux secteurs et systèmes de production et de consommation de fonctionner suivant un tout autre modèle. Dans cette approche, tout obstacle à la transformation des systèmes ('transformation system failures') motive l'intervention publique. Il peut s'agir d'une mauvaise définition de la direction de la transformation, d'un manque d'articulation de la demande, d'une mauvaise coordination des mesures politiques et une insuffisante réflexivité du processus de transformation.

Des mesures politiques individuelles et isolées ne peuvent résoudre ces défaillances transformationnelles et permettre l'essor d'un État entrepreneurial. Ce qui est requis est plutôt une combinaison de mesures qui ont chacune leur propres motivations mais qui sont coordonnées les unes avec les autres et dans la même direction. Selon cette approche, les API peuvent soutenir la transformation des systèmes et aider la résolution de grands défis, mais ils ne sauraient être un moyen suffisant pour atteindre ces objectifs. Cette thèse s'emploie donc à définir les obstacles à l'innovation auxquels différentes catégories d'API tentent d'apporter une réponse, et à déterminer leur pertinence respective au sein d'initiatives plus larges tournées vers la résolution de grands défis. En d'autres termes, le Chapitre 1 identifie les défaillances de niveau méso, dont la solution contribuerait à celle de défaillances de niveau macro, et ainsi étudie le lien entre ces deux niveaux de justification des API.

Défaillances de niveau méso : Remédier aux défaillances de marché et de système

Selon Smith (2000), la rationalité des politiques est intimement liée aux postulats de départ sur la nature de la connaissance. L'économie néo-classique et l'économie évolutionniste montrent d'importantes divergences à cet égard et mobilisent alors des concepts différents pour justifier les politiques de soutien à l'innovation.

Économie néo-classique

Selon l'approche néo-classique, les entreprises choisissent ce qu'elles produisent et leurs moyens de production de façon à maximiser leurs profits. En réponse à un changement technologique exogène venant modifier leur environnement, elles doivent adapter l'organisation de leurs activités pour pouvoir continuer à poursuivre cet objectif. Par conséquent, l'efficience d'une économie se mesure à la flexibilité avec laquelle les entreprises peuvent faire de tels ajustements et ainsi toujours maximiser leurs profits.

Dans ce cadre de pensée, une invention, qui est le fondement d'une innovation, est le résultat de la production d'informations (Arrow, 1962). Ces dernières sont génériques, codifiées, accessibles à moindre coût ou gratuitement, et indépendantes vis-à-vis du contexte dans lequel elles sont mobilisées (Smith, 2000). L'information est donc un bien public, c'est-à-dire un bien non-rival et non-exclusif.

Pour cette raison, l'allocation optimale de cette ressource sur un marché en situation de concurrence pure et parfaite n'est pas possible (Arrow, 1962). Les défaillances de marché ('market failures') sont l'ensemble de ces facteurs qui empêchent d'atteindre l'optimum. Elles provoquent un écart entre le retour privé et le retour social des investissements en R&D et donc un sous-investissement de la part des entreprises (Nelson, 1959). Outre ces effets de débordement non-désirés, Arrow (1962) met en avant l'incertitude de toute activité de recherche fondamentale, qui pourrait amener les entreprises à investir encore moins en R&D. Weber et Rohracher (2012), alors qu'ils font un inventaire des défaillances justifiant l'intervention publique, notent deux autres défaillances de marché, à savoir les externalités de coût et la tragédie des biens communs.

Les théories de la croissance endogène sont une tentative d'intégrer la notion de création endogène de connaissances aux modèles néo-classiques de la croissance économique. À la différence de Nelson (1959), Montmartin et Massard (2015) démontrent ainsi que les défaillances de marché n'aboutissent pas toujours à des situations de sous-investissement privé en R&D, mais parfois à du surinvestissement.

Ils proposent également d'ajouter les concepts d'externalités de connaissance, d'appropriabilité du surplus, de duplication, de transfert de rente, et de géographie des externalités. Quelle que soit leur nature, les défaillances de marché justifient des politiques tournées vers l'atteinte d'un optimum de deuxième ordre.

Économie évolutionniste

L'économie évolutionniste s'est notamment construite sur la théorie de Schumpeter (1934) selon laquelle les changements technologiques sont le moteur du développement économique. Elle considère que la rationalité des agents est limitée, puisqu'ils évoluent dans un environnement qu'ils sont d'autant moins capables de comprendre pleinement que la connaissance y change sans cesse (Bleda and del Río, 2013; Cantner, 2016). Les théories évolutionnistes font également la distinction entre la connaissance qui est accumulée au fils des activités de recherche, et l'information, telle que mentionnée par les économistes néo-classique, qui est une forme codifiée de connaissance (Cohendet and Meyer-Krahmer, 2001).

Selon cette approche, l'innovation résulte des interactions multiples d'acteurs combinant et coordonnant différents composants de connaissance (Dopfer and Potts, 2008). La connaissance, parce qu'elle en partie tacite, doit être traduite en information par un processus de codification qui requiert lui-même des connaissances. L'exploitation des connaissances ainsi codifiées demande également des connaissances. En résumé, la connaissance ne peut être définie comme le seul résultat de l'accumulation d'informations (Cohendet and Meyer-Krahmer, 2001). Elle exige de ses producteurs des capacités d'émission, et de ses utilisateurs des capacités d'apprentissage et d'adaptation (Cantner, 2016).

Du fait de ces postulats, l'économie évolutionniste ne justifie pas les interventions politiques de la même manière que l'économie néo-classique. Elle défend l'idée d'un décideur politique soucieux de soutenir l'adaptabilité, plutôt que celle d'un décideur politique tourné vers l'optimisation et cherchant à améliorer le comportement des entreprises sur la base de calculs de coûts-bénéfices. L'intervention publique doit garantir que le marché n'est jamais en équilibre (Metcalfe, 2005; Metcalfe and Georghiou, 1998) et encourager la création de connaissances (Bleda and del Río, 2013). Dès lors, l'approche évolutionniste trouve une justification aux politiques d'innovation dans les défaillances d'apprentissage, le déséquilibre entre variété et sélection, le piège de l'appropriation, et les défaillances dans les complémentarités dynamiques (Malerba, 1996, 2009).

Bleda et del Río (2013) proposent d'intégrer les défaillances néo-classiques de marché dans leur approche évolutionniste. Ils définissent la création de marché comme un processus dynamique au cours duquel une nouvelle connaissance se diffuse d'une première population d'acteurs (les inventeurs) à une plus large qui l'adoptera et l'intégrera (les adoptants). Trois défaillances de coordination doivent alors être surmontées : les coordinations profonde ('deep coordination') et superficielle ('surface coordination') de connaissances, et la coordination opérationnelle ('operational coordination') d'informations. Les défaillances de marché proprement dites correspondent aux problèmes de coordination d'informations, c'est-à-dire à la coordination opérationnelle tournée vers l'intégration des innovations dans les activités économiques des agents.

L'économie évolutionniste a posé les fondements d'une approche systémique de l'innovation. Le concept de système d'innovation (Lundvall, 2005) s'appuie sur l'idée que l'innovation est le résultat d'un processus d'apprentissage interactif, cumulatif et sensible au contexte dans lequel il se déroule. De nombreux acteurs (organisations) y interviennent et leurs interactions sont elles-mêmes influencées par des institutions (règles formelles et informelles). L'approche systémique met en avant autant les acteurs du marché que ceux hors du marché et montre comment ils influencent tous la direction et la vitesse de l'innovation et de la diffusion des technologies dans un système donné ainsi que les flux de connaissances entre les institutions (Box, 2009). Ce qui justifie les politiques d'innovation est dès lors la présence de tout obstacle aux interactions entre organisations au sein d'un système donné. Ces défaillances systémiques ('system failures') trouvent leur source dans les infrastructures, les interactions des acteurs et la capacité des producteurs d'innovation (Klein Woolthuis et al., 2005).

Les systèmes peuvent être nationaux (Lundvall, 2005), régionaux (Laranja et al., 2008), sectoriels (Malerba, 2002) ou technologiques (Bergek et al., 2008). Les trois premières approches s'intéressent particulièrement aux composantes des systèmes, c'est-à-dire aux organisations, à leurs interactions et aux institutions. D'après Bergek et collab. (2008), il est néanmoins difficile, si ce n'est impossible, d'évaluer le bien ou le mal d'un élément structurel particulier ou de sa combinaison avec d'autres sans étudier d'abord ses effets sur le processus d'innovation. Ils suggèrent alors de considérer plutôt le bon fonctionnement de sept dynamiques au sein des systèmes technologiques d'innovation : le développement de connaissance, la mobilisation de ressources, la création de marché, l'influence sur l'orientation de la recherche, la légitimation, les expérimentations entrepreneuriales, et le développement d'externalités positives. Selon cette approche, les interventions publiques doivent chercher à résoudre les problèmes

affectant ces fonctions et être élaborées pour atteindre cet objectif. Il ne s'agit pas ici de nier l'importance de l'identification des éléments structurels du système que les politiques doivent viser, mais d'affirmer qu'une telle entreprise doit toujours se faire dans l'optique d'améliorer une des fonctions du système dans laquelle ces éléments structurels visés interviennent.

Défaillance de niveau micro : Définir les interactions entre utilisateurs / acheteurs publics et fournisseurs

Par son approche centrée sur les mécanismes de coordination de connaissances et d'apprentissage interactif, l'économie évolutionniste met en évidence l'importance des interactions entre utilisateurs et producteurs (Smith, 2000) et le rôle parfois clef des utilisateurs dans le processus d'innovation (von Hippel, 1986). Les entreprises reconnaissent désormais leur fournisseur comme une source d'innovation pouvant leur apporter une expertise technologique, améliorer leurs produits et réduire le délai d'introduction de ces derniers sur le marché (Bidault et al., 1998). Dans un contexte de concurrence et de complexité technologique croissante, les stratégies d'achat privé et les relations contractuelles entre entreprises et leurs fournisseurs se sont éloignées du modèle initial de négociation pour la réduction des coûts pour adopter un mode de relations collaboratif tourné vers la résolution conjointe de problèmes (Nishiguchi, 1994). Le moment à partir duquel les fournisseurs sont invités à intervenir dans le processus de développement du produit dépend de leur rôle à cet égard. La conception collaborative, par exemple, requiert leur implication en amont du développement de nouveaux produits (le Dain et al., 2011).

Toute intervention publique reposant sur des interactions entre utilisateurs et producteur doit résoudre les problèmes les affectant pour produire ses effets. Des déficiences dans ces interactions pourraient, en effet, empêcher de répondre efficacement aux défaillances de niveau méso bloquant l'innovation.

Dans les API, les acheteurs publics sont les utilisateurs ou agissent en leur nom, s'ils sont différents d'eux, et les fournisseurs sont les producteurs d'innovation. Par conséquent, les API sont considérés comme des cas particuliers d'interactions utilisateur-producteur (Rolfstam, 2009). Une approche de niveau micro nous permet d'étudier les pratiques d'achat public qui peuvent gêner l'implication précoce des fournisseurs ('early supplier involvement') et alors brider l'innovation. Le chapitre 3 identifie les modalités de mise en œuvre qui permettraient aux politiques de répondre efficacement aux défaillances dans les interactions entre acheteurs publics et

fournisseurs et ainsi de libérer leur effet de levier sur l'innovation. En somme, nous avançons que mieux caractériser les défaillances dans la collaboration aide l'élaboration des politiques publiques.

À cette fin, nous nous inspirons de la littérature sur les achats privés et ses travaux sur les défaillances dans la collaboration entre acheteurs et fournisseurs pour le développement de nouveaux produits. McIvor et collab. (2006) démontrent que plusieurs problèmes peuvent affecter l'implication précoce des fournisseurs. Personnier et collab. (2013) les définissent et caractérisent à différentes étapes de la collaboration, et en distinguent deux groupes. Avant que la collaboration ne commence, des problèmes peuvent survenir dans la sélection des fournisseurs et la configuration de la collaboration. Une fois que le fournisseur est choisi et que la collaboration est effective, les problèmes peuvent concerner le niveau de confiance entre les acteurs, le déroulement de leur collaboration, et le niveau d'information qu'ils échangent (Personnier, 2013). De telles défaillances sont autant de motivations pour une intervention publique. Cependant, il est nécessaire de garder à l'esprit qu'elles ont été définies dans un contexte d'achat privé. Or, les achats sont l'un des quelques domaines dans lesquels le secteur public et le secteur privé diffèrent réellement. En effet, les achats publics sont soumis à un cadre juridique plus strict et sont sous l'auspice d'une autorité centrale (Rainey and Bozeman, 2000). Du fait de ces différences, les défaillances identifiées par Personnier (2013) pourraient ne pas s'appliquer aux achats publics et auraient besoin d'être adaptées pour nous aider à répondre à notre question de recherche dans le Chapitre 3.

Le choix d'instruments de politiques et de leurs modalités de mise en œuvre : élaboration de politique

Nous comprenons l'élaboration de politiques comme le choix et la mise en œuvre d'instruments pour répondre à des objectifs préalablement identifiés. Toutes les défaillances mentionnées précédemment peuvent justifier l'utilisation stratégique des achats publics pour encourager l'innovation. Mais résoudre ces défaillances demandent la mise en œuvre des bons instruments, c'est-à-dire des techniques appropriées pour remplir les objectifs fixés.

La littérature sur l'élaboration des politiques propose plusieurs typologies d'instruments de politique (Howlett, 2011). Elle s'est néanmoins peu penchée sur les instruments de politiques de R&D et d'innovation (Martin, 2016). La référence en matière d'instruments d'API est l'article de Georghiou, Elder, Uyarra et Yeow (2014) intitulé '*Policy instruments for public procurement for innovation : Choice, design and*

assessment'.[5] Ils y distinguent trois niveaux d'intervention publique. Au niveau supérieur, les décideurs politiques révisent le cadre juridique des achats publics pour les rendre plus ouverts aux produits et services nouveaux. Au niveau intermédiaire, les organisations d'achat public adoptent stratégies et instruments pour encourager les API. Enfin, au niveau inférieur, les instruments politiques d'API sont l'ensemble des décisions prises par les acheteurs publics au cours et au niveau d'initiatives d'API.

Cette thèse se concentre sur ce niveau inférieur d'instruments. Par notre approche, nous justifions, en effet, les instruments politiques seulement au niveau des initiatives individuelles. Nous ne nous intéressons pas aux obstacles à l'innovation dans les procédures d'achat public qui requerraient l'intervention d'organisations d'achat public et/ou la révision du cadre juridique concerné.

Georghiou et collab. (2014) définissent quatre catégories d'instrument d'API selon les déficiences qu'ils visent dans la procédure d'achat public. Les décisions des acheteurs publics correspondent à deux d'entre elles : l'identification, la spécification et le signalement des besoins, et le soutien à l'innovation. La première répond à des problèmes de communications entre acheteurs publics et fournisseurs ou à l'absence de reconnaissance du potentiel de l'innovation pour satisfaire les besoins des organisations publiques. Les instruments pour inciter l'innovation cherchent à diminuer l'aversion au risque des acheteurs publics et la réticence des fournisseurs à investir dans le développement de nouvelles solutions pour le secteur public.

Outre cette liste non-exhaustive d'instruments, Cave et Frinking (2003) identifient différentes modalités de mise en œuvre des initiatives d'API, parmi lesquelles la durée des contrats, la formulation des spécifications dans le cahier des charges, la composition de l'équipe d'achat (Johnston and Bonoma, 1981), et les modes de paiement. Il apparaît que, lorsque les API sont utilisés pour encourager l'innovation dans des secteurs ou technologies stratégiques, la demande publique doit être liée à la privée (Edler and Georghiou, 2007). Par exemple, des représentants des utilisateurs finaux (différents des acheteurs publics) peuvent être impliqués dans la procédure d'achat public (Rolfstam, 2009) notamment pour l'évaluation des offres et la sélection des fournisseurs. De même, au travers des initiatives d'API, le secteur public peut agir comme utilisateur précoce (Dalpé et al., 1992) et doit présenter, à cette occasion, les caractéristiques requises pour encourager l'adoption de l'innovation visée par d'autres acteurs (Mangematin and Callon, 1995). Uyarra et Flanagan (2010) et Uyarra et collab. (2017) traitent des implications géographiques des initiatives d'API selon leurs objectifs et le produit ou service concerné.

[5] Instruments politiques pour les achats publics pour l'innovation : choix, élaboration et évaluation.

Par exemple, des appels d'offres restreints au niveau local ne sont pas un moyen adéquat pour satisfaire des besoins qui requièrent des solutions très innovantes que seuls quelques fournisseurs spécialisés à l'échelle internationale peuvent concevoir. Enfin, lors de l'élaboration des initiatives d'API, il est nécessaire de prendre en considération que la nature des interactions entre acheteurs publics et fournisseurs peut varier. Ces dernières doivent être intenses lorsque ce qui est acheté est particulièrement complexe ou lorsque l'acheteur public a de faibles capacités technologiques. Dans le cas inverse, c'est-à-dire si les produits et services sont innovants mais peu complexes et/ou si l'acheteur est compétent pour mener à bien cet achat, ce dernier aura moins besoin de collaborer avec ses fournisseurs (Uyarra and Flanagan, 2010) et l'initiative d'achat s'apparentera à une commande.

Tout au long de cette thèse, nous tentons d'identifier et de caractériser les instruments d'API les plus appropriés pour résoudre les obstacles à l'innovation visés. Le Chapitre 1 associe différentes catégories d'API (définies selon les défaillances de niveau méso qu'ils tentent de résoudre) avec les instruments qui les aideront à accomplir leurs objectifs en termes d'innovation et à éventuellement répondre à de grands défis de niveau macro. Dans le chapitre 2, nous nous intéressons plus particulièrement aux instruments qu'il convient de mettre en œuvre pour que les API puissent stimuler la création de marché. Enfin, le chapitre 3 étudie les modalités de mise en œuvre de ces instruments d'API pour promouvoir les pratiques d'achat public qui encourageront la collaboration entre acheteurs publics et fournisseur pour le développement de nouveaux produits.

Déployer les instruments pour la collaboration acheteurs publics-fournisseurs et pour les API : les pratiques

Selon l'approche décrite plus haut, le but des API est de résoudre, avec les bons instruments, ce qui empêche l'innovation. Par conséquent, les API se définissent comme les instruments d'une politique d'innovation, c'est-à-dire d'une politique visant explicitement à accélérer l'innovation. La littérature propose cependant une lecture alternative selon laquelle les API seraient une pratique dans laquelle l'innovation n'est pas une fin en soi, mais un moyen nécessaire pour atteindre d'autres objectifs comme l'amélioration des services publics. Même si leurs définitions diffèrent fondamentalement, ces deux approches ne sont pas complètement déconnectées l'une de l'autre dans la mesure où les API comme politique ne peuvent être pensés sans considérer les

pratiques d'achat (Edler et al., 2015a). Tout au long de cette thèse, nous proposons en conséquence de lier davantage politiques et pratiques.

Nous reconnaissons que les API ne peuvent pas ignorer la raison d'être des achats publics, qui est la fourniture de biens et services pour assister les organisations publiques dans leurs missions. En d'autres termes, les API peuvent chercher à lever les obstacles barrant l'innovation et ainsi se justifier de la même manière que les politiques d'innovation (chapitres 1 et 2), mais leur but ultime reste de satisfaire des besoins publics. Par conséquent, il nous faut considérer comment les organisations publiques parviennent à gérer ces différents objectifs, et comment elles perçoivent et utilisent les instruments visant à les aider à résoudre les défaillances empêchant l'innovation.

Dès lors, nous avons besoin de prendre quelque peu nos distances par rapport à la littérature sur les politiques d'innovation, et nous devons nous intéresser aux recherches déjà menées sur les pratiques d'API et d'achat public en général, et sur les interactions entre acheteurs et fournisseurs. Les chapitres 1 et 2 identifient les instruments et pratiques qui permettent de répondre, par les API, aux défaillances dans les processus d'innovation et notamment dans les dynamiques de création et développement de marché. Le chapitre 3 se concentre sur les pratiques et autres facteurs contextuels qui ont une influence sur l'impact des instruments d'API sur l'innovation, et qui sont donc susceptibles d'affecter la collaboration entre acheteurs public et fournisseurs pour le développement de nouveaux produits.

Méthodologie

Cette thèse mobilise les concepts de défaillances, élaboration de politique et pratiques d'achat public pour répondre à nos trois questions de recherche relatives à la justification et la mise en œuvre de l'utilisation stratégique des achats publics en soutien à l'innovation : Dans quelles conditions les API peuvent-ils être raisonnablement considérés comme des instruments appropriés pour la résolution de grands défis ? Comment les API peuvent-ils soutenir, tout au long de la procédure d'achat public, la création et la coordination de connaissances pour la création de marché d'innovation ? Quels sont les facteurs freinant les collaborations entre acheteurs publics et fournisseurs pour le développement de nouveaux produits ? Toujours dans l'objectif de répondre à ces questions, nous récoltons des données qualitatives et en menons l'analyse de telle sorte qu'elles appuient l'analyse diagnostique ('diagnostic analysis') de l'élaboration des initiatives d'API.

L'analyse diagnostique est une technique pour la décision politique, par laquelle l'identification d'un problème et de ses causes aide le choix et la mise en œuvre d'instruments politiques (Edquist, 2011). Au niveau macro, ces problèmes empêchent d'atteindre des objectifs de large envergure tels que les grands défis. Ils sont complexes, ont des causes multiples, et requièrent des politiques pour orienter et coordonner un ensemble d'instruments politiques. Une activité d'innovation moindre, causée par des défaillances de niveau méso, peut participer à ces problèmes et requiert alors des politiques dédiées. Enfin, au niveau micro, les interventions publiques visent les pratiques d'achat empêchant les interactions entre acheteurs publics et fournisseurs et par conséquent l'amélioration des performances d'innovation et la résolution de grands défis. Il apparaît alors que l'élaboration de politique est une cascade de décisions relatives à la sélection et à la mise en œuvre des instruments adéquats. Les trois chapitres de cette thèse cherchent à identifier les défaillances qui viendraient appuyer ces décisions. Nous utilisons deux méthodes à cette fin.

Le Chapitre 1 définit, au travers d'une revue de la littérature et d'un exercice de théorie typologique ('typological theory'), des catégories d'API selon les défaillances de niveau méso qu'ils tentent de résoudre. Nous identifions ces défaillances dans la littérature sur les API et les politiques d'innovation, puis les organisons en trois groupes. Nous utilisons ces derniers comme dimensions pour notre typologie. Il s'agit des défaillances liées à la demande, à l'offre et aux interactions entre utilisateurs et fournisseurs. Pour répondre à notre première question de recherche, nous confrontons les défaillances de niveau méso auxquelles notre typologie fait référence aux défaillances de niveau macro, dont la solution est nécessaire pour répondre efficacement aux grands défis. Nous déterminons ainsi les catégories d'API qui sont les plus appropriées pour soutenir les politiques tournées vers des défis. Enfin, nous prenons en considération les instruments et pratiques qui sont nécessaires à la résolution effective des défaillances d'ordres méso et macro.

Dans les chapitres 2 et 3, nous menons des études de cas. Pour répondre à notre deuxième question de recherche, nous proposons une nouvelle analyse de cas d'API déjà présentés dans la littérature académique et dans des rapports pour la Commission européenne, mais ne sélectionnons que ceux ayant influencé de manière intentionnée la création de marché (Chapitre 2). Dans le Chapitre 3, nous menons nos propres études de cas à travers une série d'entretiens semi-structurés avec des représentants d'organisations publiques et de fournisseurs qui ont tous une expérience de collaboration avec l'un ou l'autre pour le développement de nouvelles solutions. L'objectif est de répondre à notre troisième question de recherche en identifiant et caractérisant les

défaillances qui affectent la collaboration entre acheteurs publics et fournisseurs, et en déterminant comment les API peuvent les résoudre, c'est-à-dire au moyen de quels instruments et pratiques. Ces méthodes qualitatives permettent de comprendre, dans le cadre de recherches exploratoires, des phénomènes sociaux complexes (Yin, 2011) comme la création de marché ou les interactions entre acheteurs publics et fournisseurs. Nous analysons de manière abductive (Van Maanen et al., 2007) l'ensemble des données collectées au travers de nos revues de la littérature et de nos études de cas. Notre objectif n'est ni de générer de nouvelles théories, ni de tester les existantes, mais d'utiliser nos données pour développer et étendre ces dernières (Dubois and Gadde, 2002).

Chapitre 1. Achat public d'innovation : Revue de leurs rationalités, élaboration et contribution aux grands défis

Les grands défis sont des problèmes sociétaux complexes qui bénéficient d'une place croissante dans les politiques nationales et internationales. Ils remettent néanmoins en question la rationalité des politiques d'innovation telle qu'elle était approchée jusqu'à présent, puisqu'ils requièrent une transformation des systèmes (Weber and Rohracher, 2012). Celle-ci ne peut être soutenue et accélérée que par les bons dosages de mesures, c'est-à-dire par des combinaisons d'instruments politiques coordonnés et orientés dans la direction sélectionnée (Flanagan et al., 2011). La littérature identifie les API comme un de ces instruments (Edquist and Zabala-Iturriagagoitia, 2012). Notre ambition est alors de développer cette affirmation et de déterminer sous quelles conditions les API peuvent effectivement soutenir des politiques orientées vers des défis. Ce que nous appelons ici « conditions » comprend les obstacles à l'innovation que les API cherchent à résoudre, les instruments qu'il convient alors d'adopter, et les pratiques d'achat public à promouvoir.

Pour ce faire, nous menons une revue des littératures sur les politiques d'innovation et les API, et y identifions les défaillances de niveau méso qui nuisent à l'innovation et dont les API se présentent comme une solution. Nous les regroupons en trois groupes selon le lieu où elles apparaissent. Elles peuvent survenir soit auprès des acheteurs et des utilisateurs finaux (côté demande), soit auprès des fournisseurs, candidats aux appels d'offres et autres producteurs d'innovation (côté offre), soit dans leurs interactions mutuelles. Les défaillances de la demande sont des facteurs empêchant l'expression de la demande de solutions innovantes pour l'amélioration des services publics, ou restreignant l'adoption et la diffusion d'innovations. Dans certaines circonstances, les

API peuvent également chercher à soutenir le développement de solutions innovantes en encourageant les entreprises à investir en R&D et en les aidant à améliorer leurs capacités d'apprentissage. Enfin, les API doivent lever tout obstacle aux interactions entre utilisateurs et producteurs et donc à l'innovation.

Ces trois catégories de défaillance de niveau méso sont utilisées comme variables pour la construction d'une typologie d'API. Huit idéo-types d'API émergent. Nous les confrontons aux défaillances de niveau macro auxquelles les politiques tournées vers de grands défis doivent répondre, et déterminons ainsi leur contribution potentielle à celles-ci. Nous montrons que les API, dont l'objectif est d'encourager le développement d'innovation et d'en accélérer la diffusion tout en promouvant l'apprentissage interactif entre utilisateurs et producteurs, sont les plus susceptibles de stimuler la transformation des systèmes et dont d'aider à résoudre de grands défis. À l'inverse, les catégories d'API qui impliquent des adaptions mineures de produits et services existants avec le seul objectif d'améliorer les services publics et qui n'encouragent que de faibles interactions entre utilisateurs et fournisseurs tournées vers la réduction d'asymétrie d'informations ne devraient avoir qu'un faible impact sur les grands défis.

Alors que la littérature affirme que les API catalytiques sont les plus à même de soutenir les politiques tournées vers de grands défis (Edquist and Zabala-Iturriagagoitia, 2012), le Chapitre 1 détermine sous quelles conditions les API peuvent avoir un tel potentiel, ce qui est en soi une contribution. Nous soutenons que certaines catégories d'API sont davantage susceptibles de résoudre des défaillances de niveau macro et donc de répondre à de grands défis. De plus, notre approche mettant en avant les fondements théoriques des API parvient à lier entre elles les typologies déjà présentes dans la littérature, à mobiliser leurs différents éléments et à les associer avec nos idéo-types d'API. En résumé, en combinant différentes revues de la littérature, nous identifions des catégories d'API, leurs rationalités et les instruments et pratiques requis pour qu'ils remplissent leurs objectifs (définis comme des obstacles à l'innovation). Par conséquent, nous pouvons repérer quels instruments devraient être mis en œuvre et quelles pratiques devraient être promues pour accroître la contribution de certaines de nos catégories d'API aux politiques tournées vers de grands défis. Pour cette raison, notre typologie, construite à partir des défaillances que les API doivent résoudre pour soutenir l'innovation, apporte une contribution au processus de décision publique, de l'identification de ces défaillances à la sélection des instruments adéquats.

Chapitre 2. Rôle des achats publics dans la création de marché d'innovation : une analyse évolutionniste

Le chapitre 2 s'intéresse aux catégories d'API qui cherchent explicitement à stimuler l'innovation. Pour ce faire, elles doivent soutenir la création de marché (Box, 2009; Edquist, 2011; Rothwell, 1984). Cependant, peu d'études ont été menées à ce sujet. Dès lors, nous cherchons à comprendre dans ce chapitre le rôle des API dans la création et le développement de marché d'innovation. Dans un cadre de pensée évolutionniste, les marchés sont des systèmes de création et de coordination de connaissances, et la création de marché est définie comme un processus dynamique au cours duquel une population restreinte d'agents, les détenteurs d'une nouvelle connaissance, croît et finalement se stabilise alors que d'autres agents, les utilisateurs, adoptent et appliquent cette nouvelle connaissance au fil du temps (Dopfer and Potts, 2008). Les API peuvent influencer ce processus en encourageant la coordination de connaissances à trois étapes différentes : l'émergence d'une innovation, son adoption, puis son application (Bleda and del Río, 2013).

Nous analysons le rôle des API au cours de ces trois étapes du processus de création de marché au moyen d'une série d'études de cas déjà existants (Yin, 2009). Nous choisissons des cas d'API qui ont eu une réelle influence sur la création de marché et pour lesquels cette influence était délibérée. Nous identifions les défaillances de coordination qu'ils ont dû résoudre et les instruments dont ils ont eu alors besoin. Nous codons les informations collectées au sujet des différents rôles des API dans la création de marché ainsi que du moment dans la procédure d'achat public où ils sont observés.

La première étape dans la création de marché est l'émergence d'une nouvelle idée qui est fonctionnelle et prête à être adoptée par une première population d'agents. Elle implique une coordination profonde ('deep coordination') de connaissances, c'est-à-dire la coordination de différents composants de connaissance dans un complexe, qui est une innovation. Cette coordination se déroule dans l'esprit de l'innovateur. Les acheteurs publics ne peuvent y intervenir pour encourager, au moyen des API, l'émergence d'une innovation. Cependant, ils peuvent soutenir cette coordination profonde au cours des étapes intermédiaires de la procédure d'achat public (définition des spécifications) en facilitant l'expression de la demande et en réduisant l'incertitude qui accompagne cette dernière. La demande est ici assimilée à un composant social de la connaissance avec lequel les innovateurs doivent coordonner des composants techniques, comportementaux et cognitif de la connaissance pour former un nouveau complexe de connaissances.

La deuxième étape dans la création de marché est l'adoption. Il s'agit d'une coordination superficielle ('surface coordination') de connaissances, c'est-à-dire la coordination entre les connaissances, routines et organisations des demandeurs avec le nouveau complexe de connaissances qu'est l'innovation. L'adoption ne sera effective que si les agents économiques (demandeurs et producteurs de l'innovation) parviennent à coordonner leurs lots de connaissances respectifs. En effet, une première population d'utilisateurs ne peut adopter une innovation si celle-ci est incompatible avec leurs organisations, routines et connaissances. Dans de telles circonstances, l'innovation restera une bonne idée et aucun marché ne se formera. Nos études de cas montrent que les API stimulent la coordination superficielle de deux manières. Tôt dans la procédure d'achat public, les acheteurs doivent coordonner les besoins des différents utilisateurs finaux de telle sorte qu'une demande émerge. Dans le cas contraire, le bien ou service acheté devra satisfaire un large éventail de demandes. La procédure d'API pourra continuer à se dérouler, mais l'adoption risque d'échouer. Les acheteurs publics peuvent également intervenir plus tard dans la procédure pour soutenir la coordination superficielle. Une fois que l'innovation est produite et prête à être fournie, ils peuvent, en effet, s'assurer que les utilisateurs finaux possèdent les bonnes connaissances pour l'adopter, en leur apportant celles qui leur manquent.

L'application de l'innovation est la troisième et dernière étape dans la création de marché. Elle consiste en l'utilisation effective de l'innovation dans les opérations économiques quotidiennes des agents. La coordination opérationnelle ('operational coordination') des informations (comprenant les incitations et les prix) entre ces agents appuie l'application de l'innovation. Dans certaines de nos études de cas, les acheteurs publics ont mis en œuvre des programmes de partage d'informations dans ce but. Il ne s'agissait pas d'améliorer la connaissance des demandeurs pour que l'adoption puisse se faire, mais de diffuser des informations aux agents économiques qui ont déjà les connaissances, routines et organisations requises de telle sorte qu'ils utilisent effectivement l'innovation concernée.

Ces résultats contribuent à l'objectif général de cette thèse de deux manières. D'abord, ils permettent de mieux caractériser des défaillances de niveau méso qui empêchent la création de marché et que les API peuvent résoudre. De plus, nous montrons que les acheteurs publics ont plusieurs rôles à jouer à différentes étapes de la procédure d'achat public pour faire émerger de nouveaux marchés. Il est encore plus intéressant d'observer qu'il y a une corrélation non-linéaire entre la mise en œuvre de mesures tout au long de la procédure d'achat et les phases du processus de création de

marché. Par exemple, l'adoption, qui est la deuxième étape dans ce dernier, devrait être préparée dès le début de la procédure d'achat public.

Chapitre 3. Implication précoce des fournisseurs dans les procédures d'achat public pour le développement collaboratif d'innovations

L'objectif du Chapitre 3 est de caractériser les interactions entre acheteurs publics et fournisseurs pour le développement de nouveaux produits et la création de leur marché. Nous cherchons à identifier les défaillances de niveau micro qui nuisent à la collaboration entre ces deux groupes d'acteurs (les défaillances de collaboration) dans différentes procédures d'achats publics, à savoir la procédure standard et le dialogue compétitif.

Dans cet objectif, nous nous appuyons sur la littérature sur les achats privés qui a déjà identifié des défaillances affectant l'implication précoce des fournisseurs (McIvor et al., 2006). Nous reconnaissons néanmoins qu'il existe d'importantes différences entre secteurs public et privé en matière d'achat (Rainey and Bozeman, 2000).

Nous menons une série d'entretiens qualitatifs (Yin, 2011) avec des représentants d'acheteurs publics et de fournisseurs sur leurs expériences de collaboration pour le développement d'innovations. Les données récoltées sont étudiées au moyen d'une analyse thématique (Paillé and Mucchielli, 2012). Nous cherchons dans nos données empiriques des défaillances de collaboration et les comparons aux défaillances déjà identifiées dans la littérature sur les achats privés (Personnier et al., 2013). Nous les regroupons ensuite en catégories et les codons en leur attribuant les informations suivantes : type d'acteur (acheteur public ou fournisseur) ayant rapporté la défaillance, et procédure au cours de laquelle la défaillance est survenue (procédure d'API standard, dialogue compétitif ou autre).

Notre recherche exploratoire révèle un certain nombre de défaillances de collaboration qui devraient retenir l'attention des décideurs politiques pour assurer le succès des initiatives d'API. Comme la collaboration entre acheteurs et fournisseurs privés, la collaboration via l'achat public est particulièrement exposée à des défaillances de niveau micro dans sa phase d'élaboration. Ces défaillances justifient le recours à des instruments et la poursuite d'actions pour éviter que la collaboration avorte. Nos résultats empiriques contribuent également à l'objectif général de cette thèse en montrant comment acheteurs publics et fournisseurs perçoivent différemment les obstacles à leur collaboration, et comment ces perceptions influencent leurs pratiques. Il est, par exemple, possible d'observer que tous font parfois référence à la même défaillance, mais que

lorsqu'ils sont interrogés sur les causes de cette défaillance ils se rejettent mutuellement la faute.

Notre recherche contribue également à la littérature sur les API en poursuivant la discussion sur l'influence du cadre juridique. Nous affirmons à ce sujet que ce n'est pas tant les règles de droit qui peuvent contraindre les interactions entre acheteurs publics et fournisseurs que la manière dont elles sont interprétées (Coriat and Weinstein, 2002). Il apparaît que d'autres défaillances peuvent mettre fin au développement collaboratif de nouveaux produits par l'API. Il est possible de citer parmi celles-ci la faible volonté des parties de collaborer ou un manque de confiance mutuelle. Ces facteurs importants pour toute collaboration devraient retenir davantage l'attention des décideurs politiques et encourager de meilleures pratiques d'achat chez les acheteurs publics.

Contributions et limites

Dans cette thèse, nous identifions trois niveaux de justification à l'utilisation stratégique des achats publics pour encourager l'innovation. Les API répondent avant tout à des défaillances de niveau méso, c'est-à-dire à des défaillances de marché et de système. Ces derniers incluent notamment les problèmes de coordination de connaissance affectant la création et le développement de marché. Les API peuvent également aider à répondre à des défaillances de niveau macro selon la nature de celles de niveau méso qu'ils cherchent à résoudre. Enfin, leur capacité à apporter une solution à l'ensemble de ces défaillances dépend des pratiques des acheteurs publics et des fournisseurs. Ces pratiques sont autant de sources de défaillances de niveau micro auxquelles les API doivent aussi remédier.

En résumé, notre thèse offre trois contributions : elle caractérise les relations entre utilisateurs et producteurs dans les API, elle justifie le rejet d'une approche atemporelle de la décision politique, et elle aide l'élaboration des initiatives d'API et leur évaluation.

Tout d'abord, nous étudions, selon différentes perspectives, les interactions entre utilisateurs et producteurs (comprenant celles entre acheteurs publics et fournisseurs) pour mieux les caractériser. Le Chapitre 1 considère ces interactions comme des sources de défaillance de niveau méso qui justifient les API. Dans notre typologie, toute catégorie d'API doit garantir un certain degré d'interactions entre utilisateurs et producteurs. Pour certaines, il ne s'agit que de résoudre des asymétries d'information unilatérales pour encourager l'innovation. D'autres, au contraire, doivent établir des espaces d'apprentissage interactif dans le même objectif. Les politiques tournées vers

de grands défis requièrent l'implication d'un grand nombre d'acteurs et leur interaction pour trouver et développer les innovations les plus appropriées et accélérer leur diffusion. En d'autres termes, les défaillances de niveau macro résultent également de mauvaises interactions entre utilisateurs et fournisseurs que les API tentent de résoudre. Le Chapitre 2 étudie ces mêmes interactions et montrent comment elles ont un impact sur l'innovation en influençant la création de marché. Nous démontrons qu'acheteurs publics, utilisateurs et (potentiels) fournisseurs doivent interagir tout au long de la procédure d'achat public pour échanger et coordonner connaissances et informations. Les étapes dans le processus de création de marché (Bleda and del Río, 2013) sont sujettes à différentes défaillances que les initiatives doivent résoudre au moyen d'instruments qui ne sauraient être identiques pour la même raison. En résumé, les chapitres 1 et 2 considèrent que ce qui affecte les interactions entre utilisateurs et producteurs cause des défaillances d'ordre méso qui justifient les initiatives d'API. Le chapitre 3 propose une autre approche. Il identifie les pratiques d'achat public influençant les interactions entre acheteurs publics et fournisseurs, et les défaillances de niveau micro qui peuvent en émerger. Il montre ensuite comment ces deux groupes d'acteurs réagissent aux instruments de API mis en place et adaptent ou non leurs pratiques. Différentes défaillances peuvent apparaître tout au long de la procédure d'achat public et du processus de collaboration, de telle sorte que leur réponse politique doit s'adapter.

Tout au long de la thèse, nous montrons que les interactions entre utilisateurs et producteurs peuvent être analysées au moyen de trois concepts clefs : défaillances, élaboration de politique, et pratiques. Elles résultent de pratiques et peuvent être la source de défaillances dont la solution requiert une élaboration particulière de politique. Notre approche permet de compléter celle d'Edler et Yeow (2016) étudiant les fonctions d'intermédiation entre offre et demande qui doivent être assurées pour lever les obstacles à l'innovation dans les procédures d'achat. Dans de futures recherches, nous proposons de poursuivre l'étude des défaillances de niveau micro en mesurant, de manière quantitative, leur impact sur la collaboration entre acheteurs publics et fournisseurs. Une meilleure compréhension des pratiques des acteurs permettrait d'expliquer comment les mêmes instruments mis en œuvre dans des contextes distincts peuvent produire des résultats différents (Flanagan and Uyarra, 2016).

La deuxième contribution de notre recherche est d'aider le rejet d'une approche atemporelle de la décision politique (Flanagan and Uyarra, 2016) en soulignant les dynamiques complexes et variées que les API doivent soutenir pour stimuler l'innovation. Dans les chapitres 2 et 3, nous montrons comment les procédures d'achat public sont entremêlées avec le processus de création de marché et celui de la collaboration entre

acheteurs publics et fournisseurs. Puisque chacune des étapes de ces dynamiques sont exposées à des défaillances différentes, les politiques et actions mises en œuvre ne sauraient être les mêmes tout au long de la même initiative d'API. Le Chapitre 1 ne doit pas non plus être interprété de manière statique. Ce que nous considérons comme la rationalité d'une initiative d'API peut évoluer. Celle-ci peut, par exemple, d'abord chercher exclusivement à améliorer la qualité d'un service public, puis décider plus tard que la diffusion du bien ou service acheté mériterait d'être encouragée. La leçon politique de notre typologie est donc la suivante : les instruments doivent correspondre aux défaillances visées et donc s'adapter à tout changement les concernant. Dès lors, la contribution de notre recherche n'est pas seulement d'identifier les instruments à mettre en œuvre et les pratiques à promouvoir pour répondre aux défaillances empêchant l'innovation. Nous démontrons aussi que l'élaboration des initiatives d'API doit s'appuyer sur une approche dynamique de leur rôle et des défaillances qui les justifient.

Notre troisième contribution est la plus évidente. Notre recherche aide l'élaboration d'initiatives d'API en identifiant les défaillances pesant sur l'innovation qu'elles doivent résoudre et les instruments et les pratiques nécessaires à cet objectif. Suivant le même raisonnement, notre thèse pourrait aider l'évaluation de politique. En effet, notre analyse diagnostique nous a permis d'associer à chaque défaillance des instruments. En d'autres termes, les théories économiques que nous mobilisons aident à mesurer la justesse des interventions politiques, c'est-à-dire la cohérence entre les défaillances visées (la fin) et les instruments utilisés (les moyens) (Edler et al., 2012; Guellec, 2001). Les décideurs politiques ne s'inspirent pas directement des théories économiques et ne se soucient guère de leurs antagonismes lorsqu'ils y piochent des arguments pour appuyer leurs décisions. Nous affirmons pourtant que ces théories gardent une certaine influence sur la décision politique. Celle-ci n'est pas prise de manière isolée, les décideurs bénéficiant du soutien de conseillers qui connaissent ces théories. Enfin, les analystes de politique les utilisent pour évaluer l'adéquation des instruments des politiques avec leurs objectifs.

Nous proposons néanmoins de poursuivre nos recherches pour que leurs résultats soient d'un meilleur soutien aux entreprises d'évaluation des API qui sont encore trop rares (Uyarra, 2016). L'objectif serait de déduire de notre cadre conceptuel des indicateurs non pas pour mesurer l'impact des API sur l'innovation, mais pour déterminer si les bons instruments ont été choisis et mis en œuvre. Notre recherche a déjà identifié quels étaient ces bons instruments. Il faudrait désormais également étudier l'influence de l'environnement et des autres instruments de politiques en place (Flanagan and Uyarra, 2016) sur l'efficacité des API et de leurs instruments à produire leurs effets.

Nous avons démontré que la justesse d'un instrument de politique dépend des défaillances qu'il doit aider à remédier. Or, pour définir ces défaillances, nous avons adopté une approche économique selon laquelle la rationalité d'une politique est de résoudre le problème empêchant que l'objectif visé soit atteint. Cette vision est considérée simpliste au regard des travaux sociologiques sur les politiques publiques. Ces derniers considèrent qu'un problème est une construction sociale qui impliquent plusieurs acteurs, les 'entrepreneurs politiques' (Kingdon, 1984), et différents processus cognitifs. Une fois qu'un problème est identifié comme tel, il est traduit en termes politiques et administratifs sur l'agenda politique (Sheppard, 2006). Dès lors, la décision politique est influencée par des facteurs et contingences multiples (Laranja et al., 2008). Les rationalités définies à partir de la littérature économique ne sont qu'un de ces facteurs et interagissent avec des rationalités plus politiques. Par conséquent, notre recherche doit prendre garde à ne pas idéaliser le décideur politique comme un agent capable de traduire directement des théories politiques des interventions publiques (Flanagan and Uyarra, 2016). Dans de futures recherches, nous proposons d'analyser comment les justifications identifiées dans cette thèse interagissent avec d'autres rationalités. Une meilleure définition de tous les types de défaillance que les API peuvent résoudre permettrait de mieux apprécier leur élaboration, dont le choix de leurs instruments. Elle aiderait ainsi une meilleure utilisation des achats publics, dont le volume représentait environ 12% du PIB de l'OCDE (moyenne pondérée) en 2013 (OECD, 2015b). En bref, de telles recherches sur la base de celle développée dans cette thèse contribuerait à la compréhension de l'utilisation stratégique des achats publics pour l'innovation et à leur mise en œuvre.

General Introduction

1. Context and ambition of the dissertation

In the Directive 2014/24/EU of 26th February 2014 on public procurement, the European Parliament and the Council of the European Union recalled that "public procurement is crucial to driving innovation, which is of great importance for future growth in Europe" (recital 95). This statement reflects the attention that the strategic use of public procurement for innovation has recently gained at the international (Section 1.1) and national (Section 1.2) levels (OECD, 2016b).

1.1. Growing initiatives for encouraging the strategic use of public procurement for innovation

1.1.1. Initiatives at the international level

Public procurement is increasingly pervasive in the innovation strategies and related action plans of the European Commission. In 2003, the report '*Investing in Research: an Action Plan for Europe'* (European Commission, 2003) considered public procurement as a means to achieve the Barcelona European Council's objective to raise R&D investment to 3% of GDP by 2010. In 2006, the Aho Group Report *'Creating an Innovative Europe'* (2006) similarly identified public procurement as an instrument for creating the recommended innovation-friendly environment. More recently, the European Research Area and Innovation Committee (ERAC) released its "*Opinion on Innovation Procurement*" advocating the establishment of a "strategic framework for innovation procurement" and the "set up of a national coordinating service offering support to contracting authorities and raising awareness on innovation procurement" (2015).

The EU public procurement framework was revised to permit such strategic use of public procurement. The Directive 2004/18/EC of 31st March 2004 introduced the competitive dialogue procedure to facilitate "particularly complex" public procurements, that is, situations in which public procurers cannot define the specifications of the solutions and therefore need dedicated interactions with potential suppliers. Ten years later, the Directive 2014/24/EU (introducing the innovation partnership) was adopted

following a proposal of the European Commission that advocated "[allowing] procurers to make better use of procurement in support of common societal goals such as […] promoting innovation" (European Commission, 2011).

The Organisation for Economic Development and Co-operation (OECD) similarly published policy recommendations (2011a) for leveraging the use of public procurement to foster innovation, in line with its 2010 *Innovation Strategy* (OECD, 2010). In 2015, the Council officially recognized that public procurement may pursue "secondary policy objectives" including innovation. These objectives should be balanced against the primary objective of public procurement, which is the delivery of products and services for the provision of public services in a timely, economical and efficient manner (OECD, 2015a).

1.1.2. Initiatives at the national level

In response to these initiatives at the international level, a growing number of OECD countries have implemented policy measures to encourage and stimulate the strategic use of public procurement to foster innovation. In 2014, 28 OECD countries reported that the public procurement of innovative goods and services was supported by procuring entities or at the central level (OECD, 2015b). In 2016, policy arrangements for public procurement of innovation (PPI) were among the most active[1] science, technology and innovation (STI) policy areas (OECD, 2016b).

The strategic use of public procurement to foster innovation gained impetus in non-OECD countries too, like China (e.g. Li, 2013), Latin America and Caribbean countries (e.g. Ribeiro and Furtado, 2014; Uyarra and Moñux, 2016).

1.1.3. Initiatives in France

Recent changes in the French innovation policy mix reflect this global tendency. In 2010, the French government reported to give medium-low priority to demand-side innovation policies including PPI (OECD, 2011b). A 2011 report to the European Commission similarly noted that France did not pursue any fully-fledged 'demand-side innovation policy' (Zaparucha and Muths, 2011). This does not mean nevertheless that

[1] Policy dynamics is measured with the means of the 'churning rate', an experimental indicator developed by Kergroach et al. (2017b) based on the country responses to the (2012, 2014 and 2016) OECD Science, Technology and Industry Outlook questionnaire (Kergroach et al., 2017a). The churning rate is the percentage of policy initiatives that have been implemented, repealed or substantially revised over a defined period (out of the total number of policy initiative in force in the last year of this period). It does not reflect the significance and magnitude of these policy changes, but reveals the STI policies that draw the most the attention of policy makers.

PPI did not play any role in innovation in France. In fact, it has been a key determinant in the development of some technologies like Information and Communication Technologies (ICTs), high speed rail (TGV) technologies and nuclear energy in the 1980s and 1990s (Terrasse, 1992).

First policy measures for stimulating the use of public procurement to foster innovation, like the *Passerelle* programme launched in 2007 and the *French Small Business Act* introduced by the 2008 *Law for the Modernisation of the Economy* (LME),[2] focused on facilitating the access to calls for tenders for innovative SMEs (OECD, 2014a). The turning point was the adoption of the *National Pact for Growth, Competitiveness and Employment* in 2012. It set the objective to support the growth of innovative SMEs by mobilising public purchasing, and to award them 2% of the total public procurement volume (from government, public agencies and hospitals), amounting approximately to EUR 1.4 billion, by 2020.

In the aftermath of the adoption of this strategy, a number of policy measures has been implemented for encouraging and supporting the use of public procurement to foster innovation. For instance, the Ministry of Economic Affairs and Finance and the Ministry of Industry released the *'Guidelines for Innovative Public Procurement*' with the view of spreading related good practices. An online platform acts as an interface between the ministries, their public agencies and innovative SMEs, to ease their mutual interactions prior to calls for tenders, and therefore facilitates public procurement of innovative solutions.[3] Another initiative worth noting is the establishment of an Innovation Unit within the Union of Public Procurement Groups (UGAP), the main French central public procurement organisation, in 2014. The mission of this unit is to organise local events to raise awareness of local authorities about PPI, and to accredit innovative solutions of SMEs and ease their procurement (OECD, 2016a).

Public procurement is mostly decentralised, with local authorities accounting for around 60% of the total volume of public procurement value in 2013 (OECD, 2015b). This might challenge the implementation of central strategies aimed at stimulating PPI. However, we observe that PPI is gaining ground in regional innovation strategies too. For instance, the then Rhône-Alpes[4] Region Council identified, as part of its 2013

[2] These two policy initiatives are currently terminated.

[3] Plate-forme des achats d'innovation de l'État et de ses établissements publics: http://www.achatspublics-innovation.fr/ (consulted on 16th March 2017)

[4] Rhône-Alpes was merged in the Auvergne-Rhône-Alpes region in 2016. It is one of the most active and innovative French regions (Lacave, 2011), ranking second in terms of Gross Regional Domestic Product in 2014 (EUR 208 billion, INSEE Statistics), total R&D expenditures in 2014 (EUR 6 billion, OECD Regional statistics), and PCT patent applications in 2011 (1390, fractional count by inventor, OECD Regional statistics), after Île-de-France. Grenoble, where we undertake this dissertation, is located in Isère, Auvergne-Rhône-Alpes.

Regional Innovation and Smart Specialisation Strategy, 'innovative public procurement' as a means to explore and develop innovation areas, and to address societal challenges. In addition to awareness-raising events, the Region financially supports local authorities engaged in public procurement by awarding them funding for preliminary feasibility studies.

1.2. Growing academic interest in public procurement of innovation

PPI gained a renewed interest from scholars before related policy measures became increasingly pervasive in innovation policy agendas. Few research were undertaken on the topic in the 1980s and 1990s (Dalpé, 1994; Dalpé et al., 1992; Geroski, 1990; Rothwell, 1984). However, the bulk of research on PPI follows the publication of '*Public Technology Procurement and Innovation*' by Edquist, Hommen and Tsipouri in 2000, and the 2007 seminal paper by Edler and Georghiou entitled '*Public Procurement and Innovation – Resurrecting the Demand Side'*.

An important stream of the literature on PPI investigates drivers of and obstacles to innovation in the public procurement process in order to explain the observed discrepancy between policy discourse and the actual implementation of PPI on the ground (Rolfstam, 2015). For that purpose, a number of case studies explore the rolling out of PPI initiatives at the local level (e.g. Dale-Clough, 2015; Knutsson and Thomasson, 2014; Lember et al., 2007, 2011; Uyarra, 2010). Other research focus on specific factors influencing the implementation of PPI initiatives, like the role of institutions (Rolfstam, 2009), the capabilities of public organisations (Valovirta, 2015), risk management (European Commission, 2010a), and the centralisation of public procurement (Albano and Sparro, 2010; Uyarra, 2010). Uyarra et al. (2014) analyse the obstacles to innovation in the public procurement procedure that are perceived by suppliers, and compare them against related policy measures in the United Kingdom. Some scholars focus on specific policy instruments for PPI, such as Forward Commitment Procurement (Whyles et al., 2015), the official accreditation of certain innovative products (Li and Georghiou, 2016), or foresight exercises (Vecchiato and Roveda, 2013).

The findings of these studies can contribute to the design of policy interventions likely to foster the strategic use of public procurement for innovation. Policy-making should indeed rely on strategic intelligence defined as "a set of sources of information and explorative as well as analytical (theoretical, heuristic, methodological) tools and indicators employed to produce useful insight in the actual or potential costs and effects

of public or private policy and management" (Kuhlmann, 2002, p. 34). An information of utmost importance for the design of policy interventions is the objective that they aim to achieve. In other words, the selection and implementation of appropriate instruments must depend on the nature of the problems to solve.

Policy instruments is an intangible concept 'carrying out quite different meanings from time to time, place to place and actor to actor' (Flanagan et al., 2011, p. 706). We understand them here as consisting of public action techniques (mobilising public resources) geared towards the achievement of policy goals (Howlett, 1991; Kergroach, 2017; Martin, 2016).

The design of PPI initiatives, that is, the identification and implementation of instruments appropriate for the achievement of their objective(s), faces two challenges. First, it must ensure that (secondary) innovation-related objectives do not divert PPI initiatives from their primary objective, that is, the delivery of products and services necessary for the delivery of public services. Secondly, the selection of appropriate instruments for PPI must accommodate the fact that PPI is polymorphous and multi-objective, involves various actors, entails the public procurement of a wide range of products and services for diverse markets, and targets a variety of needs.

The broad objective of our dissertation is to **contribute to the design of PPI initiatives by identifying their economic justifications and the most appropriate policy instruments for unleashing their innovation impact.**

For that purpose, we answer three interrelated research questions. We need first to understand in which circumstances PPI can underpin challenge-oriented policies, i.e. which impediments to innovation PPI must overcome with the means of appropriate sets of instruments (Research Question No. 1, Chapter 1). PPI can effectively spur innovation by stimulating the creation and development of markets. Therefore, we investigate the specific failures that PPI must solve to that end (Research Question No. 2, Chapter 2). Market formation is understood as a dynamic process involving knowledge coordination and adequate user-producer interactions. Public procurement practices may nevertheless inhibit collaboration between public procurers and suppliers. We explore these practices and the associated innovation failures that PPI must remedy to foster innovation (Research Question No. 3, Chapter 3).

2. Positioning our research questions

In this section, we define and delineate PPI (Section 2.1), and then introduce our three research questions and position them in the literature (Sections 2.2 – 2.4).

2.1. Definition of Public Procurement of Innovation

> Procurement is "the function of purchasing goods and services from an outside body" (Arrowsmith, 2005, p. 1), and public procurement occurs when this functions is performed by a public organisation or a private entity acting on behalf of a public organisation (Rolfstam, 2013).

The primary objective of public procurement is to help, via the purchase or order of goods and services, the performance of public services (Georghiou et al., 2014; OECD, 2015a). However, McCrudden (2004) observes that public procurement has been used as a means to underpin the Welfare State and its various goals including social policies. As described in Section 1, policy and scholarly discourses increasingly advocate linking further public procurement to innovation policy.

Despite this new impetus, the definition of PPI is still ambiguous, and the literature has been using multiple labels including 'public procurement of innovation,' 'public procurement for innovation,' 'innovative public procurement,' 'innovation-oriented public procurement,' and 'public technology procurement'. The concept of 'public technology procurement' (Edquist et al., 2000) is not used any longer, but its definition is still employed. In contrast to 'regular' public procurement, public technology procurement "occurs when a public agency places an order for a product or system which does not exist at the time, but which could (probably) be developed within a reasonable period" (Edquist et al., 2000, p. 5).

Uyarra and Flanagan (2010) discuss this definition and demonstrate that it is too restrictive and does not encompass the wide range of impacts that public procurement can have on innovation. Innovation in 'public technology procurement' refers exclusively to what is procured. Any innovation effect beyond the purchase is overlooked. Furthermore, the definition of innovation as "something that does not exist yet" focuses on radical innovation and does not therefore "account for innovation through the recombination of existing goods or services, innovation in the delivery of existing services, and excludes most process innovations" (Uyarra and Flanagan, 2010, p. 124). Therefore,

the primary concept of 'public technology procurement' is not in line with the widely accepted definition of innovation as consisting of the introduction of new goods and new methods of production, the opening of new markets, the conquest of a new source of raw materials or half-manufactured products, and the carrying out of new industry organisations (Schumpeter, 1934).

> In consequence, we adopt the definition of PPI given by Rolfstam (2013) and understand it as the procurement decisions of public organisations leading to any kind of Schumpeterian innovation (Uyarra, 2016).

We delineate accordingly our concept of PPI. Our definition encompasses innovation-friendly public procurement to the extent that it results in innovation. Pre-commercial procurement (PCP), which refers to the "government procurement of R&D services that seek to stimulate innovation" (Rigby, 2016, p. 382), is similarly considered here as a PPI. We acknowledge that PCP might be considered as a supply-side innovation policy instrument financially supporting R&D investments of firms (Edquist and Zabala-Iturriagagoitia, 2012, 2015). However, in our opinion, this does not justify the exclusion of PCP from our concept of PPI, as we focus on procurement decisions (which PCP is) leading to innovation (which PCP can do). Moreover, our definition encompasses PPI triggering innovation and PPI responsive to innovation (Edler and Uyarra, 2013).

In sum, we delineate PPI "along a continuum, which distinguishes between pre-commercial procurement on one end of the policy spectrum, followed by active attempts to stimulate innovation […] and then the use of 'innovation-friendly' procurement at the other end" (Uyarra, 2016, p. 359).

2.2. Building a unified typology of PPI: innovation failures to remedy and contribution to grand challenges

In parallel of scholarly discussion on the definition and delineation of PPI, several typologies have been elaborated, based on different variables, reflecting the variety of categories of PPI that can be considered.

Edler et al. (2005) distinguish PPI according to the locus of social needs to be satisfied (either intrinsic to public organisations, shared with private end-users, or extrinsic to public organisations), and to its effects on market (development, adaptation and standardization). Hommen and Rolfstam (2009) suggest a third dimension, which they call 'design of innovation public technology procurement' but that refers to the relation

between public and private demands, the reasons for public intervention, the kinds of innovation involved, and the modalities of public intervention. Finally, Rolfstam (2013) proposes extending the original typology by considering the cases of market destruction (market effect) and 'distributed' public procurement[5] (targeted needs).

In contrast to this approach, Uyarra and Flanagan (2010) highlight the wide variety of products and services that public organisations can procure. They elaborate a typology of PPI according to the level of specialisation of these products and services (whether their inputs come from specialists or not) and to the degree of uniformity of their users' needs (whether they target a niche or not).

Edler and Georghiou (2007) do not built any formal typology, but identify two additional forms of PPI: general PPI where innovation is an additional criterion in calls for tenders, and strategic PPI targeting specific products or services.

There is little evidence of the actual impact of these different PPI categories on innovation, because of difficulties in delineating PPI from regular public procurement and in measuring its volume (Uyarra, 2016). Furthermore, PPI challenges the definition of innovation given in the Oslo Manual (OECD and Eurostat, 2005) which is widely used to collect related data (Appelt and Gualindo-Rueda, 2016). Aschhoff and Sofka (2009) and Guerzoni and Raiteri (2015) are the very few scholars who have conducted quantitative analyses of the (relative) impact of public procurement on innovation. They confirm the statement of Geroski (1990), according to whom public procurement "is a far more efficient instrument to use in stimulating innovation than any of a wide range of frequently used R&D subsidies" (Geroski, 1990, p. 183).

Despite (severe) limitation in quantitative evidence, scholars have insisted on the potential positive influence of PPI on innovation (Uyarra and Flanagan, 2010). PPI can accelerate the modernisation of public services, making them more cost-efficient and improving their quality (OECD, 2014b). Dalpé (1994) focuses on its positive effect on industry, especially when the public sector acts as a first user (Dalpé et al., 1992). PPI can have a role in the development of knowledge-intensive regional systems (Rothwell, 1984) and the transformation of existing systems (Gee and Uyarra, 2013). It can indeed foster change in users' habits and accelerate the uptake of new products and services (Morgan and Sonnino, 2007; Phillips et al., 2007), but also support the transition of firms in a selected direction, like the provision of fresh, local and organic meals for public schools (Sonnino, 2009). For that reason, Edquist and Zabala-Iturriagagoitia (2012)

[5] In distributed public procurement, a "public agency publishes some kind of opportunity without either specifying a problem or making a commitment to procure anything" (Rolfstam, 2013, p. 26)

content that 'public procurement for innovation' can help the mitigation of grand challenges and therefore be the means of mission-oriented policies. However, PPI geared toward mitigating grand challenges differ from PPI underpinning traditional mission-oriented policies that target specific objectives like Project Apollo (Soete and Arundel, 1993). The increasing pervasiveness of grand challenges, consisting of wicked societal problems requiring complex solutions, call for re-thinking the rationales for demand-side innovation policies, including PPI, and their implementation modalities (Boon and Edler, 2017).

Taking account of the heterogeneity of PPI initiatives, we pose our first research question (RQ1): **under what conditions (failures and design) is PPI deemed a suitable policy to contribute to the achievement of grand challenges?**

To answer this research question, we need to investigate which impediments to innovation PPI must resolve with the means of which set of instruments (Chapter 1).

2.3. Explaining the role of PPI in market formation

PPI can have a positive effect on innovation by stimulating the creation of markets (Box, 2009; Edler and Georghiou, 2007; Edler and Uyarra, 2013; Rothwell, 1984). Public procurement in general can influence markets in three ways. It may increase demand, set new standards, and modify the structure of markets (Cabral et al., 2006). Through PPI, public organisations can additionally act as lead users, i.e. users less risk-averse, more inclined to absorb innovations, and "whose present strong needs will become general in a market-place months or years in the future" (von Hippel, 1986, p. 791). Lead users provide innovation producers with feedbacks and thereby contribute to make environments more favourable to innovation. Furthermore, they are willing to pay a premium for innovative products and services. Due to these characteristics, lead users can accelerate the emergence of lead markets, which consist of "regional markets with specific attributes that increase the probability that a locally preferred innovation design becomes internationally successful as well" (Beise and Cleff, 2004, p. 455). In sum, public sector can act as a lead user, through PPI, and stimulate the creation of lead markets. Finally, Neij (2001) demonstrates that PPI helps the transformation of markets by accelerating the commercialisation and market penetration of technologies that had been underutilised so far.

Market creation and development is one of the core functions that innovation systems must ensure to lead effectively to innovation (Bergek et al., 2008). It involves the

generation and coordination of knowledge and information (Potts, 2001). Any malfunction in this respect justifies policy intervention (Bleda and del Río, 2013).

Therefore, our second research question (RQ2) is the following: **in which ways can PPI, throughout the procurement procedure, support knowledge generation and coordination for the creation of markets for innovation?**

This research question requires considering the capabilities and interactions of all relevant actors, and accounting for the influence of PPI at all the stages of the market dynamic formation (Chapter 2).

2.4. Exploring public procurer-supplier collaboration

In line with Rolfstam's statement that PPI is "a special case of user-producer interaction" (Rolfstam, 2009, p. 349), some scholars adopt a micro approach and focus on the effect of public procurement on the relations between these two actors, and, more specifically, between public procurers and suppliers. For instance, Edler and Yeow (2016) identify different demand-supply intermediation functions of PPI, and Uyarra et al. (2017) explore the local anchoring of the social interactions that PPI underlies.

In contrast to regular public procurement, where each party tries to make advantage of the weaknesses of the other, PPI requires collaborative interactions between public procurers and suppliers (Edler et al., 2005). They both hold knowledge needed for the design and development of appropriate and innovative solutions. They are furthermore the carriers of knowledge that need to coordinate for the formation and development of markets (Bleda and del Río, 2013; Dopfer and Potts, 2008), hence the crucial importance of their collaboration for PPI. The lack of user-producer or public procurer-supplier interactions may explain that the rolling out of PPI is lagging.

Therefore, our third research question (RQ3) is: **What are the factors hampering the collaboration between public procurers and suppliers geared towards the development of new products or services?**

Chapter 3 identifies problems affecting public procurer-supplier collaboration and the instruments to mitigate or overcome them. If public procurer-supplier interactions are thereby improved, they will foster market formation and development, help solve impediments to innovation, and may ultimately contribute to challenge-oriented policies.

User-producer interactions are the core concept that we flesh out from different perspectives throughout our dissertation.

3. Our theoretical background: Failures – Design – Practice

Our research questions imply the use of three concepts, namely failures, design and practice. From an economic perspective, the rationales for innovation policy consist of failures that affect system transitions (Chapter 1), innovation processes (Chapter 1) including market formation (Chapter 2), and user-producer interactions (Chapter 3). Identifying these failures helps the appropriate design of PPI, i.e. the selection of a dedicated set of instruments and their modalities of implementation. However, actual practices of public procurers and suppliers have an impact on the implementation of these instruments and may consequently inhibit innovation. We should therefore explore public procurement practices that need to be taken into account for the effective implementation of PPI initiatives.

3.1. Justifying the use of public procurement for innovation: Failures

The literature identifies different sets of failures as rationales for innovation policy. Despite their hardly compatible underlying assumptions, policy-makers seemingly 'cherry-pick' them to justify their policy interventions (Laranja et al., 2008). Bach et al. (2014) similarly notice that the recipients of policy support barely distinguish underlying rationales. In this context, our contribution to policy-making would be low, if we focused exclusively on one set of failures and disregard the others.

We contend nevertheless that evolutionary economics and the derived systemic perspective of innovation enable a better understanding of PPI. They indeed focus on knowledge coordination and interactive learning, which are key to PPI. However, as market failures derived from neo-classical economics are still very pervasive in policy discourse, we cannot reasonably disregard them in our research. Therefore, following the approach advocated by Bach and Matt (2005), we focus on the complementarities of these theoretical frameworks, instead of their antagonism.

We choose a macro-meso-micro approach defining three different levels of policy rationales. At macro level, policy-makers decide on the overall direction of their policy

interventions for achieving identified broad objectives (Mazzucato, 2016; Mazzucato and Perez, 2015). They must then select a set of vertical policies and ensure their coordination in a policy mix (Flanagan et al., 2011). These vertical policies are our meso level. Although we acknowledge that policy interactions within policy mixes are of key importance, we focus, in this dissertation, on their individual rationales. We identify the so-called 'failures' that they aim to overcome in markets or systems to make innovation happen. Finally, at micro level, policy makers design their policy interventions so that they encourage practices unleashing collaboration between public procurers and suppliers for the development of new products.

3.1.1. Macro level: Encouraging system-wide transformations

Grand challenges have been increasingly pervasive in policy agendas. They consist of complex societal problems (Nelson, 2011), such as environmental degradation and ageing population. They require challenge-oriented policies, which are insufficiently justified by the concepts of market and evolutionary-systemic failures.

From a neo-classical perspective, policy interventions must address malfunctions that prevent an optimal allocation of resources and innovation in competitive markets (market failures). In the evolutionary approach, rationales for innovation policies are deficient interactions of (complementary) actors in systems, and factors hampering generation, coordination and diffusion of knowledge. These two perspectives justify policy interventions as solutions to (market and evolutionary-systemic) failures, i.e. something that does not work as it should work (it is suboptimal or could work better) and inhibits innovation. However, they say little about transformation of systems and the factors that hamper such transformation and that policy interventions must address to solve grand challenges.

Mazzucato (2013) calls instead for an 'Entrepreneurial State', the mission of which would be to identify directions for changes and orient accordingly markets and innovation systems in order to solve grand challenges. Similarly, Weber and Rohracher (2012) claim that grand challenges require "novel configurations of actors, institutions and practices that bring about a new mode of operation of entire sectors or systems of production and consumption" (Weber and Rohracher, 2012, p. 1037). In this perspective, policy interventions are justified by any burden to system transformation, that is, transformational system failures. These failures include the deficient definition of transformation direction, the lack of demand articulation, impairing policy coordination, and insufficient reflexivity of transformation process (Weber and Rohracher, 2012).

Single and isolated policy initiatives can hardly overcome these transformational failures and enforce any 'Entrepreneurial State'. What is required is a combination of policy instruments, each being justified by its own rationales, appropriately coordinated and geared towards an identified direction. Therefore, PPI may contribute to system-wide transformations and grand challenges, and a fortiori to other challenge-oriented policies, but should not be considered as an effective means to achieve these objectives in isolation. In our dissertation, we consequently explore the suitability of different categories of PPI to contribute to various challenge-oriented policies depending on the hampering factors in innovation process they aim to solve. In other words, Chapter 1 identifies the meso-level failures, whose solutions may help mitigate macro-level ones, and thus investigates the links between these two levels of failures justifying PPI.

3.1.2. Meso level: Overcoming market and/or evolutionary-systemic failures

Smith highlights that "rationales for policy are intimately bound up with assumptions about the nature of technological knowledge" (2000, p. 81). The definition of knowledge differs between neo-classical economics and evolutionary economics, which therefore mobilise different concepts to justify policy interventions for innovation.

Neo-classical economics

In neo-classical economics, firms decide on what they produce and on their means of production. The main driver of their decision is maximising their profits. In a context of exogenous technological change and changing environment, firms move to new production configurations following the same objective. Therefore, economic efficiency refers to the flexibility with which firms can make these adjustments and keep maximising their profits.

In this vision, invention, which is the premise of innovation, consists in the production of information (Arrow, 1962). Information is generic (i.e. widely applicable), codified (i.e. easily transmissible), freely accessible (i.e. negligible transmission cost or no barrier to knowledge and to its application) and context-independent (i.e. economic agents have equal capabilities to apply accessed knowledge) (Smith, 2000). It has the attributes of public goods: it is non-rival (multiple economic agents can use it simultaneously) and non-exclusive (its access cannot be restrained e.g. by forcing user to pay for it).

Because of the public-good attributes of information, firms cannot make optimal allocation of resources in a context of perfect competition (Arrow, 1962). These

malfunctions preventing the achievement of an optimum are market failures. They create a negative gap between private and social returns to R&D, hence corporate under-investment in R&D (Nelson, 1959). In addition to these undesired knowledge spill-over effects, Arrow (1962) highlights the uncertainty implied by basic research, which may dissuade firms even further from investing in R&D. In their stock-taking of failures justifying innovation policy, Weber and Rohracher (2012) identify two other market failures, namely the externalisation of costs (to the detriment to the environment and other social actors) and the over-exploitation/tragedy of commons.

New growth theory attempts to integrate the notion of endogenous knowledge creation into neo-classical models of economic growth. In contrast to Nelson (1959), Montmartin and Massard (2015) demonstrate, based on this literature, that market failures do not always lead to firms' underinvestment in R&D, but sometimes to overinvestment. They also extend the list of market failures with the concepts of knowledge externalities, surplus appropriability, duplication, rent transfer and location externalities. In any case, market failures justify policy interventions geared towards the achievement of a second-best optimum.

Evolutionary economics

Evolutionary economics draws on Schumpeter's statement that technological change is at the root of economic development (1934). It additionally considers that the rationality of economic agents is bounded, as they operate in an environment that they can understand ever less as knowledge is constantly changing (Bleda and del Río, 2013; Cantner, 2016). Furthermore, evolutionary economists make a distinction between knowledge, which is mainly accumulated via research activities, and information, as defined in neo-classical theories, which consists of codified knowledge (Cohendet and Meyer-Krahmer, 2001).

Innovation involves multiple interactions between various actors for the combination and coordination of different knowledge components (Dopfer and Potts, 2008). Because knowledge is partly tacit, it must be translated into information through a codification process, in which some knowledge is additionally needed to codify knowledge and then to exploit the codified knowledge. In sum, knowledge is not the sole accumulation of information (Cohendet and Meyer-Krahmer, 2001), and requires that knowledge producers have emitting capabilities, and that knowledge users/adopters have learning and adaption capabilities (Cantner, 2016).

Because of these underlying assumptions relative to the concept of knowledge and the role of technological change and associated industry dynamics in the economy, evolutionary economics differs from the neo-classical theory in terms of justification of policy interventions. It advocates a switch from optimising policy-makers aimed at improving the behaviour of firms based on the calculus of marginal costs and benefits, to adaptive policy-makers. The mission of policy-makers is here to ensure that the market is never in equilibrium (Metcalfe, 2005; Metcalfe and Georghiou, 1998), and that it can always accommodate and encourage knowledge creation (Bleda and del Río, 2013).

Based on this theoretical background, Malerba (1996, 2009) contend that the evolutionary justifications for policy interventions are:

1. 'Learning failures'.[6] Firms or industries are unable to adapt to technological change because they cannot learn rapidly and effectively.

2. Inappropriate balance between technology variety and selection. Wide technological variety restrains capabilities to exploit fully the most promising technologies, but tough selection may kill variety and prevent the emergence of technological options that would be more promising than the status quo.

3. 'Appropriability trap'. Measures to increase the appropriability of knowledge, as recommended in a neo-classical perspective, might affect the diffusion and circulation of knowledge, which is detrimental to innovation and economic growth in an evolutionary perspective.

4. 'Dynamic complementarities failures'. It refers to the lack of connection between complementary activities or actors required in the innovation process, like user-producer interactions.

Bleda and del Río (2013) propose to integrate (neo-classical) market failures in evolutionary economics. They define market formation as a dynamic process whereby a new knowledge diffuses from a first population of agents (inventors) to a larger one that adopt and retain it (adopters). Three kinds of knowledge and information coordination – deep, surface and operational – failures must be overcome for market formation to be effective. Market failures correspond to information coordination problems, that is,

[6] The concept of 'failure' does not refer here to malfunctions inhibiting the achievement of an optimal situation. Evolutionary economics doubts about the existence of such an optimum (Nelson, 2009), or claims that it would mean the end of technological change and economic development, if it did exist and was achieved. The role of the Schumpeterian 'entrepreneur' is indeed to challenge and break equilibrium (Cantner and Dopfer, 2015). Therefore, the evolutionary justifications for policy interventions are called 'gaps', 'trade-offs', 'malfunctions', 'dysfunctions', 'bottlenecks', 'weaknesses', 'problems'. Some evolutionist economists choose nevertheless to use the term 'failure' to convey more easily their findings, as the neo-classical theories have successfully imposed this concept in the (innovation) policy research.

operational coordination geared toward the retention of innovations. This dissertation explores how PPI can operate these different forms of knowledge and information coordination to stimulate market formation and foster innovation (Chapter 2).

Evolutionary economics has historically led to the development of a systemic perspective of innovation process. Indeed, the concept of innovation systems (Lundvall, 2005) builds on the idea that innovation is the outcome of an interactive, cumulative and context-dependent learning process, which involves a number of actors (organisations) whose interactions are themselves influenced by institutions (formal and informal rules). Systemic analysis of innovation puts emphasis on both market and non-market actors and how they "influence the direction and speed of innovation and technology diffusion in a country and the knowledge flows that move between these institutions" (Box, 2009, p. 14). In this perspective, innovation policies are justified by any bottleneck in inter-organisational interactions hampering the innovation process. These systemic 'failures' relate to infrastructures, institutions, interactions of organisations and capabilities of innovation producers (Klein Woolthuis et al., 2005).

Systems can be national (Lundvall, 2005), regional (Laranja et al., 2008), sectoral (Malerba, 2002), or technological (Bergek et al., 2008). The first three approaches – national, regional and sectoral – focus on the components of the systems, that is, organisations and their interactions (in networks), and institutions. Bergek et al. (2008) nevertheless contend that "it is difficult, if not impossible, to evaluate the 'goodness' or 'badness' of a particular structural element or combination of elements without referring to its effects on the innovation process" (Bergek et al., 2008, p. 409). They propose instead to consider the well-functioning of seven dynamics within technological innovation systems, namely 'knowledge development', 'resource mobilisation', 'market formation', 'influence on the direction of search', 'legitimation', 'entrepreneurial experimentations', and 'development of positive externalities'. In this view, an adequate policy intervention is a policy intervention aimed at solving a problem that affects one of these functions, and designed accordingly (Borrás and Edquist, 2013; Edquist, 2011). This approach does not discard the importance of identifying the structural components of the system to be targeted, but contends that this must be done in relation to the identification of the functions that these structural components should perform better.

3.1.3. Micro level: Exploring interactions between users/public procurers and suppliers

In the evolutionary-systemic perspective, the focus on knowledge coordination and on the underlying interactions between learning actors (Lundvall, 1992) highlights the importance of user-producer interactions (Smith, 2000), and the key role of users in the innovation process (von Hippel, 1986). This translates into new supply chain strategies, in which firms (users) recognize their suppliers (producers) as a source of potential innovation which can provide technological expertise, improve their products and reduce lead time (Bidault et al., 1998). In a context of increasing competition and technological complexity, corporate procurement strategies and contractual relations between firms and their suppliers have gradually moved away from arm-length relationships geared towards bargaining and cost-reduction, to collaboration for joint problem solving (Nishiguchi, 1994). The timing of involvement of suppliers in the development of new products depends on their role in this respect: collaborative design implies early involvement of suppliers in the development of new products (le Dain et al., 2011).

Policy interventions relying on effective user-producer interactions need to identify and address any related hampering factors. Deficient interactions may prevent resolving innovation-related failures. In PPI, public procurers are users or act on behalf of external end-users, and suppliers are innovation producers. Therefore, PPI can be conceived as a special case of user-producer interactions (Rolfstam, 2009). We adopt a micro approach investigating public procurement practices that inhibit early supplier involvement and ultimately innovation. Chapter 3 identifies implementation modalities that help policy interventions overcome failures in public procurer-supplier interactions and unleash the innovation potential of these interactions. In sum, we contend that the identification of collaboration failures can help the appropriate design of policy interventions.

To that end, we need to draw on the literature on private procurement and its insights on the failures in private procurer-supplier collaboration for the development of new products. McIvor et al. (2006) demonstrate that early supplier involvement may suffer from a number of impediments. Personnier et al. (2013) define and flesh out these hampering factors which can occur at any stage of collaboration and hinder or prevent the development of new products. They distinguish two groups thereof. During the collaboration design, failures relate to the selection of suppliers and the configuration of collaboration. Once suppliers are selected and collaboration is ongoing, failures consist of lack of or insufficient trust, deficient coordination between collaboration parties, and poor information exchange (Personnier, 2013). All these failures can be overcome by

policy interventions carefully designed and implemented. However, they are defined in the context of private procurement, that is, the procurement of products or services by private organisations. Procurement is among the few areas in which private and public organisations truly differ. Indeed, public procurement is subject to a more stringent legal framework and influenced by a central authority (Rainey and Bozeman, 2000). Because of these differences; the failures identified by Personnier (2013) may not fully apply to public procurement, but need adaptations to be relevant for PPI (Chapter 3).

Throughout our dissertation, we mobilise these different sets of failures – macro, meso, micro – in order to understand the strategic use of public procurement to foster innovation and, more specifically, its justification from an economic perspective. Our contribution to policy-making in this area will be higher, if we additionally explore the implementation of this strategic use, i.e. the instruments to be utilised, the actions to be undertaken for ensuring appropriate practices in relation to these instruments.

3.2. Choice of policy instruments and modalities of implementation: Design

We understand the design of policy interventions as the choice and implementation of policy instruments following the identification of objectives to achieve. All failures listed above can justify the strategic use of public procurement to foster innovation. Solving these failures requires the implementation of relevant policy instruments, which consist of all techniques that policy makers can undertake to achieve identified policy objectives.

The literature on policy design has elaborated a number of typologies of policy instruments (Howlett, 2011), but pays little attention to innovation and R&D policy instruments (Martin, 2016). Regarding PPI, the main reference is the article by Georghiou, Edler, Uyarra and Yeow (2014) entitled '*Policy instruments for public procurement for innovation: Choice, design and assessment*'. They distinguish three levels of policy interventions. At the highest level, policy-makers revise the legal framework to make it more conducive to PPI. Public procurement organisations adopt strategies and instruments to encourage PPI at an intermediate level. Finally, policy instruments for PPI can consist of all decisions of public procurers as part of individual PPI initiatives. This is the lowest level of policy interventions.

Our dissertation focuses on this last level of PPI instruments, that is, all decisions that public procurers take during individual PPI initiatives. Indeed, our approach consists in

the identification of impediments to innovation that PPI initiatives can overcome with the appropriate set of instruments and practices. Therefore, we justify policy instruments at the level of PPI initiatives. We do not consider obstacles to innovation in public procurement processes that require interventions of public procurement organisations (e.g. innovation-oriented training for public procurers) or revision of public procurement rules.

In addition to the distinction of these three levels of intervention, Georghiou et al. (2014) elaborate a taxonomy of policy measures for PPI. They group them in four categories depending on the deficiencies in the public procurement procedure they seek to remedy. Decisions of public procurers as part of PPI initiatives can consist of measures for identifying, specifying and signalling their needs, and for incentivising innovations. The other two categories of PPI instruments are out of the scope of our research since they relate to framework conditions, and organisation and capabilities of the public sector.

Identification, specification and signalling of needs may be affected by deficiencies in communication between public procurers and suppliers and within procuring organisations. Policy instruments should ensure that the public needs to be solved are effectively communicated to (potential) suppliers, and that public procurers are aware of the potential of suppliers' innovative solutions. They include Pre-Commercial Procurement and initiatives similar to the US Small Business Innovation Research (SBIR) programme (Edquist and Zabala-Iturriagagoitia, 2015; Rigby, 2016), competitive dialogue (Uyarra, 2016), technology platforms, foresight exercises (Vecchiato and Roveda, 2013), and certification and accreditation of innovative solutions (Li and Georghiou, 2016).

Policy measures for 'incentivising innovation' aim to address public sector's risk aversion and suppliers' reluctance to invest in the development of innovative solutions. Georghiou et al. (2014) suggest the implementation of insurance guarantees for public organisations, as well as the introduction of an innovation-related criterion in calls for tenders and/or the explicit commitment to procure innovative solutions that satisfy expressed needs (Whyles et al., 2015).

In addition to this non-exhaustive list of policy measures, Cave and Frinking (2003) identify various modalities of implementation of PPI, including the time-length of contracts, the way specifications are phrased in calls for tenders (prescriptive or functional), the composition of the procurement team (Johnston and Bonoma, 1981), and the modes of payment. When PPI is used to encourage innovation in strategic sectors and/or technologies, public demand must be linked up with private demand (Edler and

Georghiou, 2007). For instance, representatives of end-users (different from procuring organisations) may be involved in the public procurement procedure (Rolfstam, 2009), e.g. for the evaluation and selection of tenders, and PPI initiatives must ensure that public organisations act as first users (Dalpé et al., 1992) with the characteristics to encourage adoption by other actors (Mangematin and Callon, 1995). Uyarra and Flanagan (2010) and Uyarra et al. (2017) discuss the geographical implications of PPI initiatives considering their objectives and the characteristics of procured products. For instance, local public procurement may not be appropriate to satisfy needs requiring highly innovative solutions that only few specialist suppliers (possibly located outside the local area) can provide. Finally, the nature of the interactions between public procurers and suppliers may vary. Public procurement of complex products and services and procuring organisations' low capabilities require more intense collaboration between public procurers and suppliers. Conversely, if public procurers have sufficient technical capabilities, or if public procurement targets innovative but little specialised products and services (i.e. products and services whose specifications can be easily defined by public organisations), collaboration between public procurers and suppliers will be less a requirement (Uyarra and Flanagan, 2010) and public procurement will be similar to top-down order.

In contrast to Georghiou et al. (2014), we do not consider policy instruments in accordance with the deficiencies in the public procurement procedure that they need to remedy, but in accordance with the failures in the innovation process that PPI seeks to resolve (Chapters 1 and 2). Therefore, our research questions should lead to the identification and characterisation of different sets of policy instruments possibly overlapping. Chapter 1 focuses on the policy measures to help PPI overcome innovation-related failures and to increase its likelihood to contribute to challenge-oriented policies. In chapter 2, we investigate policy instruments to stimulate market formation and development via PPI. Chapter 3 considers implementation modalities of policy instruments, so that they can effectively influence practices on the ground and foster public procurer-supplier collaboration for the development of new products.

3.3. Rolling out instruments for public procurer-supplier collaboration and PPI: Practices

In the approach described above, the aim of PPI is to overcome impediments to innovation with appropriate sets of instrument. Therefore, PPI is defined as an innovation policy tool used deliberately to spur innovation. The literature has developed an

alternative approach considering PPI as a practice, where innovation is not the ultimate goal but a necessary means to achieve other objectives, such as improvement in public services quality. Even though their underlying rationales differ, these two approaches should not be disconnected, as “PPI as a policy cannot be thought out of procurement practices on the ground” (Edler et al., 2015a). Throughout our dissertation, we similarly advocate linking further policy and practices considerations.

We take into account that PPI must accommodate the primary objective of public procurement, which is the delivery of goods and services assisting public organisations in their public services missions. In other words, PPI may seek to remedy failures in the innovation process and can have therefore similar rationales to other innovation policy tools (Chapters 1 and 2), but its ultimate objective is still to solve public needs (possibly including grand challenges). Therefore, we must consider how public organisations accommodate these different objectives, and how they perceive and use the policy measures aimed at helping PPI resolve innovation-related failures.

To that end, we need to distance ourselves from the literature on innovation policy, and draw upon research exploring the practice of PPI, public procurement in general, and procurer-supplier interactions. These streams of the literature explore what Rolfstam (2015) calls the ‘endogenous context’ of public procurement. Chapters 1 and 2 consider PPI instruments and practices that contribute to solving failures in the innovation process including market formation and development. Chapter 3 focuses on the practices and other endogenous context factors that influence the impact of PPI instruments on innovation, and that may inhibit public procurer-supplier collaboration for the development of new products.

4. Methodology for answering our research questions

Our dissertation draws on the concepts of failures, policy design and public procurement practices to answer our three research questions relative to the justification and implementation of the strategic use of public procurement for innovation. Moreover, we rely on qualitative data collection and analysis methodologies to conduct appropriate diagnostic analysis for policy design.

Diagnostic analysis is a technique for policy-making, whereby the identification of a problem and its cause(s) leads the selection and implementation of policy instruments (Edquist, 2011). At macro level, problems consist of impediments to achieve broad

objectives like the mitigation of grand challenges. These problems are complex and have multiple causes. They require policy interventions that set the appropriate direction and ensure the appropriate coordination of policy instruments in policy mixes. Innovation policies are often only one among other policies in these policy mixes. The problems that they can address is a measured low innovation performance that assumedly inhibit the achievement of macro-level objectives. The cause of these problems are the failures at meso level we identified above, i.e. market and evolutionary-systemic failures. Finally, as each PPI initiative is a special case of user-producer interactions (Rolfstam, 2009), policy interventions must address failures at micro level, that is, public procurement practices hampering these interactions and consequently preventing the improvement of innovation performance and ultimately the achievement of identified broader objectives.

Therefore, policy design consists of a cascade of decisions regarding the choice and implementation of appropriate policy interventions. In our three chapters, we identify the relevant failures and appropriate instruments and practices. To that end, we use two methods.

Chapter 1 identifies, through a literature review and a typological theory exercise, categories of PPI based on the (meso-level) failures they aim to solve. We explore the literature on PPI and innovation policy to identify these failures. We organize them in three groups that we use as variables for our typology, namely demand- and supply-side failures, and failures related to user-producer interactions. To answer our first research question, we confront the meso-level failures of our PPI categories with the macro-level failures that must be resolved for mitigating grand challenges. We consequently determine the PPI categories that are the most appropriate to contribute to challenge-oriented policies. Finally, we consider the practices that are required for the effective solution of these meso- and macro-level failures.

In Chapters 2 and 3, we use a case study approach. To address our second research question, we undertake a secondary analysis of case studies available in the academic literature and reports for the European Commission, selecting only cases of PPI that deliberately influenced market formation (Chapter 2). In Chapter 3, we elaborate our own case studies through a series of semi-structured interviews with representatives of public organisations and suppliers that have experienced collaboration for the development of new solutions. The objective of our case studies is to answer our third research question, by identifying and fleshing out specific failures hampering public procurer-supplier collaboration, and determining how PPI can resolve them, i.e. with which instruments and practices on the ground. Such qualitative research methodologies help in

understanding complex social phenomena (Yin, 2011), like market formation or public procurer-supplier collaboration, as part of exploratory research. We analyse data collected through our literature reviews and case studies in an abductive way (Van Maanen et al., 2007). Our objective is neither to test theories, nor to generate a new theory based on our empirical findings. We instead use them to develop and extend existing theories (Dubois and Gadde, 2002).

5. A three-essay dissertation

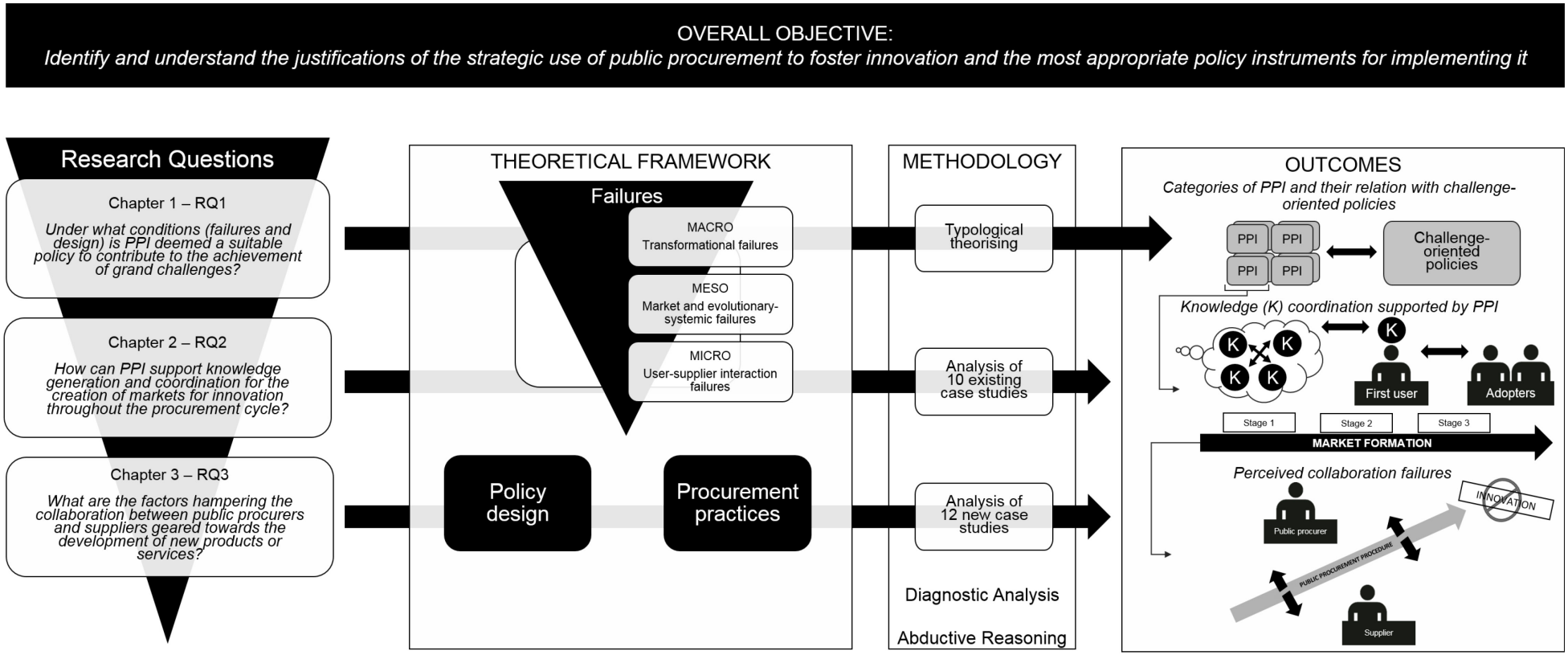
5.1. Overall outline of the dissertation

Our three chapters explore respectively the macro, meso and micro dimensions of the justification of PPI and their respective implications in terms of design and practice, based on a diagnostic analysis approach and qualitative research methodologies (Figure 0.1). Chapter 1 defines categories of PPI and determines their potential contribution to challenge-oriented policies, based on the failures inhibiting innovation that they aim to overcome. Chapter 2 concentrates on the categories of PPI that deliberately aim to foster innovation by stimulating market formation. These two chapters highlight the key role of interactions between public procurers and suppliers. Chapter 3 follows a micro level approach and seeks to flesh out these interactions. It investigates the failures preventing the collaboration between public procurers and suppliers in PPI defined as day-to-day practices.

5.2. Chapter 1 - Public procurement of innovation: A review of rationales, designs and contributions to grand challenges

The policy implications of grand challenges, which are complex societal problems increasingly pervasive in international and national policy agendas, challenge how rationales for innovation policies have been conceived so far. They call for transformation of systems (Weber and Rohracher, 2012) accelerated and underpinned by consistent policy mixes, that is, combinations of policy instruments appropriately coordinated and oriented towards selected directions (Flanagan et al., 2011). The literature identifies PPI as a suitable instrument in this respect (Edquist and Zabala-Iturriagagoitia, 2012). Our ambition is to elaborate on this statement and to determine under what conditions PPI can effectively contribute to challenge-oriented policies. Conditions mean here the innovation failures that PPI aims to overcome, and the instruments to be adopted and

Figure 0.1. Overall structure of the dissertation



the public procurement practices to be promoted to that end.

We conduct a two-step review of the literature. We first explore the literature on PPI and innovation policy, and contend that PPI can address three categories of failures: demand-side, supply-side, or user-supplier interactions. We derive a typology fleshing out the economic rationales and, thus, the theoretical foundations of eight PPI ideal-types. The review of typologies of PPI already elaborated in the literature helps then identify elements of design of PPI initiatives. Our ambition is to build a unified framework linking rationales for and elements of design of PPI initiatives, and thus to contribute to policy-making and policy evaluation.

We determine that the PPI category aimed at encouraging the development of innovations and accelerating their uptake, while favouring intense user-supplier collaboration, is the most likely to contribute to mitigating grand challenges. Furthermore, we identify which set of instruments and practices may help this PPI category achieve these objectives. Other categories of PPI accelerate ongoing transformations and have limited contribution to mitigating grand challenges; contribute to other types of challenge-oriented policies (man-on-the-moon type); or are unlikely to have any impact on any type of challenge.

5.3. Chapter 2 - The role of public procurement in the formation of markets for innovation: an evolutionary perspective

Chapter 2 focuses on the categories of PPI deliberately aimed at spurring innovation and investigates the ways in which they can support the creation of markets for innovation. We use an evolutionary perspective that allows taking into account the knowledge capabilities and interactions of all relevant actors and to analyze the influence of public procurement at the different stages of the dynamic formation of a market. In an evolutionary setting, markets for innovations are defined as complex systems that emerge and form along a dynamic developmental trajectory (Dopfer and Potts, 2008). In this dynamic trajectory, knowledge is created and coordinated at three different interrelated stages, namely origination, adoption and retention (Bleda and del Río, 2013). Each of these stages is associated with potential failures that may inhibit market formation and consequently hamper innovation. Our objective is to analyze the influence of PPI on this dynamics.

Our diagnostic analysis draws upon empirical evidence provided by a series of existing case studies (Yin and Heald, 1975). We select cases that provide evidence of

PPI having deliberatively an effect on processes of market creation and development. We list all the PPI instruments used and actions undertaken as reported in these cases, while considering the timing of their implementation. We then group them in categories defined according to their objectives and functions along the different stages of the public procurement procedure. By doing so, we identify coordination problems (or lack thereof) that might have affected the functioning of the market at each stage of its formation, and how they might have been promoted or solved by PPI instruments and actions.

Our empirical findings reveal that PPI can support the origination of innovation at one of intermediate stages of the procurement procedure by facilitating the expression of demand, and by reducing uncertainties in relation to this demand. The effectiveness of adoption, the next stage of market formation, depends on the capacity of innovation producers and users to learn and adapt their knowledge sets so that they fit with each other. We show that PPI can help such coordination by ensuring the complementarity among these knowledge sets at the very early stages of the procurement procedure. At later stages, PPI may influence mutual co-adaptation of these actors and their interactive learning. Finally, PPI can support the retention of innovation, the last stage of market formation, by contributing to the coordination of the behaviours of users and producers in the market via the alignment of their information messages, incentives, and prices. To that end, it can provide users with (financial and non-financial) incentives and relevant information in relation to the use of the procured innovation, at the final stage of the procurement procedure.

Based on our case studies, we demonstrate that PPI can support the different phases of knowledge and information coordination for market formation, and that the adoption of innovations must be supported from the earliest stages of the public procurement procedure. Furthermore, we make a justified objection of atemporal approach to policy-making.

5.4. Chapter 3 - Collaborative development of innovations though early supplier involvement in public procurement procedures

The ambition of Chapter 3 is to flesh out the interactions between public procurers and suppliers for the development of new products and the creation of a market for them. We aim to identify the micro-level failures affecting the collaboration between both actors (so-called ‘collaboration failures’) in different PPI procedures, namely the standard procedure and competitive dialogue.

To that end, we draw on the literature on private procurement, which has already identified failures in early supplier involvement (McIvor et al., 2006). We acknowledge nevertheless differences between the public and private sectors with regard to procurement (Rainey and Bozeman, 2000). We conduct qualitative interviews (Yin, 2011) with representatives of public procurers and suppliers about their experience of collaborative development of innovations. We employ the thematic analysis methodology (Paillé and Mucchielli, 2012) to analyse the data thereby collected. We look for collaboration failures in the empirical data and compare them to the failures already identified in the literature on private procurement (Personnier et al., 2013). Finally, we group them in categories, and code them according to: the type of organisation (public procurer or supplier) reporting the failure, and the type of procedure (standard PPI procedure, competitive dialogue, or others) in which the reported collaboration failures occurred.

Our findings provide a set of collaboration failures possibly occurring in the standard PPI and the competitive dialogue procedures, and demonstrate that the most critical ones are likely to occur in the early phases of collaboration, i.e. before the selection of suppliers. We highlight differences in these types of failures and their loci between the two procedures. Competitive dialogue improves information and knowledge sharing, which, in turn, helps in the definition of demand and, to a lesser extent, justification for the selection of a particular solution. However, the organisation of such formalised interactions makes public procurement procedures lengthy and complex and requires additional skills and resources from both parties involved. In addition, public procurers and suppliers reported that competitive dialogue is more sensitive to collaboration failures relative to their respective willingness to collaborate. Our results additionally show that the perceptions of the sources of failures diverge between both types of actors. They also suggest additional techniques and strategies in relation to PPI initiatives that are favoured by suppliers depending on the degree of innovativeness of the procured products or services.

Based on our empirical finding, we can discuss the influence of the legal framework on public procurer-supplier collaboration and on PPI in general (Rolfstam, 2013). Even though many scholars consider that the legal framework hampers such interactions (Edquist and Zabala-Iturriagagoitia, 2012), we found that this negative effect is more due to the interpretation of rules than because of the rules themselves (Coriat and Weinstein, 2002). In fact, the current legal framework has been recently revised to be more conducive to innovation. Drawing upon the management and industrial engineering literatures (Personnier et al., 2013), we observe collaboration failures e.g. related to

willingness to collaborate and trust building that have a significant influence on public procurer-supplier collaboration, but which the literature on PPI has overlooked.

Chapter 1. Public procurement of innovation: A review of rationales, designs and contributions to grand challenges

Foreword

This chapter is based on the paper with the same title co-authored with Mireille Matt (INRA, France). In September 2016, we submitted it to the Special Issue of *Science and Public Policy* on "The next generation of innovation policies: Directionality and the role of demand-oriented instruments" edited by Wouter Boon (Utrecht University, the Netherlands) and Jakob Edler (University of Manchester, United Kingdom).

A preliminary version of this paper was presented at the 2015 DRUID Academy Conference in Aalborg, Denmark, and at the 2015 EU-SPRI (European Forum for Studies of Policies for Research and Innovation) Conference "Innovation policies for economic and social transitions: Developing strategies for knowledge, practices and organizations" in Helsinki, Finland. The comments received at these events have improved the paper. The authors are grateful to Jakob Edler, Wouter Boon and anonymous reviewers for their valuable feedback and comments.

2. Introduction

'Grand challenges', related, for instance, to environmental and health issues, have become increasingly pervasive in policy discourse and in the Science, Technology and Innovation (STI) policy literature. The policy responses appropriate to these societal challenges differ from mission-oriented policy interventions that relied on large R&D programmes such as Manhattan and Apollo projects. Grand challenges call for system-wide transformations for which a single instrument is not sufficient. They require policy-makers to implement policy mixes (Kuhlmann and Rip, 2014) that include demand-oriented policy measures (Amanatidou et al. 2014; Weber & Rohracher 2012). As a result, Public Procurement of Innovation (PPI) has been considered a suitable instrument to address grand challenges (Edquist and Zabala-Iturriagagoitia, 2012; Kuhlmann and Rip, 2014).

The literature focuses mostly on the heterogeneity of PPI and its impact on innovation. Several typologies have been proposed to define PPI categories based on criteria such as the market's degree of maturity, nature and size; type of social need being targeted; user-producer interactions; and degree of specialization of the procured products and services (e.g. Edler et al. 2005; Hommen & Rolfstam 2009; Uyarra & Flanagan 2010; Wang & Bunn 2004). This literature includes a growing stream of work on the obstacles to innovation in procurement processes (e.g. Edler & Yeow 2016; Edquist et al. 2015; Lember et al. 2011; Uyarra et al. 2014), which provides some justifications for the selection of instruments (Georghiou et al., 2014). However, to the best of our knowledge, none of these works draws explicit links between the various categories of PPI and grand challenges, nor do they identify which type of PPI would make a positive contribution to those challenges.

Due to the differences among PPI types, we suggest the statement that PPI is a suitable instrument to address grand challenges requires some refinement. The research question we address is: under what conditions (failures and design) is PPI deemed a suitable policy to contribute to the achievement of grand challenges? The argument we propose is based on the concept of 'diagnostic analysis' (Edquist, 2011), which states that identification of the problems to be solved and their causes must precede policy design (instruments and characteristics).

In this chapter, we focus on the meso-level failures that obstruct innovation and which PPI might resolve, in order to guide its design (i.e. instruments and characteristics). This

requires a comprehensive diagnostic analysis that considers the different sets of failures which might derive from various economic theories.

The conceptual argument presented here is built on a two-step literature review. First, based on work on the rationales for innovation policy and PPI, we contend that PPI can be used to address three broad categories of meso-level failures: demand-side, supply-side, and user-producer interaction. As a demand-side policy intervention, PPI can foster innovation by encouraging its uptake (Edler, 2009). In some instances, PPI also can target supply-side failures, that is, innovation producers' deficiencies. In addition, the success of PPI depends largely on user-producer interactions. These interactions could be hampered by information asymmetries and poor dynamic complementarities. We investigate the range of these failures and build an analytical framework that allows us to derive a typology highlighting the economic rationales and, thus, the theoretical foundations of our PPI types.

A theoretical foundation of PPI allows us to associate our PPI ideal-types with the scattered elements of the PPI typologies previously elaborated. The outcome of this second literature review step for PPI design is a typology that links rationales and other elements of design within a unified framework. In addition, we determine to what extent each of our PPI ideal-types is likely to be an appropriate response to challenge-oriented policies. Our proposed typology should contribute to policy-making by highlighting the PPI categories with the highest potential societal impact.

The chapter is organized as follows. Section 2 presents issues related to challenge-driven policies, the macro-level failures that they must overcome, and their appropriate instruments and underlying practices. Section 3 presents the objectives of our study and steps followed to build our failure-based PPI typology. Section 4 reviews the various failures impairing innovation for which PPI could be the remedy and, accordingly, builds PPI ideal-types and assesses their likelihood of providing powerful support to challenge-oriented policies. Section 5 discusses the design of our PPI types and Section 6 concludes.

3. Challenge-driven innovation policies

The literature on STI policy often compares two different kinds of challenge-oriented policies: historical mission-oriented programmes such as the Manhattan and Apollo projects, and challenge-driven STI policy focusing on societal challenges (climate

change, the ageing population, or public health). The first type of provides solutions to well-defined problems, framed in technical terms and requiring the development of specific technological capabilities. Such policies are based on a top-down, rational planning approach. They support the competitiveness of specific industries (defence, aerospace) through the choice of a well-defined direction in order that the solutions achieve a clear end goal. Conversely, societal challenges, underpinning grand challenges, are complex, multi-sided, uncertain, unstructured and difficult to manage, and comprise macro-level problems calling for long-term transformative change (Weber & Rohracher 2012). This fundamental change requires a transformation of the whole system of innovation production and consumption, that is, new configurations of actors and knowledge bases, cross-sectoral collaboration, technological and social innovations, a wider set of institutions and interests, multi-level policy efforts and multi-agency responses related to the long run (Foray et al., 2012; Nelson, 2011).

There is a consensus that grand challenges cannot be met by current innovation policy justified by 'traditional' (meso-level) rationales such as market and structural evolutionary-systemic failures; there is agreement that a system transformation is needed (Mazzucato 2016; Weber & Rohracher 2012). Policies inspired by market failure and innovation system approaches are attempts to optimize the functioning of existing markets and the structure of innovation systems. A comprehensive policy framework aimed at facilitating transformative change and, thus, correcting (macro-level) transformational system failures, should encompass a set of policies inspired by multi-level and socio-technical transitions perspectives (Geels and Schot, 2007). According to Weber and Rohracher (2012), policy interventions addressing grand challenges need to consider transformational failures, that is, directionality, demand articulation, policy coordination and reflexivity failures in addition to market failures and structural system failures (Woolthuis et al. 2005). Challenge orientation advocates the development of a policy approach that combines supply-side instruments, market creation (Mazzucato, 2016) and demands (Boon & Edler 2017) to set the direction of change.

The comprehensive framework developed by Weber and Rohracher (2012) assumes that there are various levels at which challenges should be addressed. Solving transformational system failures assumes vertical public policies implemented by public organizations that allow bottom-up learning, experimentation and discovery (Mazzucato, 2016; Mazzucato and Perez, 2015) to set appropriate directions of change. Once directionality is implemented, innovation policy instruments, such as PPI, can be implemented in combination with other 'horizontal' instruments (Flanagan et al., 2011) to support innovation activities relevant to the selected challenge. Policy interventions at a

more local level might be needed to help to mitigate this challenge (Edquist and Zabala-Iturriagagoitia, 2012). Each instrument in the policy mix has legitimacy and encompasses design issues related to (meso-level) market and structural evolutionary-systemic failures. Cagnin et al. (2012) show how the structural (actors, interactions, institutions) and functional (learning, knowledge creation and diffusion, direction of search and selection, market creation) elements of innovation systems might be influenced by public policies and reoriented towards grand challenges. We analyse theoretically how PPI might shape these elements of innovation systems and, thus, tackle the issues related to grand challenges.

4. Typology building methodology: a two stage literature review

This section presents the method used to build our PPI 'ideal-types' (Weber 1949). By ideal-types, we mean PPI categories that focus on a set of coherent characteristics, linked in a logical manner, and which isolate the more significant features of the reality.

Our approach consists of typological theorising, building on a review of two broad literature streams: the rationale for innovation policy, and economic approaches to PPI. The papers were selected via an online search of the Web of Science, Business Source Complete and EconLit databases. To identify publications on the rationales for PPI, we searched on the following terms in relevant peer-reviewed academic journals and books: public procurement of innovation AND rationale/ failure/ obstacle/ impediment/ dysfunction/ problem/ imperfection/ weakness. Only six publications met our criteria and appeared relevant for our research. We conducted a similar search for publications on the characteristics of PPI and PPI instruments using the search terms: public procurement of innovation AND instrument/ measure/ design/ typology/ characteristic. We identified 20 relevant publications.

This method nevertheless focuses on academic publications and ignores 'grey' literature. Also, publications that do not include the search terms used are excluded although they may be relevant. To try to counter these shortcomings, we identified additional relevant publications using the snowballing method. We selected the (relevant) publications most cited by the publications identified by our reviews of the literature on online databases.

Based on this literature review, we built a typological theory, that is:

> *a theory that specifies independent variables, delineates them into categories for which the researcher will measure the cases and their outcomes, and provides not only hypotheses on how these variables operate individually, but also contingent generalizations on how and under what conditions they behave in specified conjunctions or configurations to produce effects on specified dependent variables. (George and Bennett, 2005, p. 235)*

Within this perspective, we characterized PPIs in terms of variables, combinations of variables, or a series of effects fitting the particular type.

We constructed our ideal-types using abductive reasoning (Van Maanen et al., 2007), which "consists of assembling or discovering, on the basis of an interpretation of collected data, such combinations of features for which there is no appropriate explanation or rule in the store of knowledge that already exists" (Reichertz, 2009, p. 304). We had no preconceived beliefs about the links between the failures identified in the innovation policy and PPI literatures (Section 4) and the design (characteristics and instruments) identified in the PPI literature (Section 5). However, we hypothesize that there are a limited number of PPI types, each characterized by specific (meso-level) failures, implementation modalities and relevant instruments.

Since we define the rationales for PPI based on innovation failures, following Edler et al. (2015a) we consider PPI as an innovation policy instrument whose primary goal is to spur innovation. However, PPI can be defined also as a practice on the ground, where innovation is merely the means to achieve other objectives (such as improving public services). These two approaches are linked: PPI as a policy cannot be conceived of in the absence of actual practice (Edler et al., 2015a). Similarly, our typological theory will include PPI types that will consist of actual practices (see Section 4.1.1).

We build our ideal-types in two steps. In the first step, we define the 'output legitimacy' (Boon and Edler, 2017) of PPI, that is, the (meso-level) failures that justify state intervention. The objective is to develop a general framework legitimizing the broad categories of PPI to support grand challenges. Careful analysis of the failure-based innovation policy literature (Section 4) led to our grouping failures relevant to PPI legitimization into three categories, which we used as our discriminating independent variables. The first discriminating variable considers demand-side failures: failures linked to improvements to public services provision vs diffusion to external users. The second focuses on supply-side failures: adaptations of existing solution vs failures related to the

development of new solutions. The third relates to failures linked to the degree of user-producer interactions required during the public procurement process: information asymmetry vs interactive learning space failures. Based on these independent variables, we propose four types and eight sub-types of PPI (Table 1.1).

The second step in our typology building focuses on 'operational intelligence requirements' (Boon and Edler, 2017), that is, the data and analysis needed for the design and implementation of policy, and their translation into particular choices and instruments. Based on the review of the PPI literature, we extracted data related to innovation characteristics, implementation modalities and instruments. This literature proposes several typologies that take account of the type of social needs addressed by PPI in the market development process (Edler et al., 2005; Lember et al., 2011; Rolfstam, 2013): market size and degree of specialization of production processes, innovation types, implementation modes, risks and geographic considerations (Uyarra and Flanagan, 2010); and level of information exchange between users and producers (Wang and Bunn, 2004). Georghiou et al. (2014) identify instruments to remedy deficiencies in the PPI process. We analyse how the data collected (social needs, market size, specific design) might be linked to the three different types of failures referred to above, and under what conditions they interact to influence specific PPI. The integration of our two-step literature review leads to an extended typology of PPI (Table 1.2).

5. Policy rationales for PPI from a challenge-oriented perspective: Towards an analytical framework

In this section, we present three broad categories of (meso-level) failures that PPI might resolve. This results in a failure-based analytical typology that justifies ('output legitimacy') PPI from a challenge-oriented perspective.

5.1. Demand-side failures

We can distinguish two groups of PPI (Cave and Frinking, 2003; Edquist and Zabala-Iturriagagoitia, 2012). The first relates to situations where innovation is a by-product of a public procurement initiative aimed at improving the quality and efficiency of public services. The second focuses explicitly on fostering innovation, by accelerating the diffusion of novel products and services.

These two groups of PPI are linked to different types of demand-side failure, involving different actors. The first group of demand-side actors involves public organizations interested in improving public services (plus the direct users of these public services); the second group includes all potential new users (including or not public procurement organizations). If the objectives of PPI are to improve the performance and delivery of public services through the introduction of an innovation and to support its diffusion, these two groups of actors overlap.

5.1.1. Failures related to the provision of high-quality public services

The role of PPI relative to the performance and delivery of high-quality public services should not be underestimated. These types of PPI initiatives correspond to direct PPIs, that is, PPIs aimed at addressing needs that are intrinsic to public procurers and are related to their particular missions (e.g. Edler et al. 2005; Edler & Georghiou 2007). Direct PPI initiatives might be suitable to deal with mission-oriented programmes, that is, programmes where the user of the technology to be developed is also the funding agency (Foray et al., 2012). In such circumstances, directionality and demand articulation can be solved through the purchasing decisions of public actors.

Innovation that is publicly procured and introduced into the public sector “increase[s] the responsiveness of services to local and individual needs; and [allows them] to keep up with public needs and expectations” (Mulgan and Albury, 2003, p. 5). Indeed, public sector purchase of innovative products and/or services results in “improve[d] process efficiency and enhance[s] the quality and availability of public services delivery” (OECD, 2014b, p. 13). This objective is assumed to be the justification for most PPI initiatives (Edquist and Zabala-Iturriagagoitia, 2012).

The role of PPI in improvements to public services consists essentially of translating into demand the needs that the public sector is trying to satisfy (Cave and Frinking, 2003). This demand-pull effect encourages innovation activity if the articulated need is novel. The lack of translation of novel needs into demand constitutes a failure that might be resolved by PPI. Because the primary objective of these PPI initiatives is not to spur innovation, they might be considered to be practices rather than innovation policy instruments (Edler et al., 2015a).

5.1.2. Impediments to innovation adoption and diffusion

Some PPI initiatives are aimed directly and explicitly at promoting innovation and its diffusion (Edquist et al., 2015; Edquist and Zabala-Iturriagagoitia, 2012). They correspond to cooperative or catalytic PPI. In the former case, PPI addresses needs that are shared by private users, while in the latter, targeted needs are extrinsic to public procurers (e.g. Edler et al. 2005; Edler & Georghiou 2007). In this second case, PPI does not target improvements to public procurers' missions, but contributes to wider market formation and development. In general, demand-side measures to support innovation consist of efforts "to increase the demand for innovations, to improve the conditions for the uptake of innovations and/or to improve the articulation of demand" (Edler, 2009, p. 3). Catalytic PPI initiatives can be powerful instruments for supporting challenge-oriented problems (Edquist and Zabala-Iturriagagoitia, 2012). They can contribute to the resolution of demand articulation failures by developing a shared vision and demand-articulating competencies (Weber & Rohracher 2012). Innovation is fostered by its broader diffusion via new channels among non-traditional potential users (Cagnin et al., 2012), that act outside the framework of public services.

Also, public procurers can facilitate innovation diffusion by becoming early adopters, risk-taking organizations or entrepreneurial public agents (Mazzucato, 2016) managing grand challenges. The public sector is considered a major user of new products and services based on its rather low sensitivity to price (Geroski, 2000). Public administrations willing to bear the risks associated to the purchase of novelty and to pay the related premium, can act as lead users (Dalpé et al., 1992; von Hippel, 1986). In agreeing to be early adopters of innovations they can provide the innovation producer with feedback and, in some cases, influence the adoption decisions of other users. Lead users contribute to building an environment that is sympathetic to innovation and the generation of lead markets (Edler and Georghiou, 2007; OECD, 2011a).

In order to accelerate the diffusion of innovations, public procurers must resolve adoption failures. Adoption involves learning and adaptability from users. Adopting an innovation requires organizations and individual agents to acquire new knowledge and to adapt existing knowledge. Adoption failure is "essentially related to organizational inertia […], and/or to a lack of adaptive capacity of agents" (Bleda and del Río, 2013, p. 1047). PPI can encourage the diffusion of innovation by improving the adaptation and learning capabilities of demand-side actors. This will increase the chances that demand-side actors will become learning organizations effective at supporting transformative changes (Mazzucato, 2016).

PPI can ease the diffusion of innovation by reducing switching costs and increasing the returns to adoption (Mangematin and Callon, 1995). Switching costs comprise transaction and learning costs and the costs related to the adoption of complementary equipment. Excessively high costs can deter the adoption of novelty and lock agents into existing products. PPI can work to create network externalities through initial mass purchase; enlarging the installed base of an innovation makes it more attractive compared to other products (Edler and Georghiou, 2007; Geroski, 2000). Public procurers acting as early users can help to reduce switching costs by generating an 'information cascade' (Geroski, 2000). Their experimentation with the innovation, allows them to provide other agents with information, which reduces agents' learning gaps and hastens their adoption decisions.

The public sector can affect consumers' preferences by orienting them towards new products and promoting the emergence of demand for the innovation. In this context, PPI can contribute to the elaboration of new standards (Uyarra, 2016), which help to increase demand for the particular product compared to other products and/or services. By opting for novelty, public procurers can increase the switching costs related to other technologies or products and contribute to ending their life cycles (Rolfstam, 2013).

Alternatively, potential users may be given the opportunity to experiment with and become familiar with innovations that have been publicly procured and then are made available to them. In this case, there is no early user providing information on the innovation. It is expected that experimenting with the innovation will result in consumers changing their preferences. Facilitating experimentation and learning should be strengthened in areas potentially relevant to grand challenges (Cagnin et al., 2012).

5.2. Supply-side failures

Although PPI commonly is described as a demand-side innovation policy, it can overcome failures affecting innovation producers such as lack of incentives for firms to conduct R&D activities, and the lack of innovation capabilities.

5.2.1. Lack of incentives to invest in R&D

Firms may be reluctant to invest in R&D if the uncertainties relating to the demand for the outcomes are too high (Arrow, 1962). Therefore, any increase in or guarantee of demand can be effective encouragement for R&D. In some sectors, such as construction, healthcare and transport (Edler et al., 2005; Edler and Georghiou, 2007), the public

sector is a main source of demand and has an impact on firms and their decisions. In these circumstances, specification of public demand is more likely to influence supplier activities. In the United Kingdom, the Forward Commitment Procurement is a PPI technique that is used to improve the provision of information to suppliers about future public sector needs, and to reduce uncertainty and, hence, perceived risks (Whyles et al., 2015). For example, such information could convince firms to invest in specific R&D activities, targeted, in the short term, to single breakthrough technologies to support 'classical' mission-oriented goals, or directed towards the long run development of a variety of relevant technologies to escape path dependencies and address grand challenges. In general, by acting as a type of insurance scheme, large PPI can have a significant effect on the decisions made by these firms. This type of PPI guarantees a minimum level of sales in a given time period (Cave and Frinking, 2003; OECD, 2014b). Public administrations can increase this effect by aggregating similar demands from other actors (Edler et al., 2005; Edler and Georghiou, 2007).

5.2.2. Learning and capabilities failures among producers

Although the World Trade Organization Government Procurement Agreement and European norms prohibit procurement practices aimed at championing specific firms, one of the effects of procurement is that it strengthens the selected suppliers (Dalpé, 1994). PPI can incentivize firms and other innovators to enhance their capabilities to innovate.

The main failures impeding firms' innovation performance have been identified as insufficient accumulation of competencies, inadequate level of human capital, and limited knowledge diffusion in the business sector (Malerba, 1996). Because selected suppliers need to engage in innovation activities to be able to provide public procurers with products and/or services tailored to their needs, they work to create knowledge and improve their capabilities. PPI can reduce firms' learning deficiencies (Malerba, 1996). The new knowledge and capacities accumulated through the development of new solutions could be employed by firms to develop subsequent new products and/or services. In addition, their ability to solve complex problems entailed in grand challenges is boosted (Cagnin et al. 2012).

The process of knowledge accumulation can promote path dependencies: a dominant technology can emerge and result in market actors becoming progressively locked in to it, with the consequence that no better alternative technologies are introduced to the market. A PPI can be interpreted as a choice of one technology to the detriment of some

other(s) or as “guiding the direction of search and selection” (Cagnin et al., 2012, p. 145). On the other hand, PPI could favour alternatives to the dominant technology and, thereby, break path dependencies and affect firms’ innovation performance (Malerba, 1996).

5.3. User-producer interaction failures

The most basic effect of PPI is to create an interface between users and producers (Rolfstam, 2009), whose interactions are crucial for the generation of innovation and, thus, successful PPI. For simplicity, this chapter distinguishes two polar cases of user-producer interaction in PPI: interaction restricted to reducing information asymmetry between producers and users, and absence of an interactive learning space. These failures are transversal to demand and supply-side issues and could affect any situation between our two polar cases.

5.3.1. Uncertainties related to information asymmetry

The first case consists of situations where information asymmetry related to users’ needs hampers the generation of innovation. The role of public procurers is to identify these needs and their (innovative) solutions, and to specify them in calls for tenders. In these extreme circumstances, calls for tenders are assumedly sufficient to reduce information asymmetry and to create a demand-pull effect. Suppliers are told what they must supply and left with no scope to develop alternative solutions. PPI becomes an order that requires minimum user-producer interactions for the public procurement of an appropriate innovation.

Calls for tenders provide firms with the information they lack on existing demand and, thus, reduce some of the uncertainties deterring investment in R&D activity. By reducing these information asymmetries, PPI can address market failures (Arrow, 1962) related to firms’ lack of knowledge about demand. This category of PPI is better suited to ‘classical’ mission-oriented policies addressing well-defined problems (Nelson, 2011). Public organizations are able to resolve issues of directionality and demand articulation in a top-down manner.

5.3.2. Lack of an interactive learning space

At the other end of the spectrum is the case of a PPI where the innovation is co-developed by users and suppliers. This form of collaboration represents the highest level

of interaction between these two actor types and plays a crucial role in the innovation process. Users provide producers with feedback, which helps to align the focal innovation to users' needs. Thus, PPI allows the emergence of 'dynamic complementarities' (Malerba, 1996). It provides a space where users and suppliers can interact with each other and enable the former to contribute to the innovation process of the latter.

This type of user-producer interaction promotes mutual learning. As already stated, the adoption of an innovation may require additional learning and adaptive capacity from potential users. Interactions with innovation suppliers, and early use of and experimentation with the innovations, can provide users with the knowledge needed for their adoption (Bleda and del Río, 2013). In this case, PPI can be interpreted as enabling the knowledge creation and coordination needed to tackle grand challenges and to solve 'wicked' problems (Boden et al., 2012). The complex and boundary-spanning nature of these societal challenges require the involvement of a wide array of stakeholders, which need to be coordinated appropriately (not top-down) to achieve directionality and articulation of demand (Kallerud et al., 2013).

5.4. A failure-based analytical framework

By combining the nature and degree of demand-side (improvements to public service vs diffusion related failures), supply-side (failures linked to innovation creation vs no failure) and user-producer (information asymmetry vs learning space failures) interaction failures, we can identify eight PPI types. These eight types can be collapsed to four broader PPI types (i.e., transformational, diffusive, developmental and adaptive), based on combining demand- and supply-side failures only (Table 1.1). In other words, each of the eight PPI types is a theoretical construct characterized by a specific combination of the three types of meso-level failures and, thus, by a specific economic rationale and capacity to mitigate grand challenges. The authors' type labels indicate their more significant features. This failure-based typology constitutes the analytical framework used to guide the literature review related to the design of PPI.

Table 1.1. Types of PPI according to targeted failures

PPI broader Types	**Transformational**		**Diffusive**		**Developmental**		**Adaptive**	
PPI Types	**Industrial**	**Systemic**	**Epidemic diffusion**	**Coordination of first users**	**Experimental**	**Creative**	**Top-down public orders**	**Negotiated public orders**
Demand-side failure	Diffusion-related failures (cooperative/catalytic PPI)				Failures linked to the improvement of public services (direct PPI)			
Supply-side failure	Failures linked to creation of new solution		Existing Solution		Failures linked to creation of new solution		Existing Solution	
User-producer interaction failures	One-sided information asymmetry failures	Interactive learning space failures	One-sided information asymmetry failures	Interactive learning space failures	One-sided information asymmetry failures	Interactive learning space failures	One-sided information asymmetry failures	Interactive learning space failures
Challenge orientation	Large impact on grand challenges driven by the entrepreneurial state	Large impact on grand challenges through symbiotic partnerships, experimentation and learning space	Lower impact on grand challenges mainly via new channels for diffusing and adapting existing solutions among new actors		Impact on mission-oriented policies through single breakthrough technologies		Very little contribution on mission-oriented policy. Optimization of existing markets and innovation systems.	

5.4.1. Transformational PPI

Transformational PPI is the means adopted by public organizations to try to transform systems. The aims are to develop new products or services and diffuse them to society. Since they both contribute to improving the learning and innovation capabilities of firms and accelerate the uptake of the innovation, transformational PPI is the most appropriate type of PPI to solve or mitigate grand challenges.

Among transformational PPI category, *industrial PPI* are characterized by low levels of user-producer interactions and the favouring of a particular industry. The public sector identifies the characteristics of the products to be developed and diffused, and drives the transformation of systems in a clearly identified direction. *Systemic PPI* is aimed at transforming systems by acting simultaneously on the innovation capabilities of producers and the absorptive capacity of the demand side, through the establishment of an interactive learning space. In this configuration, public procuring organizations have identified needs whose effective translation into demand requires dialogue with potential users and suppliers. These two sub-categories of transformational PPI can contribute to challenge-oriented policies. However, while industrial PPI relies on the capabilities of public organizations to act as an 'Entrepreneurial State' (Mazzucato, 2013), systemic PPI encourages dialogue, new types of symbiotic partnerships (Mazzucato, 2016), experimentation and a learning space (Cagnin et al. 2012) among the various stakeholders, in order to identify the best solution to the targeted challenges. In light of the current limitations in the abilities of the public sector, the latter approach is likely to make a bigger contribution to policies related to grand challenges.

5.4.2. Diffusive PPI

Diffusive PPI initiatives aim at accelerating the diffusion of already available goods and services. Despite their positive impact on the uptake of innovations and on the articulation of demand more generally, they are likely to make a smaller contribution than transformational PPI to policies targeting grand challenges. They are not indeed aimed explicitly at either supporting firms' R&D investments or improving their learning capabilities.

Diffusive PPI, in which user-producer interactions are restricted to calls for tenders, rely mostly on a process of *epidemic diffusion*, which implies that "information diffusion drives technology diffusion" (Geroski, 2000, p. 609). To provide potential users with the information they need to adopt an innovation, public administrations procure this innovation and put it into the public domain. This provides a group of first users with the

opportunity to familiarize themselves with the innovation and, subsequently, to diffuse information about it. Policy instruments orienting consumer preferences can accelerate epidemic diffusion. However, in other cases, diffusion requires *coordination among first users* and potential suppliers to achieve successful diffusion of the targeted products and/or services. If diffusion is impeded by a demand-supply mismatch, public procurers need to establish an interactive learning space for users and suppliers, in order to promote adaptation of existing products to users' expectations and, thus, accelerate their diffusion. The responsibility of first users is to collaborate in order to identify and signal needs clearly, and contribute to the adapted solution. This articulation of demand helps to accelerate the transformation of systems required to solve grand challenges.

5.4.3. Developmental PPI

Developmental PPI is aimed at stimulating the development of new innovative solutions to improve the performance of public services. It can be used also to improve the capabilities of firms to develop specific products or services to be used, primarily, by the public procuring organization to address a well-defined (although possibly difficult) problem. Thus, developmental PPI is likely to contribute to 'classical' mission-oriented policies.

If a call for tender, drafted unilaterally by the public procurer, is sufficient to encourage firms to undertake R&D activities, the developmental PPI initiative is described as *experimental*. The public purchasing organization calls for the development of a precisely identified product to improve a public service. The user-producer interaction failure in this case, consists of one-sided information asymmetry. In *creative PPI*, procurers and suppliers are required to create an interactive learning space to co-develop the most appropriate solution to the problem hampering the public service.

5.4.4. Adaptive PPI

The main objective of adaptive PPI is to improve public services through the purchase of goods and services, in a context where there are no obstacles to their production and supply. Since it does not involve support for firms' R&D investments or improved learning capabilities, this category of PPI is likely to provide the smallest contribution to any type of challenge-oriented policy. Adaptive PPI should be understood as a classical innovation policy instrument and practice (Edler et al., 2015a), which optimizes the functioning of existing market and innovation systems.

Adaptation to existing products starts with the provision of information to the business sector on the public sector's particular need. In some cases, calls for tenders are deemed sufficient to enable the supply of an appropriate solution to improve the public service. This vertical coordination between procurers and suppliers means that this category of PPI can be considered a *top-down public order*. In other cases, improvements to public services might require a product or service whose technical specifications is not identifiable by the public procuring organization on its own, but requires suppliers and procurers interacting within a learning space in order to pinpoint the most suitable solution for both parties. This coordination between procurers and suppliers includes negotiation and can be described as *negotiated public order*.

6. PPI rationale and design

The aim of this section is to use our failure-based PPI types described above (see Section 4.4) and, for each PPI type, to link the practices, characteristics and instruments ('operational intelligence requirements') highlighted in the PPI literature. Each of the eight types can be elaborated with elements of design compatible with its specific set of (meso-level) failures. The appropriate design (characteristics and instruments) of each PPI type will contribute to its successful implementation (Table 1.2).

6.1. Consequences of demand-side failures

Demand-side failures are associated with types of social needs and market size. Edler et al. (2005) suggest defining PPI categories according to the nature of the needs they target and the stage of market development at which they intervene. Uyarra and Flanagan (2010) propose a typology focusing on the product and/or service being procured. They consider the size of the targeted market and the degree of specialization of the production process.

If the sole objective of PPI is to improve public services, end-users will be mostly public procuring organizations (and public service users). Direct PPI (developmental and adaptive PPI) aims at improving public services and targets 'dedicated' demands/markets. Transformational and diffusive PPI (i.e. catalytic PPI) address a generic demand/market: public procuring organizations try to satisfy needs shared by other end-users.

Within the procurement process, obstacles to the public procurement of innovation can be due to deficiencies in the capabilities of procurers to gauge the potential of an innovation to satisfy the targeted need. Innovation-friendly procurement processes require that public procurers have appropriate skills. In this context, Georghiou et al. (2014) recommend: explicit reference to PPI in innovation policy strategies; training, guidelines and exchanges of good practice related to innovation-friendly procurement practices; and financial support for procurers to cover the additional costs that PPI might incur.

In some circumstances, a central department or organization or dedicated team may conduct PPI on behalf of the final users. This outsourcing of the public procurement process might be a suitable solution to poor capabilities among public procurers to conduct the procurement of complex products, technologies or services, and to coordinate a high number of public purchasers (Dimitri et al., 2006). However, such governance requires interactions among the various actors to ensure that the needs expressed in the calls for tenders reflect end-users' actual needs.

The diffusion of an innovation calls for specific instruments to boost the decisions of additional potential users and ease adoption of the innovation. These instruments include information and communication tools and education programmes (Morgan and Sonnino, 2007) to help potential end-users to acquire the knowledge and information they need to adopt and use the procured innovation (Bleda and del Río, 2013).

6.2. Consequences of supply-side failures

There are links between supply-side failures, Uyarra and Flanagan's (2010) product-based typology, and Wang and Bunn's (2004) categories of user-producer interactions. Wang and Bunn consider the degree of cooperative norms, that is, whether or not both users and suppliers regard their cooperation as necessary to the success of the focal PPI, and the level of intensity, frequency and openness of information exchange (Wang and Bunn, 2004).

Supply-side failures are considered more likely in the case of complex products and services, which require specialized inputs and are associated with high uncertainty (Uyarra and Flanagan, 2010). This uncertainty can be reduced by greater information exchange between the procurement parties (Uyarra and Flanagan, 2010; Wang and Bunn, 2004). Therefore, instruments for developmental and transformational PPI should ensure that users and suppliers exchange information about their needs and capabilities

in order to solve supply-side failures. This requirement is lower for adaptive and diffusive PPI, which is not aimed explicitly at supporting suppliers' innovation activities.

Again, direct links can be drawn between Uyarra and Flanagan's (2010) PPI categories (technological, efficient, experimental and adapted), the types of innovation identified by Abernathy and Clark (1985) (architectural, regular, revolutionary and niche creation) and our failure-based PPI categories. Transformational PPIs are equivalent to 'technological procurement'; they target a generic market and require high levels of information exchange. Innovation is considered 'architectural' if it departs from established systems and attempts to build new industries and markets. In diffusive PPIs, which also target a generic market, procured products and/or services are assumed to be less complex and require less specialized production inputs. These 'efficient procurements' result in 'regular' innovations "[building] on established technical and production competence and that is applied to existing markets and customers" (Abernathy and Clark, 1985, p. 12). In developmental PPI, the procured products and/or services are assumed to be complex and to target a niche market. They are similar to 'experimental procurements'. They are expected to lead to revolutionary innovations, which have a disruptive effect on existing markets. Finally, in adaptive (or 'adapted') PPI, the niche market demand is met by products and/or services, whose production process is standardized. The resulting innovation is a niche creation, opening up new market opportunities for existing goods and services.

Efforts to solve supply-side failures may be hampered by the risk aversion of public procurers. Instruments should be implemented to convince public procurers to bear the risks associated with demand for and adoption of innovative solutions. In this context, Georghiou et al. (2014) suggest that public procurers demanding innovations should be provided with insurance guarantees and 'financial cushions'. Standards and certificates can reduce the uncertainty related to new products. The chances of procuring an innovation also will be maximized by clear requirements in the calls for tenders for innovative solutions, and an indication of a guaranteed price and/or purchase volume. The access of small innovative firms to public procurement can be eased by specific mechanisms, such as allotment, which is the splitting of demand into individual lots which firms can bid for.

Specific instruments should be implemented to overcome firms' R&D and innovation capabilities failures. They include efforts to encourage the development of new solutions to expressed needs by means of design contests, functional specifications in the calls for tenders and Pre-Commercial Procurement (PCP) (Edquist and Zabala-Iturriagagoitia,

2015). All these instruments would support the development of new solutions directly or leave suppliers scope to propose new ways to address expressed needs.

6.3. Consequences of user-producer interactions failures

We consider two polar types of PPI based on the degree of user-producer interactions involved. The first consists of PPI with minimum interactions between these two categories of actors. Since information on the nature and state of demand is considered here to be sufficient to 'pull' innovation, 'collaborative norms' (Wang and Bunn, 2004) are low: none of the procurement parties believes that their co-operation is required. The core role of public procurers is to select suppliers to develop solutions to specific problems. Thus, their interactions follow a 'vertical coordination' model requiring policy-makers to have thorough knowledge of needs and their solutions, based on their accumulated experience and know-how (Foray and Llerena, 1996).

The other type consists of PPI requiring all the actors involved to co-adapt. In this interactive learning space context, the configuration of user-producer interactions is reversed. Both parties must acknowledge the importance of co-operation to identify and develop optimal solutions. Public procurers need to interact with potential suppliers and experts, to draft appropriate calls for tender and to help in the development of the best solutions. These 'dynamic complementarities' (Malerba, 1996) represent high cooperative norms (Wang and Bunn, 2004) between users and suppliers. Public procurers are assumed not to be knowledgeable actors, so any 'vertical coordination' would be inconsistent.

Wang and Bunn (2004) identify four types of user-producer interactions based on the degree of information exchange and the level of cooperative norms. During a 'collaborative relationship' (constituted of transformational systemic and developmental creative PPIs), both procurement parties share information "frequently, intensively and openly" (Wang and Bunn, 2004, p. 95) and have a common awareness that their collaboration is *sine qua non* to the success of the PPI. These cooperative norms are lower in 'supervisory relationships' where the procurer dominates the procurement process, but provides suppliers with all the necessary information. This kind of user-producer interaction is observed in transformational industrial and developmental experimental PPI. In 'recurrent relationships', the level of information exchange is low, but both parties need to interact frequently in order to achieve the objective of the PPI, which may be either diffusive through the coordination of first users, or (adaptive) negotiated public orders. Finally, in 'arm's-length relationships', the flow of information

exchange is low and the parties do not need to cooperate. These forms of user-producer interactions constitute diffusive PPI based on epidemic diffusion and (adaptive) top-down public orders for innovation.

Georghiou et al. (2014, p. 10) consider that the objective of policy instruments related to user-producer relationships should be to address deficiencies related to "identification, specification and signalling of needs". Policy-makers must ensure that the communication among stakeholders is sufficiently frequent, that procurers and users are aware of suppliers' innovation potential, and that suppliers are aware of the needs of procurers and users (Edler and Georghiou, 2007). In the formal procurement process these interactions are guaranteed by techniques, such as competitive dialogue (Uyarra, 2016), which supports the definition of potential and complex solutions to targeted needs. In addition, public procurers can publish functional calls for tenders reporting needs, but leave it to suppliers to choose the best solutions. Another related solution is PCP, which consists of financing R&D projects to address identified needs and define potential solutions. The business sector might also be involved in foresight exercises, which would provide them with information on future public sector demands and help them identify priorities (Vecchiato and Roveda, 2013). Efficient communication among stakeholders could be facilitated also through dedicated Internet websites and the participation of public procurers in commercial fairs, exhibitions, etc.

Table 1.2 presents a synthesis of our eight types of PPI. Each type is described by its specific design (characteristics and instruments - Section 5), which has been derived from the corresponding set of failures defined in our analytical framework (Section 4).

7. Conclusion

The objective of this chapter is to extend the case study based body of work on PPI and build a theoretically based typology. By doing so, we make at least two contributions to the PPI literature. First, we link together the various typologies developed in the PPI literature through the analysis of a broad set of meso-level innovation failures justifying the existence of several PPI types. This theoretical analysis leads to a failure-based framework encompassing the characteristics and instruments of the PPI types analysed in the literature. The aim is not to replace the existing categorizations, but to link them and include them in a general theoretical framework. Second and more importantly, since

Table 1.2. Extended typology of PPI types

PPI broader types	Transformational		Diffusive	
PPI types	Industrial	Systemic	Epidemic diffusion	Coordination of first users
Market size	Generic market			
Production process	Specialized		Standardised	
Product-based PPI category	Technological		Efficient	
Cooperative norms	Low	High	Low	High
Information exchange level	High		Low	
User-producer interaction	Supervisory	Collaborative	Arm's length	Recurrent
Innovation type	Architectural		Regular	
PPI instrument	For procurers: Explicit identification of PPI in innovation policy strategy Training, guidelines and exchange of good practice Financial support Interactions with end-users Insurance guarantees and financial cushions Standards and certificates For users: Measures to ease adoption and diffusion: provision of required knowledge, information and incentives For producers: Clear requirement for innovation in calls for tenders Guaranteed prices and/or purchase volumes Firm population-targeted eased access Design contest, functional specification, PCP	For procurers: Explicit identification of PPI in innovation policy strategy Training, guidelines and exchange of good practice Financial support Interactions with end-users Insurance guarantees and financial cushions Standards and certificates Measures for identifying, specifying and signalling needs For users: Measures to ease adoption and diffusion: provision of required knowledge, information and incentives For producers: Clear requirement for innovation in calls for tenders Guaranteed prices and/or purchase volumes Firm population-targeted eased access Design contest, functional specification, PCP Early supplier involvement Information and communication tools; project related events	For procurers: Explicit identification of PPI in innovation policy strategy Training, guidelines and exchange of good practices Financial support Interactions with end-users For users: Measures to ease adoption and diffusion: provision of required knowledge, information and incentives	For procurers: Explicit identification of PPI in innovation policy strategy Training, guidelines and exchange of good practices Financial support Interactions with end-users Measures for identifying, specifying and signalling needs For users: Measures to ease adoption and diffusion: provision of required knowledge, information and incentives For producers: Early supplier involvement Information and communication tools, and project related events

Table 1.2. Extended typology of PPI types (cont.)

PPI broader types	Developmental		Adaptive	
PPI types	Experimental	Creative	Top-down public orders	Negotiated public orders
Market size	Dedicated market			
Production process	Specialised		Standardised	
Product-based PPI category	Experimental		Adapted	
Cooperative norms	Low	High	Low	High
Information exchange level	High		Low	
User-producer interaction	Supervisory	Collaborative	Arm's length	Recurrent
Innovation type	Radical		Niche creation	
PPI instrument	For procurers: Explicit identification of PPI in innovation policy strategy Training, guidelines and exchange of good practices Financial support Interactions with end-users Insurance guarantees and financial cushions Standards and certificates For users: Measures to ease adoption: provision of required knowledge For producers: Clear requirement for innovation in calls for tenders Guaranteed prices and/or purchase volumes Firm population-targeted eased access Design contest, functional specification, PCP	For procurers: Explicit identification of PPI in innovation policy strategy Training, guidelines and exchange of good practices Financial support Interactions with end-users Insurance guarantees and financial cushions Standards and certificates Measures for identifying, specifying and signalling needs For users: Measures to ease adoption: provision of required knowledge For producers: Clear requirement for innovation in calls for tenders Guaranteed prices and/or purchase volumes Firm population-targeted eased access Design contest, functional specification, PCP Early supplier involvement Information and communication tools and project related events	For procurers: Explicit identification of PPI in innovation policy strategy Training, guidelines and exchange of good practices Financial support Interactions with end-users For users: Measures to ease adoption: provision of required knowledge	For procurers: Explicit identification of PPI in innovation policy strategy Training, guidelines and exchange of good practices Financial support Interactions with end-users Measures for identifying, specifying and signalling needs For users: Measures to ease adoption: provision of required knowledge For producers: Early supplier involvement Information and communication tools and events on the project

each PPI ideal-type is defined by a set of specific failures, our theoretical approach provides the opportunity to analyse how each type might respond to challenge-oriented policy.

While Edquist and Zabala-Iturriagagoitia (2012) call for a stronger focus on catalytic PPI to address grand challenges, our typology suggests that, among catalytic PPI types, transformational PPI, which, essentially, encourages architectural innovations (Abernathy & Clark, 1985), might be the most appropriate to contribute to the resolution of grand challenges. In our failure-based typology, only transformational PPI fosters market creation by encouraging the simultaneous generation and deployment of different technologies. The contribution of diffusive PPI to the achievement of grand challenges is likely to be lower; it could accelerate the uptake of the technologies required for system transformations, but would have very little impact on their development. Therefore, we assume that the role of diffusive PPI is mostly one of fostering ongoing system-wide changes. Developmental PPI appears to be more likely than diffusive PPI to be able to address grand challenges, although it targets improvement in public services rather than accelerated uptake of innovation. Developmental PPI can encourage the development of innovations initially for use solely by public administrations and their direct users. Therefore, it is assumed to contribute to mission-oriented policies. Nevertheless, if improved public services satisfy related human and societal needs, developmental PPI, indirectly, could contribute to the resolution of grand challenges. Moreover, although deployment of the procured innovation is not the initial aim of this PPI type, adoption and diffusion could occur later without specific public intervention. Finally, we assume that adaptive PPI has the lowest impact in the context of grand challenges, since the related innovation consists mainly of the introduction into the public sector of an existing technology previously not exploited in that sector.

Defining the objectives of PPI initiatives can be challenging. The rationales for policy interventions are not limited to the failures identified in the economic literature. Targeted problems are social constructs influenced by “multiple factors and contingencies” (Laranja et al., 2008, p. 825) that change over time and are in competition with other policy agenda priorities (Flanagan and Uyarra, 2016). For instance, a solution developed initially to satisfy the needs of the public procurer might ultimately prove useful to other users, resulting in the public procurer promoting the diffusion of this new solution. Therefore, our typology must be considered as defining PPI at a particular moment. If the objectives of a PPI initiative change, this might result in its recategorization and relevant revision to its design. This is one of the main general lessons from our study of policy design.

Our failure-based PPI typology should be informative for policy makers. The focus on the failures impeding innovation, which need to be addressed, is part of a diagnostic analysis that should be the premise of any policy design (Edquist, 2011). Policy-makers

have to identify the overall needs to be addressed and their directionality and, most importantly, what is preventing their solution and justifies a policy intervention. Identification of the barriers to innovation that need to be tackled should contribute to determination of the design of each type of PPI initiative. Finally, the rationales for intervention must be clearly identified to allow an evaluation of PPI. Our typology links targeted failures and best practice in the context of PPI implementation. Comparing "underlying rationales and the way in which the implementation itself complies with this rationale" (Edler et al., 2012, p. 35) is crucial for an evaluation of demand-side policy instruments. Therefore, our failure-based typology contributes to the whole policy-making cycle and, specifically, with respect to PPI and 'challenge-oriented' policy, from the identification of problems to evaluation of the policy via the design of policy instruments.

In this chapter, we adopted a broad approach of innovation failures justifying PPI. In the following chapters, we should explore further specific failures. Following a dynamic approach, we will focus on the role of PPI in the formation and development of markets. We will identify instruments that must be adopted at each stage of the PPI procedure to that end, and the public procurement practices that must be ensured for the appropriate implementation of these instruments.

Chapter 2. The role of public procurement in the formation of markets for innovation: An evolutionary perspective

Foreword

This chapter is based on the paper with the same title co-authored with Mercedes Bleda (The University of Manchester, the United Kingdom), and submitted to *Research Policy* in February 2017.

This work was financially supported by the French Rhône-Alpes region (CMIRA 2014 grant). A first version of the paper was presented at the 2016 International Schumpeter Society Conference “Building Bridges” in Montreal, Canada, with a financial support from the Canadian Social Sciences and Humanities Research Council. The authors are grateful to Jakob Edler, Jonatan Pinkse, John Rigby and Elvira Uyarra (University of Manchester, the United Kingdom), Mireille Matt (INRA, France), and Jason Potts (RMIT University, Australia) for their valuable feedback and comments.

1. Introduction

Public procurement of innovation (PPI) can overcome a number of meso-level failures impeding innovation (Chapter 1). Our failure-based PPI typology successfully links categories of PPI with elements of design (including instruments) and thus helps policy-making in this area. Policy implications of Chapter 1 can assist PPI initiatives in attaining their innovation-related objectives at meso level, and in contributing to challenge-oriented policies at macro level. PPI can spur innovation, by solving the related failures and stimulating the creation of market for new products and services (Edquist, 2011; Rothwell, 1984). The market formation function (Bergek et al., 2008) constitutes one of the main strategic PPI goals, especially for PPI initiatives geared towards mitigating grand challenges (Mazzucato, 2016), that is, transformational PPI and, to some extents, diffusive PPI.

Several scholars have recently highlighted the importance of markets for innovation, and emphasised the key role that the public sector has both as a market creating force - by setting the direction of novelty creation (Mazzucato, 2016) and as an enabler of further market development via the implementation of PPI (Edquist and Zabala-Iturriagagoitia, 2012) within relevant innovation policy mixes (Flanagan and Uyarra, 2016). Once the direction of 'change' has been established via vertical public policies (Mazzucato, 2016; Mazzucato and Perez, 2015), PPI acquires a fundamental role in supporting the market creation processes required for this change.[12]

The literature has proposed several ways in which PPI can support the creation of markets (Box, 2009; Edler et al., 2005; Edquist, 2011; Rothwell, 1984). Some of these ways relate to failures identified in Chapter 1. First, governments can use public procurement to enlarge the market therefore ensuring sufficient critical mass to encourage both R&D investment and product and process innovation (Aschhoff and Sofka, 2009; Uyarra and Flanagan, 2010). This can be achieved by aggregating the demand of multiple users or, in the cases in which the public sector is itself the end user of a specific innovation, by using its own purchasing power to create a demand-pull effect (Dalpé et al., 1992; Uyarra, 2013). Existing markets for certain types of products or services can also be enlarged via public procurement that supports the emergence of a new standard technology that facilitates their diffusion. The public sector can also contribute to the generation of lead markets. Lead markets are "regional markets with specific attributes that increase the probability that a locally preferred innovation design also becomes internationally successful" (Beise and

[12] PPI will be implemented and act in combination with other "horizontal" instruments in the relevant innovation policy mix (Flanagan et al., 2011).

Cleff, 2004, p. 455). The formation of lead markets requires lead users (von Hippel, 1986) who, by being more willing to take risks and to provide early feedback to innovation producers, create a more favourable environment for the development of an innovation. The public sector can help the creation of lead markets via public procurement by taking the role of a lead user (Edler and Georghiou, 2007; Geroski, 1990; OECD, 2011a).

PPI can also encourage the formation of a market by helping the articulation of the demand, by signalling to innovation producers the existence of unmet needs, and by facilitating interaction between users and producers of an innovation (Uyarra, 2013). Finally, and not necessarily only for the case of markets for innovation, public procurement in general can have a "transformational role" (Neij, 2001), and influence the evolution of a market by affecting competition and changing its structure to make it more attractive and/or more accessible for new entrants (Caldwell et al., 2005; Knutsson and Thomasson, 2014; Uyarra and Flanagan, 2010).

Existing work has therefore shown that, given the scale and scope of the public sector in certain areas, public procurement can have a substantial influence on how a market for a particular innovation emerges. However, most of this work is underpinned by a static view of the market (Georghiou et al., 2014). Current analyses generally centre on issues and instruments related to the act of procurement at the initial stages of the creation of a market,[13] overlooking the influence that PPI might have on the different phases through which a market forms over time. As a result, they do not provide a full account of the ways in which PPI can support the market at specific stages of its dynamic development. In addition, existing works tend to focus on the capabilities and characteristics of procuring organisations underplaying the key role that the capabilities and interactions of users and innovation suppliers have in the dynamics of a market. Finally, as a result of the emphasis on the initial stages, they generally neglect the way in which the market formation process and the different phases of the procurement procedure interrelate over time.

In this chapter, we investigate the ways in which PPI throughout the procurement procedure can support the creation of markets for innovation, taking into account the capabilities and interactions of all relevant actors, and accounting for its influence at all the stages of the market dynamic formation. In order to account for the market dynamics we use an evolutionary analytical framework, in which markets for innovations are defined as complex systems that emerge and form along a dynamic developmental trajectory (Bleda and del Río, 2013). To analyse the influence that PPI can have in this dynamics, we employ what is known in the innovation policy literature as a "diagnostic analysis" (Borrás and

[13] See Edler et al. (2005), Rolfstam (2013), and Phillips et al (2007) for some exceptions.

Edquist, 2013; Edquist, 2011): we first identify factors promoting or hindering the emergence and the well-functioning of a market, and then investigate possible PPI actions and tools throughout the procurement procedure that might encourage the development of the market, or support it by addressing potential problems. As we explain below, within an evolutionary framework, well-functioning markets in the context of innovation are markets that perform well as knowledge coordinating and creating systems. Hence, our diagnostic analysis focuses on problems that are essentially systemic, and have their origin in knowledge related malfunctions occurring along the market formation process. Our analysis also draws upon empirical evidence provided by a series of PPI case studies, and on the existing portfolio of PPI actions and tools proposed in current theoretical work, which we however understand and interpret in a dynamic setting and through an evolutionary analytical lens.

The contribution of our chapter is twofold: first, it is theoretical as we provide a conceptual elaboration of how PPI can influence the creation of markets from a dynamic perspective. Second, by accounting for the complex evolutionary dynamics of markets our analysis can help PPI to overcome the 'dangers' of adopting an atemporal approach to policy-making that have been recently posited in the literature (Flanagan and Uyarra, 2016). Chapter 2 is in line within the current view that innovation policy tools, and PPI among them, should be associated with a more dynamic evolutionary notion of policy in which knowledge and learning are central elements and the basis of policy and practice development (Cohendet and Meyer-Krahmer, 2001; Dopfer and Potts, 2008). Our more comprehensive view of how PPI can affect the creation of markets provides policy makers and practitioners with an enhanced theoretical basis that can be used to inform more effective policy design in relation to this goal. As it has been also recently highlighted, robust and conceptually coherent theoretical analyses can help shape actual policy making decisions by signalling situations in need of government intervention, and offering guidelines for specific instruments, actions or policy mix choices (Laranja et al., 2008; Nelson, 2009).

The chapter is organised as follows. In Section 2 we explain what it is understood by a well-functioning market for innovation in an evolutionary framework, and describe the different stages of the formation of a market within this framework. In Section 3 we present the empirical evidence from our selected PPI case studies, and describes our research methodology. Section 4 provides the main results of our diagnostic analysis. Section 5 presents a summary of our key results, and concludes.

2. Evolutionary formation of markets for innovation

The concept of a well-functioning market is generally understood in reference to the idea of market failures, that is, as a market that does neither present 'failures' or 'imperfections' in the performing of its function (Hviid and Price, 2014; Littlechild, 2015). The function of the market in the context of innovation is to use knowledge (as an input) in order to produce or create new knowledge (in the form of a new product, technology, or service) as an output. As explained in the general introduction, if knowledge is conceived as equivalent to information, as is generally the case in neoclassical analysis, the function of the market is to coordinate information and allocate resources for the production and distribution of new knowledge (an innovation), also understood or conceived as information (Potts, 2001; Smith, 2000). Since information is generic, codifiable, more or less freely accessible, and context independent, an innovation understood as information can be defined as an economic commodity with the properties of a public good, i.e. indivisibility and limited appropriability (Smith, 1996). Due to these properties, fully or boundedly rational actors interacting and interchanging information (i.e. the innovation as a commodity and its price) in the market are unable to carry out optimal choices, and this results in (meso-level) failures or imperfections that require 'amending' via policy intervention (Arrow, 1962; Nelson, 1959).

When knowledge (as an input and an output of a market for innovation), is conceived as fundamentally different from information, as in the case of evolutionary analyses (Loasby, 1999; Metcalfe, 1998; Nelson, 2000), the function of the market is the coordination and the creation of knowledge, which in this case is defined as partly tacit, not freely accessible, and dependent both on the (limited) cognitive and learning capacities of its holders, and on the particular nature of their interactions (Metcalfe, 2005; Smith, 1996, 2000). Accordingly, in an evolutionary setting, the effectiveness of a market in fulfilling its function for innovation cannot be defined in terms of its efficiency in coordinating information, but in terms of its evolutionary efficacy in coordinating and creating knowledge (Bleda and del Río, 2013; Dopfer and Potts, 2008; Metcalfe and Ramlogan, 2005; Metcalfe and Georghiou, 1998). In this setting, problems affecting the formation of a market are those that hinder the fulfilment of its knowledge creating and coordinating function. They are not information related failures, but knowledge related 'malfunctions' rooted in the uncertain and unsettling or destructive nature (in a Schumpeterian sense) of novelty-induced change.[14]

[14] Indeed as many evolutionary scholars have highlighted (Metcalfe, 1998, 2005; Nelson, 2009; Potts, 2001), the imperfections considered as market failures from a neoclassical perspective are integral and necessary aspects of the production and dissemination of knowledge, as they prompt entrepreneurs to introduce novelty, and disturb established patterns of activity and interaction. 'Imperfect' markets provide a framework within which to conduct innovative experiments, and a framework for facilitating adaptation to those experiments (Metcalfe, 1998).

These problems are rooted in the cognitive characteristics and interactions of the market agents, and will be different at different stages of the dynamic development of a market. Bleda and del Río (2013) provide a definition of market formation problems from an evolutionary viewpoint based on the micro-meso-macro analytical framework developed by Dopfer and Potts (2008). In Bleda and del Rio (2013) a market is defined as a meso unit consisting of a population of micro-units or agents,[15] and the formation of a market for an innovation (understood as new knowledge-output) as a process taking place over a dynamic meso trajectory in which knowledge is created and coordinated at three different interrelated stages namely: origination, adoption and retention. More specifically, a meso trajectory is the dynamic process by which a population of agents grows starting with one agent or group of agents, the holder(s) of new knowledge (innovation), to eventually stabilise as other agents (users) demand, adopt and apply this new knowledge over time. The new knowledge (in the form of a new product, technology, service) that is created and adopted along this meso trajectory is understood in this framework as a *knowledge complex*, that is, as a system with a specific structure that is formed by interrelated 'knowledge components' (Metcalfe and Ramlogan, 2005) of two different types: (object) social and technical knowledge components about new ways of organizing people and resources, and (subject) cognitive and behavioural capabilities or knowledge components associated to new ways of thinking and behaving (Dopfer and Potts, 2008).

The first phase in the formation of a market is the origination of this new knowledge system as an innovation. This phase consists in the transition from a purely private state where a novel idea is generated by an innovative agent (entrepreneur) or group of agents, usually in the context of an organisation, to a state where it is ready to be understood and applied by other agents. Origination is essentially the process by which the knowledge embodied by an invention is made functional, i.e. communicable and accessible so that it can be used by other agents (Cohendet and Meyer-Krahmer, 2001). For this process to take place, the object and subject knowledge components of the novel idea have to be coordinated, fit with each other so that a new knowledge system that can be used by others emerges. Or in other words, for an invention to effectively become an innovation that is functional and ready to be 'marketable', all its relevant interrelated associated technical, social, cognitive and behavioural knowledge components must be simultaneously coupled and combined (Galbraith, 1982). As Metcalfe (2005) has put it, "innovation involves the coordination and growth of multiple kinds of knowledge, not only technical knowledge, …,

[15] Agents or micro-units in the micro-meso-macro analytical framework can be individuals/people or organisations of people (Dopfer and Potts, 2008).

and these different types of knowledge are gained inseparably from the market process" (Metcalfe, 2005, p. 48).

This coordination process, known as *deep coordination* of knowledge in the micro-meso-macro evolutionary framework, takes place at the micro level of the individual(s), and generally involves adaptive changes in their existing technical, cognitive, social and behavioural knowledge sets, and in many cases also changes in existing organisational forms. As previously indicated, the key components of the new knowledge system relate to the cognition and behaviour of the entrepreneurs[16] (subject components), as well as to the capacities to organise themselves and interact with others (object components). The entrepreneurs thus must ensure that they possess or develop the mental models (cognitive component), and the rules and routines (behavioural component) that are compatible with the invention, as well as the organisational and technical infrastructure and expertise that it requires (technical component). The process also requires that others are able to understand and (are willing) to use the novelty involved by this idea (social component). The knowledge complex involved by an innovation is a system with a specific structure, and the epistemic content of this structure matters: if the structure does not form or breaks, deep coordination will not take place, and the invention will remain a novelty (even possibly just a very good idea) but will not originate as an innovation.[17]

Once an innovation, that is, a new knowledge system has been successfully originated via deep coordination, it needs to be adopted by a population of users. This second stage in the formation of a market for the innovation (adoption) takes place via another knowledge related coordination process, known in the micro-meso-macro framework as *surface coordination.* Surface coordination takes place between the innovator(s), namely the holder or carrier of the newly generated knowledge complex, and its potential adopters, who carry their own relevant knowledge complexes themselves. As innovators and potential adopters carry heterogeneous knowledge sets, the success of this process mainly depends on their level of complementarity, which will determine how easy or difficult it is for these different knowledge structures to fit with each other. It is also to a great extent a function of the ability of both types of agents to learn and co-adapt, that is, of their capacity to modify their knowledge sets so that they click/fit. Indeed, surface coordination in the adoption stage

[16] Here the term 'entrepreneurs' is used to refer to the micro-units that effectively make the novel idea functional and ready to enter the market. It is usually business organisations that take inventions to the market, i.e. that originate an innovation, although the process is influenced and triggered by other factors and agents in their environment. In some cases, the new idea might even be generated by other micro-units such as users (as in the case of user-led innovation). In the context of PPI, public procuring organisations can also be the idea generators both as users, and as non-users of the procured innovation.

[17] Dopfer and Potts (2008) provide the following example of an unsuccessful deep coordination process: "Leonardo da Vinci had a viable concept (cognitive component) of a helicopter. He was, as an inventor, possibly ready to go for a test run for demonstration purposes (behavioural component), but he had neither aluminium and a combustion engine (technical component) nor the means to make others believe in the viability of his novel idea (social component)" (Dopfer and Potts, 2008, p. 39).

generally involves a process of learning and co-adaptation: potential adopters must be able to adapt the cognitive, organisational, behavioural and social components of their knowledge structures so that they fit with the new knowledge components embodied in the innovation that they want to adopt, and vice versa, innovators must have the capacity to adapt the corresponding components of their novel knowledge complex to those of their potential users. These processes, taking place at the meso level of the population of innovators and adopters, can be thwarted due to individual cognitive biases and inertia, and/or to lack of organisational dynamic capabilities on the part of the both types of agents, which will involve differences in adoption frequency, and hindrances to surface coordination.

The last stage in the formation of the market is the retention of the new knowledge system, that is, of the innovation. Retention takes place via a process of *operational coordination* by which the new knowledge, after having been adopted by a first population of users, is applied over time so that it becomes 'institutionalised', that is, susceptible to be stably replicated and used for social and economic activities and operations (Dopfer and Potts, 2008). Retention is essentially a process of coordination of information by which incentives and information messages on prices and quantities (for a given knowledge structure or innovation) are aligned allowing market agents to interact and carry out activities and transactions. Unsuccessful operational coordination thus is due to the inability of agents to use the innovation in their ongoing economic operations in a sustained manner as a consequence of information related problems (such as misalignment of prices, incentives, information asymmetries and so on). In the retention phase of the market, it is only information that changes, as it is underpinned by knowledge that has become stable (although not static, as it can change again at any time). The operations in the newly formed market are thus fundamentally related to the exchange and coordination of information, and, at this stage therefore, malfunctions or disturbances can be considered from a theoretical point of view as an equivalent to market failures as defined in the neoclassical approach (Bleda and del Río, 2013).

Having described the evolutionary framework that we use to account for the dynamics of market formation, the next section presents the empirical evidence and research methodology that we employ within this theoretical framework to analyse the influence of PPI in this dynamics.

3. Research methodology: analysis of secondary case studies

In order to analyse the ways in which PPI can support the knowledge coordination processes throughout the three stages in the formation of markets for innovation previously outlined, we examined evidence and secondary data provided by selected existing PPI case studies. The case studies approach has been proposed as one of the most appropriate ways to conduct exploratory research on the dynamics of complex phenomena in socio-economic contexts (Larsson, 1993; Yin, 2009), that is, in contexts like ours, in which the existence of complex coordination processes make it difficult the gathering of data and the use of traditional quantitative tools to analyse them. In these contexts, employing multiple case studies contributes to make findings more compelling and robust (Eisenhardt and Graebner, 2007; Yin, 2009) enhancing their value in the analysis and implementation of policy decisions (Schramm, 1971).

As indicated in the introduction, the current literature has not explored the ways in which PPI might influence market creation from a dynamic perspective. Thus, there are not empirical analyses or case studies that specifically examine how instruments and actions implemented as part of PPI initiatives can support the deep, surface and operational knowledge coordination processes necessary for a market to successfully develop. Nevertheless, the literature provides case studies that include extensive and rich evidence on public procurement initiatives that have influenced processes of market creation. We have examined this evidence using an 'abductive approach' to carry out our diagnostic analysis. The abductive approach, generally associated with qualitative methods of data collection and analysis, has been proposed as a method for case research (Dubois and Gadde, 2002) particularly appropriate for the generation of new theoretical discoveries (Locke et al., 2008; Van Maanen et al., 2007).

Abduction and the related thought process of retroduction (Peirce, 1960) are a way of reasoning that allows deriving explanatory conclusions from factual evidence. More specifically, abduction involves the reinterpretation and recontextualisation of a phenomenon within a conceptual context or set of ideas; i.e. "it is about being able to understand something in a new way by observing and interpreting this something within a new conceptual framework" (Eastwood et al., 2014, p. 3). Abductive reasoning thus, rather than moving directly from empirical observations to theoretical inferences, as is the case in purely inductive research, relies on "theories as mediators for deriving explanations" (Modell, 2009, p. 213). Retroduction is a mode of inference in which phenomena are explained by identifying mechanisms which can potentially produce them, it is a thought

process that enquires about what facts and conditions make a particular phenomenon possible (Easton, 2010). An abductive approach, allows via retroduction, to originate possible explanations for a phenomenon, providing an opportunity to generate creative solutions, new ideas, explanatory propositions, and new theoretical elements (Locke et al., 2008).[18] In our analysis, we use the rich empirical evidence provided by selected case studies and apply abductive reasoning to derive explanations of how PPI throughout the public procurement procedure might influence the knowledge coordination processes that underlie the different stages of market creation. Via an abductive approach we reinterpret the empirical evidence provided by those cases within an evolutionary conceptual framework, and use an evolutionary conceptualization of the market as a mediator to derive explanations of how PPI can affect its dynamic formation.

The remainder of this section describes our case selection criteria, the basic characteristics of the selected cases, and our method for information and evidence coding.

Regarding the processes of case collection and selection, we examined 160 existing PPI case studies from academic articles and communications, policy reports, and databases (see Table 2.1 for the list of sources) on the role of public procurement in fostering innovation in general. Among these cases, we first selected those that provided evidence of PPI having an effect on processes of market creation and development. A second selection criterion concerned the goal of the PPI initiative included in each case. In this respect, we selected those cases in which public procurement deliberately aimed to spur innovation by exerting an influence on the market, excluding initiatives whose primary objective was essentially the improvement of the quality of public services, and in which innovation occurred only as a by-product. In other words, we focus on transformational and diffusive PPI, and discard developmental and adaptive PPI, which do not aim deliberately to foster market formation (Chapter 1). When the goal of the initiative was not reported explicitly in case studies, we inferred if from reported implemented actions and instruments by considering that initiatives that used instruments aimed to promote and support the uptake or diffusion of an innovation had the deliberative goal to encourage market creation. Making such inference required that information on instruments and actions was clear and sufficient, therefore the quality of this information constituted our third selection criterion.

[18] Since the abductive mode of reasoning implies to interpret the ‘actual’ in light of the ‘possible’ the conclusions it derives are not definite but remain conjectures; however, it is this high flexibility that loosens the boundaries on thinking and constitutes the source of its creative potential (Locke et al., 2008).

Table 2.1. Summary of selected cases

Case number	Procured product/ technology/ service	Public procurer	Broad objective	Market-related objectives	Existing product/ technology / service?	Is the public procurer among end-users?	Result	Sources
1	Electric and Compressed Natural Gas (CNG) vehicles	City of Ghent (Belgium)	Promote sustainable urban mobility to be CO_2-neutral by 2050	Support the development of the market of electric and CNG vehicles	Yes	Yes	Mitigated success	Clement et al. (2015)
2	Lighting system	State and City of Hamburg (Germany)	Contribute to anti-climate change measures while increasing economic efficiency	Support the development and adoption of an energy-efficient lighting system	No	Yes	Success	Edler et al. (2005)
3	Renewable energy centre	Bracknell Forest Borough Council (United Kingdom)	Develop a renewable energy centre for supplying the new town centre	Support the creation of a local market for renewable energy	No	No	Failure	Rofstam (2007, 2009, 2012a)
4	Organic public school meals	City of Rome (Italy)	Support and promote organic agriculture	Support a market of local organic and fresh food	Yes	No	Success	EC (2010b); Morgan & Sonnino (2007); Sonnino (2009)
5	Intelligent speed limiter for delivery vans	Ministry of Traffic and Water Management (the Netherlands)	Contribute to national policies on traffic safety	Support the development and adoption of intelligent speed limiters	No	No	Success	EC (2009)
6	Energy producing greenhouses	Ministry of Agriculture, Nature and Food Quality (The Netherlands)	Contribute to the reduction of fossil energy consumption by developing CO_2-neutral technology	Support the development of an energy-producing greenhouse for he horticulture industry	No	No	Success	EC (2009)
7	Extension lifts	Foundation for Experiments in Social Housing (The Netherlands)	Make older social building more accessible to older tenants	Support the development and installation of extension lifts in social building	No	No	Short-term success	EC (2009)
8	Ethanol-fuelled pick-up cars	Stockholm Environment and Health Administration (Sweden)	Contribute to increasing the availability of clean vehicles	Support the development and adoption of ethanol-fuelled light-duty vehicles	Yes	No	Mitigated success	EC (2010a); Lember et al., (2007)
9	Electric and Plug-in Hybrid Vehicles	Stockholm Environment and Health Administration (Sweden)	Contribute to increasing the availability of clean vehicles	Support the development and adoption of electric and plug-in hybrid vehicles	Yes	Yes	Mitigated success	Clement et al. (2015)
10	Renewable energy centre	Svensk Växkraft AB (Sweden)	Develop an energy plant producing bio-fertilizers for local farmers	Support the creation of a market for organic waste & agricultural crops & bio-energy fertilisers via the development of a new energy plant	No	No	Success	EC (2010a); Rolfstam (2010, 2012a)

Based on these criteria, we selected a total of ten cases (see Table 2.1 for a summary of cases and sources). They analyse PPI for a variety of technologies, products and services: three cases analyse the public procurement of green local car fleets (cases 1, 8 and 9). Two cases deal with PPI and the operation of energy centres (cases 3 and 10). The remaining cases analyse public procurement of lighting systems (case 2), organic meals (case 4), speed limiters (case 5), greenhouses (case 6) and lifts (case 7). In four of the ten selected case studies, public procurement aims at introducing an existing technology into a new market (cases 1, 4, 8 and 9), while, in the remaining six, public procurement attempts to trigger the creation of a completely new technology (that is, a technology that did not exist at the time at which the initiative was implemented or developed). The range of targeted end-users varies across selected case studies too. Three of them (cases 1, 2 and 9) deal with cooperative PPI, that is, public procurement where public buyers are also end-users. In the rest of the cases, public procuring organisations act on behalf of external end-users (catalytic PPI).

Finally, our selected cases present different outcomes. Based on the reported information, the initiatives in cases 2, 4, 5, 6 and 10 successfully achieved to create a market for their respective technologies and services. Case 7 was also a success in the short term but a failure in the long run as the market eventually collapsed. Three cases could be considered as mitigated successes: the diffusion of the new technology was limited in case 1, and delayed in case 8. In case 9, the purchasing of the technology proceeded much slower than expected. The remaining case (case 3) is a failed attempt to generate a market, as the procurement was ceased before the selection of any tenderer.

Underpinned by our previously described objective and methodology, we coded the information extracted from our selected cases as follows: we listed all the PPI instruments used and actions undertaken as reported in our selected case studies, taking into account the timing of their implementation; we then grouped them in categories (and sub-categories when appropriate) defined according to their objectives and functions along the different stages of the public procurement procedure. The typical stages of a procurement procedure are (Edler et al., 2005; Edquist et al., 2015; European Commission, 2005):[19] the identification of needs; market exploration and stakeholders consultation; definition of specifications; tendering, and tender evaluation and selection; and, delivery of the procured innovation (encompassing its adoption and wider diffusion). Following an abductive reasoning, we identified deep, surface and operational coordination problems (or lack

[19] The definition of these stages might vary depending on the analysis and also the type of procurement. For instance in mission-oriented PPI these are (Edquist and Zabala-Iturriagagoitia, 2012): identification of a grand challenge, translation of this challenge into functional specifications, tendering process, assessment of tenders and awarding of contracts, and delivery process.

thereof) that might have affected the functioning of the market at each stage of its formation, and how they might have been promoted or solved by the aforementioned categories of PPI instruments and actions (see Figure 2.1).

It has to be noted that in the identification of coordination aspects or problems of our diagnostic analysis we only consider the behaviour and interactions that take place at the level of the market. Therefore, our analysis 'blackboxes' the interactions and coordination process taking place at the lower level of the individuals and departments that compose the micro-units involved in the process of market formation. This means that we are not accounting for the influence of the internal dynamics of the entrepreneurs (originators of the innovation), neither that of its potential users, or the procuring organisations. The latter is particularly relevant in the context of PPI, since as it has been highlighted in the literature (Georghiou et al., 2014; Rolfstam, 2009, 2013) coordination problems within and among relevant procuring organisations can be highly detrimental to the success of PPI initiatives. However, since our work constitutes a first step in the conceptual development of a dynamic view of the role of PPI in market formation, for the sake of simplicity, our analysis focuses on the coordination processes and interactions that take place among micro-units at the meso level of the market.

The following section provides the main findings of our analysis. Following our theoretical dynamic evolutionary view of the creation of markets we present our results following the natural order of knowledge coordination for market formation, that is, we follow the sequence of deep, surface, and operational coordination stages. Each sub-section starts with a brief summary of our main findings relative to the roles of PPI in regard to knowledge coordination processes, which are further elaborated in the following paragraphs. We provide a selected example of these respective roles extracted from our secondary case studies, and for each coordination stage of market formation and development, a table summarises the role of PPI, instruments and actions that could be implemented to support that stage, and the timing of their respective implementation.

4. Influence of PPI in the evolutionary dynamics of market formation

4.1. Origination (stage 1 of market formation)

In this section, we present the potential ways in which PPI can influence the first stage of the market formation, by supporting the deep coordination of the interrelated cognitive, behavioural, social and technical knowledge components that underpins the origination of an innovation. Based on the evidence provided by our case studies, we have found that PPI can contribute to the integration of these components so that they 'fit together' during the definition of specifications and market exploration and stakeholder's consultation stages of the procurement procedure, mainly in three ways (see Table 2.2). First PPI can contribute to this process by facilitating the expression of a new demand by users, it can also help innovators reduce the uncertainties relative to demand that characterises the creation of novelty; finally, PPI can contribute to an improvement of general context conditions to make them more favourable for the origination of new knowledge.

Table 2.2. PPI and deep coordination

Contribution to deep coordination	PPI instruments/actions	Procurement procedure stage
Facilitating the expression of a new demand	• Design contests • Functional specifications in calls for tenders	Definition of specifications
Reducing uncertainties relative to demand	• Commitment to purchase	
Improving the innovation environment	• Changes in norms and rules • Contribution to social acceptance	Market exploration and stakeholders consultation

The generation of a well-articulated demand for an innovative product, technology or service is key in the process of deep coordination as it provides potential innovators with a clearer understanding of the users needs. As we have previously explained, deep coordination requires that the cognitive, technical and behavioural knowledge elements of a new solution fit with each other. They must also fit with the social knowledge component of the solution so that potential users understand and believe in its viability and are also willing to use it. Innovators with a very good understanding of the users' needs as a result of a well expressed demand will be able to better integrate all these knowledge components and develop a solution that is able to address users' needs in a more effective manner. PPI can support the expression of a new demand via the use of design contests, and by using functional specifications in calls for tenders.

Design contests can be used in the cases in which unmet needs exist for which procurement organisations could not find solutions available in existing markets. A design contest is a procedure that is used to obtain a plan or a design based on competition among potential suppliers. The designs are evaluated by a professional panel of experts (European Commission, 2009). In a first phase, several tenderers are shortlisted, and their number is subsequently reduced based on their outcomes along different stages of the process, e.g. solution design, prototype development, and testing, until (usually) at least two solutions are deemed the most appropriate ones to deliver those outcomes.

In one of our cases (case 6) in the Netherlands, the Ministry of Agriculture, Nature and Food with representatives of the horticulture industry used a design contest in an initiative aimed at fostering the use of energy-producing greenhouses to reduce the CO_2-emissions of the domestic greenhouse sector. During the first rounds of the contest, selected candidates were asked to produce preliminary sketches, proposals and prototypes of green houses, which were evaluated by an independent jury. The horticulture sector (users) provided feedback throughout all stages of the process, and as a result of the contest a highly energy efficient greenhouse was successfully developed.

This case provides an illustration of how the use of design contests can help expressing a new demand, and the deep coordination of knowledge. The contest facilitated the expression and communication of the horticulture industry needs, and contributed to an improvement of the definition of the new solution (a more efficient greenhouse). The green houses manufacturing industry in the Netherlands (the potential originators) possessed a viable concept of what a more efficient greenhouse in terms of CO_2 emissions reduction would involve (cognitive component of the potential innovation). Manufacturers also had the knowhow and the technological expertise required to build a prototype (i.e. technical component). Through their interactions with potential users and procurers in the contest they were able to identify or develop the behavioural component of the innovation (i.e. the relevant routines, organisational processes and capabilities) in order to build the greenhouse, and test it. Finally manufacturers knew that they could count on users (i.e. the horticulture industry) believing in the viability of this idea as these were actively participating in the design contest (social component).

The coordination of all these ‘knowledges’ would have not taken place without the PPI initiative, and the design contest as a part of it. As the European Commission (2009) stated in relation to this case study: “the development of such new technology had apparently not been taken up by the private sector on its own. The market possessed the knowhow and expertise required to assemble a total concept, but some further coordination was needed to utilise this knowledge in order to come up with concrete solutions” (European

Commission, 2009, p. 70). This coordination is precisely what the design contest achieved: it provided the social component of the innovation (which was missing), and enabled recurrent interactions and feedback between procurers, users and tenderers: this connected the other (existing) components among them and with the social element, by facilitating the communication of needs and by constraining or directing the definition and specifications of the new solution towards those needs.

As indicated, another way in which PPI can facilitate the expression of a new demand, and hence deep coordination, is by using open, functional specifications in calls for tenders. Specifying needs as outcome-based requirements usually contributes to added clarity and accuracy in the determination of unmet and future users needs by public sectors organisations (Georghiou et al., 2014; Uyarra et al., 2014).[20] In functional calls for tenders the selected supplier(s) of the new solution must address the needs, and achieve the results specified in the call, however they are free to choose how to develop this solution. On the one hand, therefore, functional specifications offer suppliers greater scope and flexibility to develop the innovation, than for instance design contests in which the performance of possible proposed solutions are assessed at every stage. On the other hand, functional tenders provide less knowledge and less scope for interaction to direct or guide the integration of the different knowledge components that underpins the origination process, and it results in a larger degree of uncertainty about what solutions may be developed (Whyles et al., 2015).

In one of our cases (case 10), Svensk Växkraft AB, a consortium of Swedish municipalities and associations of farmers, in procuring a new kind of power plant that produced bio-energy and fertilisers based on bio-waste, used functional specifications. According to these specifications suppliers were allowed to choose the design and technological characteristics of the plant. A very experienced public procurer acted as a consultant to the project. The use of a functional call for tenders was considered a key factor behind the success of this initiative: using our evolutionary lens, in this case the flexibility and the clear communication of needs allowed by the functional specifications made it easier for the supplier to integrate all the relevant knowledges required for the development the plant.

According to the evidence provided in our selected case studies, procurement organisations can also support deep coordination and the origination process by committing to purchase the innovation, i.e. by becoming an end user of the new solution,

[20] Our cases studies did not incorporate evidence of Forward Commitment Procurement (FCP). However, FCP has been recently proposed as a way for PPI to support the development of markets for environmental innovations which as functional specifications contributes to the delivery of the specific outcomes that customers require (Whyles et al., 2015).

or by encouraging others to do so, reducing in this way the uncertainty that characterises the demand of novelty. In both cases, potential suppliers can count on others believing in the viability of the new solution, and their willingness to use it (social component of the innovation), which will help their integration efforts, and the deep coordination of knowledge process. Indeed, potential innovators may be reluctant to engage in R&D and other innovation related activities to develop a new solution if there is too high a level of uncertainty in relation to its final demand. PPI can support the origination process in these cases by committing to purchase a certain volume of the innovation, and/or encouraging similar commitment from other end-users.

This was the challenge in one of our cases (case 9) in which the city of Stockholm, Sweden, aimed at demonstrating to car manufacturers via a joint procurement initiative that a local demand for electric and plug-in hybrid electric vehicles existed. To this end, the Stockholm Environment and Health Administration invited both public and private organisations to take part in the initiative. The final buying group consisted of 296 organisations, and each of them committed to a minimum number of purchases. The objective was to send a strong signal to manufacturers of electric and plug-in hybrid electric vehicles of the potential demand for these. Showing potential innovators that people believed in the viability and usefulness of the new technology supported car manufacturers deep coordination efforts and contributed to its origination as an innovation.

Finally, PPI may also support the first stage of the market formation process by making the general context factors (economic, regulatory, institutional framework) more favourable for the origination of innovations. First, public procurement can change the regulatory and legal framework in those cases in which this prevents or hampers the use of a specific targeted new solution, for instance by adapting existing norms or delivering certificates to enable the commercialisation and the use of the procured new solutions. In case 7, in the Netherlands, the Foundation for Experiments in Social Housing (SEV) aimed at encouraging the development of extension lifts to equip old social housing buildings, so that they could meet the housing and caring needs of the elderly. As part of this initiative, the SEV had to adapt the safety regulations in order to allow the installation and use of the new technology.

PPI can also act to encourage the acceptance of a new solution by the public in general (not necessarily only by identified potential users) reducing again potential obstacles that entrepreneurs might face in the coordination and integration of the innovation social knowledge component. In certain cases, procured innovations can have an impact on individuals and organisations who neither supply nor use them, and the origination process in these cases will depend to a great extent on the acceptance of the innovations by these

third-party actors. PPI can contribute to origination by involving these actors early in the procurement process such that they can provide feedback to suppliers to develop new solutions that will be widely accepted. In case 10 from our case studies, in the procurement of the new bio-waste fed power plant, the procurers Svensk Växkraft AB consulted the future neighbourhood of the plant as well as environmental and consumer organisations in order to assess and gain their acceptance of the project.

4.2. Adoption (stage 2 in market formation)

The second stage in the formation of the market is the adoption of the innovation by a first population of users. As outlined in Section 3, adoption involves a process of surface coordination between knowledge carriers namely: the suppliers of the innovation (that hold or carry the new knowledge complex) and those that demand it, its potential users (individuals and organisations) which carry knowledge in their own knowledge systems (which underpin their routines, habits, behaviours) within their specific social and organisational contexts. While deep coordination concerns the interaction among different types of knowledge that must be coordinated at the micro-level of the innovator(s), surface coordination occurs at the meso level since it concerns the integration of different types of knowledge sets that are held by different micro-units, namely innovators and users. Since innovators and users have very heterogeneous knowledge systems, the success of this coordination, and hence of the adoption process depends on how complementary these systems are. It also depends to great extent on the ability of both types of agents to learn and co-adapt, i.e. to change their knowledge systems so that they fit with each other.

Our case studies provide evidence of two ways in which PPI can support the adoption process. First PPI can reduce the likelihood of coordination problems among suppliers and users by helping ensure the complementarity among their knowledge sets at the initial stages of the procurement procedure. Second, it can facilitate their actual coordination at later stages of the procedure by supporting suppliers and users' co-adaptation and interactive learning with experimentation and trial-and-error processes, and by helping improve their knowledge capabilities (see Table 2.3).

Table 2.3. PPI and surface coordination

Contribution to surface coordination	PPI instruments/actions	Procurement procedure stage
Encouraging complementary between users and suppliers' knowledge sets	• Involvement of end-users in: • identifying, integrating and aligning needs • market consultation and exploration	Identification of needs Market exploration and stakeholders consultations
	• Outsourcing the public procurement process to a central organisation*	
Facilitating suppliers and users co-adaptation and interactive learning	• Experimentation and testing	Tendering, and tender evaluation and selection
	• Providing end-users with relevant knowledge	Delivery of the procured innovation

Note: * the outsourcing of the public procurement process is not restricted to these two stages but if undertaken it will be in force throughout the whole public procurement procedure. However, our focus here is on its specific role at these two stages of the procedure.

At the initial stages of the procurement procedure (prior to the actual process of the definition of specifications in the call for tenders) procurers must identify and align end-users needs. They then must determine (usually via intelligence gathering and market exploration) if there are already 'off-the-shelf' products, technologies or services that can satisfy these needs, or if potential suppliers can develop a new solution within a reasonable period of time.

PPI can reduce the likelihood of market surface coordination problems at these initial stages by contributing to make sure that the knowledge sets of the supplier of the new solution, and those of a population of users, fit with each other, helping thus their future coordination when the time to adopt and use the solution comes. One way to do so is through the involvement of end-users in the procurement teams. The creation of teams involving users facilitates the expression of a demand that most adequately match their needs. It also helps end-users coordination and the alignment of needs, that is, the identification of their common denominator to express a demand for a product, technology or service that will satisfy most of them (Edler et al., 2005; Edler and Yeow, 2016). PPI can also increase the fit between users and suppliers' knowledge sets by involving users in the process of market exploration and intelligence gathering. This allows procuring organisations to acquire a better understanding of to what extent existing or proposed new solutions match the identified users' needs. Public procurers can also act as external brokers in the process and generate linkages between buyers and potential suppliers to search for solutions, signal existing demand to suppliers and possibly adapting the needs to what firms are able to supply with (Edler and Yeow, 2016). The effectiveness of these processes at the early stages of the procurement procedure is fundamental for surface

coordination as an inadequate match between the needs, knowledge sets and capabilities of both suppliers and users will hinder their interaction (and hence the adoption of the new solution) in the future.

The effectiveness of these initial stages, however, and somehow counter-intuitively, has a much less influence in the process of deep coordination. For instance, involving users in the definition of specifications stage may contribute to deep coordination by improving the process of communication of previously identified and aligned users needs. However, an ineffective identification and alignment of needs at the initial stages of the procedure (e.g. due to misunderstandings, or to clumsy market exploration) will not necessarily prevent deep coordination from occurring: as long as users' needs are clearly specified and accurately communicated, knowledge integration may occur, and a new solution may emerge even if it will be one that fulfils those 'mispecified' needs. This is not unusual as indeed in reality many innovations are procured but few are scaled up sufficiently to create a market. The inadequate identification of users needs at the early phases of the procedure will however cause surface coordination problems, which will be manifested at the later stages of the market formation and of the procurement procedure, most likely during and after delivery of the procured innovation.

In one of our case studies (case 1), the City of Ghent, Belgium, attempted to introduce via public procurement environmentally friendly vehicles in its public fleets in order to help the development of a market, and encourage their wider diffusion among the private sector. Users needs, in relation to infrastructure required, fuel availability, and usage were identified and aligned. Electric and compressed natural gas (CNG) vehicles were selected as the most appropriate solution to address these needs, a demand was created for these vehicles, and the project was implemented. The initiative however only had a moderate level of success: the public sector adopted the new solution, but the technology failed to be adopted by the private sector and the local citizens. Applying our evolutionary lens, this was due to a deficient identification of users needs at the early stages of the procurement procedure, which while allowing a clear expression of a demand, and the emergence of a new solution, had detrimental consequences later on in the market adoption process. In particular, the procurement organisations did not take into account suppliers and users knowledge complementarities or were unable to adequately match their different knowledge sets regarding the infrastructure, fuel availability and characteristics of the CNG vehicle. For instance, it is possible that the vehicle charging points, speed, and mileage allowed (before additional re-charging) were adequate or satisfactory for its use by public organisations (to use in a work related context) but did not address the needs of the public in general (most likely using the car in a different context). It is also possible that although

the solution might adequately address their needs, private agents were more reluctant to modify their habits due to inertia (typical of behavioural change), and/or that they actually lacked the ability to drive the car. An additional explanation, could also relate to the ability (dynamic capabilities) of the suppliers to adapt the technology to these specific needs based on their interactions.

Effective assessing and facilitating the matching of needs, knowledge sets and capabilities of both suppliers and users at the initial stages of the procurement procedure requires highly capable and experienced public administrations. Therefore, in some cases, outsourcing of the public procurement process to a highly experienced centralised procurement organisation can also contribute to reduce potential future problems in surface coordination. Centralised organisations concentrate skilled human capital and expertise, and might therefore be more able to identify suppliers and solutions that better match end-users needs (Albano and Sparro, 2010; Dimitri et al., 2006; Georghiou et al., 2014). Most importantly, they might be able to assess their respective knowledge sets, as well as their capabilities to change these over time, if required, in later phases of market development, which as we will see below is also fundamental for surface coordination and adoption. In one of our case studies (case 2), the City and State of Hamburg, Germany, procured and facilitated the diffusion of a new lighting system that allowed a better local energy management. The Agency for City Development and Environment of both the state and the city had a long experience with similar technologies. Its centralised and extended know-how allowed the accurate identification of the knowledge sets and capabilities of the supplier of the new lighting system, and the effective match between these and those of the end-users. It might also have allowed the identification of a supplier who not only had a knowledge set that effectively matched existing users' knowledge and needs at that particular time, but that was able to learn and adapt the technology to potential unforeseen changes that might have occurred over time contributing significantly to the success of the adoption and the diffusion of the technology.

As indicated, PPI can also support the surface coordination of users and suppliers' knowledge systems by facilitating the co-adaptation and learning processes of both types of agents at later stages of the procurement procedure (at the tendering, tender evaluation and selection, and the delivery of the procured innovation stages). One way of doing this is by using PPI to promote trial-and-error and experimentation of the novel solutions. Once an existing solution (or a potential new one to develop) has been identified and selected, procurers can carry out or support experiments in which both users and suppliers have the opportunity to learn about it, and to acquire the knowledge that they need to incorporate in their knowledge sets for its successful adoption. Experimentation processes undertaken

within a PPI initiative indeed can be used to build “dynamic complementarities” (Klein Woolthuis et al., 2005; Malerba, 1996) between users and suppliers as they allow them to provide feedback to each other, and to learn in an interactive manner about how to use the new solution (by users), and how it can be adapted to better address the users’ needs (by suppliers).

We found evidence of how experimentation supported market surface coordination in case 5. In this case, the Dutch Ministry of Traffic and Water Management (V&W) attempted to promote the adoption of speed limiters for delivery vans to increase traffic safety. This was a new technology that consisted in the new combination of existing functions of hard restrictions (e.g. fuel truncation) and driving assisting features. Once the new solution was developed, V&W organised an experiment in which 100 systems were leased for users to test during a limited period of time. The initiative essentially built an interactive learning space in which users and suppliers adapted their knowledge bases in order to respectively use and develop further the new technology: it allowed drivers to learn how to use the new functions and driving assisted features of the vans with the support of the technical and organisational knowledge provided by the suppliers; and it allowed suppliers to learn about how to improve or refine the technology via the feedback received from the users that were testing it. The speed limiters were widely adopted, and the project was successful in the creation of a market for this technological innovation.

Finally, once a new solution has been developed, PPI processes can be designed and implemented to support surface coordination by providing users with the knowledge that is missing in their knowledge systems in order to use it. If users have the right adaptive capabilities, they can learn and adapt so that their knowledge can effectively ‘fit’ or coordinate with the knowledge (the new knowledge system) carried by the innovator. In several of our case studies, public procurers implemented initiatives such as training and educational programmes to enable potential adopters (both individuals and organisations) to develop new skills and organisational routines and capabilities, and to break the cognitive and behavioural inertia in relation to the adoption of new solutions. For instance, in its attempt to support the development of a local market for electric and CNG vehicles, the City of Ghent (case 1) organised driving lessons for its civil servants, in order for them to learn how to use these vehicles. In case 4, the City of Rome, Italy, aimed at supporting organic agriculture and the creation of an organic food market through the public procurement of public school meals. As part of this initiative, the public sector asked school meal suppliers to provide training for teachers, and organise informational campaigns for children and their parents. In addition, the initiative included compulsory canteen commissions in which pupils’ parents could evaluate the food in order to report any related

problem. This measure, apart from ensuring a control of food quality requirements, was also aimed at educating consumers in and beyond the classroom and the school canteen, to promote a behavioural change in consumers in favour of organic food (Morgan and Sonnino, 2007).

4.3. Retention (stage 3 in market formation)

As previously indicated, the last step in the market formation process is the retention of the new knowledge complex, the innovation, so that it becomes widely used by a targeted population of users. This involves the operational coordination of the market agents' transactions and activities, which takes place via the alignment of their information messages, prices, and incentives. PPI can contribute to this coordination process at the final stage of the procurement procedure (delivery of the innovation stage) by providing potential users with (financial and non-financial) incentives and relevant information in relation to the use of the procured innovation. Based on the evidence and analysis provided by our case studies we have identified three categories of PPI instruments that can support market operational coordination: financial and non-financial support to additional purchase, and information sharing and communication tools (see Table 2.4).

Table 2.4. PPI and operational coordination

Contribution to operational coordination	PPI instrument/actions	Procurement procedure stage
Provision of information and incentives	• Financial support	Delivery of the procured innovation
	• Non-financial support	
	• Information sharing and communication tools	

Financial support to (public) buyers is usually considered a means to reduce financial risks (Edler et al., 2005; European Commission, 2010a), and hence to encourage them to purchase innovative solutions. Financial incentives in the form of direct subsidies or tax incentives can however be used to lower *de facto* the price of new products, technologies, or services in order to make them more attractive for private buyers contributing in this way to a better alignment of prices and incentives between suppliers and potential buyers of the innovation, i.e. to operational market coordination. For instance, in case 7 (see above), the diffusion and use of extension lifts in old social housing buildings was supported by a financial incentive in the form of a subsidy that the Dutch Ministry of Housing granted for the purchase of lifts that complied with the technical specifications drafted by SEV and passed a cost-quality test.

Innovative solutions developed with the support of PPI may also become more competitive through a reduction in the transaction costs associated with their purchase by means of non-financial aid. In this case, the role of public organisations consists in facilitating the purchasing activities and procedures of an additional population of users by providing them with dedicated services. For instance, in Ghent (case 1), the City Services and Logistics Departments was responsible for identifying and recommending, to the other city departments willing to purchase new vehicles, the most suitable ones among the electric and CNG ones targeted by the initiative's framework agreement. In Hamburg (case 2), the Agency for City Development and Environment of both the city and the state provided firms with the usage of the procurement agreement established with the selected supplier to accelerate the spill-over of the procured innovative lighting system. In other instances, framework agreements (used as mechanisms for demand aggregation) "avoided the duplication of 'transaction costs' that would have arisen if each purchasing unit were to conduct the procurement process on its own, and competing firms were to submit distinct offers for each procurement process" (Albano and Sparro, 2010, pp. 5–6). In two of our case studies (cases 1 and 8, see above), additional buyers could use such selected suppliers framework agreements in order to significantly reduce the transaction costs associated with their purchases.

Finally, a third category of PPI instruments that might be implemented to address operational coordination issues concerns information sharing and communication tools. These instruments can reduce or help eliminate the information asymmetries, and deficiencies associated with the lack of awareness of innovations that may prevent or dissuade economic agents from using an innovation in their economic activities. These, in contrast to PPI actions and instruments in support of the adoption stage of the market formation for the adoption of innovation, are not aimed at promoting learning and change in the knowledge sets (i.e. habits and/or organisational routines) of potential adopters, as these are supposed to have already fit with those of the providers of the innovation via surface coordination. Information related PPI instruments contributing to operational coordination act, once surface coordination has occurred, by reducing sources of malfunctions at the retention stage, which are essentially related to the lack of information and/or incentives on the actual use of the innovation. In several of our case studies, related solutions consisted of communication tools and events aiming at increasing potential adopters' awareness of targeted innovations. In both cases 1 and 10 (respectively on the public procurement of electric and CNG vehicles in Ghent, and of a renewable energy centre by Svensk Växkraft AB in Sweden), public procurers implemented an array of dissemination activities to target potential additional purchasers. These included the creation of websites, and the organisation of presentations, workshops, and networking

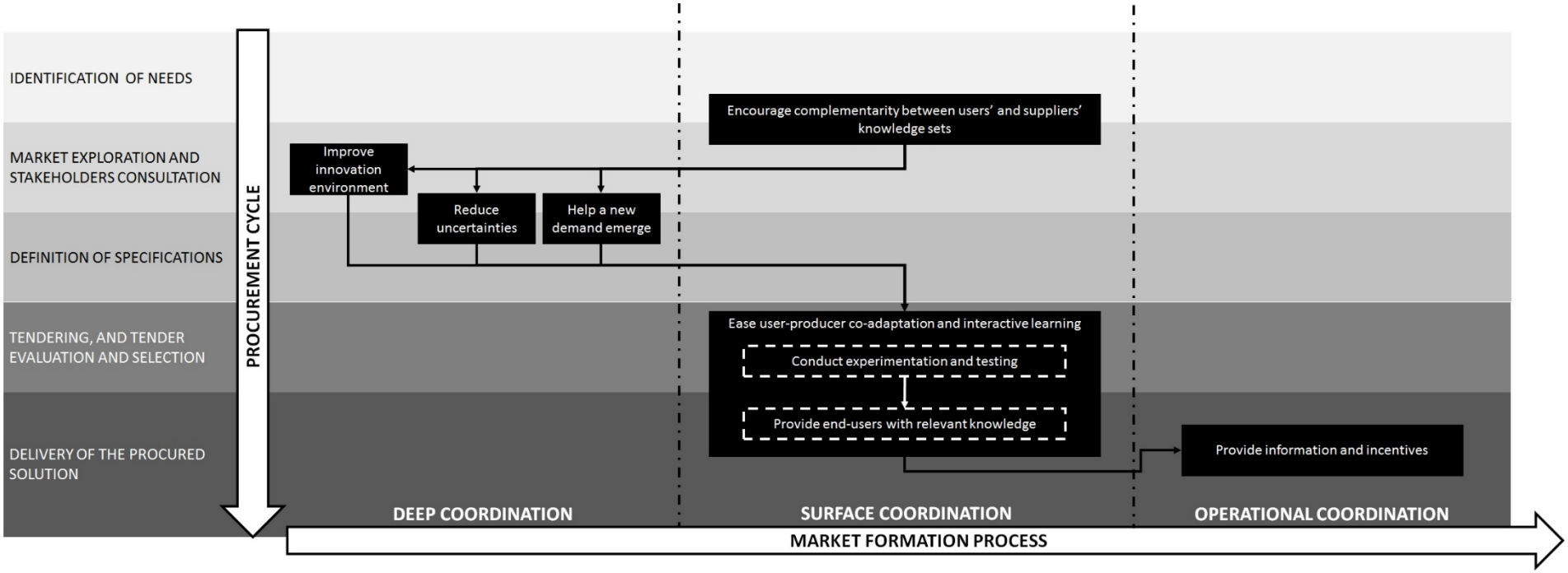
events for the dissemination of relevant information on the innovation. By improving the provision of information and creating incentives through these different communication channels, public procurement encouraged the use of the procured new solution by a higher number of users, supporting in this way the market retention stage.

5. Discussion and conclusion

The diagnostic analysis conducted in the previous section has allowed us to identify specific ways in which PPI, at different phases of the procurement procedure, can support the formation of a market for an innovation throughout all the stages of its dynamic development. We have adopted an evolutionary systemic perspective in which markets for innovation are defined as complex systems whose main function is to create and coordinate knowledge. Within this perspective hence the essential role of PPI as a policy tool is to support the three types of knowledge coordination processes that underpin this function of the market throughout its formation over time. We have used an abductive approach and examined existing empirical evidence using an evolutionary perspective to identify PPI actions and measures that can support these coordination processes, and to ascertain at which stage of the procurement procedure these might be more effectively undertaken. We have also considered how the knowledge related capabilities and learning abilities of all agents involved affect knowledge coordination throughout the process of market creation.

As explained in the preceding sections, the creation of a market for an innovation in an evolutionary setting follows what it is defined in the micro-meso-macro analytical framework as ‘the natural order’ of knowledge coordination (Dopfer and Potts, 2008) namely: operational coordination of information (retention) presumes the surface coordination of knowledge (adoption), which presumes the deep coordination of knowledge (origination). This “natural order” characteristic of the three phases of the dynamic meso trajectory over which a market forms cannot be circumvented: deep, surface and operational coordination must take place in this order otherwise a market for novelty will not be created. Our analysis has shown that PPI has a key role supporting these three types of coordination at different stages of the procurement procedure but not necessarily following this natural order in a sequential manner (see Figure 2.1). This has significant policy implications when PPI is considered as a policy tool with the strategic objective to support the creation of a market.

Figure 2.1. Market formation and PPI



The origination of an innovation via deep coordination of knowledge occurs at the initial stages of market formation. The knowledge embodied by the innovation for which a market is to be created is a system formed by a variety of components of different nature (technical, social, cognitive and behavioural), and has a specific structure, i.e. these components must be interrelated in a particular way for the innovation to emerge. We have shown that PPI can support deep coordination at these early phases of market formation at one of intermediate stages of the procurement procedure (the definition of specifications stage) by facilitating the expression of demand, and by reducing uncertainties in relation to this demand. At this stage, the role of PPI is essentially concerned with the provision of the social knowledge component of the innovation (by creating it if it is missing, or by making potential suppliers aware of an existing one), and with encouraging the integration of this component with their associated technical, behavioural and cognitive ones. PPI can also support this integration, and thus deep coordination, by influencing the relevant social and institutional environment during both the defining of specifications stage, and at the later stage of market exploration and stakeholders' consultation of the procurement procedure.

Our analysis suggests that the effectiveness of PPI at these two procurement stages is key to ensure that all knowledge components necessary for deep coordination, and hence origination, are in place. This is so in both cases in which PPI is supporting the origination of a completely new solution (not yet developed), and in those in which an existing innovation (already originated via deep coordination in a different market) is introduced in a new market context, i.e. in the procurement of an existing product, technology or service that is novel for the users and/or purchasing organisations. From a policy viewpoint, when the procurement involves the introduction of an existing solution into a different population of users, origination will most likely require further changes and adaptation of its knowledge components and/or structure. The role of PPI in this case will be to facilitate this adaptation process. Adaptation will involve a disruption or structural breakage of knowledge, or in other words, the de-coordination of a previously coordinated knowledge system and the creation of a new one that fits with new users' needs, and their associated new cognitive, behavioural, and social context. Procuring organisations in these cases thus must be capable not only to provide the new social knowledge component, and make the innovation suppliers aware of the existence of a new demand, but also make sure that these suppliers already have the technical knowledge, and the cognitive and behavioural routines and capabilities to adapt the solution to the new context, or that they are able (they have the dynamic capability) to learn these in a reasonable period of time.

Following the natural order of knowledge coordination, the next stage in the formation of a market is the adoption of the newly originated solution via surface coordination. The

success of the coordination of the suppliers and users' interactions and behaviour depends on how complementary their knowledge sets are, and on the capacity of both types of agents to learn and adapt these sets so that they fit with each other. We have shown that PPI can help surface coordination and ensure knowledge complementarity by acting at the very early stages of the procurement procedure, namely at the identification of needs, and the market consultation and exploration stages. How complementary and how well or efficaciously the knowledge sets of users and (potential) suppliers are aligned at these stages will greatly determine the success of the adoption market process at a later time.

Our analysis therefore suggests that even if adoption issues might seem far away in time at the initial stages of the procurement procedure, it is precisely at these stages where potential surface coordination and adoption related problems might be addressed. This has important policy implications as it shifts the focus of PPI initiatives towards a more long-term less myopic dynamic approach, and towards a greater consideration of the knowledge bases and learning capabilities of users and suppliers at the very early phases of the procurement procedure. Previous (static) analyses of PPI for market creation disregard the interrelation between the dynamics of market formation and that of the procurement procedure, and hence overlook the influence that the initial steps in the procurement of an innovation can have for its future adoption and diffusion in the market formation process. From a dynamic evolutionary perspective framework, however, PPI at the very beginning of the procurement procedure acquires fundamental policy relevance.

Our evolutionary perspective also highlights the importance of an additional capability of procuring organisations in contributing to future adoption, namely their ability to assess the learning and adaptive (dynamic) capabilities of suppliers and users. Successful future adoption can be supported at the beginning of the procurement procedure if public organisations, in addition to be able to help the matching of the knowledge structures of both types of agents, are able to identity and/or assess their ability to learn and co-adapt to each other throughout their interactions as a market for the solution forms. In an evolutionary setting, knowledge is not static, it changes over time, and the more able their carriers are to adapt their knowledge structures to any novelty that might arise during the process of market formation (e.g. in the form of changes in the needs of existing users, the emergence of new users, advances in the technical component of a solution, changes in environmental influences and so on) the better the market will fulfil its knowledge coordinating and growing function, and will continue to develop and evolve over time.

In the final phase of the formation of a market, the retention phase, the innovation becomes widely used and applied by agents in their activities and operations. The success of the retention phase depends on the effectiveness of the coordination of the behaviours

of users and suppliers in the market via the alignment of their information messages, incentives, and prices. We have shown in our analysis that PPI can contribute to this operational coordination mainly at the final stage of the procurement procedure (delivery of the innovation stage) by providing users with (financial and non-financial) incentives and relevant information in relation to the use of the procured innovation. Once deep and surface coordination have taken place, the use of these PPI instruments is important since even if a new solution that can be adopted has been successfully originated, misaligned incentives and information asymmetries between suppliers and users can still hamper its wide use and diffusion. However, from a policy viewpoint, our analysis suggests that these PPI instruments and actions will only be effective as long as the knowledge systems underpinning the solution and both types of agents in the market remain stationary. As already indicated, any novelty that might arise (e.g. variations in users needs, in users and suppliers' cognitive frames and mental models, technological advancement, behavioural changes, and/or alterations in the market environment) will involve changes in the knowledge components of the new solution and in their interrelation. Using PPI information and incentive related tools in the face of novelty will prove a waste of policy resources as these will be addressing operational problems that are underpinned by the 'old' knowledge structure. In other words, PPI intervention at the later stages of the procurement procedure will only influence the outcomes of a specific 'already coordinated' knowledge structure. If exogenously or endogenously generated novelty changes or ruptures this structure, PPI must focus on supporting the new required deep and/or surface coordination processes before any operational intervention.

All in all, the general policy lesson that can be derived from our work is that PPI must focus its efforts on addressing deep, surface and operational market coordination issues: that is, it needs to take into account the dynamic and systemic nature of knowledge, and the nonlinear interrelation between the implementation of measures along the procurement procedure and the different stages at which these different types of coordination take place. PPI must also consider the limitations in both suppliers and users' knowledge capabilities (rather than their information processing abilities), and the problems that affect their adaptive and learning processes by which they generate, adopt and retain knowledge as the market develops. Our analysis thus allows much more differentiation when it comes to the conditions under which PPI can be used for the creation and dynamic development of the market. As we have shown, PPI has a significant effect on the market as a whole, and can influence the interactions and the capabilities of both suppliers and users of an innovation at different points in time. In other words, PPI influences all the elements of the market system (as a knowledge coordinating and creating system), and not specifically some of the agents or micro-units that compose it. This suggests the possibility of

conceiving PPI for market formation as a systemic policy tool (Crespi and Quatraro, 2013; Smits and Kuhlmann, 2004; Wieczorek and Hekkert, 2012) acting on a system (the market) that is embedded within a wider system (technological or sectoral systems of innovation) and within a particular geographical area (national or regional systems of innovation).

Our analysis also emphasises the transformational role of public policy in general (and PPI within it) to encourage the development of adaptive and dynamic capabilities in the market and to favour knowledge structures that can subsequently accommodate and make possible further processes of novelty creation, i.e., to favour order and structures that are evolutionary efficacious (so that they allow operations and value creation) and sufficiently 'open' and adaptive to accommodate future novelty and change.

Our work on PPI for market creation within an evolutionary framework provides the first analytical steps for further conceptual developments that can inform more effective policy design. In our diagnostic analysis we have used existing evidence, and hence relied on prior analysis and empirical research efforts from selected case studies. A natural first step for us therefore will be to undertake additional work to gather data and empirical evidence that allows us to achieve a better understanding of the ways in which PPI can contribute to the creation of markets for innovation within a dynamic analytical framework.

As we have previously indicated, our analysis 'blackboxes' the interactions and coordination process taking place at the lower level of the individuals and departments that compose both business and procurement organisations. In the context of PPI, coordination problems within and among relevant procuring organisations can be highly detrimental to the success of its initiatives so another natural next step will be to attempt to incorporate the influence of these processes of internal coordination in the analysis. Finally, as we have described, one of the key roles of procuring organisations is to provide knowledge to potential innovators and support the origination of new solutions. The provision of knowledge involves the collaboration between public organisations and innovators, and this process of collaborative development is also subject to a number of potential problems that policy makers should forestall. This issue has been extensively explored by the management and industrial engineering literature on private purchasing (McIvor et al., 2006). The incorporation of these key insights into our evolutionary framework constitutes an additional avenue for further research. Chapter 3 subsequently focuses on the factors that may hamper the collaboration between public procurers and suppliers for coordination of knowledge, and that have their root in the public procurement practices of these actors.

The analytical steps provided by our work and the several avenues for future research that it opens encourage the abandonment of the atemporal approach that has characterised existing analyses of the role of PPI in market formation, and the use of a

more dynamic evolutionary theoretical framework as the basis of policy and practice development. In our view our conceptually enhanced framework, by providing a better understanding of how PPI can affect the dynamics of the creation of markets for innovation, can contribute to inform more effective policy design. Chapter 3 adopts a similar dynamic approach looking for impediments to public procurer-supplier collaboration along the different stages of the public procurement procedure that we will explicitly intertwine with the collaboration process.

Chapter 3. Collaborative development of innovations though early supplier involvement in public procurement procedures

Foreword

This chapter is based on the paper with the same title co-authored with Marie-Anne le Dain (Grenoble INP, France), and Mireille Matt (INRA, France).

This work was financially supported by the Foundation for Industrial Innovation of Grenoble INP. Preliminary versions of the paper were presented at the 2016 International Conference “What’s new in the economics of innovation? Theory, empirics and public policy” in Grenoble, France, and at the 2017 IPSERA (International Purchasing and Supply Education and Research Association) Conference “Coping with the Future: Picking your Battles” in Balatonfüred, Hungary.

1. Introduction

Public Procurement of Innovation involves interactions between public procurers and suppliers. Chapter 1 showed that any PPI category must ensure certain degrees of interactions between these actors to unleash their innovation impact. Market formation and development via PPI similarly requires interactions between public procurers and suppliers for relevant coordination of knowledge and information (Chapter 2). The objective is to engage suppliers early in public procurement procedure, so that public organisations and possible additional users may provide them with knowledge components to form a new knowledge complex, that is, an innovation (Bleda and del Río, 2013). However, practices related to early involvement of suppliers in public procurement procedures are a source of failures. A United Kingdom survey asked public sector's suppliers about the barriers to innovation in public procurement procedures (Edler et al., 2015b; Georghiou et al., 2014; Uyarra et al., 2014). Around 60% of respondents claimed that early interactions with procuring organisations was good practice, but less than 35% of respondents had experienced it.

The literature acknowledges that PPI involves interactions between suppliers and public procurers (Chapter 1; Rolfstam, 2009). For instance, several recent works explore the role of PPI in the intermediation between demand and supply (Edler and Yeow, 2016), the geographical anchoring of interactions underpinned by PPI (Uyarra et al., 2017), and the coordination of knowledge and information for market creation via PPI (see Chapter 2). However, none of these studies identifies or characterises the failures affecting or impeding collaboration between public procurers and suppliers. The literature continues to focus mostly on the general obstacles to innovation within PPI procedures. The aim of this chapter is to address the following question: What are the factors hampering collaboration between public procurers and suppliers geared towards the development of new products or services?

A better understanding of these micro-level failures could be informative for public procurers and guide appropriate design of their PPI projects, and would help policy-makers to formulate policy interventions to encourage and support PPI. We draw on the management and industrial engineering literatures, which identify failures in early supplier involvement that, consequently, affect the collaboration between private procurers and suppliers for the development of new products. To address our exploratory research question, we conducted a series of semi-structured interviews with representatives of public procurers and suppliers, to enquire about their respective

experience of collaboration in public procurement. In selecting interviewees, we considered PPI as a practice on the ground where public organisations ask for or buy something new to improve public services or address societal problems. We do not tackle the complementary case of PPI defined as a (demand-side) innovation policy tool aimed primarily at spurring innovation.

We conduct thematic analysis of the data collected, drawing on work on collaboration failures in private procurement. We code the data with the view of identifying collaboration failures from two perspectives (procurer and supplier) and in alternative PPI procedures. Our empirical findings reveal that the early phases of collaboration are the most critical, that collaboration failures differ across PPI procedures, and that public procurers and suppliers do not always perceive the sources of failures similarly. Our results help to open the black box of procurer-supplier interactions in PPI and shed more light on possible collaboration failures emerging in public procurer-supplier interactions.

The chapter is organised as follows. Section 2 presents the obstacles to innovation in public procurement procedures, the PPI procedures we scrutinise for collaboration failures, and the already identified failures in collaborations involving private procurers and suppliers. Section 3 describes the empirical data collected and explains the methodology used for their analysis. Section 4 provides the main results of the coding and thematic analysis. Section 5 discusses our empirical findings and how they contribute to the literature. Section 6 concludes with some implications for theory and policy.

2. Defining procurer-supplier collaboration failures: theoretical background

Our research aims to complement the literature on PPI, which focuses mostly on the obstacles to innovation in public procurement procedures (Section 2.1) by exploring collaboration failures. We need a better understanding of the influence of public procurement procedures on collaboration between public procurers and suppliers, which is addressed in Section 2.2, and draws on the management and industrial engineering literatures and the insights on collaboration between private procurers and their suppliers (Section 2.3).

2.1. Main obstacles to innovation in public procurement

One of the main characteristics of public procurement is the high level of formalisation of its procedures, which are subject to a number of rules and regulations (Stentoft Arlbjørn and Vagn Freytag, 2012) often imposed by a central oversight department or agency under (central or local) government authority (Rainey and Bozeman, 2000). In the EU, transparency, equal treatment and open competition are binding principles and impose a level playing field. These public procurement norms and rules have an influence on procurer-supplier interactions and, therefore, on the innovative outcomes of these interactions. Several scholars have criticised (Rolfstam, 2009) the Directives of the European Commission in this respect. They warn that the requirements relative to the principle of open competition may inhibit "collaboration and interaction for innovation in PPI processes" (Edquist and Zabala-Iturriagagoitia, 2012, p. 1767). Georghiou et al. (2014) contend that policy efforts should be geared towards making procurement rules more conducive to innovation, and acknowledge recent revisions of the framework conditions aimed explicitly at fostering innovation (Stentoft Arlbjørn and Vagn Freytag, 2012). Rolfstam (2009, 2013) contests the view that inhibiting procurement rules is slowing the rolling out of PPI and argues that, in some instances, public authorities can procure innovative solutions whilst complying with binding norms and rules. Thus, he recommends exploration of the drivers of or obstacles to PPI, which focuses on the procurement context beyond the framework conditions embodied in procurement law (Rolfstam, 2015).

We adopt this approach in our attempt to identify the micro-level failures impeding collaboration between public procurers and their (potential) suppliers. We define "collaboration failure" as the potential risk of malfunctions, in public procurement practices, preventing or hindering collaboration between suppliers and procurers and, thus, inhibiting the development of innovation. Whatever the ultimate consequence of a failure, it increases the costs incurred for all actors involved in the affected collaboration.

While the literature highlights the benefits of early engagement with suppliers in the public procurement procedure (Edler and Georghiou, 2007; Uyarra, 2010; Uyarra et al., 2014), few attempts have been made to systematically identify related collaboration failures. Erridge and Greer (2002) find that the public sector culture (i.e. risk aversion and resistance to change), its internal organisation and coordination, and the skills and expertise of its staff constrain relationships between public procurers and suppliers. Public sector's risk aversion and lack of capabilities and skills could explain the poor innovative outcomes of PPI initiatives (Edquist et al., 2015; Georghiou et al., 2014; OECD, 2014b) and the inability and reluctance of public organisations to engage early

with (potential) suppliers (Erridge and Greer, 2002; Uyarra et al., 2014). These factors hindering collaboration between public procurers and suppliers have been defined in broad terms and we build on this literature to explore how collaboration failures can emerge at different stages of and within different PPI procedures. This requires a better understanding of public procurement procedures and the state of the art in research on early supplier involvement failures.

2.2. Procedures of public procurement of innovation

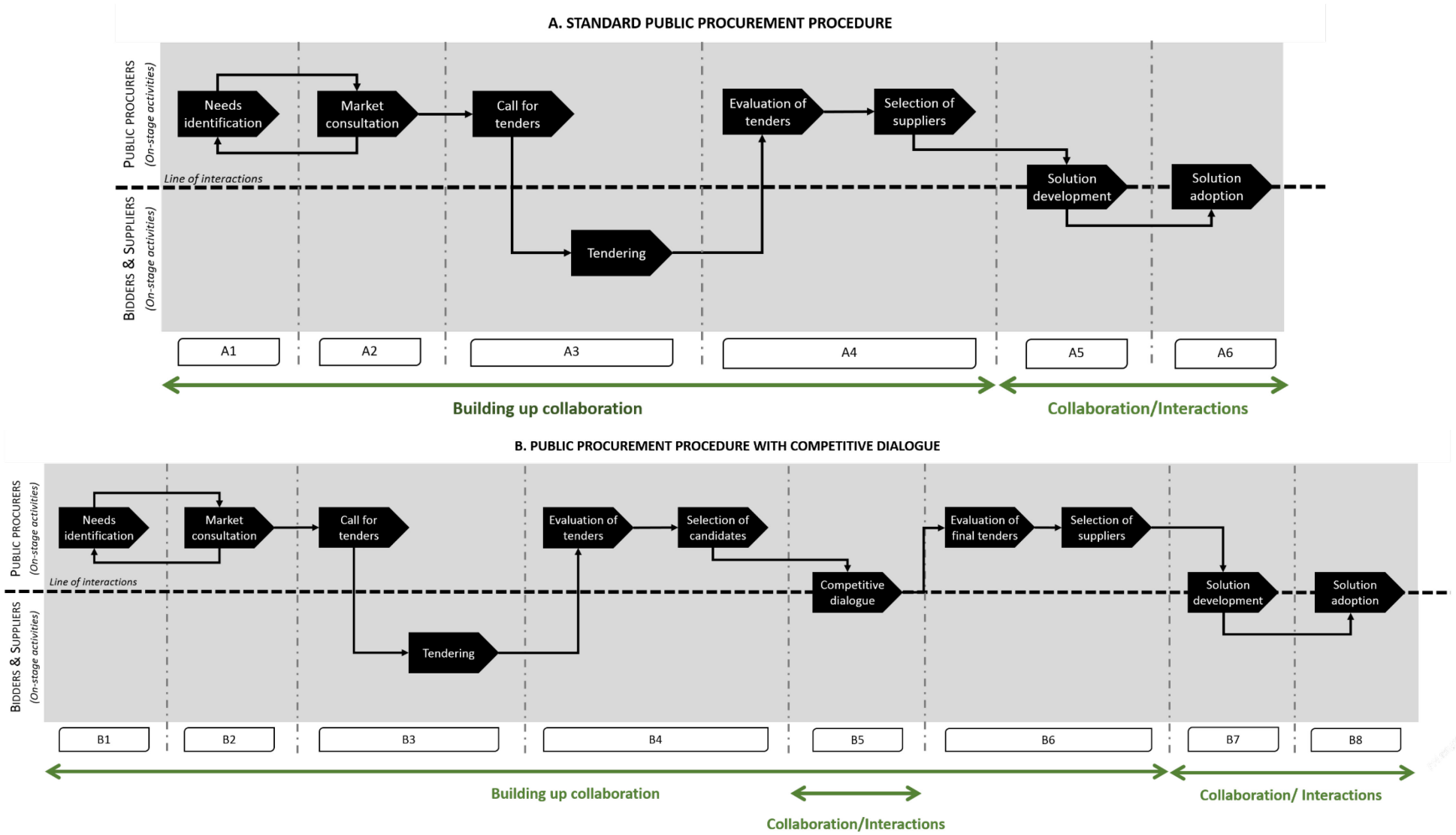
In the EU, there are binding rules and norms that shape PPI procedures around a competitive model. We use the blueprint method (Fließ and Kleinaltenkamp, 2004) to represent the stages of these procedures (Figure 3.1). A blueprint is a two-dimensional picture and chronological representation of a procedure that identifies the loci of collaboration among two broad categories of actors.[21] The horizontal axis describes the successive actions and stages necessary to perform PPI. The vertical axis distinguishes the performers of these different actions: demand-side actors (public procurers and additional adopters) are above the 'interaction line' and (potential) suppliers are depicted below the line. Actions that induce both actors to collaborate are depicted on the interaction line.

A standard PPI procedure (Edler et al., 2005) can be considered to include six stages[22] (Figure 3.1-A). It starts with identification of the needs of end-users (A1). Public procurers then consult market actors, to identify potential existing solutions to these needs or determine whether firms have the capabilities to develop new ones in a reasonable period of time (A2). The market intelligence thereby gathered informs the specifications for the products, services or systems that need to be procured to address the needs identified. In the next stage, based on these specifications, firms submit tenders to public procurers (A3), which evaluate them (against criteria listed in the calls for tenders) and, eventually, select one (or several) firms (A4). Selected supplier(s) – possibly in cooperation with public procurers (Rolfstam, 2013) – develop the new solution (A5), which, ultimately, is delivered to and adopted by end-users (A6).

[21] The blueprint method enables representation also of the interactions within the two categories of actors, whose collaboration is the focus of the study. Although we acknowledge that those internal interactions are key to the success of PPI (Rolfstam, 2013), we do not focus on them in this paper and, for simplicity and to improve readability, they are not included in our blueprints.

[22] The definition of these stages can vary according to the objectives of the PPI initiative, such as addressing grand challenges (Edquist and Zabala-Iturriagagoitia, 2012) or spurring innovation through market formation and development (see Chapter 2).

Figure 3.1. User-supplier interactions within public procurement procedures



In addition to this standard procedure, additional procedures exist, including 'competitive dialogue', which is considered most appropriate for the public procurement of innovative solutions (Commission of Experts for Research and Innovation, 2013). Its flexibility "allows the contracting authority to have discussions with the candidates during the procedure so to better define its needs and the appropriate means to achieve its objectives" (Telles, 2010, p. 1). This procedure eases identification and communication of needs (Uyarra, 2016) by enabling public procurers to engage with selected firms in focused dialogues. The objective is to assist in the specification of complex innovative solutions.

Like the standard PPI procedure, competitive dialogue (Figure 3.1-B) starts with identification of the needs to be satisfied (B1). Via preliminary market consultation, public procurers identify potential solutions (B2). However, their high level of complexity means their technical specifications cannot be defined from the outset (HM Treasury, 2010), which necessitates competitive dialogue. After submission of tenders – in response to a dedicated call (B3), public procurers select at least three candidates (B4) and engage in parallel dialogues with each (B5). Once the technical, economic and legal aspects of the solutions have been identified, the competitive dialogue is closed and candidates are asked to submit final tenders. These are evaluated by the public procurer which then selects one or several suppliers (B6). As in the standard PPI procedure, the final steps consist of the production (B7) and, ultimately, the adoption and diffusion of the innovative solution (B8).

2.3. Procurer-supplier collaboration failures: theoretical insights from early supplier involvement approaches

The failures affecting Early Supplier Involvement (ESI) have been explored primarily in the literatures in management and industrial engineering. Bidault et al. (1998, p. 719) define ESI as "a form of vertical cooperation where manufacturers involve suppliers at an early stage in the product/innovation process, generally at the level of concept and design."

Implementation of ESI involves various drawbacks and impediments, which need to be identified and addressed in order to reap the positive impacts of ESI on the development of new products (McIvor et al., 2006). Based on a literature review and case studies, Personnier (2013) and Personnier et al. (2012, 2013) propose a list of failures related to collaboration between (private) procurers and suppliers for the development of new products. Since failures can occur throughout the project of new

product development, they distinguish between *ex-ante* failures affecting collaboration building (occurring before supplier selection), and *ex-post* failures impacting the actual collaboration and interactions between procurers and suppliers (occurring after supplier selection). We transposed this distinction to PPI procedures. For standard PPI procedure, the phases of collaboration building and collaboration/interaction are consecutive and occur before and after supplier selection (Figure 3.1-A). In competitive dialogue, we assume that these two phases overlap (B5) since, essentially, competitive dialogue consists of interactions between public procurers and potential suppliers aimed at building a future collaboration (Figure 3.1- B). Personnier et al. (2013) identify these collaboration failures as 'glitches', or "costly mistake[s] that could have been avoided if some of the parties involved had understood things that were known by other participants" (Hoopes and Postrel, 1999, p. 838). By evaluating the cost of these mistakes at the different stages of the co-design process, Personnier et al. (2013) contend that the phase focusing on the building of collaboration is more critical than the actual collaboration phase. An ill-designed collaboration may lead to stillborn collaboration activity or have a negative impact on downstream interactions.

This chapter draws on the stream of research on private procurement, explores the collaboration failures (i.e. their nature and timing) that might affect collaboration between public procurers and suppliers aimed at the development of new products and services, through the two procedures described above.

3. Methodology: Qualitative interviews

To identify those failures that might affect collaboration between public procurers and their suppliers for the development of new products and services, we conducted qualitative interviews with representatives of those two categories of actors. In exploratory research, qualitative interviews (Yin, 2011) are appropriate to understand complex social phenomena, such as inter-organisational collaboration, from the perspective of participants (Partington, 2001). They explain "how [participants] make meaning of their own lives, experiences and cognitive processes" (Brenner, 2006, p. 357). We chose multiple interviews to provide varied empirical evidence and strengthen the validity of our findings (Eisenhardt and Graebner, 2007). We use the empirical data collected from the interviews to adapt, develop and extend existing (Dubois and Gadde, 2002) procurer-supplier theories, based on an abductive reasoning (Van Maanen et al., 2007).

When a phenomenon has little or no theoretical background, Yin (2011) suggests selecting exemplary cases of the phenomenon. The interviewees were selected according to this criterion. Because our aim is to identify failures in collaborations between public procurers and suppliers from their respective perspectives, we needed interviewees with experience in PPI. In public organisations, several individuals and departments are involved in public procurement decisions (Johnston and Bonoma, 1981), e.g. public procurement department, legal and financial departments, end-users and/or operational departments, and, sometimes, elected representatives. Our interviewees include individuals who initiated PPI projects and individuals responsible for the project. Thus, we focused on public procurement managers and managers of individual PPI projects. We also interviewed some legal counsellors and public officers responsible for innovation policy, to obtain background information on their organisation's strategy regarding PPI. Finally, we selected some representatives of different types of French public organisations: central administrations (e.g. ministries), local authorities and public agencies. We also interviewed representatives of suppliers, i.e. firms selling mostly products or services to public organisation or firms that had adapted, at least once, their products or services to satisfy the needs of public organisations. Due to the variety of public needs, public organisations procure a wide variety of products and services (Uyarra and Flanagan, 2010), which should be reflected in our selection of interviewees. From suppliers, we interviewed the CEO or Sales Directors of small firms, on the grounds that they are the persons most likely to interact with public procurers. In the case of larger firms, we interviewed the Project Managers with direct involvement in PPI projects.

To identify representatives of public organisations and suppliers who best met these requirements, we consulted the local Chamber of Commerce and Industry. We gained a better understanding of the local public procurement context and its actors, and obtained information on past and ongoing PPI initiatives and participating public organisations and firms. We selected additional interviewees following a snowball sampling technique (Yin, 2011).

Table 3.1. Description of interviews

Public Organisations				
No	**Type of organisation**	**Organisation**	**Position of interviewees**	**Short description**
PO1	Local authority	Economic Affairs Department	Project Manager (in charge of innovation)	General information on public procurement and the innovation strategy of the local authority, and on past PPI initiatives.
		Legal Department	Procurement Manager	
			Legal Counsellor	

		Waste Collection and Disposal Department	Head of the Waste Disposal Unit	Information on a competitive dialogue as part of a public procurement of an innovative system for the treatment of incinerator bottom ash and their transformation into glass. The competitive dialogue failed to identify a solution that was commercially viable and was terminated.
PO2	Local authority	Transport Department	Project Manager (in charge of Intelligent Transportation System)	Information on an EU-funded PPI project aimed at facilitating inter-urban traffic management via the procurement of new sensors for an improved road data gathering system. Competitive dialogue helped identify the most appropriate solution. We conducted the interview during the pilot phase of the project.
			Administrative and Financial Manager	
PO3	Public agency	Local Branch of a Central Public Procurement Organisation	Director	Information on the innovation-related activities of the Central Public Procurement Organisation.
PO4	Public Agency	Research Unit	Project Manager	Information on the public procurement of a large platform for wheat phenotyping. The platform is considered an innovation, since it relies on the coordination of multiple technologies to perform phenotyping on a large scale. The public procurement was outsourced to a professional project manager, selected through a similarly competitive procedure.
			Procurement Manager	
PO5	National Ministry	Procurement Department	Procurement Manager	General information on the PPI strategy and initiatives of the Ministry of Defence. We focused on the general mechanism of PPI and identified the particularities of the public procurement of weapons and other defence materials to avoid any inaccurate generalisation.
Private Firms				
No	**Firm size**	**Main domain of activities**	**Position of interviewees**	**Short description**
S1	SME	Lighting technologies	Sales Director	General information on the public procurement projects in which the firm was involved. The public procurement of its products and services is facilitated by legal exemptions to the otherwise mandatory competitive tendering phase, and by their accreditation by the Central Public Procurement Organisation.
S2	SME	Water level and current speed measurement systems	Sales Director	General information on the public procurement projects in which the firm was involved. At the time of the interview, the Sales Director had just applied to the accreditation procedure of the Central Public Procurement Organisation.
S3	SME	Time distribution and synchronisation systems	CEO	General information on the public procurement projects in which the firm was involved. The company has sold its solutions to publicly-owned enterprises (subject to the public procurement law) including the French public service radio

				broadcaster and public railway company).
S4	SME	Workforce management and time scheduling software	CEO	General information on the public procurement projects in which the firm was involved. Because the software was sold to public hospitals, the CEO has an extensive experience of PPI and underlying interactions with public organisations.
S5	SME	Autonomous drones	CEO	General information on the public procurement projects in which the firm was involved. The company is involved in collaborative R&D projects with public organisations (including the French public railway company and a local public transport operator) that aim to allow and ease the use of drones in cities e.g. for the maintenance of railway infrastructures.
S6	SME	Traffic sensors	Project Manager	Information on the involvement of the company in an EU-funded PPI project (with competitive dialogue) aimed at facilitating inter-urban traffic management via the procurement of new sensors for an improved road data gathering system.
S7	SME	Short-stories vending machines	CEO	General information on the public procurement projects in which the firm was involved. A City Council procured its product and installed it in public service buildings (to increase the comfort of citizens). The company subsequently benefitted from large media coverage and now sells its products and services to clients overseas.

We conducted 13 interviews between April and October 2016 and collected the perspectives of 17 individuals (from 12 organisations) on collaboration experience with either a public organisation or suppliers, for the development of new products (Table 3.1). According to the study by Griffin and Hauser (1993), this number of interviews is sufficient to collect almost 90% of the information that is sought. Ten of our interviewees were officers from five different public organisations. The remaining seven informants were CEOs, Sales Directors or Project Managers in Small and Medium-Sized Enterprises (SMEs) that at least once had supplied innovative products or services to public sector organisations. With the exception of the Director of the local branch of the Central Public Procurement Organisation (PO3), all reported at least one experience of mutual collaboration via standard PPI procedures and seven had participated in competitive dialogue (Table 3.2). Among these, two public officers of a public organisation (PO2) and one Project Manager of a firm (S6) had participated in the same competitive dialogue.

Table 3.2. Experience of interviewees in the standard PPI procedure and competitive dialogue

	Standard PPI procedure	Competitive dialogue
Public organisations	PO1, PO2, PO4, PO5	PO1, PO2, PO4
Public sector's suppliers	S1, S2, S3, S4, S5, S6, S7	S4, S5, S6

The interviews were semi-structured. The interviewees were asked about their organisations overall strategies regarding PPI, and their experience of collaborative development through PPI. Interviews lasted between 60 and 120 minutes and were recorded and transcribed to facilitate data analysis.

We analyse our data abductively employing a thematic analysis methodology (Paillé and Mucchielli, 2012). We look for collaboration failures in the empirical data and compare them to the failures identified by Personnier (2013) and Personnier et al. (2012, 2013). We adapted their framework to public procurement; we identified some additional failures during the interviews, while some of those identified in the collaboration between private procurers and suppliers in their framework were not reported. We grouped the identified failures in categories (Table 3.3). Finally, we coded all the reported collaboration failures according to: type of organisation (public procurer or supplier) reporting the failure, and type of procedure (standard PPI procedure, competitive dialogue, or others) in which the reported collaboration failures occurred. Generic statements about PPI procedures were coded as referring to the standard PPI procedure since other procedures are considered only as variants of the standard procedure. The coding and thematic analysis identified collaboration failures in the context of public procurement and allowed us to observe differences between PPI procedures and between actors.

4. Procurer-supplier collaboration failures

Based on our empirical data, we propose a framework of failures according to the collaboration phase (Section 4.1). Their perceived importance differs between standard PPI procedure and competitive dialogue (Section 4.2), and between public procurers and suppliers (Section 4.3). Finally, our interviews revealed alternative procedures and strategies for avoiding the failures encountered in the standard PPI procedure and in competitive dialogue (Section 4.4).

4.1. Categories of collaboration failures

Based on our empirical evidence, we identified 22 procurer-supplier collaboration failures. We group them into seven categories according to the collaboration phase (Table 3.3), drawing on Personnier et al. (2012, 2013). Four of them affect the collaboration building phase, two include failures occurring during the effective collaboration between public procurers and suppliers, and one is related to transversal collaboration factors.

Table 3.3. List of sources of failures likely to impede the collaborative development of innovations via public procurement

Failures (locus)	Categories of failures	Phase
• Definition of needs (A1, B1) • Definition of objectives (A1, B1) • Public organisations' awareness of potential solutions (A2, B2) • Definition of specifications (A3, B3) • Definition of selection criteria (A3, B3)	Definition of demand	Building up collaboration
• Definition of contractual terms (A3, B3) • Definition of project management (A3, B3) • Choice of public procurement procedure (A3, B3)	Organisation of the collaboration	
• Early information on projects (A3, B3) • Evaluation and comparison of tenders (A4, B4, B6) • Assessment of bidders' capabilities (A4, B4, B6) • Agreement on selected solutions/suppliers (A4, B4, B6)	Selection of suppliers	
• Alignment of pursued objectives (A3) • Collaborative alignment (A3) • Purchase commitment (A3, B3, B5),	Willingness to collaborate	
• Knowledge and information sharing (A5, A6, B5; B7, B8) • Collaboration parties' internal coordination (A5, A6, B5; B7, B8) • Interface management (A5, A6, B5; B7, B8)	Daily collaboration	Collaboration / interactions
• Significant change in initial conditions (A5, B5, B7)	Turbulence in collaboration	
• Public sector's capabilities (A1-A6, B1-B8) • Level of risk aversion of public organisations (A1-A6, B1-B8) • Mutual trust (A1-A6, B1-B8)	Transversal collaboration factors	

4.1.1. Definition of demand

Definition of demand is the first step in any procurement project. This step can generate various collaboration failures (see Table 3.4). The main challenge is to translate needs, identified in advance, into demand that can be met immediately or within a short period of time. The different services/departments within public administrations and other end-users, if any, need to coordinate to **identify the needs** to be satisfied and agree on

the **objectives** to be pursued via the PPI initiative (Rolfstam, 2012b). Public procurers need to consult market actors to get a better **understanding of existing solutions** that could be supplied immediately or solutions that could be developed within a short time period. **Definition of the specifications** of the innovative solution to be procured and the **supplier selection criteria** have a major influence on the outcome of the PPI initiative (Edquist and Zabala-Iturriagagoitia, 2012). They can encourage or impede the supply of new products, services or systems.

Table 3.4. Identified failures in definition of demand

Collaboration failures	Selected verbatim
Definition of needs	"The point of competitive dialogue is to address the difficulties with the definition of needs. It is a means to define needs via a dialogue with suppliers, when we do not have the required capabilities" [PO1, Head of the Waste Disposal Unit]
Definition of objectives	"In public authorities, procurement departments do not really care about what they procure, as their decisions have no impact on them. They procure on behalf of other departments, and do not look for any potential innovative solution. They do not feel the need for innovation." [S3, CEO]
Public organisations' awareness of potential solutions	"There are very few public organisations undertaking technology watch. […] If we do not [present our innovations to them], PPI will not happen" [S3, CEO]
Definition of specifications	"On the one hand, we must define our needs very precisely, and, on the other hand, we should opt for functional specifications in order to permit (innovative) tenders. This is the core difficulty." [PO1, Head of the Waste Disposal Unit]
Definition of selection criteria	"If calls for tenders are from public administrations that we do not know, if we have never worked with them, and if we do not feel that their calls for tenders are open, we will not submit any tender because we know that we will never be selected." [S3, CEO]

4.1.2. Organisation of the collaboration

This category of failures relates to the formal collaboration arrangements (Table 3.5). **Contractual arrangements** relative to the definition of milestones and deliverables and intellectual property (IP) ownership (Matt et al., 2012) can influence the collaboration between public procurers and suppliers. Similarly, the level of resources committed to PPI initiatives and other **project management aspects** may determine the degree of involvement of the actors in the collaborative development of innovations. Finally, failures in the organisation of the collaboration often are reported as relating to the **choice of PPI procedure** and its perceived impact on the scope for collaboration between public procurers and suppliers.

Table 3.5. Identified failures in the organisation of procurer-supplier collaboration

Collaboration failures	Selected verbatim
Definition of contractual terms	"We did not try to define all contractual provisions beforehand as it was not easy." [PO1, Head of the Waste Disposal Unit]

Definition of project management	"We were advised to apply for grants, as they are simpler and much faster to obtain than public procurement, which is a very long procedure." [S7, CEO]
Choice of public procurement procedure	"If our need does not have any available solution, we cannot decided to interact with only one firm. Why would we pick this one and not another one? We must launch a competitive call for tenders." [PO5, Public Procurement Manager]

4.1.3. Selection of supplier

A key step in collaboration for the development of innovative solutions is selection of the most appropriate suppliers (Table 3.6). Selection of the most appropriate solutions depends primarily on the ability of firm or firms to develop such solutions. Therefore, **information on the objectives pursued by individual PPI initiatives** and on the targeted public needs should be shared early with firms, so that they can submit appropriate tenders. The main challenge faced by public procurers is **comparison of tenders**, which can be especially complex if the calls for tenders are open to different technological solutions (Edler et al., 2005; Uyarra et al., 2014). In addition to comparing the proposed technological solutions, public procurers must **properly assess the capabilities of the various bidders**. Finally, the success of the collaboration depends also on the **consensus within the public administration regarding the ultimate selection of tenders/suppliers** (Kleinsmann and Valkenburg, 2008; le Dain et al., 2010).

Table 3.6. Identified failures in the selection of supplier

Collaboration failures	Selected verbatim
Early information on projects	"If we do not get any information about a coming project in a particular place, if we do not have the opportunity to get ready for it (at least through the provision of information), it will be difficult for us to submit a tender." [S6, Project Manager]
Evaluation and comparison of tenders	"We are aware that we are likely to face difficulties during the evaluation of tenders, as some might propose solutions that we were not expecting." [PO1, Head of the Waste Disposal Unit]
Assessment of bidder's capabilities	"The fact that a supplier is listed in [PO3's] catalogue reassures public procurers, because this means that it has been already evaluated." [PO1, Project Manager]
Agreement on selected solution/suppliers	"Intermediaries, like [PO3] or Chambers of Commerce, have more legitimacy to select innovative tenders." [PO1, Legal Counsellor]

4.1.4. Willingness to collaborate

This category of failures relates to the respective willingness and readiness of public procurers and suppliers to engage in mutual collaboration (Schiele, 2006; Walter et al., 2003) (Table 3.7). It requires that both groups of actors **pursue similar objectives via PPI initiatives**. Moreover, they need to **adopt behaviours and routines and undertake actions that favour collaboration** (Wang and Bunn, 2004) and the development and adoption of innovative solutions. For instance, one party might be reluctant to collaborate if the other party is not willing to commit to a successful collaboration by, e.g. sharing the

costs incurred. The **timing of this commitment** is another important source of failure; firms may be unwilling to carry out costly R&D and innovation activities as part of the collaboration until procurers commit formally to procuring the outcome.

Table 3.7. Identified failures in the willingness to collaborate

Collaboration failures	Selected verbatim
Alignment of pursued objectives	"This is a question relating to the role of local authorities: is it part of our missions to support suppliers in activities that might increase afterwards their revenues? It goes beyond our core missions." [PO1, Legal Counsellor]
Collaborative alignment	"Regarding our collaboration with the National Railway Company and the Local Public Transport Operator, problems relate to timing. We were ready to proceed much faster than they were able to do. We were already able to make a demonstration three months ago." [S5, CEO]
Purchase commitment	"SMEs generally cannot invest in R&D activities if they have no guarantee of purchase." [S6, Project Manager]

4.1.5. Daily collaboration

A category of collaboration failures relates to the daily collaboration between public procurers and suppliers (or candidates in competitive dialogue) (Table 3.8). The most obvious failure in this respect is **insufficient sharing of information and knowledge** (Wang and Bunn, 2004). PPI involves user-producer interactions, in which **both actors need to exchange and coordinate knowledge** for the successful development of innovative solutions (see Chapter 2). Daily collaboration may be affected by deficient coordination within the actors (Rolfstam, 2009) and by an **poor management of the interaction interface** between them.

Table 3.8. Identified failures in daily collaboration

Collaboration failures	Selected verbatim
Knowledge and information sharing	"If [public organisations] need to define their future needs in a public procurement procedure, they need either partners which are ready to interact with them, or they should revise the procedure to make it more interactive." [S5, CEO]
Collaboration parties' internal coordination	"Consortia are complex. [...] A consortium means that there are more persons involved with different responsibilities in the project, and that coordination is needed." [PO1, Head of the Waste Disposal Unit]
Interface management	"It is not easy for SMEs to interact with an organisation as large as the State administration." [PO5, Procurement Manager]

4.1.6. Turbulence in collaboration

Few failures reported during our interviews relate to turbulence in the late stages of the collaboration, i.e. **significant changes in the initial conditions of the collaboration,** which can lead to a premature termination (Table 3.9). PPI involves well publicised decisions (Dalpé, 1994) and strong political leadership (Phillips et al., 2007).

A change in elected officials or in political priorities can affect collaboration for new solutions.

Table 3.9. Identified failures related to changes in collaboration

Collaboration failure	Selected verbatim
Significant change in initial conditions	"The risk for suppliers is that the Department Council revises its strategy or that elected representatives change." [PO2, Project Manager]

4.1.7. Transversal collaboration factors

Several failures occur at different stages in the PPI procedure and the collaboration and, are, therefore, considered transversal (Table 3.10). They consist of **poor capabilities** and the **risk aversion of the public sector** (Georghiou et al., 2014; Uyarra et al., 2014), and **low level of mutual trust** (Vanneste et al., 2014) between public procurers and suppliers.

Table 3.10. Identified transversal collaboration failures in public procurement

Collaboration failures	Selected verbatim
Public sector's capabilities	"To conduct a competitive dialogue, we need a legal expertise that we do not have in-house." [PO4, Procurement Manager]
Level of risk aversion of public organisations	"Mayors do not procure innovation, because innovation entails risks." [S1, Sales Director]
Mutual trust	"Contracts influence trust-building. We define selection criteria (level of performance, some specific criteria, and specifications). If suppliers do not respect them, they will be get penalties." [PO5, Procurement Manager]

4.2. Comparison of collaboration failures affecting the standard PPI procedure and competitive dialogue

Our analysis reveals that the most striking differences between the standard PPI procedure and competitive dialogue, in terms of collaboration failures, are observed during the phase of collaboration building.

4.2.1. Definition of demand

Competitive dialogue is a procedure introduced by the European Commission Directive 2004/18/EC with the objective of facilitating particularly complex contracts. Here, complexity refers to instances of public procurement, in which the technical, legal and/or financial aspects of the solutions to be procured cannot be defined by any other procedural means. By engaging in parallel discussions with pre-selected bidders (B5), public procurers can help to **identify the specifications** of the products or services to

be procured (Uyarra, 2016). During our interviews, both public procurers and suppliers involved in competitive dialogue insisted on the 'co-construction' of the solutions thereby enabled:

> *"The main benefit is that the candidates fine-tune the specifications in our call for tenders. We co-construct the solution via a multiple-round dialogue, which is more than a negotiation meeting." [PO1, Legal Counsellor]*

> *"We considered competitive dialogues as a means to fine tune calls for tenders." [S4, CEO]*

However, both the standard procedure and competitive dialogue require thorough **identification of the needs** (A1, B1) to be satisfied, e.g. via consultation with all end-users. For instance, one reported competitive dialogue initiative terminated prematurely because of incomplete definition of needs. A local authority (PO1), in collaboration with other local authorities, launched a competitive dialogue to procure a system for recycling incinerator bottom ashes to produce glass. The interactions were geared towards solving the technological barriers identified in a preliminary study. An appropriate technological solution was identified by means of competitive dialogue; however, this was discontinued prior to the selection of a supplier because it transpired that there was no buyer for the type of glass that would be produced. In other words, competitive dialogue failed because the public procurer had neglected to investigate the needs of one category of end-user.

> *"We had not explored enough the potential outlet for the product. […] Therefore, we decided to suspend the competitive dialogue in order to investigate further this aspect." [PO1, Head of the Waste Disposal Unit]*

4.2.2. Collaboration configuration

Competitive dialogue is more resource demanding (including time and skills) than the standard PPI procedure. It includes multi-stage and parallel interactions with a set of candidates (B5) that require careful prior selection (B4). This makes it very time-consuming and increases the transaction costs for both parties. Our interviews with public procurers and suppliers that had been involved in competitive dialogue reported more critical collaboration failures relative to the organisation of their future collaboration and, more specifically, to **project management**:

"Competitive dialogue is time-consuming and costly for all parties." [PO1, Legal Counsellor]

"The only problem is the time length." [S6, Project Manager]

4.2.3. Selection of suppliers

Public procurers reported that competitive dialogue helps to **justify the selection of a particular solution/supplier** (B6). They are required to demonstrate to public procurement, legal and/or financial services/departments that their choice is not 'pulled out of a hat' (as a Procurement Manager in a central ministry [PO4] put it). Competitive dialogue allows the public procurers to obtain knowledge and information relative to different solutions (B5) and to make subsequent well-justified decisions and achieve internal agreement more quickly. However, competitive dialogue does not help with the **comparison of different technologies**. In fact, opening the call for tenders to different technological proposals, makes comparison among solutions more challenging and requires more highly skilled public procurers, like other techniques such as allowing variant bids do. Representatives of public procurers pointed to such failures in supplier selection:

"Difficulties might emerge during the evaluation of tenders, as variant bids might differ from one another." [PO1, Legal Counsellor]

"It is difficult to evaluate the technical and economic performance of a solution to a need that had been expressed only in functional terms" [PO2, Project Manager]

4.2.4. Willingness to collaborate

Because competitive dialogue requires greater commitment from both parties, it reportedly is more subject to collaboration failures related to the willingness to collaborate. The candidates must attend several rounds of dialogue (B5) and may be expected also to develop new solutions or, at least, to improve and adapt existing ones to satisfy the targeted needs. Because of the high associated costs, many firms, especially SMEs, may be reluctant to engage in competitive dialogue, unless public procurers demonstrate their willingness to collaborate by providing financial support for their participation. However, this increases the costs incurred by the public organisations (project management failure) and, often, are perceived as insufficient to cover the

investment required for participation in competitive dialogue. This can lead to **collaborative alignment failure**.

> *"The financial compensation is a sensitive issue. To be honest, we are really upset! This is scandalous! During one year and a half, the four members of the consortium made long journeys to meet and discuss with the public procurer. Do you have any idea of the incurred costs? The contracting authority told us that there would be a financial compensation. However, it was ridiculously low for a four-member consortium and did not even cover our travel costs." [S6, Project Manager]*

Also, because there is no guarantee of purchase until the selection of a prospective solution (**late commitment failure**), firms delay their R&D efforts, which can be perceived by the public procurer as signalling low willingness to collaborate:

> *"I overestimated candidates' investments in R&D prior to the formal contractual agreement." [PO2, Project Manager]*

Thus, competitive dialogue can result in a situation where each party decides to reduce its collaboration because of the perceived low willingness of the other party to collaborate.

4.2.5. Daily collaboration

Public procurers and suppliers agree that a major fault in the standard procedure is the limited interaction between public procurer and supplier during the collaboration-building phase (A1-A4):

> *"The procedure with formalised Europe-wide call for tenders is the worst. There is no dialogue allowed. We cannot negotiate." [PO1, Head of the Waste Disposal Unit]*

> *"Public procurement procedures are heavily influenced by the legal framework. They are not flexible at all. They are not appropriate to the procurement of innovation." [S2, Sales Director]*

Unlike the standard PPI procedure, competitive dialogue organises interactions between public procurers and selected candidates (B5) and fosters **knowledge and**

information sharing between them, with the objective of fine tuning the specifications for the new product or service being procured.

> *"Public organisations and we interact through the competitive dialogue. We co-construct the solution at the same time." [S6, Project Manager]*

4.2.6. Synthesis of differences in terms of collaboration failures

In sum, the main perceived benefit of competitive dialogue (Table 3.11) is better information and knowledge sharing, which, in turn, helps in the definition of demand and, to a lesser extent, justification for the selection of a particular solution. However, organising and formalising dedicated interactions, makes public procurement procedures lengthy and complex and requires additional skills and resources from both of the parties involved. In addition, public procurers and suppliers reported that competitive dialogue is more sensitive to collaboration failures relative to their respective willingness to collaborate.

Table 3.11. Relative effects of competitive dialogue on public procurer-supplier collaboration (in comparison to standard PPI procedure)

Relative effect of competitive dialogue vs. standard PPI procedure	Collaboration failures
Collaboration failures solved/mitigated by competitive dialogue	• Definition of specifications • Choice of public procurement procedure • Agreement on solution/supplier selection • Knowledge and information sharing
Neutral effect	• Identification of needs • Comparison of tenders*
Collaboration failures worsened by competitive dialogue	• Project management • Comparison of tenders* • Collaborative alignment • Purchase commitment • Public sector's capabilities

Note: (*) The comparison of tenders may be a source of collaboration failures in competitive dialogue and standard PPI procedure that allow variant bids (and not the most common standard PPI procedure).

4.3. Diverging perceptions of collaboration failures between procurers and suppliers

The identification of collaboration failures in competitive dialogue highlights possible differences in the respective perceptions of public procurers and suppliers. They may

perceive the same failures, but their reasons for identifying them as failures may be different.[23] In the interviews, we observed two examples of such a situation. One was the way that public procurers and suppliers perceive the respective willingness of the other party to collaborate in competitive dialogue and, especially, failures related to **collaborative alignment** (see above, Section 4.2.4). Suppliers complain about the lack of or low financial support from public organisations during competitive dialogue. Indeed, dialogue competitive incurs costs deterring the firms (especially SMEs) that cannot bear them from participating. However, in the view of public organisations, candidates in competitive dialogue do not show strong commitment to collaboration for the development of new products and services prior their formal selection as suppliers. In such circumstances, both categories of actors identify collaboration failures due to collaborative misalignment, but they disagree on whom is responsible for it.

Another example of a different perception of a collaboration failure relates to the **evaluation and comparison of tenders** (A4, B6). Both public procurers and suppliers claim that public organisations need higher skills at this stage in the PPI procedure. In the opinion of public procurers, strong analytical skills are required to identify unrealistically low-priced tenders and overestimated technological solutions. Conversely, suppliers assume that, because of their inability to evaluate and compare different technological solutions public procurers will favour technological solutions and/or suppliers with whom they have worked in the past,. In sum, both categories of actors refer to a collaboration failure emerging during the phase of evaluation and comparison for tenders (for the selection of suppliers), but shift the fault in different directions.

> *"We made a critical analysis of tenders, because bidders are confident of their technology and their proposal. They make attractive tenders on purpose. Therefore, we need to check whether they have been under evaluated in terms of investments and operating cost or not." [PO2, Project Manager]*

> *"Public procurers take a risk when they procure a technology or an innovation. Are they also willing to take the risk associated with the selection of suppliers that they do not know? I think this is a relevant question. They do not admit it; but cannot avoid it." [S6, Project Manager]*

[23] The fact that a collaboration failure was reported by one category of actors and not by the other does not mean that this failure did not exist for the latter. It might be that it was perceived as less harmful so was not raised in the interview.

4.4. Additional procedures and strategies for the collaborative development of innovations via public procurement

Our interviews reveal that strategies and procedures other than the standard PPI and competitive dialogue procedures are implemented to ease collaboration between public procurers and (potential) suppliers for the development of innovative solutions. They consist of public procurement procedures legally exempt from competitive calls for tenders (Section 4.4.1), collaborative R&D projects conducted before the launch of PPI procedures (Section 4.4.2), and the outsourcing of PPI (Section 4.4.3).

4.4.1. Legal exemptions from competitive calls for tenders

During our interviews, public procurers and suppliers insisted on the positive role of legal exemptions from competitive calls for tenders for collaborative development of new solutions. In French public procurement law, these exemptions concern the public procurement of R&D services (if they do not aim to recover the associated expenditure) and the public procurement of products and/or services that can be supplied only by the firm owning the related exclusive IP rights. Public procurers willing to procure an innovation made by a particular firm may use these exemptions to avoid a competitive phase that would not favour their objective. These exemptions were praised by firms reluctant to compete and/or that claimed that a competitive tendering procedure does not have any sense as they are in a monopolistic situation due to their innovation. During the interviews, the Sales Director of a public sector's supplier (S1) claimed that the principle of open competition in public procurement prevents PPI. To justify his claim, he reported a rule enforcing open competition that bound PPI initiatives in which he was involved as a supplier. Interestingly, this rule was more stringent than the actual rules in this respect.

> *"In respect of the French legislation, a call for tenders is terminated if there is less than three tenders, as it means that there is not enough bidders." [S1, Sales Director]*

Even though the legal exemptions may help to avoid collaboration failures related to the **choice of public procurement procedure**, their rolling out implies other failures. One supplier interviewee said that public procurers are often reluctant to divert from the well-known standard PPI procedure, which is much easier to implement.

> *"The implementation of public procurement of experimentation activities is highly complex. Complexity does not relate to the*

> *contractual arrangement between public procurers and suppliers, but between public procurers, State administration and public procurement law." [S1, Sales Director]*

The use of the legal exemptions to competitive calls for tenders must be justified. For instance, public organisations must prove that the selected supplier is the only organisation owning the intellectual property rights on the solution they want to procure. This increases the transaction costs, which are incurred only by public organisations. Furthermore, the diversion from standard and well-known public procurement procedures may be incompatible with the **high-risk aversion of public organisations**.

> *"Based on the article 35 of the French Public Procurement Law,[24] mayors could purchase directly without a competitive call for tenders. However; if they do not have the support of the Ministry of Economics, they will not opt for this procedure, because they are afraid that their initiative will be invalidated." [S1, Sales Director]*

4.4.2. Prior collaborative R&D projects

In addition to the formal procurement of R&D services, several representatives of suppliers explained that they conduct R&D activities in collaboration with public organisations prior to the launch of a formal public procurement procedure. This strategy is aimed at collaboration between the public organisation and the firm without formal public procurement arrangements and boosts collaborative exploration of new solutions. Such collaborative R&D projects can have a technology-push effect and result in radical innovations that public organisations then may procure via standard PPI procedure.[25] The firms acquire competitive advantage over other potential bidders and can commercialise their innovations in other markets. This explains why they are often willing to bear the costs of these prior collaborative R&D projects.

Our interviews identified benefits and drawbacks associated with the conduct of (collaborative) R&D projects ahead of PPI. Suppliers insisted that these projects allow them to understand the **needs of public organisations** and that, based on this improved understanding, they are able to develop appropriate solutions.

[24] The interviewee referred to the former public procurement law revised in 2015.

[25] If we define innovation as novelty from the perspective also of the user (not just the market), such public procurement initiatives are considered instances of PPI.

> *"We collaborate with them to better understand their needs and to innovate with them accordingly." [S3, CEO]*

For public organisations, these informal collaborative projects allow them to consult experts on a specific problem and to **identify and specify the most appropriate solutions**. The specifications of the newly developed product or service can be included in the subsequent tender call for its procurement by the public organisation.

PPI strategies relying on prior collaborative R&D projects also can avoid failures related to the organisation of public procurer-supplier collaboration and to the **choice of public procurement procedure**. If the intellectual property rights associated with a newly developed solution belong exclusively to its producers, public organisations may not need to launch a competitive call for tenders to acquire it. As already mentioned, French public procurement law allows public organisations to procure products or services directly from the firm with exclusive rights to them since, in those circumstances, competition would make no sense. However, even when a competition phase is required or opted for, suppliers believe that demonstration of their innovative product or service via a prior R&D project, **helps to achieve public sector's internal agreement on the selection of innovative tenders**.

> *"We conduct demonstrations to convince management units of public organisations to invest in the development of complete solutions." [S5, CEO]*

The most frequent benefit reported by suppliers relates to willingness to collaborate and, more specifically, to **collaborative alignment**. Prior R&D projects enable the demonstration of innovative solutions (preferably to end-users) and reduce the resistance of public organisations to change.

> *"Prior to the demonstration stage, end-users distrusted us. Once it was completed, they said: 'you understood how we work'" [S4, CEO]*

Furthermore, prior collaborative R&D projects provide firms and public organisations with a first opportunity to collaborate and get to know each other and start **building mutual trust**. Firms' engagement in collaborative R&D and innovation projects with public organisations paves the way to future collaboration and public procurement.

> *"We engaged in a R&D project with the French public railway company SNCF, because, if it is interested in the outcomes, we will sell it our innovative products more easily." [S5, CEO]*

The single reported collaboration failure relates to the **implications of the choice of this strategy** on the organisation of public procurer-supplier collaboration. According to a supplier, a considerable amount of time is lost by public organisations on devising a legal framework around their collaborative R&D projects for subsequent articulation within a PPI procedure.

4.4.3. Outsourcing of public procurement

A common problem of the strategies for the collaborative development of innovations described above is that their success depends mostly on the **capabilities and the low risk aversion of public organisations**. These organisations must be willing to engage in lengthier than normal procedures and in which usually they have less experience. The outsourcing of public procurement to a more knowledgeable and capable organisation might be a solution to this problem.

Central public procurement organisations accredit a number of products or services, negotiate prices with suppliers, and add them to their catalogue. Public organisations that decide to procure these accredited products or services do not need to undertake public procurement procedures since the central public procurement organisations are considered legally as having already performed these procedures.

In 2014, the French Government charged the main Central Public Procurement Organisation (PO3) with the promotion of PPI. In response, an Innovation Department was established to identify innovative products or services that would deserve inclusion in the Central Public Procurement Organisation's catalogue.[26] These innovative solutions need first to be sponsored by a public organisation, such as a public authority, with a statement that it would satisfy one of its needs. The Innovation Department then evaluates the solution and, if the outcome of the evaluation is positive, adds them to its catalogue, so that public organisations could procure them more easily. However, this procedure is optional and public organisations can still engage in bilateral procedures with suppliers to procure products or services that have been accredited.

The outsourcing of public procurement is reported to help to define demand (A1). This allows public organisations to gain external expertise to improve their **knowledge and awareness of potential solutions** to their needs. The supplier we interviewed perceived that outsourcing to a central public procurement organisation has a positive effect on PPI,

[26] Similar catalogues have been implemented in China, but with a stronger focus on endogenous innovations. Their main rationale was to incentivise further the procurement of accredited innovative solutions through simplified public procurement procedure (Li et al., 2015; Li and Georghiou, 2016).

as it diminishes the **risk borne by public administrations** by ensuring respect of binding norms and rules.

> *"Mayors do not procure innovation, because innovation entails risks. However, the fact that public procurement is conducted by [PO3] reassures public organisations. If they decide to outsource their public procurement project to such an organisation, they are sure that public procurement rules and norms will be respected." [S1, Sales Director]*

The two categories of interviewed actors reported benefits associated with the outsourcing of public procurement in relation to the configuration of their mutual collaboration and **project management**. Central public procurement organisations offer better prices, legal protection to public authorities, and guarantee of faster payment to suppliers. As mentioned above, a major benefit of outsourcing is a **simplification of public procurement procedures** by relieving public organisations of the compulsory competition phase (A3).

> *"Our mission is to propose innovative solution, ease public procurement and lower prices." [PO3, Director]*

As reported by the public procurers interviewed, the outsourcing of public procurement contributes also to the selection of suppliers (A4). Accreditation by an organisation with recognised expertise in PPI can **legitimise selection** by public organisations of an innovative solution. Finally, because central public procurement organisations evaluate all suppliers prior to the inclusion of their products or services in their catalogues, they reassure public organisations about the **capabilities of these firms to supply** them with the solution selected.

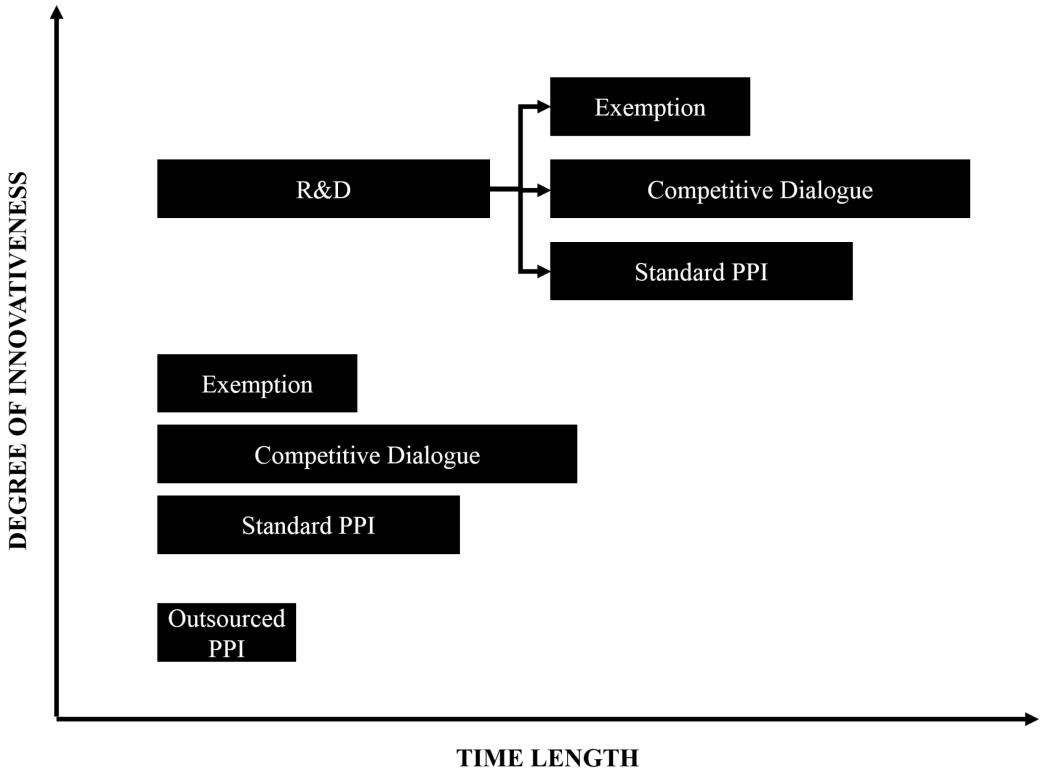
However, some interviewees were critical of the outsourcing of public procurement. For instance, suppliers highlighted that the public procurement of accredited products or services is inappropriate for other than mature innovations and solutions that do not need to be tailored to end-users' needs (failure associated with the **choice of public procurement procedure**).

4.4.4. Ranking procedures and strategies of PPI relative to their degree of innovativeness

Our interviews gave us the perspectives of suppliers on the standard PPI procedure, competitive dialogue and other PPI procedures and strategies, and the respective

suitability of these procedures and strategies to procure more or less innovative products and services. We used these empirical data to map these procedures along two variables (Figure 3.2). The horizontal axis represents time. The length of the boxes representing each procedure or strategy is proportional to their respective time-length as reported by the actors we interviewed.[27] The vertical axis represents the degree of innovativeness of the procured solution. The higher the position of the box on this axis, the more disruptive the innovation. Products and services considered as innovative only from the point of view of users are at the bottom of the vertical axis. Products and services adapted/tailored to end-users' needs are incremental innovation and are located in the middle of the axis. Finally, radical innovations are at the top of the axis.

Figure 3.2. Procedures of and suppliers' strategies for PPI according to degree of innovativeness



For mature innovations and innovations requiring low levels of adaption to end-users' needs, outsourcing of PPI seems to be the most appropriate solution. For radical innovations, suppliers prefer to engage in prior collaborative R&D projects followed by standard PPI, competitive dialogue, or exemption procedures. In this case, suppliers are not afraid of the competition process because the solution generated by the R&D project

[27] The measurement of time-length is subjective since it is based on suppliers' perceptions.

is appropriate to the end-users' needs and is difficult for other potential competitors to challenge it. Finally, for innovations with medium levels of adaption, public procurers might prefer competitive dialogue or standard PPI procedure, while suppliers seemingly advocate exemptions and competitive dialogue.

5. Discussion

Our empirical data reflect a wide variety of failures perceived likely to occur in public procurer-supplier collaboration. They allow discussion of the influence of the legal framework on the organisation and outcome of public procurer-supplier collaboration. Interviewees stressed the importance of the willingness to collaborate and mutual trust building throughout the collaboration. Although the management and industrial engineering literatures explore these factors hampering (private) procurers-supplier interactions, they are not addressed in work on PPI.

5.1. Interpretation of the PPI rules by public procurers and suppliers as a source of failures

Both public procurers and suppliers perceived the choice of public procurement procedures as having a strong impact on the conduct and the result of collaboration. In line with criticisms against the EU Directives on Public Procurement (Edquist and Hommen, 2000; Edquist and Zabala-Iturriagagoitia, 2012), the (standard) public procurement procedure is reported to restrict interactions between public procurers and firms. However, our empirical findings highlight the existence of legal procedures, such as competitive dialogue and exemptions from the mandatory competitive tendering phase, which facilitate collaboration between public procurers and suppliers. In line with Rolfstam (2011, 2013), we observe that public procurement rules include innovation-friendly procedures (Georghiou et al., 2014).

Norms and rules are one of two types of institutions identified by Coriat and Weinstein (2002). 'Type 1 institutions' consist of 'rules of the game', i.e. laws and similarly binding rules, imposed on all economic agents (within a defined system) and enforced via a dedicated sanction system. 'Type 2 institutions' complement and specify them. [28] They are 'the rules that individual agents decide to give themselves' (ibid. 2002, p. 282). They

[28] Type 1 and type 2 institutions are called respectively external and endogenous institutions by Rolfstam (2009, 2013)

adapt the behaviours and routines of organisations to Type 1 institutions. Some of the collaboration failures relative to the choice of public procurement procedures, reported during our interviews, refer to these Type 2 institutions. In other words, they result from the interpretation of public procurement rules.

This theoretical framework helps to explain suppliers' confusions with the French public procurement law noted during our interviews, e.g. regarding the rules enforcing open competition in public procurement. There are two assumptions that might explain these misunderstandings. Both relate to the complexity of the (French) public procurement rules and norms. Firstly, because suppliers may lack legal skills, they may misunderstand them and transfer this misinterpretation to their routines and behaviours (Type 2 institutions). Secondly, because public organisations do not have the legal skills and/or because they are risk-averse (which is in line with our findings), they impose requirements on themselves (and suppliers) (Type 2 institutions), which are unwarranted, but guarantee respect of the rules (Type 1 institutions). For instance, some public organisations may require three admissible tenders, as a sign of enforcement of the principles of open and fair competition (see Section 4.4.1). Both these assumed explanations refer to Type 2 institutions and not to actual procurement rules and norms (Type 1 institutions). In other words, the public procurement legal framework may be too complex, but the source of the failures may not be the rules, but rather their interpretation by public procurers and suppliers.

Our empirical findings are in line with Rolfstam (2012b, 2015), who claims that an endogenous approach examining the context of PPI initiatives provides a better explanation of their success or failure than the legal procedures involved. Innovation is a collaborative process involving organisations and actors with varying cognitive capabilities (Smith, 2000). Therefore, it is subject to a number of failures related to the learning capabilities and adaptation skills of the actors and organisations, their willingness and capabilities to interact and collaborate, and the existence of appropriate infrastructure and institutions (Klein Woolthuis et al., 2005). Institution is one category of possible failures.

5.2. Shedding light on the willingness to collaborate and varying forms of trust building in public procurement

The literature on PPI explores in depth the risk aversion and poor capabilities of the public sector and their (negative) impact on demand definition and selection of suppliers (Erridge and Greer, 2002; Uyarra et al., 2014). However, drawing upon the management

and industrial engineering literatures (Personnier et al., 2012, 2013), it seems that other kinds of failures can inhibit public procurer-supplier collaboration and PPI. Our methodology does not allow us to evaluate and compare the respective impact of these collaboration failures, but some were reported to be significant for the choice of PPI procedure. The most critical collaboration failures reported are those that occur during the collaboration building phase. The management and industrial engineering literatures shed light on failures not highlighted in work on PPI such as failures related to the willingness to collaborate and trust, which are key to collaboration success.

Willingness to collaborate refers to the alignment of the objectives pursued by collaborating parties, to their respective efforts to achieve a successful collaboration, and to the commitment of public organisation to procure the outcome of the collaboration. In the industrial management literature, numerous studies show that the more private procurers are willing to collaborate, the more suppliers contribute to the design and development of new products and services (Sako, 1992; Schiele, 2006; Walter et al., 2003). An important stream in the literature finds that the obstacles to PPI are rooted in public sector's deficiencies (Georghiou et al., 2014). However, our empirical findings suggest that suppliers also may be responsible for the failure of collaboration with public organisations, and that the success of collaborations between public procurers and suppliers is not dependent exclusively on the public procurer's willingness. For instance, public procurers can interpret firms' reluctance to invest in R&D activities in the context of their collaboration as a sign of their unwillingness to collaborate and may decide to reduce their own commitment to the collaboration. Willingness to collaborate encompasses the 'cooperative norms' defined by Wang and Bunn (2004), which include a shared belief that the cooperation of both parties is crucial for the success of their collaboration. Since our research characterises the willingness to collaborate from the perspective of public procurers and suppliers, it helps to characterise these cooperative norms and highlights that the public sector's risk aversion is only one among many other factors.

Our interviews with public procurers and suppliers sheds light also on the role of trust in the success (or failure) of their collaboration. Although trust is seen primarily as a transversal collaboration factor, we found that failures in other categories were caused by lack of trust (e.g. deficiencies in alignment of objectives) and that other collaboration failures have an impact on trust (e.g. political involvement in the definition of the objectives of PPI initiatives). Trust is defined as "a psychological state comprising the intention to accept vulnerability based upon positive expectations of the intentions or behaviour of another" (Rousseau et al., 1998, p. 395). It is based on the perceived

trustworthiness of the respective collaboration partner (Vanneste et al., 2014) and evolves via repeated interactions (Cantner, 2016) in a cyclical process of negotiation, commitment and execution (Ring and Ven, 1994). Trust is considered as comprising two components (Kale and Singh, 2009). It can refer to the expectation that other parties will not act opportunistically, but in accordance with the expectations underpinning their collaboration. This kind of trust relies on deterrence mechanisms, mostly achieved through contractual arrangements and other governance mechanisms, and refers to the contractual trust (delivering the promised good or service) and the competence trust (ability to fulfil the expectations) proposed in Sako (1992). Trust is also confidence in the other partner's good will, reliability and integrity, which induces in the partner commitment to do more than formally required (Sako, 1992). This component emerges gradually from the interactions between two partners and leads to "socio-psychology bonds of mutual norms, sentiments, and friendships" (Ring and Ven, 1994, p. 93). This component of trust is unlikely to develop in the standard PPI procedure which constrains the interactions between the public organisation and its suppliers. In the case of most of the public procurers interviewed, trust results not from interactions with suppliers, but from confidence in the public procurement procedures and contractual arrangements, i.e. the first trust category defined above. Public procurers trust suppliers because the legal framework reportedly prevents opportunistic behaviour. Conversely, suppliers insist on early interactions with public organisations, via either prior collaborative R&D projects or demonstrations to end-users, to gain the confidence of public organisations and, consequently, increase the likelihood of being the chosen supplier. Our empirical findings reveal certain problems related to trust building in public procurement, which have been overlooked in the literature on PPI. Trust is nevertheless a key component of inter-organisational collaboration. It facilitates their design and management by improving information sharing, lowering perceived risks and encouraging the partners to adapt their behaviours in the collaboration to contingencies (Kale and Singh, 2009). Since PPI is "a special case of user–producer interaction" (Rolfstam, 2009, p. 349), it relies on trust and other collaboration determinants, which, therefore, deserve further exploration.

6. Conclusion

In this chapter, we identified and defined the failures that can hinder collaboration between public procurers and suppliers for the development of new products and services. We conducted a series of exploratory qualitative interviews with both categories

of actors and drew upon the literature in management and industrial engineering. We compared different PPI procedures in terms of the collaboration failures that can occur and identified the and, sometimes, diverging perceptions of public procurers and suppliers in this respect. Based on these empirical findings, we made some assumptions regarding the appropriateness of PPI procedures (standard PPI, competitive dialogue, and alternative procedures and strategies reported by our interviewees) based on the degree of innovativeness of the product or service being procured.

Despite some limitations, our empirical findings corroborate previous research underlining the importance to both parties of the upstream phases in public procurer-supplier collaboration (Personnier et al., 2013). They reveal key differences in terms of collaboration failures between the two PPI procedures identified. The standard PPI procedure is highly criticised for its lack of flexibility and its compulsory competitive tendering stage. Competitive dialogue does not reduce the competition, but rather allows for interactions that benefit the collaborative development of innovation. However, it is resource consuming and adds complexity to the project management. We showed also that the public procurement norms and rules that have attracted the attention of several scholars, are only one contributor to collaboration failures. Public procurer-supplier collaboration appears to be inhibited more by the interpretation of the rules than by the rules themselves, and the current legal framework of public procurement allows for a number of innovation-friendly procedures and strategies. We contribute to scholarly debate on the impact of the legal framework on PPI and reinforce the findings in Rolfstam (2009, 2012b, 2013).

Drawing on the management and industrial engineering literatures, this chapter sheds light also on the failures that might impede collaboration between public procurers and suppliers since they affect other kinds of collaboration. These failures, e.g. related to the willingness to collaborate and to trust building, have been neglected by the literature on PPI, despite their perhaps explaining why implementation of PPI is lagging. The research in this chapter advocates further use of the different insights from studies of private procurement in the PPI literature. It suggests directions for future research. It would be interesting to interview representatives of state-owned enterprises to compare the collaboration failures they perceive with those reported by the types of public organisations explored here. More in-depth case studies and surveys could help the assessment of the relative significance of these failures, by evaluating their respective costs (Personnier, 2013) or by asking the collaborating parties to evaluate, e.g. on Likert scales, to what extent each failure impedes their collaboration. Finally, the particularities of trust building in public procurement, and other collaboration failures, such as those

related to the willingness to collaborate, deserve more detailed investigation. A better understanding of their underlying mechanisms would identify good practice and appropriate policy interventions that might stimulate the rolling out of PPI in larger numbers of public organisations.

General Conclusion

The overall ambition of our dissertation is to support the strategic use of public procurement to foster innovation and to reduce the discrepancy between policy discourse and practice in this respect (Rolfstam, 2015). We contend that appropriate policy design is needed to achieve this objective. It implies identifying the failures that impair innovation and that PPI can resolve, and investigating the appropriate modalities of its implementation (Edquist, 2011), i.e. the instruments and practices that will enable PPI to attain its aims. In this research, we consider three levels of failures that justify implementing innovation policy. At macro level, the development and diffusion of innovations underpin the transformation of systems for solving grand challenges (Weber and Rohracher, 2012). Policy interventions must resolve (market and/or evolutionary-systemic) failures hampering innovation at meso level. Finally, innovation relies on appropriate user-supplier interactions. Policy interventions, at micro level, should aim to ensure their effectiveness.

Chapter 1 reviews the innovation policy and PPI literatures. We identify the (meso-level) failures that hamper innovation and that PPI can resolve, and group them in three categories depending on their locus. They relate to procurers and end-users (i.e. demand-side actors), to suppliers, bidders and other innovation producers (i.e. supply-side actors), or to their mutual interactions. Demand-side failures are malfunctions either preventing demand for novelties exclusively geared towards improvement of public services, or inhibiting the uptake and diffusion of innovations. In some circumstances, PPI additionally aims to support the development of innovative solutions, by encouraging firms' R&D investments and improving their learning capabilities. Finally, PPI must address factors hampering user-producer interactions and consequently impairing innovation.

We choose these three categories of meso-level failures as variables to build our typology of PPI. Eight PPI ideal-types emerge from this typological theorising exercise. We confront them with the macro-level failures that challenge-oriented policies must address, and thus determine their possible contribution to mitigating grand challenges. We demonstrate that the PPI category aimed at encouraging development of innovations and accelerating their diffusion, while promoting interactive learning between users and suppliers, is the most likely to stimulate system-wide transformations and therefore the most appropriate to achieve grand challenges. Conversely, PPI categories involving

minor adaptations of existing products or services with the sole objective to improve public services, and low user-supplier interactions geared towards reduction of information asymmetry are likely to have low impact on grand challenges.

While the literature states that catalytic PPI could be a suitable instrument to contribute to challenge-oriented policies (Edquist and Zabala-Iturriagagoitia, 2012), the contribution of Chapter 1 is in determining under what conditions PPI may have such potential. We contend that some PPI categories are more likely to help solve macro-level failures and address grand challenges, because they target relevant innovation failures at meso level. Furthermore, our approach focusing on the theoretical foundations of PPI links typologies elaborated in the literature, encompasses their features, and associates them with our PPI ideal-types. In sum, through combined literature reviews, we identify categories of PPI, their rationales and the instruments and practice necessary for the attainment of their objectives (defined in terms of innovation-related failures). Therefore, we can ascertain which policy instruments should be implemented and which practices should be ensured to increase the contribution of some of our PPI categories to challenge-oriented policies. For this reason, our failure-based typology of PPI can contribute to the policy-making process, from the identification of innovation failures that PPI can be reasonably expected to overcome, to the selection of appropriate instruments.

Some PPI categories are assumed to solve failures, which we identified in the first chapter, by stimulating the formation of markets (Box, 2009; Edquist, 2011; Rothwell, 1984). For instance, the literature highlights that PPI can support Lead Markets initiatives (Edler and Georghiou, 2007). Little is nevertheless said about its possible influence on the dynamics for market formation. In consequence, we decided to investigate, in Chapter 2, the role of PPI in the creation and development of markets for innovations. In an evolutionary perspective, markets are complex systems for knowledge creation and coordination, and market formation is conceived as a dynamic process by which a small population of agents, being the holders of new knowledge, grows and eventually stabilises as other agents (users) demand, adopt and apply this new knowledge over time (Dopfer and Potts, 2008). PPI can influence this process by encouraging knowledge coordination at three stages, namely innovation origination, adoption and retention (Bleda and del Río, 2013).

We define the role of PPI in respect to these phases of knowledge coordination over the market formation process via a series of existing case studies (Yin, 2009). We choose case studies of PPI initiatives that had an effective influence on market formation, and that deliberately aimed to have such impact. We identify the coordination failures that

they needed to solve, and the instruments they used to that end. We code the collected information relative to the roles of PPI in market formation and the timing of these roles within the public procurement procedure.

The first stage in market formation is the origination of a novel idea that is functional and ready for adoption by a first population of users. It entails deep coordination of knowledge, that is, the coordination of different knowledge components to form a knowledge complex, i.e. an innovation. This coordination occurs in the mind of innovation producers. Public procurers cannot intervene in the mind of their suppliers, through PPI, to encourage the origination of innovative solutions. However, they can underpin deep coordination at intermediate stages of the public procurement procedure (the definition of specifications stage) by facilitating the expression of demand, and by reducing uncertainties in relation to this demand. Demand is indeed conceived as a social component of knowledge that innovation producers must coordinate with other technical, behavioural and cognitive knowledge components to form a new knowledge complex.

The second stage in market formation is adoption. It involves surface coordination of knowledge, that is, the coordination between the knowledge, routines and organisation of adopters with the knowledge complex embodied in innovation. Adoption will be effective if economic agents (adopters and innovation producers) manage to coordinate their respective sets of knowledge. Indeed, a first population of users cannot adopt innovations that do not fit their organisation, routines and set of knowledge. In such circumstances, innovations would remain a good idea, and no market would emerge. Our case studies demonstrate that PPI can stimulate surface coordination in two ways. At an early stage of the public procurement procedure, public procurers must coordinate the various needs of targeted end-users and make a consistent demand arise. If such a demand does not exist, so that various demands need to be met by the products or services to be procured, PPI may proceed to the next stages, but adoption is likely to fail. Later in the PPI procedure, once the innovation is produced and about to be delivered, public procurers must ensure that end-users have the right set of knowledge to adopt it, by providing them the knowledge they possibly lack e.g. through training programmes.

Retention of innovation is the third and last stage in market formation. It entails the effective use of innovation in daily economic operations of agents. Operational coordination understood as the alignment of information (including incentives and price messages) between economic actors underpins the retention stage. In some analysed case studies, public procurers implemented information-sharing schemes. Their objective was not to improve knowledge of potential adopters so that adoption can

happen (surface coordination), but to diffuse information to economic agents who already have the necessary knowledge, routines and organisations in order to encourage their effective use of innovation.

These findings contribute to achieving the broad objective of our dissertation in two ways. First, they characterise meso-level failures that may impair market formation and that PPI can overcome. Furthermore, we highlight that public procurers play distinct roles at different stages of the public procurement procedure to make a market emerge. More interestingly, our empirical findings show a nonlinear interrelation between the implementation of measures along the procurement procedure and the different stages of market formation. For instance, adoption, that is, the second phase of market formation, must be prepared at the earliest stage of the public procurement procedure.

Even though deep coordination is defined as a process occurring in the mind of inventors, our research show how public procurers can influence externally this process. They provide firms with knowledge components to form new knowledge sets, that is, innovations. Interactions between public procurers and users, on the one hand, and suppliers, on the other hand, are similarly key to the effective coordination of knowledge and information in subsequent stages of market formation and development. Knowledge coordination for market formation implies, in PPI, early supplier involvement (ESI). This concept was phrased in management and industrial engineering literatures (Bidault et al., 1998), which have also demonstrated that ESI is subject to a variety of failures (McIvor et al., 2006). The PPI literature focuses on the presumed detrimental influence of the legal framework and on the negative impact of public sector's risk aversion and low (innovation-related) capabilities on public procurer-supplier collaboration for the development of new products and services. We propose to improve our understanding of factors impairing public procurer-supplier collaboration and PPI by drawing on the literature on private procurement (Personnier et al., 2013). Chapter 3 investigates collaboration failures, at micro level, along different public procurement procedures (standard PPI procedure and competitive dialogue) from the perspective of public procurers and suppliers. To that end, we conduct interviews with representatives of public organisations and suppliers all with experience in PPI. We find collaboration failures and compare them to the failures already identified in the literature on private procurement. We then group identified failures in categories and code them in respect to the type of organisation that reported them, and to the type of procedure in which they occurred. Finally, these data undergo thematic analysis.

Our exploratory research reveals a set of collaboration failures that should draw the attention of policy-makers for ensuring the success of PPI initiatives. Like collaboration in private procurement, public procurer-supplier collaboration is particularly sensitive to micro-level failures in phases of collaboration building. These failures justify implementing appropriate instruments and/or undertaking relevant actions to avoid stillborn collaboration. Furthermore, our empirical findings contribute to the broad objective of our dissertation by unveiling how the perceptions of public procurers and suppliers differ in relation to the obstacles to their collaboration in PPI, and how these perceptions shape their practices. For instance, we observe that both actors may report the same failures, but when they were asked about the roots of these failures they shifted the fault in different directions. Our empirical findings contribute to the literature on PPI by discussing the influence of the legal framework on PPI. We contend in this respect that the interpretation of rules influences more public procurer-supplier collaboration than the rules themselves do (Coriat and Weinstein, 2002). Furthermore, other collaborations failures may lead to the termination of public procurer-supplier collaboration if they are not addressed properly. They include low willingness to collaborate and deficient mutual trust building. These factors underlying any collaboration should draw the attention of policy-makers and public procurers and encourage them to adapt their practices accordingly.

Our dissertation identifies justifications for the strategic use of public procurement to foster innovation at the three levels described in introduction. PPI can primarily overcome meso-level failures, that is, market and evolutionary-systemic failures. The latter include coordination malfunctions affecting market formation and development. PPI can additionally contribute to addressing failures at macro level, depending on the nature of the meso-level goals they target and attain. Finally, the ability of PPI initiatives to overcome these macro and meso level failures depends on practices of public procurers and suppliers on the ground. Practices hampering innovation are micro-level failures that PPI must remedy.

In sum, the contribution of our dissertation is threefold. Throughout our three chapters, we first explore and flesh out user-producer interactions (including public procurer-supplier interactions) from different perspectives. Chapter 1 thus conceives user-producer interactions as a source of meso-level failures justifying PPI. In our failure-based typology, any PPI category must ensure some degrees of user-producer interactions. For some categories, overcoming one-sided information asymmetries is

enough to foster innovation, while, at the other end of the spectrum, other PPI categories must establish mutual learning spaces to achieve the same objective. Challenge-oriented policies must ensure the involvement of a wide range of stakeholders and their interactions to find out and develop appropriate innovations, and accelerate their uptake. In other words, macro-level failures may result from inappropriate user-producer interactions, which PPI may help resolve. Chapter 2 explores further user-producer interactions and show how they can actually have an impact on innovation by influencing and underpinning market formation. We demonstrate that public procurers, users and (potential) suppliers must interact all along the public procurement procedure to share and coordinate knowledge and information. Market formation entails several stages of knowledge and information coordination (Bleda and del Río, 2013). They are subject to distinct failures that PPI initiatives can overcome with the means of different instruments. In short, chapters 1 and 2 similarly consider that malfunctions in user-producer interactions cause meso-level innovation failures that justify PPI. Chapter 3 has a different approach. It identifies practices that generate micro-level failures in collaboration between public procurers and suppliers, while shedding light on how these actors react to PPI instruments and change their practices or not. Variations in the nature of these micro-level failures all along the public procurement procedure and collaboration process call for distinct policy interventions. Throughout our dissertation, we demonstrate that interactions between users and producers or, more specifically, between public procurers and suppliers cut across our three core concepts namely, failures, design and practices, and the three levels of failures that we consider. These interactions result from practices and can lead to failures calling for instruments. These failures may prevent achievement of societal challenges, inhibit innovation, and/or hamper early supplier involvement for the development of innovative solutions. Our approach focusing on innovation failures stemming from user-producer or public procurer-supplier interactions complements the work of Edler and Yeow (2016), which focuses on the intermediation functions of public procurement between demand and supply to alleviate obstacles to innovation in public procurement procedures. In future research, we should elaborate on our exploration of micro-level collaboration failures by means of quantitative analyses of their impact on public procurer-supplier collaboration e.g. through Likert scales in surveys. A better understanding of actors' practices may explain how same policy instruments could be implemented in different endogenous public procurement contexts and consequently have various results (Flanagan and Uyarra, 2016).

The second contribution of our research is to help overcome the danger of an 'atemporal' approach to policymaking (Flanagan and Uyarra, 2016), by taking into

account the various complex dynamics that PPI must underpin to foster innovation. In Chapters 2 and 3, we demonstrate how public procurement procedure may intertwine with the processes of market formation and public procurer-supplier interactions, and that policy and practice development should be based consequently on dynamic conceptual framework. The stages of public procurement procedure, which are connected with stages of market formation and public procurer-supplier collaboration processes, are subject to different types of failures that call for distinct policy interventions. Furthermore, our failure-based typology of PPI, in Chapter 1, should not be interpreted in a static way. What we conceive as rationales for PPI initiatives may evolve, and a same initiative may target varying types of failures in the course of its execution. For instance, a PPI initiative primarily aimed at improving exclusively the quality of a public service, may decide later to help accelerate the uptake of the innovation procured. The policy implication of our typology is that the set of instruments underpinning such evolving PPI initiatives must change and adapt accordingly. Therefore, the contribution of our research relative to policy-making is not only in identifying the instruments to be implemented and the practices to be promoted in order to solve identified failures impairing innovation. We also show that the design of PPI initiatives must be based on a dynamic approach of the role of PPI and of the failures that it must overcome to achieve its ultimate objectives.

Finally, as a third contribution, our research satisfies our primary ambition to assist in the design of PPI initiatives by identifying the innovation failures that PPI must overcome and the instruments to be implemented and the practices to be ensured for achieving this objective and spurring innovation.

Our research may additionally contribute to policy evaluation. Indeed, following a diagnostic analysis approach, we can identify the most appropriate policy instruments in regard to policy instruments. In other words, economic theories may help assess the appropriateness of policy interventions, that is, the consistency between the failures targeted by policy interventions and the instruments implemented to achieve this objective (Edler et al., 2012; Guellec, 2001). Even though policy makers do not draw their interventions directly from scholar theories and may cherry pick justifications in theories hardly compatible, we claim that these theories have some influences on policy-making. Policy-makers do not usually decide in isolation, and they may get the support of advisors knowledgeable about economic theories. Finally, policy analysts use these theories to analyse policy interventions and their effectiveness *vis-à-vis* their objectives.

However, our findings need to be further elaborated to underpin more effectively evaluation exercises of PPI initiatives, which are still scarce despite the recent momentum of policy measures for stimulating the strategic use of public procurement to foster innovation (Uyarra, 2016). Further research should derive indicators from our conceptual framework and exploratory research in order to assess the appropriateness of PPI instruments. The objective will not to measure the impact of PPI in general on innovation, but to determine whether the appropriate sets of instruments underpin PPI initiatives or not. Our research already helps identify what an appropriate set of instruments is. Furthermore, it advocates a dynamic approach considering how failures and therefore policy interventions must vary along the public procurement procedure, the market formation dynamic, and the public procurer-supplier collaboration process. Further investigations on PPI instruments, and on the effectiveness of their implementation and impact on innovation, should additionally consider the potential influence of framework conditions and other policy measures already in force, as PPI initiatives do not act in isolation (Flanagan and Uyarra, 2016).

We demonstrate that the appropriateness of policy instruments for PPI depends on the nature of the failures to overcome. In the definition of policy rationales, our research followed an economic perspective. Economists consider that the justification of any policy intervention is a problem hampering the achievement of targeted objectives. Regarding innovation policy, problems are failures impairing innovation in a system. Although this view is widespread in economic literature, it might be considered too simplistic relative to the policy-making models that the policy studies literature has elaborated. In a sociological perspective, problems are essentially social construct. They involve a number of actors, the ‘policy entrepreneurs’ (Kingdon, 1984), and cognitive processes. Once identified and considered as such, problems are translated into political and administrative terms on policy agenda (Sheppard, 2006). Therefore, Laranja et al. (2008, p. 825) state that policy-making is shaped by “multiple factors and contingencies”. Rationales derived from economic theories, that is, the failures aforementioned, are one factor among many, distinct from but interacting with specific policy rationales. Our research should not consequently lead to ‘idealising’ policy-makers as being actors able to infer from scholar theories policy interventions (Flanagan and Uyarra, 2016). Its main purpose is to focus on the justification of the strategic use of public procurement to foster innovation from an economic perspective. We identify the failures that justify PPI in this view. Therefore, in future research, we may analyse how these rationales derived from economic literature interact with policy rationales for PPI. A better definition of failures of any kind that are expected to be overcome by PPI initiatives will help assess the

appropriateness of policy instruments underpinning them. This would support a better use of public procurement, which accounted for around 12% of GDP in OECD (weighted average) in 2013 (OECD, 2015b). It would permit to extend our understanding of the justifications of the strategic use of public procurement to foster innovation, and of the appropriate means for its effective rolling out.

References

Abernathy, W.J., Clark, K.B., 1985. Innovation: Mapping the winds of creative destruction. Research Policy 14, 3–22. doi:10.1016/0048-7333(85)90021-6

Aho, E., Cornu, J., Georghiou, L., Subirà, A., 2006. Creating an Innovative Europe (Report of the Independent Expert Group on R&D and Innovation appointed following the Hampton Court Summit and chaired by Mr. Esko Aho No. EUR 22005). European Commission, Luxembourg.

Albano, G.L., Sparro, M., 2010. Flexible Strategies for Centralized Public Procurement. Review of Economics and Institutions 1. doi:10.5020/rei.v1i2.4

Amanatidou, E., Cunningham, P., Gök, A., Garefi, I., 2014. Using Evaluation Research as a Means for Policy Analysis in a "New" Mission-Oriented Policy Context. Minerva 52, 419–438. doi:10.1007/s11024-014-9258-x

Appelt, S., Gualindo-Rueda, F., 2016. Measuring the link between Public Procurement and Innovation. OECD Science, Technology and Industry Working Papers 2016/03.

Arrow, K., 1962. Economic Welfare and the Allocation of Resources for Invention, in: The Rate and Direction of Inventive Activity: Economic and Social Factors. Princeton University Press, Princeton, pp. 609–626.

Arrowsmith, S., 2005. The Law of Public and Utilities Procurement. Sweet & Maxwell, London.

Aschhoff, B., Sofka, W., 2009. Innovation on demand—Can public procurement drive market success of innovations? Research Policy 38, 1235–1247. doi:10.1016/j.respol.2009.06.011

Bach, L., Matt, M., 2005. From Economic Foundations to S&T Policy Tools: a Comparative Analysis of the Dominant Paradigms, in: Llerena, P., Matt, M. (Eds.), Innovation Policy in a Knowledge-Based Economy: Theory and Practice. Springer, Berlin.

Bach, L., Matt, M., Wolff, S., 2014. How do firms perceive policy rationales behind the variety of instruments supporting collaborative R&D? Lessons from the European Framework Programs. Technovation 34, 327–337. doi:10.1016/j.technovation.2014.02.008

Beise, M., Cleff, T., 2004. Assessing the lead market potential of countries for innovation projects. Journal of International Management 10, 453–477. doi:10.1016/j.intman.2004.08.003

Bergek, A., Jacobsson, S., Carlsson, B., Lindmark, S., Rickne, A., 2008. Analyzing the functional dynamics of technological innovation systems: A scheme of analysis. Research Policy 37, 407–429. doi:10.1016/j.respol.2007.12.003

Bidault, F., Despres, C., Butler, C., 1998. The drivers of cooperation between buyers and suppliers for product innovation. Research Policy 26, 719–732. doi:10.1016/S0048-7333(97)00034-6

Bleda, M., del Río, P., 2013. The market failure and the systemic failure rationales in technological innovation systems. Research Policy 42, 1039–1052. doi:10.1016/j.respol.2013.02.008

Boden, M., Johnston, R., Scapolo, F., 2012. The role of FTA in responding to grand challenges: A new approach for STI policy? Science and Public Policy 39, 135–139. doi:10.1093/scipol/scs026

Boon, W., Edler, J., 2017. Demand, challenges and innovation policy. Making sense of new trends in innovation policy. Science and Public Policy forthcoming.

Borrás, S., Edquist, C., 2013. The choice of innovation policy instruments. Technological Forecasting and Social Change 80, 1513–1522. doi:10.1016/j.techfore.2013.03.002

Box, S., 2009. OECD Work on Innovation – A Stocktaking of Existing Work. Science, Technology and Industry Working Papers 2009/02.

Brenner, M.E., 2006. Interviewing in Educational Research, in: Green, J.L., Camilli, G., Elmore, P.B. (Eds.), Handbook of Complementary Methods in Education Research. American Educational Research Association, Washington, D.C.

Cabral, L., Cozzi, G., Denicolò, V., Spagnolo, G., Zanza, M., 2006. Procuring innovations, in: Handboof of Procurement. Cambridge University Press, Cambridge.

Cagnin, C., Amanatidou, E., Keenan, M., 2012. Orienting European innovation systems towards grand challenges and the roles that FTA can play. Science and Public Policy 39, 140–152. doi:10.1093/scipol/scs014

Caldwell, N., Walker, H., Harland, C., Knight, L., Zheng, J., Wakeley, T., 2005. Promoting competitive markets: The role of public procurement. Journal of Purchasing and Supply Management 11, 242–251. doi:10.1016/j.pursup.2005.12.002

Cantner, U., 2016. Foundations of economic change—an extended Schumpeterian approach. Journal of Evolutionary Economics 26, 701–736. doi:10.1007/s00191-016-0479-z

Cantner, U., Dopfer, K., 2015. Schumpeter and his contemporaries—précis and road marks. Journal of Evolutionary Economics 25, 1–19. doi:10.1007/s00191-015-0404-x

Cave, J., Frinking, E., 2003. Public Procurement for R&D: Short Analysis of the Potential and Practices, in: Public Procurement and R&D: A JRC/IPTS-ESTO Fast Track Working Paper. European Commission Joint Research Centre-Institute for Prospective Technological Studies, European Science and Technology Observatory, Brussels, pp. 11–44.

Clement, S., Evans, N., Chandler, C., Wiesinger, P., Robb, A., Hosking, E., Koch, H., Sunnerstedt, E., Anastase, D., Kury, C., Gilbert, M., Helsloot, L., Uhan, M., Babb, W., 2015. Clean fleets case studies. Clean Fleets.

Cohendet, P., Meyer-Krahmer, F., 2001. The theoretical and policy implications of knowledge codification. Research Policy 30, 1563–1591. doi:10.1016/S0048-7333(01)00168-8

Commission of Experts for Research and Innovation, 2013. Research, innovation and technological performance in Germany. Report 2013. Commission of Experts for Research and Innovation (EFI), Berlin.

Coriat, B., Weinstein, O., 2002. Organizations, firms and institutions in the generation of innovation. Research Policy 31, 273–290. doi:10.1016/S0048-7333(01)00141-X

Crespi, F., Quatraro, F., 2013. Systemic technology policies: Issues and instruments. Technological Forecasting and Social Change 80, 1447–1449. doi:10.1016/j.techfore.2013.07.007

Dale-Clough, L., 2015. Public procurement of innovation and local authority procurement: procurement modes and framework conditions in three European cities. Innovation: The European Journal of Social Science Research 28, 220–242. doi:10.1080/13511610.2015.1012709

Dalpé, R., 1994. Effects of Government Procurement on Industrial Innovation. Technology in society 16, 65–83.

Dalpé, R., DeBresson, C., Xiaoping, H., 1992. The public sector as first user of innovations. Research Policy 21, 251–263. doi:10.1016/0048-7333(92)90019-Z

Dimitri, N., Dini, F., Piga, G., 2006. When should procurement be centralized?, in: Dimitri, N., Piga, G., Spagnolo, G. (Eds.), Handbook of Procurement. Cambridge University Press, Cambridge.

Dopfer, K., Potts, J., 2008. The general theory of economic evolution. Routledge, London.

Dubois, A., Gadde, L.-E., 2002. Systematic combining: an abductive approach to case research. Journal of Business Research 55, 553–560.

Easton, G., 2010. Critical realism in case study research. Industrial Marketing Management 39, 118–128. doi:10.1016/j.indmarman.2008.06.004

Eastwood, J.G., Jalaludin, B.B., Kemp, L.A., 2014. Realist explanatory theory building method for social epidemiology: a protocol for a mixed method multilevel study of neighbourhood context and postnatal depression. SpringerPlus 3, 12. doi:10.1186/2193-1801-3-12

Edler, J., 2009. Demand policies for innovation in EU CEE countries. Manchester Business School working paper No. 579.

Edler, J., Edquist, C., Vonortas, N.S., Zabala-Iturriagagoitia, J.M., 2015a. Conclusions: lessons, limitations and way forward, in: Edquist, C., Vonortas, N.S., Zabala-Iturriagagoitia, J.M., Edler, J. (Eds.), Public Procurement for Innovation. Edward Elgar, Cheltenham.

Edler, J., Georghiou, L., 2007. Public Procurement and Innovation--Resurrecting the Demand Side. Research Policy 36, 949–963. doi:10.1016/j.respol.2007.03.003

Edler, J., Georghiou, L., Blind, K., Uyarra, E., 2012. Evaluating the demand side: New challenges for evaluation. Research Evaluation 21, 33–47. doi:10.1093/reseval/rvr002

Edler, J., Georghiou, L., Uyarra, E., Yeow, J., 2015b. The meaning and limitations of public procurement for innovation: a supplier's perspective, in: Edquist, C., Vonortas, N.S.,

Zabala-Iturriagagoitia, J.M., Edler, J. (Eds.), Public Procurement for Innovation. Edward Elgar, Cheltenham.

Edler, J., Ruhland, S., Hafner, S., Rigby, J., Georghiou, L., Hommen, L., Rolfstam, M., Edquist, C., Tsipouri, L., Papadakou, M., 2005. Innovation and Public Procurement. Review of Issues at Stake, Study for the European Commission. Fraunhofer Institute Systems and Innovation Research, Karlsruhe.

Edler, J., Uyarra, E., 2013. Public Procurement of Innovation, in: Osborne, S.P., Brown, L. (Eds.), Handbook of Innovation in Public Services. Edward Elgar, Cheltenham.

Edler, J., Yeow, J., 2016. Connecting demand and supply: The role of intermediation in public procurement of innovation. Research Policy 45, 414–426. doi:10.1016/j.respol.2015.10.010

Edquist, C., 2011. Design of innovation policy through diagnostic analysis: identification of systemic problems (or failures). Industrial & Corporate Change 20, 1725–1753.

Edquist, C., Hommen, L., 2000. Public Technology Procurement and Innovation Theory, in: Edquist, C., Hommen, L., Tsipouri, L. (Eds.), Public Technology Procurement and Innovation. Kluwer Academics, Boston, pp. 5–70.

Edquist, C., Hommen, L., Tsipouri, L.J., 2000. Public Technology Procurement and Innovation. Kluwer Academics, Boston.

Edquist, C., Vonortas, N.S., Zabala-Iturriagagoitia, J.M., Edler, J. (Eds.), 2015. Public Procurement for Innovation. Edward Elgar, Cheltenham.

Edquist, C., Zabala-Iturriagagoitia, J.M., 2015. Pre-commercial procurement: a demand or supply policy instrument in relation to innovation? R&D Management 45, 147–160. doi:10.1111/radm.12057

Edquist, C., Zabala-Iturriagagoitia, J.M., 2012. Public Procurement for Innovation as mission-oriented innovation policy. Research Policy 41, 1757–1769. doi:10.1016/j.respol.2012.04.022

Eisenhardt, K.M., Graebner, M.E., 2007. Theory building from cases: opportunities and challenges. Academy of Management Journal 50, 25–32. doi:10.5465/AMJ.2007.24160888

ERAC, 2015. ERAC Opinion on Innovation Procurement (No. ERAC 1209/15). European Union, Brussels.

Erridge, A., Greer, J., 2002. Partnerships and public procurement: building social capital through supply relations. Public Administration 80, 503–522. doi:10.1111/1467-9299.00315

European Commission, 2011. Proposal for a Directive of the European Parliament and of the Council on Public Procurement (No. COM(2001) 896).

European Commission, 2010a. Risk management in the procurement of innovation - Concepts and empirical evidence in the European Union (Expert Group Report). European Commission, Luxembourg.

European Commission, 2010b. Green Public Procurement: A collection of good practices.

European Commission, 2009. Exploring public procurement as a strategic innovation policy instrument (EU Project OMC-PTP). European Commission, Berlin.

European Commission, 2005. Public Procurement for Research and Innovation: Developing Procurement Practices Favourable to R&D and Innovation (Expert Group Report). Office for Official Publications of the European Communities, Luxembourg.

European Commission, 2003. Investing in research: an action plan for Europe. Office for Official Publications of the European Communities, Luxembourg.

Flanagan, K., Uyarra, E., 2016. Four dangers in innovation policy studies – and how to avoid them. Industry and Innovation 23, 177–188. doi:10.1080/13662716.2016.1146126

Flanagan, K., Uyarra, E., Laranja, M., 2011. Reconceptualising the "policy mix" for innovation. Research Policy 40, 702–713. doi:10.1016/j.respol.2011.02.005

Fließ, S., Kleinaltenkamp, M., 2004. Blueprinting the service company: Managing service processes efficiently. Journal of Business Research 57, 392–404. doi:10.1016/S0148-2963(02)00273-4

Foray, D., Llerena, P., 1996. Information structure and coordination in technology policy. Journal of Evolutionary Economics 6, 157–173. doi:10.1007/BF01202592

Foray, D., Mowery, D.C., Nelson, R.R., 2012. Public R&D and social challenges: What lessons from mission R&D programs? Research Policy 41, 1697–1702. doi:10.1016/j.respol.2012.07.011

Galbraith, J.R., 1982. Designing the innovating organization. Organizational Dynamics 10, 5–25. doi:10.1016/0090-2616(82)90033-X

Gee, S., Uyarra, E., 2013. A role for public procurement in system innovation: the transformation of the Greater Manchester (UK) waste system. Technology Analysis & Strategic Management 25, 1175–1188. doi:10.1080/09537325.2013.843660

Geels, F.W., Schot, J., 2007. Typology of sociotechnical transition pathways. Research Policy 36, 399–417. doi:10.1016/j.respol.2007.01.003

George, A.L., Bennett, A., 2005. Case Studies and Theory Development in the Social Sciences. MIT Press, Cambridge.

Georghiou, L., Edler, J., Uyarra, E., Yeow, J., 2014. Policy instruments for public procurement of innovation: Choice, design and assessment. Technological Forecasting and Social Change 86, 1–12. doi:10.1016/j.techfore.2013.09.018

Geroski, P.A., 2000. Models of technology diffusion. Research policy 29, 603–625. doi:10.1016/S0048-7333(99)00092-X

Geroski, P.A., 1990. Procurement policy as a tool of industrial policy. International Review of Applied Economics 4, 182–198. doi:10.1080/758523673

Griffin, A., Hauser, J.R., 1993. The Voice of the Customer. Marketing Science 12, 1–27. doi:10.1287/mksc.12.1.1

Guellec, D., 2001. Les politiques de soutien à l'innovation technologique à l'aune de la théorie économique. économie & prévision 150, 95–105.

Guerzoni, M., Raiteri, E., 2015. Demand-side vs. supply-side technology policies: Hidden treatment and new empirical evidence on the policy mix. Research Policy 44, 726–747. doi:10.1016/j.respol.2014.10.009

HM Treasury, 2010. HM Treasury Review of Competitive Dialogue. HM Treasury, London.

Hommen, L., Rolfstam, M., 2009. Public Procurement and Innovation: Towards a Taxonomy. Journal of Public Procurement 9, 17–56.

Hoopes, D.G., Postrel, S., 1999. Shared knowledge, "glitches," and product development performance. Strategic Management Journal 20, 837–865.

Howlett, M., 2011. Designing public policies: principles and instruments. Routledge, Abingdon.

Howlett, M., 1991. Policy instruments, policy styles, and policy implementation. Policy Studies Journal 19, 1–21. doi:10.1111/j.1541-0072.1991.tb01878.x

Hviid, M., Price, C.W., 2014. Well-Functioning Markets in Retail Energy. European Competition Journal 10, 167–179. doi:10.5235/17441056.10.1.167

Johnston, W.J., Bonoma, T.V., 1981. The Buying Center: Structure and Interaction Patterns. Journal of Marketing 45, 143. doi:10.2307/1251549

Kale, P., Singh, H., 2009. Managing Strategic Alliances: What Do We Know Now, and Where Do We Go From Here? Academy of Management Perspectives 23, 45–62. doi:10.5465/AMP.2009.43479263

Kallerud, E., Amanatidou, E., Upham, P., Nieminen, M., Klitkou, A., Olsen, D.S., Toivanen, M.L., Oksanen, J., Scordato, L., 2013. Dimensions of research and innovation policies to address grand and global challenges. NIFU Working Paper 13/2013.

Kergroach, S., 2017. Innovation policy mix: exploratory approach for a mapping. OECD Science, Technology and Industry Working Papers Forthcoming.

Kergroach, S., Chicot, J., Petroli, C., Pruess, J., van OOijen, C., Ono, N., Perianez-Forte, I., Watanabe, T., Fraccola, S., Serve, B., 2017a. Mapping the policy mix for innovation: the OECD STI Outlook and the EC/OECD International STIP Database. OECD Science, Technology and Industry Working Papers forthcoming.

Kergroach, S., Pruess, J., Fraccola, S., Serve, B., 2017b. Measuring some aspects of the policy mix: exploring the EC/OECD International STI Policy Database for policy indicators. OECD Science, Technology and Industry Working Papers forthcoming.

Kingdon, J.W., 1984. Agendas, alternatives, and public policies. Little Brown, Boston.

Klein Woolthuis, R., Lankhuizen, M., Gilsing, V., 2005. A system failure framework for innovation policy design. Technovation 25, 609–619. doi:10.1016/j.technovation.2003.11.002

Kleinsmann, M., Valkenburg, R., 2008. Barriers and enablers for creating shared understanding in co-design projects. Design Studies 29, 369–386. doi:10.1016/j.destud.2008.03.003

Knutsson, H., Thomasson, A., 2014. Innovation in the public procurement process: A study of the creation of innovation-friendly public procurement. Public Management Review 16, 242–255. doi:10.1080/14719037.2013.806574

Kuhlmann, S., 2002. Governance and Intelligence in Research and Innovation Systems.

Kuhlmann, S., Rip, A., 2014. The challenge of addressing Grand Challenges. A think piece of how innovation can be driven towards the “Grand Challenges” as defined under the prospective European Union Framework Programme Horizon 2020. European Research and Innovation Area Board.

Lacave, M., 2011. Regional Innovation Report Rhône-Alpes (Regional Innovation Monitor). European Commission.

Laranja, M., Uyarra, E., Flanagan, K., 2008. Policies for science, technology and innovation: Translating rationales into regional policies in a multi-level setting. Research Policy 37, 823–835. doi:10.1016/j.respol.2008.03.006

Larsson, R., 1993. Case survey methodology: Quantitative analysis of patterns across case studies. Academy of Management Journal 36, 1515–1546.

le Dain, M.-A., Calvi, R., Cheriti, S., 2011. Measuring supplier performance in collaborative design: proposition of a framework: Measuring supplier performance in collaborative design. R&D Management 41, 61–79. doi:10.1111/j.1467-9310.2010.00630.x

le Dain, M.-A., Calvi, R., Cheriti, S., 2010. Developing an approach for design-or-buy-design decision-making. Journal of Purchasing and Supply Management 16, 77–87. doi:10.1016/j.pursup.2010.03.010

Lember, V., Kalvet, T., Kattel, R., 2011. Urban Competitiveness and Public Procurement for Innovation. Urban Studies 48, 1373–1395. doi:10.1177/0042098010374512

Lember, V., Kalvet, T., Kattel, R., Penna, C., Suurna, M., 2007. Public procurement for innovation in Baltic metropolises. BalMet Inno, Tallinn.

Li, Y., 2013. Public Procurement as a Demand-side Innovation Policy in China - An Exploratory and Evaluative Study. The University of Manchester, Manchester.

Li, Y., Georghiou, L., 2016. Signaling and accrediting new technology: Use of procurement for innovation in China. Science and Public Policy 43, 338–351. doi:10.1093/scipol/scv044

Littlechild, S., 2015. The CMA energy market investigation, the well-functioning market, Ofgem, Government and behavioural economics. European Competition Journal 11, 574–636. doi:10.1080/17441056.2016.1153311

Loasby, B.J., 1999. Knowledge, institutions, and evolution in economics. Routledge, London.

Locke, K., Golden-Biddle, K., Feldman, M.S., 2008. Perspective—Making Doubt Generative: Rethinking the Role of Doubt in the Research Process. Organization Science 19, 907–918. doi:10.1287/orsc.1080.0398

Lundvall, B.Å., 2005. National Innovation Systems - Analytical Concept and Development Tool. Presented at the DRUID Tenth Anniversary Summer Conference 2005 on Dynamics of Industry and Innovation: Organizations, Networks and Systems, Copenhagen.

Lundvall, B.Å., 1992. National innovation system: towards a theory of innovation and interactive learning. Pinter, London.

Malerba, F., 2009. Increase Learning, Break Knowledge Lock-ins and Foster Dynamic Complementarities: Evolutionary and System Perspectives on Technology Policy in Industrial Dynamics, in: Foray, D. (Ed.), The New Economics of Technology Policy. Edward Elgar, Cheltenham, pp. 33–45.

Malerba, F., 2002. Sectoral systems of innovation and production. Research Policy 31, 247–264. doi:10.1016/S0048-7333(01)00139-1

Malerba, F., 1996. Public Policy and Industrial Dynamics: an Evolutionary Perspective, in: Edquist, C. (Ed.), The Innovation Systems and European Integration (ISE) Final Report. Linköping.

Mangematin, V., Callon, M., 1995. Technological competition, strategies of the firms and the choice of the first users: the case of road guidance technologies. Research Policy 24, 441–458. doi:10.1016/0048-7333(93)00776-P

Martin, B.R., 2016. R&D policy instruments – a critical review of what we do and don't know. Industry and Innovation 23, 157–176. doi:10.1080/13662716.2016.1146125

Matt, M., Robin, S., Wolff, S., 2012. The influence of public programs on inter-firm R&D collaboration strategies: project-level evidence from EU FP5 and FP6. The Journal of Technology Transfer 37, 885–916. doi:10.1007/s10961-011-9232-9

Mazzucato, M., 2016. From market fixing to market-creating: a new framework for innovation policy. Industry and Innovation 23, 140–156. doi:10.1080/13662716.2016.1146124

Mazzucato, M., 2013. The Entrepreneurial State: debunking public vs. private sector myths. Anthem Press, London.

Mazzucato, M., Perez, C., 2015. Innovation as Growth Policy: the Challenge for Europe, in: Fagerberg, J., Laestadius, S., Martin, B.R. (Eds.), The Triple Challenge for Europe: Economic Development, Climate Change and Governance. Oxford University Press, Oxford.

McCrudden, C., 2004. Using public procurement to achieve social outcomes. Natural Resources Forum 28, 257–267. doi:10.1111/j.1477-8947.2004.00099.x

McIvor, R., Humphreys, P., Cadden, T., 2006. Supplier involvement in product development in the electronics industry: A case study. Journal of Engineering and Technology Management 23, 374–397. doi:10.1016/j.jengtecman.2006.08.006

Metcalfe, J.S., 2005. Systems Failure and the Case for Innovation Policy, in: Llerena, P., Matt, M. (Eds.), Innovation Policy in a Knowledge-Base Economy. Springer, Berlin.

Metcalfe, J.S., 1998. Evolutionary economics and creative destruction. Routledge, London.

Metcalfe, J.S., Ramlogan, R., 2005. Limits to the economy of knowledge and knowledge of the economy. Futures, Complexity and the limits of knowledge 37, 655–674. doi:10.1016/j.futures.2004.11.006

Metcalfe, S., Georghiou, L., 1998. Equilibrium and evolutionary foundations of technology policy. STI Review 22, 75–100.

Modell, S., 2009. In defence of triangulation: A critical realist approach to mixed methods research in management accounting. Management Accounting Research 20, 208–221. doi:10.1016/j.mar.2009.04.001

Montmartin, B., Massard, N., 2015. Is financial support for private R&D always justified? A discussion based on the literature on growth. Journal of Economic Surveys 29, 479–505. doi:10.1111/joes.12067

Morgan, K., Sonnino, R., 2007. Empowering consumers: the creative procurement of school meals in Italy and the UK. International Journal of Consumer Studies 31, 19–25. doi:10.1111/j.1470-6431.2006.00552.x

Mulgan, G., Albury, D., 2003. Innovation in the public sector (Discussion Paper). Strategy Office, UK Cabinet Office, London.

Neij, L., 2001. Methods of evaluating market transformation programmes: experience in Sweden. Energy Policy 29, 67–79.

Nelson, R.R., 2011. The Moon and the Ghetto revisited. Science and Public Policy 38, 681–690. doi:10.1093/scipol/38.9.681

Nelson, R.R., 2009. Building Effective “Innovation Systems” versus Dealing with “Market Failures” as Ways of Thinking About Technology Policy, in: The New Economics of Technology Policy. Edward Elgar, Cheltenham.

Nelson, R.R., 2000. On the complexities and limitations of market organizations. Mimeo.

Nelson, R.R., 1959. The Simple Economics of Basic Scientific Research. Journal of Political Economy 67, 297–306. doi:10.2307/1827448

Nishiguchi, T., 1994. Strategic industrial sourcing: the Japanese advantage. Oxford University Press, New York City.

OECD, 2016a. Public Procurement for Innovation: Good Practices and Strategies, OECD Public Governance Reviews. OECD Publishing, Paris.

OECD, 2016b. OECD Science, Technology and Innovation Outlook 2016, OECD Science, Technology and Innovation Outlook. OECD Publishing, Paris. doi:10.1787/sti_in_outlook-2016-en

OECD, 2015a. Recommendation of the Council on Public Procurement.

OECD, 2015b. Government at a Glance 2015. OECD Publishing, Paris.

OECD, 2014a. OECD Reviews of Innovation Policy: France 2014. OECD Publishing, Paris. doi:10.1787/9789264214026-en

OECD, 2014b. Intelligent Demand: Policy Rationale, Design and Potential Benefits. OECD Science, Technology and Industry Policy Papers 13.

OECD, 2011a. Demand-side Innovation Policies. OECD Publishing, Paris.

OECD, 2011b. Business Innovation Policies: Selected Country Comparisons. OECD Publishing, Paris. doi:10.1787/9789264115668-en

OECD, 2010. The OECD Innovation Strategy: Getting a Head Start on Tomorrow. OECD Publishing, Paris.

OECD, Eurostat, 2005. Oslo Manual. OECD Publishing, Paris.

Paillé, P., Mucchielli, A., 2012. L'analyse qualitative en sciences humaines et sociales. A. Colin, Paris.

Partington, G., 2001. Qualitative research interviews: Identifying problems in technique. Issues in Educational Research 11, 32–44.

Peirce, C.S., 1960. Collected papers. Harvard University Press, Cambridge.

Personnier, H., 2013. La conception collaborative avec les fournisseurs : proposition d'une méthode d'analyse par les dysfonctionnements. Université de Grenoble, Grenoble.

Personnier, H., le Dain, M.-A., Calvi, R., 2012. Failures in collaborative design with suppliers: Literature review and future research avenues. Presented at the 21st Annual IPSERA Conference: Purchasing & Supply Management in a Changing World, Naples.

Personnier, H., le Dain, M.-A., Holger, S., Calvi, R., 2013. Failures in collaborative design with suppliers: Impact analysis on project innovation. Presented at the 22nd IPSERA Conference, Nantes.

Phillips, W., Knight, L., Caldwell, N., Warrington, J., 2007. Policy through procurement—The introduction of digital signal process (DSP) hearing aids into the English NHS. Health Policy 80, 77–85. doi:10.1016/j.healthpol.2006.03.008

Potts, J., 2001. Knowledge and markets. Journal of Evolutionary economics 11, 413–431.

Rainey, H.G., Bozeman, B., 2000. Comparing Public and Private Organizations: Empirical Research and the Power of the A Priori. Journal of Public Administration Research and Theory 10, 447–470.

Reichertz, J., 2009. Abduction: The Logic of Discovery of Grounded Theory. Forum Qualitative Sozialforschung / Forum: Qualitative Social Research 11.

Ribeiro, C.G., Furtado, A.T., 2014. Public procurement for innovation in developing countries: the case of Petrobas, in: Edquist, C., Vonortas, N.S., Zabala-Iturriagagoitia, J.M., Edler, J. (Eds.), Public Procurement for Innovation, EU-SPRI Forum on Science, Technology and Innovation Policy. Edward Elgar, Cheltenham.

Rigby, J., 2016. The impact of pre-commercial procurement on innovation, in: Edler, J., Cunningham, P., Gök, A., Shapira, P. (Eds.), Handbook of Innovation Policy Impact, EU-SPRI Forum on Science, Technology and Innovation Policy. Edward Elgar, Cheltenham.

Ring, P.S., Ven, A.H.V.D., 1994. Developmental Processes of Cooperative Interorganizational Relationships. Academy of Management Review 19, 90–118. doi:10.5465/AMR.1994.9410122009

Rolfstam, M., 2015. Public procurement of innovation for a better world: a consolidation or a new beginning? Innovation: The European Journal of Social Science Research 28, 211–219. doi:10.1080/13511610.2015.1065139

Rolfstam, M., 2013. Public Procurement and Innovation: The Role of Institutions. Edward Elgar, Northampton.

Rolfstam, M., 2012a. Public procurement of innovation: demand as in command or facilitation of endogenous knowledge conversion? Presented at the Conference on Demand, Innovation and Policy: Underpinning Policy Trends with Academic Analysis, Manchester.

Rolfstam, M., 2012b. Good Rules or Bad Rules in Public Procurement of Innovation: But is it really the (Right) Question? Administrative Culture 13, 109–129.

Rolfstam, M., 2010. Early involvement of stakeholders in Public Procurement of Innovation The Case of The Biogas and Upgrading Plant. Presented at the 19th Annual International Purchasing and Supply Education and Research Association (IPSERA) Conference, Lappeenranta.

Rolfstam, M., 2009. Public procurement as an innovation policy tool: the role of institutions. Science and Public Policy 36, 349–360. doi:10.3152/030234209X442025

Rolfstam, M., 2007. Organisations and Institutions in Public Procurement of Innovations: The Case of the Energy Centre in Bracknell, UK. Presented at the DRUID-DIME Academy Winter 2007 PhD Conference on Geography, Innovation and Industrial Dynamics, Aalborg.

Rothwell, R., 1984. Creating a Regional Innovation-oriented Infrastructure: The role of public procurement. Annals of Public & Co-operative Economy 55, 159–172.

Rousseau, D.M., Sitkin, S.B., Burt, R.S., Camerer, C., 1998. Not So Different After All: A Cross-Discipline View Of Trust. Academy of Management Review 23, 393–404. doi:10.5465/AMR.1998.926617

Sako, M., 1992. Prices, quality, and trust: inter-firm relations in Britain and Japan, Cambridge studies in management. Cambridge University Press, Cambridge.

Schiele, H., 2006. How to distinguish innovative suppliers? Identifying innovative suppliers as new task for purchasing. Industrial Marketing Management 35, 925–935. doi:10.1016/j.indmarman.2006.05.003

Schramm, W., 1971. Notes on Case Studies of Instructional Media Projects. Stanford University, California Institute for Communication Research.

Schumpeter, J.A., 1934. The Theory of Economic Development: An Inquiry into Profits, Capital, Credit, Interest, and the Business Cycle. Transaction Publishers, New Brunswick.

Sheppard, E., 2006. Problème public, in: Dictionnaire Des Politiques Publiques. Presses de Sciences Po, Paris, pp. 349–356.

Smith, K., 2000. Innovation as a Systemic Phenomenon: Rethinking the Role of Policy. Enterprise & Innovation Management Studies 1.

Smith, K., 1996. Systems Approach to Innovation: Some Policy Issues, in: The Innovation Systems and European Integration (ISE) Final Report. Linköping.

Smits, R., Kuhlmann, S., 2004. The rise of systemic instruments in innovation policy. International Journal of Foresight and Innovation Policy 1, 4–32. doi:10.1504/IJFIP.2004.004621

Soete, L., Arundel, A., 1993. An Integrated Approach to European Innovation and Technology Diffusion Policy: a Maastricht Memorandum (No. EUR 15090 EN). European Commission, Luxembourg.

Sonnino, R., 2009. Quality food, public procurement, and sustainable development: the school meal revolution in Rome. Environment and Planning A 41, 425–440. doi:10.1068/a40112

Stentoft Arlbjørn, J., Vagn Freytag, P., 2012. Public procurement vs private purchasing: Is there any foundation for comparing and learning across the sectors? International Journal of Public Sector Management 25, 203–220. doi:10.1108/09513551211226539

Telles, P., 2010. Competitive dialogue in Portugal. Public Procurement Law Review 1–32.

Terrasse, Y., 1992. Les politiques d'achat en France. Politiques et management public 10, 3–19. doi:10.3406/pomap.1992.3049

Uyarra, E., 2016. The Impact of Public Procurement of Innovation, in: Edler, J., Cunningham, P., Gök, A., Shapira, P. (Eds.), Handbook of Innovation Policy Impact, EU-SPRI Forum on Science, Technology and Innovation Policy. Edward Elgar, Cheltenham.

Uyarra, E., 2013. Review of Measures in Support of Public Procurement of Innovation, Compendium of Evidence on the Effectiveness of Innovation Policy Intervention. Manchester Institute of Innovation Research, Manchester.

Uyarra, E., 2010. Opportunities for innovation through local government procurement. A case study of Greater Manchester. NESTA, London.

Uyarra, E., Edler, J., Garcia-Estevez, J., Georghiou, L., Yeow, J., 2014. Barriers to innovation through public procurement: A supplier perspective. Technovation 34, 631–645. doi:10.1016/j.technovation.2014.04.003

Uyarra, E., Flanagan, K., 2010. Understanding the Innovation Impacts of Public Procurement. European Planning Studies 18, 123–143. doi:10.1080/09654310903343567

Uyarra, E., Flanagan, K., Magro, E., Zabala-Iturriagagoitia, J.M., 2017. Anchoring the innovation impacts of public procurement to place: The role of conversations. Environment and Planning C: Politics and Space 239965441769462. doi:10.1177/2399654417694620

Uyarra, E., Moñux, D., 2016. Spurring Innovation-led Growth in Latin America and the Caribbean through Public Procurement (Discussion Paper No. IDB-DP-488). Inter-American Development Bank.

Valovirta, V., 2015. Building capacity for public procurement of innovation, in: Edquist, C., Vonortas, N.S., Zabala-Iturriagagoitia, J.M., Edler, J. (Eds.), Public Procurement for Innovation, EU-SPRI Forum on Science, Technology and Innovation Policy. Edward Elgar, Cheltenham.

Van Maanen, J., Sørensen, J.B., Mitchell, T.R., 2007. The interplay between theory and method. Academy of management review 32, 1145–1154.

Vanneste, B.S., Puranam, P., Kretschmer, T., 2014. Trust over time in exchange relationships: Meta-analysis and theory: Research Notes and Commentaries. Strategic Management Journal 35, 1891–1902. doi:10.1002/smj.2198

Vecchiato, R., Roveda, C., 2013. Foresight for public procurement and regional innovation policy: The case of Lombardy. Research Policy 43, 438–450. doi:10.1016/j.respol.2013.11.003

von Hippel, E., 1986. Lead Users: A Source of Novel Product Concepts. Management Science 32, 791–805. doi:10.1287/mnsc.32.7.791

Walter, A., Müller, T.A., Helfert, G., Ritter, T., 2003. Functions of industrial supplier relationships and their impact on relationship quality. Industrial Marketing Management 32, 159–169. doi:10.1016/S0019-8501(02)00230-4

Wang, S., Bunn, M.D., 2004. Government/Business Relationships: Insights into Contract Implementation. Journal of Public Procurement 4, 84–115.

Weber, K.M., Rohracher, H., 2012. Legitimizing research, technology and innovation policies for transformative change: Combining insights from innovation systems and multi-level perspective in a comprehensive “failures” framework. Research Policy 41, 1037–1047. doi:10.1016/j.respol.2011.10.015

Weber, M., 1949. The Methodology of the Social Sciences. Free Press, Glencoe.

Whyles, G., Meerveld, H. van, Nauta, J., 2015. Forward Commitment Procurement: a practical methodology that helps to manage risk in procuring innovative goods and services. Innovation: The European Journal of Social Science Research 28, 293–311. doi:10.1080/13511610.2015.1024638

Wieczorek, A.J., Hekkert, M.P., 2012. Systemic instruments for systemic innovation problems: A framework for policy makers and innovation scholars. Science and Public Policy 39, 74–87. doi:10.1093/scipol/scr008

Yin, R.K., 2011. Qualitative research from start to finish. Guilford Press, New York.

Yin, R.K., 2009. Case study research: design and methods, Fourth edition. ed. Sage Publications, Los Angeles.

Yin, R.K., Heald, K.A., 1975. Using the case survey method to analyze policy studies. Administrative science quarterly 371–381.

Zaparucha, E., Muths, A.-G., 2011. Mini Country Report/France (Thematic Report 2011 under Specific Contract for the Integration of INNO Policy TrendChart with ERAWATCH (2011-2012)). European Commission, Brussels.

Abstract

An increasing number of OECD countries has adopted measures to encourage the use of public procurement to foster innovation. However, implementation of public procurement of innovation (PPI) is lagging behind policy discourse. The ambition of this dissertation is to address this discrepancy by assisting in the design of PPI initiatives, that is, by identifying the innovation-related failures that PPI can overcome, and the most appropriate policy instruments and practices for achieving this objective.

We define eight PPI ideal-types according to the type of meso-level market or system failures they address. These failures can relate to users, producers or to their mutual interactions. We confront them with macro-level failures, and determine accordingly the contribution of each PPI ideal-type to distinct mission-oriented policies. Our typology provides a unified PPI framework associating their rationales with their design. Therefore, it contributes to policymaking, and to policy evaluation and analysis. Some PPI categories aim to spur innovation by stimulating the formation of markets. We employ an evolutionary approach to analyse the influence of PPI at the different stages of the dynamic process of market formation through a series of selected existing case studies. We demonstrate that PPI can underpin the different phases of knowledge coordination for market formation, by ensuring appropriate interactions between users and producers early in the public procurement procedure. The literature on private procurement nevertheless shows that early supplier involvement is subject to a number of micro-level failures having their root in procurement practices. Based on interviews with public procurers and suppliers, we identify relevant collaboration failures related to the standard PPI and competitive dialogue procedures. We highlight differences in these failures and their loci between the two procedures. Furthermore, public procurers and suppliers appear to have different perception of the causes of the failures they have encountered. Finally, our findings discuss the influence of the legal framework on PPI and suggest additional PPI procedures and strategies that are favoured by suppliers to varying extents.

In sum, our research identifies innovation-related failures at different levels that PPI can resolve, and relevant instruments to help PPI initiative to achieve their objectives. Furthermore, it advocates a dynamic approach considering failures, instruments, and practices at different stages of public procurement procedures, and market formation and public procurer-supplier collaboration processes.

Keywords: Public procurement of innovation; Policy rationales; Policy instruments; Mission-oriented policies; Market formation; Procurer-supplier collaboration

Résumé

Un nombre croissant de pays de l'OCDE encourage l'utilisation des achats publics en soutien à l'innovation, mais les discours ont été peu suivis d'effets. L'ambition de cette thèse est d'aider l'élaboration des initiatives d'achat public d'innovation (API), en identifiant les obstacles à l'innovation qu'ils peuvent résoudre, ainsi que les instruments et les pratiques les plus à mêmes de les aider dans cet objectif.

Nous identifions huit idéo-types d'API selon les défaillances de marché ou de système (niveau méso) auxquelles ils tentent de répondre pour stimuler l'innovation. Ces défaillances affectent soit les utilisateurs, soit les producteurs ou touchent leurs interactions. Nous les comparons à celles de niveau macro et déterminons ainsi la contribution potentielle de chacun de ces idéo-types d'API aux politiques tournées vers de grandes missions. Notre typologie constitue un cadre théorique unifié associant défaillances et modalités de mise en œuvre des API. Elle en aide ainsi l'élaboration, l'évaluation et l'analyse. Certains de nos idéo-types doivent soutenir la création de marché pour encourager l'innovation. Nous nous appuyons sur les théories économiques évolutionnistes et une série d'études de cas pour comprendre comment les API peuvent y parvenir. Nous identifions leurs rôles, à différentes étapes de la procédure d'achat public, dans la coordination de connaissances et d'informations pour la création et le développement de marché. Les API doivent notamment permettre aux utilisateurs d'interagir avec les fournisseurs de manière appropriée et suffisamment tôt dans la procédure d'achat. Les recherches sur les achats privés ont néanmoins montré qu'une telle implication précoce des fournisseurs est source de problèmes de niveau micro. Une série d'entretiens avec des acheteurs publics et des fournisseurs permet de mieux identifier les problèmes affectant leur collaboration au cours d'une procédure standard d'API ou d'un dialogue compétitif. La nature de ces défaillances diffère selon la procédure d'achat public, du même que leur moment d'apparition. Les entretiens révèlent également que les acheteurs et fournisseurs perçoivent différemment les pratiques à l'origine de ces défaillances. Nos résultats appellent enfin à reconsidérer l'influence du cadre juridique sur les API, et soulignent l'existence de procédures et stratégies alternatives qui sont plus ou moins privilégiées par les fournisseurs.

En somme, notre travail de recherche identifie différents niveaux d'obstacles à l'innovation que les API peuvent résoudre, ainsi que les mesures les plus appropriées pour les aider dans cet objectif. Il plaide en faveur d'une approche dynamique de la décision politique, qui définit problèmes, instruments de politique et pratiques à chacune des étapes des procédures d'achat public, de formation des marchés, et de collaboration entre acheteurs public et fournisseurs.

Mots-clefs : Achat public d'innovation ; Justifications de politique ; Instrument de politique ; Politiques tournées vers de grandes missions ; Formation de marché ; Collaboration acheteur public-fournisseur