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Connecting demand and supply: The role of intermediation in public procurement of innovation



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ABSTRACT

Intermediation in innovation serves to establish or improve the link between different actors with complementary skill sets or interests in order to support the generation and diffusion of innovation. This article conceptualises and analyses intermediation between supply and demand using the example of public procurement of innovation. It defines specific intermediation needs and functions in different procurement situations and outlines the pre-condition for effective intermediation. The paper combines and contributes to the growing literature on innovation intermediation and public procurement of innovation.

As the paper looks at the *demand* for innovation it adopts a broad understanding of innovation, defined as a product, service or process that is *novel to the buying organisation*. In order to develop the conceptualisation of intermediation in the process of demanding innovation, it builds on the existing, rather rudimentary conceptualisation of intermediation in the innovation and management literature. It presents an in-depth analysis of two very different procurement processes in two cases in a complex public sector setting, the English NHS, case of a public buying organisation triggering the generation of an innovation, and another in which an organisation sought to respond to an innovation offered in the marketplace. In both cases, the solution bought necessitated strong adaptation processes with considerable learning costs within the buying organisation. The paper shows how intelligent and tailored intermediation can tackle some of the well-known procedural and capability failures in the process of public procurement of innovation. In terms of policy implications, the article makes the claim for an increased effort to build up effective intermediation across procurement systems to support agencies in concrete procurement and, in doing so, to build up capacity for more intelligent public buying. While the focus on intermediation responds to an existing gap in the literature on public procurement of innovation, the paper has implication for demand-supply intermediation more generally.

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1. Introduction

Intermediation in innovation serves to establish or enable the link between different actors with complementary skill sets or interests in order to support the generation and diffusion of innovation. Our understanding of the distributed nature of innovation generation has led to a focus on the need to create linkages and support actors in their ability to link. Consequently, the need for linkages is a building block in all variants of the innovation systems literature (Edquist, 1997; Freeman, 1995; Lundvall, 1988; Nelson and Winter, 1982), the literature on innovation networks and clusters (Chapain et al., 2010; Uyarra and Ramlogan, 2012), and the highly diverse streams of literature on different modes of knowledge and innovation generation (Chesbrough, 2003; Gibbons et al., 1994; Kline and Rosenberg, 1986).

The different functions and modes of intermediation in innovation have become a linchpin of our understanding of interaction in innovation systems (Howells, 2006; Klerkx and Leeuwis, 2008; van Lente et al., 2003). With this paper we want to make a conceptual contribution to this growing literature by focusing on specific aspects of the link between the demand and supply of innovation. This focus is triggered by an empirical observation and a policy problem. In recent years we have seen a growing concern with the conditions of demand for innovation and how demand shapes, spurs, or hinders the direction and speed of innovation. The focus has shifted somewhat to the problems of demanding and adopting innovative solutions. Most prominently, public procurement of innovation (PPI) has climbed up the ladder of policy and academic attention considerably in the last 5–10 years (Aschhoff and Sofka, 2009; Edler and Georghiou, 2007; Edquist et al., 2015; Edquist and Zabala-Iturriagoitia, 2012; Rolfstam et al., 2009). As recent policy reviews have shown, public procurement of innovation is at the heart of many innovation policy initiatives across the OECD

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and at EU level (Izsak and Edler, 2011; OECD, 2011; Rigby et al., 2012; Uyarra, 2016). While public procurement as a “tool for innovation policy” (Geroski, 1990) has had a comeback, the adoption of external innovation to make public services more efficient and effective has always been part of the public sector modernisation and improvement agenda.

To focus on PPI as an *innovation policy tool* is to support and stimulate the demand for and adoption of innovation for the sake of generating economic benefit for suppliers and supply chains, on top of the social benefit generated by the public sector organisation. Consequently, a range of additional policy measures and changes in regulations have been introduced or are being discussed to support PPI (Georghiou et al., 2013; Uyarra, 2016). While there is a plethora of policy initiatives, there is still a range of shortcomings in the actual conduct of public procurement of innovation. A number of reviews (Aschhoff and Sofka, 2009; Bonaccorsi and Molinari, 2011; Edquist and Hommen, 1998; Lember et al., 2007; Rolfstam, 2005; Rolfstam et al., 2011; Uyarra, 2010, 2016) and a recent survey (Uyarra et al., 2014) indicate that some of the reasons for that are a lack of organisational capabilities of all kinds (e.g. technological, managerial), counter-productive incentive and organisational structures and a lack of transparency and appropriate interaction between demand and supply (Uyarra et al., 2014).

This paper starts with the assumption that the process by which public agencies ask for, buy, and adopt an innovative solution is characterised by specific, persistent challenges, and buying organisations need to be enabled and supported systematically to tackle them. In line with our concern about generation and diffusion of innovation, we define innovation from the perspective of the buying organisation. Crucially, this view highlights that public procurement of innovation “is not primarily done to enhance the development of a new product, but to target functions that satisfy a human need or societal problems” (Edquist and Zabala-Iturriagoitia, 2012, p. 1758). We focus on the latter part of this argument, i.e. the needs of a public body providing a public service and responding to a societal need. Thus, in this article we define public procurement of innovation as the purchase of a solution that is novel to the buying organisation in order to serve an organisational need. This purchase can lead to the generation of a new solution (thus *triggering* an innovation) or it can relate to a solution that already exists, but has not been previously adopted by the buying organisation (thus *responding* to an innovation in the marketplace). As we are concerned with generation *as well as* adoption of innovation and the intermediation needs that arise from asking for and adopting something new, this definition goes beyond the understanding of Edquist and Zabala-Iturriagoitia (2012) whose work is limited to procurement that *results in* (i.e. triggers) an innovation.¹

Public procurement of innovation in our definition poses a range of challenges. Procurement is a complex market transaction with a high level of functional demands and risks involved that necessitates a broad range of capabilities. Markets for innovation are – by definition – not established, needs are often novel and ill-defined, a multitude of different functions within public organisations produce different expectations and incentives to demand innovation, the business case of new solutions offered to organisations is ill-defined at best, and the learning and adaptation costs within the

buying organisation are often high. Further, the generation and adoption of innovation frequently involves iterative interactions and necessitates joint risk management against the background of constraining public procurement regulations. Public organisations are – by and large – overwhelmed by those demands. They lack crucial capabilities, are poor at linking up complementary skills and interest both *within* the organisation and with *external* actors in the process of defining needs, exploring solutions, conducting the procurement and adopting and using innovations. The successful examples we have seen in the literature stress the importance of exactly those capabilities and linkages (Edler and Uyarra, 2013; Lember et al., 2011; Rolfstam et al., 2011; Edquist et al., 2015). This is where intermediation comes in. Procurement of innovation generates a range of intermediation needs, both between and within organisations.

Consequently, the aim of this paper is to develop a conceptualisation of intermediation between public demand and supply, which, we hope, can serve as a basis for a deeper understanding of intermediation between demand and supply more generally. We do so by answering the following questions: What needs for intermediation do public organisations have when they ask for, buy and adopt products and services that are novel to them? How do these needs translate into specific functions of intermediation in different procurement situations and what are the corresponding roles of intermediation?

To answer these questions, the paper first presents and mobilises various existing conceptualisations of intermediation in innovation more generally as a starting point for the empirical analysis (Section 2.1). It then establishes a concept of challenges in public procurement of innovation as defined above as a basis for understanding specific intermediation needs, differentiating between situations in which public procurement triggers an innovation and those in which it responds to an innovation offered. While both situations share some challenges, they have somewhat different functional requirements and therefore different needs for intermediation and support (Section 2.2). The paper then explores two empirical examples of active intermediation (Section 3), both situated within a complex public sector setting – the National Health Service (NHS) in England. We have chosen the English NHS as it is a multi-layered organisation which has long been criticised for not being able to reap the most out of the innovations offered and not being demanding enough in asking for and adopting innovation (Greenhalgh et al., 2004; Phillips et al., 2007; Wanless, 2002). In this complex and challenging setting, we first explore how an intermediary organisation supported a case of public procurement of innovation characterised by a complicated need definition, complex market interaction and the triggering of a novel solution. The second case is an attempt to enable the adoption of an existing technology through intermediation. An in-depth analysis of these two cases allows us to illustrate and explore the breadth of the functions of intermediation. By doing so, we develop a more general concept to understand intermediation in public procurement of innovation (Section 4). Even if limited to public procurement, this concept can, we believe, also be useful to better understand the under-explored issue of private buying of innovation. The conclusions highlight the need for a step-change in our understanding of intermediation in innovation in order to capture the complexity of demand intermediation, and to discuss the concrete implications for the practice of public procurement of innovation and for policy that seeks to mobilise procurement to spur innovation.

2. Conceptual background and literature review

To bring some order in the complexity of intermediation needs and functions within the procurement of innovation, we follow a

¹ The more limited definition of public procurement of innovation has its justification when the focus is on innovation *generation* due to public procurement and the specific problems associated with the link of buying and *generating* innovation. While we include this *problematique* in this article, we go beyond this limitation as we are interested in the challenges of buying something new, and the resulting intermediation needs. We regard our contribution as an important extension of the current literature on public procurement of innovation.

two-step approach. First, we turn to the general intermediation literature to understand the different functions of intermediation in innovation. Second, we define those challenges in public procurement innovation that in turn determine the need for intermediation. This then provides the initial framework with which we analyse our cases and define intermediation needs and options for the public procurement of innovation.

2.1. Innovation intermediation

The common nucleus for innovation intermediation is that it provides a link between at least two entities which need to connect in order to generate or adopt innovation, but which do not do so sufficiently without having a linking device or linking support (Howells, 2006; Klerkx and Leeuwis, 2008, 2009; van Lente et al., 2003; Winch and Courtney, 2007). Intermediation can be *direct*, bringing actors together and supporting their interaction, or *indirect*, enabling and supporting actors to better understand others, their preferences, interests and skill set as well as the object of the transfer, i.e. knowledge, technological artefacts, products, etc.

Intermediation serves a large variety of roles, and has been conceptualised and analysed in various streams of literature. Intermediation is increasingly seen and conceptualised at a systems level, whereby intermediaries are not so much brokers between distinct parties, but instruments to support systemic functions in innovation systems (Hekkert et al., 2007) or the directed change of socio-technical systems (van Lente et al., 2003). While we will argue later on that system level intermediation is needed in public procurement, we start with an actor-centric rather than a systems perspective, as our empirical and conceptual starting points are about distinct organisations as moderators and brokers between distinct parties, only to generalise our findings towards system level considerations later on.

Within this actor-centric perspective, we can build on two functional differentiations provided by (Howells, 2006) and van Lente et al. (2003). First, Howells (2006) distinguishes four basic functions of innovation intermediation:

- (1) supporting diffusion and technology transfer. This fits our broader understanding of innovation and intermediation as outlined above, whereby intermediaries influence the decision of buyers through various intelligence activities (e.g. information dissemination, evaluation), by supporting the transferability of an innovation and the actual interaction in the process of buyings
- (2) enabling innovation in the context of organisational innovation management;
- (3) providing a general infrastructure for bridging within systems and across networks in a broader, systemic sense (e.g. funding organisation bridging between policy and research performers (Lynn et al., 1996, p. 97);
- (4) enabling specific systems and networks functions (Howells, 2006), mainly through specialist service organisations, such as knowledge intensive business services (Miles et al., 1995).

Second, van Lente et al. (2003) distinguish between three major types of intermediation. This partly overlaps with Howells (2006) above, but it highlights three aspects that are important in our context. First, and most appropriate for our purposes, the authors stress the diffusion and transfer aspect from the perspective of the demand side, as their first type of intermediation is *demand articulation*. Intermediation helps to articulate innovation needs in terms of technology, knowledge, funding and policy. In their second type of intermediation, van Lente et al. (2003) accentuate the dynamic and procedural aspect of intermediation: intermediation is seen as crucial in the *formation of actor networks and facilitating linkages*

between relevant actors (scanning, scoping, filtering, and match-making of possible cooperation partners). In their third intermediation type, *innovation process management*, intermediation is about learning over time, enhancing “alignment and learning of the multi-actor network, which involves facilitating learning and cooperation in the innovation process” (Klerkx and Leeuwis, 2009, p. 851).

This sketch of the variety of intermediation lays the ground for zooming into the aspects of intermediation that relate to the complex setting of procurement of innovation in public sector organisations. Two most important dimensions from the conceptualisations above are “diffusion and technology transfer” and “demand articulation” respectively. Intermediaries have been found in many studies to be important determinants of the direction and speed of adoption (Winch and Courtney, 2007). Much research has focused on the ways in which intermediaries actively interact with and support the *selling firm* in exploiting the market, through trying to understand the potential of technologies, products and services for the broader market and supporting the marketing efforts of the seller (Hargadon, 1998; Lichtenthaler and Ernst, 2008; Morgan and Crawford, 1996). Much of the work done by intermediaries for the suppliers is in effect a reaction to their “internal limitations” as they extend their “own resources for identifying technology commercialization opportunities” (Lichtenthaler and Ernst, 2008, p. 1006).

Zooming in even further, towards the heart of our interest, we find various ways in which intermediaries *broker* between supplier and buyer and *intervene in the adoption* decision and implementation process of *buyers*. To better conceptualise the role of intermediaries from the *perspective of the buyers*, we take advantage of Bessant and Rush (1995) who have articulated seven functions for the *purchase* of technology to which intermediaries can contribute: (1) recognition of requirements for the technology (in other words: understanding the need), (2) exploring the range of solutions, (3) comparison of solutions, (4) selection, (5) acquisition, (6) implementation, and (7) operating and learning (in other words, upgrading the skill base of buyers to perform complex acquisitions themselves). Fig. 1 situates the dimension of the buyer–supplier intermediation in the broader framework of innovation intermediation.

This simplified framework translates into a range of different concrete activities of intermediaries. Intermediaries help “in defining and selecting the needs of the client in relation to innovation” (Díaz-Puente et al., 2009, p. 368), i.e. they can support the internal understanding of the need in a “diagnostic role” (Bessant and Rush, 1995, p. 102). Intermediaries can help to identify potential solutions or partners to deliver the solution; they scan and collect data and evaluate performance, and disseminate data and findings about the potential supply side solution(s). Intermediaries create awareness and transparency by providing information about the technological and business opportunities offered by an innovation (Díaz-Puente et al., 2009; Hargadon and Sutton, 1997; Lynn et al., 1996; Mantel and Rosegger, 1987; Watkins and Horley, 1986; Wolpert, 2002). Intermediaries thus translate from one context to the other, and, overall, create market enabling communication and trust between the parties.

With regards to the actual process of buying, intermediaries can be involved in supporting the buyer to make the actual selection and buying decision (Mantel and Rosegger, 1987) and in the subsequent process in formalising interaction and supporting concrete negotiations between partners during the entire process (Shohet and Prevezer, 1996) up to the actual purchase and adoption.

This leads us towards an important aspect of intermediation, that is, activities conducted by the intermediary only for one party rather than at the interface (Howells, 2006, p. 724). This is relevant in two ways. First, intermediation can be linked to, even be based upon, a one-party consultancy (van Lente et al., 2003).

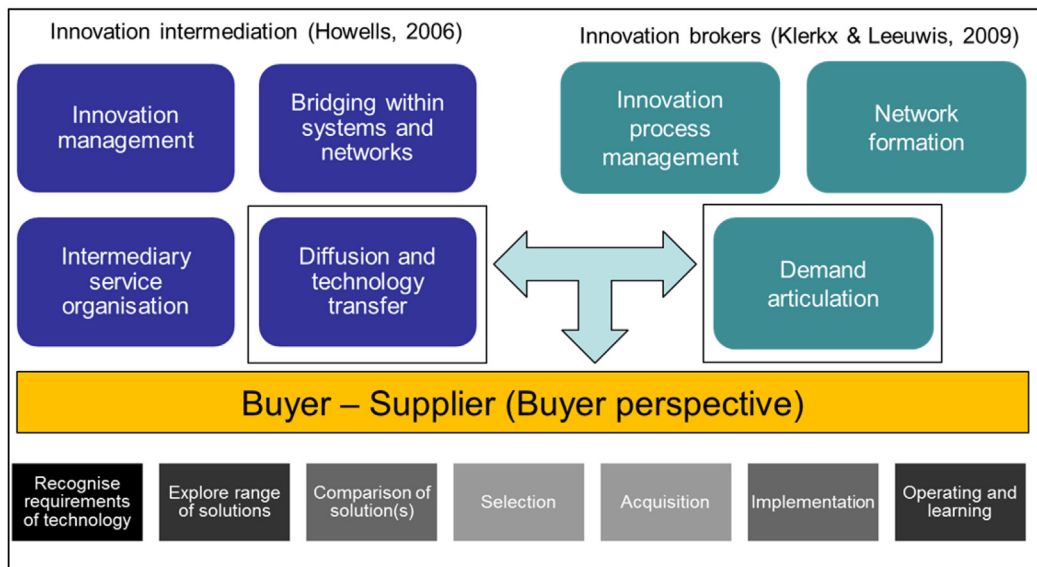


Fig. 1. Buyer–supplier intermediation.

To enable linkages here means to address the capabilities of the actors that are to be linked (Lichtenthaler and Ernst, 2008). Second, enabling systematic decision making within organisations, especially large organisations, involves an element of intermediation between different *internal* organisational units. Intermediaries can bridge normative and cognitive gaps not only between organisations, but between different organisational units.

This points to a final, largely underexplored aspect. Intermediaries can contribute to the building up of relational, managerial and intelligence capability on both sides, especially within the buying organisation. By doing so, they not only enable distinct transactions, but also enhance transactional capabilities more generally. For example, referring to diffusion programmes in innovation policies in the 1980s, Bessant and Rush (1995, p. 99; 103) claim that consultancies as intermediaries in the adoption process contributed to the management capabilities of the consulted partners. However, the literature on intermediaries is strangely thin when it comes to the long-term learning effect on the abilities of all actors involved. The contribution of intermediaries not only in supporting others by providing systemic and managerial capabilities, but in building up those capabilities within their partner organisations appears to be underexplored.

Against this background of intermediary functions, we now need to establish the specific challenges in the public procurement of innovation that constitute the needs for intermediation.

2.2. Challenges of public procurement

The literature on public procurement of innovation has identified which factors concerning the process and capabilities of the buying organisation are conducive to buying and adopting innovation in the public sector (Edler et al., 2005; Edquist et al., 2000; Izsak and Edler, 2011; Rolfstam, 2013; Rolfstam et al., 2009; Tspouri et al., 2009; Yeow et al., 2011). To establish those enabling factors poses severe challenges for buying organisations and opens up possibilities – and needs – for intermediation to support. In general, the most important *challenges* for public procurement of innovations are related to:

- (1) *understanding* and assessing the *market* and its opportunities, both in terms of what is already offered and in terms of what

the market could deliver if asked for by the public buyer (Edler et al., 2005);

- (2) being able to *understand one's need* and the functional improvements possible through innovation (Edler and Gee, 2013);
- (3) *establishing incentive structures* that reflect the risk–reward distribution, to ensure that those organisational units that bear the risk also share some of the efficiency or reputational gains associated with innovation. Moreover, innovation procurement needs capabilities and procedures to overcome risk aversion through risk management approaches (Tspouri et al., 2009; Wilkinson et al., 2006);
- (4) being able to *implement the innovation and change organisational procedures*, routines and capacities needed to do so (Kyratsis et al., 2010; Rolfstam et al., 2011; Rye and Kimberly, 2007).

Those functional needs in innovation procurement ask for internal skills, capabilities and incentive structures, as well as for *inter-organisational* (challenge 1, understanding markets) and *intra-organisational coordination* (challenges 2–4). Poor inter-organisational interaction is a real bottleneck. A survey of 800 suppliers to the UK public sector found that out of a list of 17 variables influencing the public procurement process, “early interaction with the procuring organisation” was the second most important factor encouraging public procurement of innovation (Uyerra et al., 2014); only the explicit demand for innovation in tender documents was regarded to be even more important. At the same time, only 35% of the responding suppliers to the public sector experience early interaction with public bodies in procurement processes. More worryingly, when asked about the significance of 13 obstacles for selling innovation to the public sector, 45% of suppliers said that the lack of interaction with the procuring body was a very significant bottleneck, the second highest after “too much emphasis on price”. Finally, only a minority of suppliers to the public sector assessed the knowledge of public organisations relating to supplier products and related markets as well as their ability to make use of the whole supply chain in that market positively (Uyerra et al., 2013, 2014).

The challenge of intra-organisational coordination stems, inter alia, from a considerable level of internal fragmentation of functions (Uyerra and Flanagan, 2010; Wilkinson et al., 2006). There is rarely a broad match or sufficient coordination within buying organisations between those actors who conduct the purchase in technical

terms (i.e. procurers), those who are responsible to commission it, those who have the overall responsibility to deliver the service and those who might be internal users of the solution bought. This internal differentiation is compounded by “silo-budgeting”, where the budgetary responsibilities on the one hand and the locus of the actual use and benefit of a product on the other hand do not match.

Further, challenges for the buying organisation are determined by what organisational adaptations are needed in the buying organisations when adopting an innovation. Highly disruptive innovations mean that public organisations have to learn at all levels, adapt their capabilities and, in the extreme, establish entirely new organisational processes and routines. In principle, the more disruptive an innovation, the higher the need for learning, internal coordination and change management and thus the more severe the challenges mentioned above.

As previously mentioned in the introduction, challenges also differ between triggering and responsive demand for innovation (Allman et al., 2011, p. 27; Miles et al., 2009, p. 17). Responsive procurement is determined by the willingness and ability of an organisation to absorb and utilise products and services that are offered to them in the marketplace, but that are new to the buying organisation. The need of a public buyer is not the origin of the innovation, but important for its diffusion, and public organisations responsive to innovations are important assets in the demand conditions of countries (Allman et al., 2011, p. 27; Miles et al., 2009, p. 17). The main specific challenges here are assessing the business case for an innovative solution, i.e. the added value and reliability of an innovation for the established functions, creating a consensus across the organisation concerning the added benefit, and the ability to implement the innovation (including convincing citizens should the innovation be critical to the delivery of the public service).

When public organisations express a need that cannot adequately be met by an existing product or service, they trigger the generation of an innovation. The innovative solution required to fulfil the need can be generated by suppliers (alone) or in co-operation between the public organisation (as user) and the suppliers, where interactions can extend into user-producer interactions to actually co-produce the solution up to a prototype (as explained in the work within the von Hippel tradition, e.g. Prandelli et al., 2008; Von Hippel, 1986). In addition to the challenges for responsive procurement, triggering an innovation through procurement means that public organisations need to be able to understand, define and clearly express their future needs. They also need to be able to approach the marketplace and to interact with potential producers in a way that stirs market interest. For producers, it is important to be close to the early signals of sophisticated customers, to be able to communicate and co-produce the knowledge and technologies needed to satisfy the needs expressed by potential demanders and to support the early testing and implementation phase.

3. Intermediation in action: public procurement in the English public health sector

3.1. The setting: the NHS as procurer of innovation

It has been considered that the National Health Service in England, as indeed in most OECD countries, is in principle in a very good position to stimulate innovation by acting as the first customer and early adopter of new innovations, setting clear and strategic directions and better communicating where and how it is seeking to procure innovative solutions in the future (DH, 2011). However, the NHS in England has generally been found to be a late and slow adopter of innovation (Wanless, 2002). This has largely

been attributed to the complex landscape of the NHS with multiple levels of governance, multi-entry points for the purchase of new technologies and the internal functional differentiation necessitating a high level of coordination for purchase decisions and adoption processes (Phillips et al., 2007). Further, barriers relating to the adoption of innovative solutions in the NHS have been consistently highlighted in the literature and appear to be associated with asymmetries in interaction, information and capability (Ferlie et al., 2000, 2005; Kyratsis et al., 2010; Liddell et al., 2008; Rosen and Mays, 1998).² The role of and opportunity for the procurement of innovation in the NHS has come to the forefront in recent years and many steps and initiatives have been taken within the health system in the UK to harness the potential that procuring innovation could bring (DH, 2009; HITF, 2004; Phillips et al., 2007).³

3.2. Two empirical cases

3.2.1. Case selections

Against this background, we selected two distinct cases within the English NHS that represent different procurement situations, institutional settings and thus procurement challenges: the procurement of a technology to monitor cardiac activity during surgery (Doppler Monitor) to be used in hospital surgery settings, and the design and procurement of a new blood donor chair by the NHS Blood and Transplant Service.

The cases were selected after a broad scan of public procurement activities across the English NHS. The two cases were chosen to represent two different intermediation situations. The first case is about the attempts of buying and adopting an existing innovative technology for the first time on a larger scale outside dedicated pilot case settings, while the second one is about triggering and buying an innovation to fulfil a specific need. The case studies were conducted in 2010 and 2011. We examined a broad range of primary documents reflecting the case process and conducted twenty-four semi-structured interviews with context experts (in NHS procurement and NHS innovation) and key actors from the intermediary organisations, from different layers and functionalities across the buying organisations (including those actually using the innovation), from the supplying firms and relevant industry associations. In addition, we conducted ethnographic research observing important stages of the interactions and processes while they were unfolding.

3.2.2. First time procurement of a disruptive solution

The CardioQ-Oesophageal Doppler Monitor (hereafter referred to as the Doppler) is a technology that assesses the cardiac output of a patient to guide appropriate administration of fluid and drugs during surgery. It presents a less invasive way to measure cardiac output⁴ and there is convincing evidence of its clinical and economic benefit⁵ (NICE, 2011), not to mention delivering better patient outcomes and improving the patient experience. The Doppler is not a new technology per se; it already exists on the market. However, in line with our broad definition of innovation above (see also Bergek, 2014; Fagerberg, 2014), it is considered to be an innovation in this study as it is new to the buying and adopting organisation and, if adopted, it has a strongly disruptive effect

² For a comprehensive review of adoption barriers in the NHS, see Robert et al. (2009) and York Health Economics Consortium (2009).

³ For example, the NHS introduced an online tool to help increase the scale and pace of innovation adoption in the NHS, http://www.institute.nhs.uk/option.com.spread_and_adoption/Itemid,6946.html.

⁴ Compared to the use of a central venous line/catheterisation.

⁵ It is estimated that the use of the Doppler could save the NHS around £1100 per patient, based on a 7.5-day hospital stay and in comparison to a central venous catheter, leading to a potential saving throughout the NHS of over £410 m.

Box 1: The NHS Technology Adoption Centre (NTAC)

The NHS Technology Adoption Centre (NTAC) was established in 2007 with the remit of providing a more systematic approach to the adoption of technology in the NHS, particularly those that were under-utilised within the NHS. It enables organisations to better understand and overcome their adoption barriers, and helps to support the implementation of innovative technologies in NHS organisations. It also assists technology and diagnostics suppliers to navigate the complexities of the NHS. In 2013 it moved into the National Institute for Health and Clinical Excellence, NICE (see [Box 2](#)).

for organisational practices as it significantly changes work practices of different clinicians and the delivery of medicine and patient care. Despite its benefits, it has not been rolled out or adopted as widely as it could be, and there is only anecdotal evidence that some hospitals in the UK have used it. The main barriers identified in our interviews with clinicians, roadshow attendees and procurers and also expressed in a feasibility study conducted by the National Technology Adoption Centre (NTAC, 2010, see [Box 1](#)) for the purchase and adoption have been resistance by clinicians (particularly anaesthetists, who are often trained and experienced in using a different technology or method of fluid management) and a lack of training and resources available to apply the new technology. Furthermore, there were barriers stemming from the institutional complexity within an NHS hospital setting, with its multi-layered governance and vastly complex functional differentiation (e.g. cardiology, paediatrics, emergency medicine, general surgery), employing a wide range of healthcare professionals, from doctors to nurses and support staff. This resulted in a fragmented understanding of the cost-benefit of the Doppler, as it has different consequences for different functions and departments (i.e. separate budgets held for theatres, anaesthetics, surgical procedures and palliative care). While the Doppler enables and necessitates a re-design of previously unlinked enhanced recovery pathways, this institutional complexity stood in the way of a holistic understanding of the cost-benefit and business case.

There had previously been two large initiatives to try and tackle the problem of adoption and diffusion of the Doppler. First, in 2007, NTAC supported its implementation in three pilot NHS sites to understand and overcome the barriers to widespread adoption. In this pilot study, issues of silo-budgeting, often widespread in the NHS, were overcome by mobilising high-level managerial buy-in through getting Finance Directors to approve inter-department funding. Similarly, NTAC reported that a lack of confidence among anaesthetists to use the technology was addressed through a structured training programme delivered by the supplier. NTAC subsequently produced a How-To-Why-To Guide (NTAC, 2010) that hospitals and Trusts could download and use as guidance to support their own adoption of the Doppler (or similar) technology.⁶

The second initiative to overcome adoption problems for the Doppler was undertaken in the framework of the Innovation Technology Adoption Procurement Programme (iTAPP) set up by the Department of Health (DH) in 2009. iTAPP was an initiative of the DH's Procurement Investment and Commercial Division (PICD) in collaboration with NTAC and the medical technology industry, to facilitate the procurement, implementation, adoption and diffusion of innovative medical devices (as part of the National Innovation

Procurement Plan)⁷ in a more coherent manner across the NHS through the ten English regional Strategic Health Authorities⁸ (DH, 2009). The initiative was embedded within the local implementation of a broader NHS strategic agenda to improve Quality, Innovation, Productivity and Prevention (QIPP) within the NHS. Industry suppliers of health technologies and products were invited to recommend innovations already on the market or in the pipeline that could increase quality and reduce cost for the NHS if rolled out; the Doppler being one of them. The iTAPP team then produced a long list of technologies and each SHA selected up to three technologies to take forward to implementation. A Regional Innovation Fund was also created alongside to support faster innovation and more widespread diffusion of best practice among (and throughout) each of the ten regions. Up to £15,000 was available to assist regional SHAs in adopting any of the technologies on the iTAPP list.

In 2011, the East Midlands SHA selected the Doppler from the iTAPP list as one of the three technologies to implement and diffuse in its region as part of its delivery of the Enhanced Recovery After Surgery (ERAS) Programme. NTAC was commissioned by DH to support the SHA in pushing the adoption of the Doppler throughout the region using their experience with the pilot implementation and in line with their role as a technology enabler.⁹ The process was first approved at SHA level by the regional Clinical Cabinet, Planned Care Board and various Trust Chief Executives in the region. This, however, only functioned as guidance for the lower levels where the actual budget holders for purchasing decisions sit (in the hospitals within Trusts). An implementation project team was put together consisting of people with different specialities and from different areas of healthcare. Their goal was to engage various stakeholders (e.g. surgery leads, anaesthetists, procurement leads, ERAS Programme leads within Trusts) through a series of Trust-based road shows to showcase the evidence base of the technology and to provide support for the negotiation in what many interviewees describe as the “minefield” of NHS procurement to finally enable its adoption and diffusion. A project manager within East Midlands SHA was appointed, and worked closely with an NTAC technology implementation manager to develop an overarching implementation plan across all Trusts and hospitals, and subsequent individual implementation plans for hospitals that are keen to take the project forward. There was also a clinical lead in the project team whose role was to act as a ‘clinical champion’.

One of the main challenges encountered by the implementation team was the view by clinicians that the procurement process was often too bureaucratic and complicated; a point repeatedly stressed by clinicians attending the road shows. Even in cases where the clinicians were convinced of the benefits of the Doppler, many of them argued that the landscape was too complex and they did not have the knowledge or expertise (or time or inclination) to present the relevant business case in the best way. Such a problem could be overcome through the project implementation team, who would have the dedicated time and resources to devote to take the adoption forward, for example, by providing help and experience in writing a business case, as well as mobilising the relevant people in

⁷ The IPP were mandatory plans for each national UK department to spell out the innovation procurement strategy. A change of government subsequently led to their disbandment.

⁸ This would be done through an SHA innovation lead located within each Authority, who is employed to deliver the SHA's legal duty to promote innovation, raise the profile of innovation and encourage a more rapid adoption of innovation throughout the NHS.

⁹ If a Trust or hospital commits to adopting and implementing the technology, NTAC's role would be to provide project support in terms of putting in place a local champion that would run the project and also support other activities such as bring together a team of representative stakeholders, getting a good baseline of metrics in place, establishing a proper project plan with defined goals over a period of time, and formulating a communication plan.

⁶ In addition, NTAC also created an ‘adoption pack’ with more prescriptive guidance about the steps an acute organisation needs to take in order to start using, or increase their use of, these technologies.

Box 2: The National Institute for Health and Clinical Excellence (NICE)

The National Institute for Health and Clinical Excellence (NICE) was set up as Special Health Authority funded by the Department of Health in 1999 to reduce variation in the availability and quality of NHS treatments and care. NICE develops evidence-based guidelines on the most effective ways to diagnose, treat and prevent disease and ill health. While NICE has a strong history in setting standards for high-quality care in the NHS, recommendations on drugs and guidance on public health, more recently the institute has also provided guidance on medical technologies with the objective of opening up access to new or innovative medical technologies and devices on the NHS. In 2013 NICE became a Non-Departmental Body with an expanded remit to include guidance and quality standards in social care.

the Trusts and hospitals to take things forward. Findings from the NTAC pilot study (NTAC, 2010) indicated that the development of a strong business case was essential to obtain senior management support to overcome the issue of silo budgeting. This was a point of focus for the East Midlands SHA implementation team in this second initiative.

Consistent with findings from the NTAC pilot study, the implementation team found that resistance to use of new technologies by clinicians, particularly anaesthetists, was prevalent (NTAC, 2010). The majority of those interviewed stressed that clinical buy-in was the most important yet most challenging barrier to overcome. This was a view shared not only by hospital administrators and managers, but also by clinicians themselves. In the pilot study, concerns about the technology were overcome through peer-led training (NTAC, 2010). In the case of the East Midlands SHA, an anaesthetist consultant was appointed as the clinical lead for the project, who acted as a “champion” to help overcome this problem as it was felt that having someone who “spoke their language” made the evidence base more relevant to the clinicians.

In a complementary move, the National Institute for Clinical Excellence (NICE – see Box 2) published guidance¹⁰ on the Doppler (MTG 3) and offered several tools to help organisations put the guidance into practice. The SHA implementation team suggested that NICE guidance might act as an incentive for those who are sitting on the fence and act as a lever for those who are really keen to use it but struggle to gain the support of their Trusts.

To date, a lot of progress has been made with regards to the ERAS Programme and the intermediation has brought about awareness; however, at the time of writing there was still no concrete commitment from a specific organisation within the region to take up the offer from NTAC to help them with the process of adopting the technology. Reasons cited by the implementation team and hospital administrators include persistent resistance of users in the operating theatre and of financial directors to commit to this technology. Despite a clear economic and clinical case, the intermediation did not succeed in convincing the multiplicity of actors that need to learn, adopt and act. Our data suggest that the main reasons for this were the high learning costs at various levels, the fragmentation of responsibility for finances and for health benefits, the lack

¹⁰ NICE produces guidance in five main areas, including medical technology guidance (MTG). MTG considers a single medical device or diagnostic technology (notified to NICE by manufacturers) which provides equivalent or enhanced clinical outcomes at equivalent or reduced cost. The outcome is specific recommendations on the adoption of the technology; however “the specific recommendations on individual technologies are not intended to limit use of other relevant technologies which may offer similar advantages” (NICE, 2011, <http://guidance.nice.org.uk/MTG3>).

of sufficient involvement or pressure from the user group and the absence of any pressure from the end beneficiaries (the patients). While there has been some learning effect – the system has been pushed and is now willing to consider innovation to tackle the issue – there has not been a widespread adoption of a specific solution.

3.2.3. Procurement triggering innovation

NHS Blood and Transplant (NHSBT) is a special health authority set up to provide a limited set of clearly defined services nationally (in this case for England and Wales). It is less fragmented and institutionally complex compared to an NHS Trust and accountable directly to the NHSBT Board, but nonetheless has differentiated service provision units and supporting functions such as procurement. For many years, NHS Blood and Transplant searched to procure a new blood donation chair to replace their current beds, one that would fit a modern environment, satisfy all the health and safety issues and concerns, and improve their service delivery efficiency.¹¹ The search in the market was unsuccessful; several chairs with different designs existed in the market, many were bought and trialled but none was deemed suitable for the organisation.¹² Following a traditional procurement route, i.e. purchasing ‘off-the-shelf’, had not worked. The inability to formulate the concrete need and to articulate it to the market resulted in several failed procurement attempts that wasted time, money and resources. The organisation also tried to work with their incumbent supplier to design a new chair but to no success. There was a concern by the Assistant Director of Nursing that a failure to procure a new chair to meet their changing needs could impact on their service delivery efficiency. The idea to get a bespoke design met with resistance within NHSBT. The procurement team had never done this and objected for fear of risk and costs. Further, they were sceptical and questioned the strategy to go beyond what was already in the market, doubting that there was no product available on the market that was suitable and that could be purchased. The procurement team did not understand why the user needs could not just be written into a specification that would mobilise a supplier to develop and provide it. In 2009, the Assistant Director of Nursing became aware of the National Innovation Centre (NIC; see Box 3) and its role in the NHS innovation process and realised they could assist NHSBT in getting a bespoke chair designed, built and procured.

From a clinical and operational perspective, the Assistant Director of Nursing had a clear idea about what functionalities the chair would have to deliver, but was unable to translate that into clear technical specifications. She lacked the necessary skills for this, and could not assess how the various functions would be best delivered. NIC presented to NHSBT the possible options available to procure a new chair, making sure they had already considered ‘conventional’ procurement routes and framework agreements. NIC then introduced a five-step process (known as WIBGI¹³), which would allow NHSBT to get a prototype of a bespoke design produced, tested, and eventually procured. WIBGI is a formal process in which relevant stakeholders are invited to participate in a workshop to identify, validate and rank the clinical needs of the innovation

¹¹ Blood donation is conducted in a variety of locations and environments, e.g. mobile sessions, donor centres, blood mobiles, and would also be either whole blood or component donation sessions. Therefore, some of the requirements for the new chair related to ease of mobility, storage, transport, comfort and safety for those using it (both the donor and the staff). Improving faint rates was also high on the agenda; research has found that collecting blood in a horizontal position (i.e. on a bed) was not good clinical practice.

¹² Purchasing an existing chair on the market that did not wholly meet its needs would mean significant compromises to NHSBT standards and strategic objectives around donor safety.

¹³ WIBGI stands for “Wouldn't It Be Great If...”.

Box 3: The National Innovation Centre (NIC)

The NIC was part of the NHS Institute for Innovation and Improvement (NHSI) and was established in 2004 as part of a wider initiative to address the issue of the NHS being a late and slow adopter of innovation. Its role was to work with innovators to develop a product or process innovation, and subsequently work with NHS customers to get that innovation adopted and used. While procurement was not within the remit of NIC, at the time they had been granted special powers by the Secretary of State for Health to support the generation of innovative solutions. The main procedure with which this should be achieved was for them to design and support a so-called pre-commercial procurement (PCP) process that would lead to a prototype and a clear understanding of needs as well as of what would technically be feasible. NIC considered two paths to the development of technological innovation that can benefit the health sector – reactive and proactive paths. The reactive model aimed to “receive” innovative ideas and solutions from industry, which the NIC then supported through awarding funding for further development or establishing contact with other experts or the NHS for collaboration or to conduct trials. The proactive model sought to develop a solution for a need and requirement which the current marketplace could not meet.

Following a Review of Arm’s Length Bodies by the UK Coalition government concluded that NHSI would be abolished in 2012. Since January 2012, NIC has become an independent mutual organisation, ICONIC. They continue to support innovators of healthcare technology and work with NHS organisations to drive greater savings for the NHS through innovation.

in question, ranging from those that are essential to those that are “nice to have”. It has elements that are very similar to a pre-commercial procurement (PCP) approach,¹⁴ as it leads to the design of a prototype solution, thereby reducing risk and allowing interaction in the service provision process to ensure needs are clearly met. However, while PCP initiatives normally end with the production of a prototype, rather than leading to a purchase of an innovative solution, the objective of the NHSBT process was from the outset to procure the designed chair on a larger scale, after initially testing and trialling it on a smaller scale. Therefore, this is a case of a procurement that triggered innovation, with a design contest as an initial, separate step of the procurement process to reduce risk.

The need to get new blood donor chairs was established as a strategic change project, and the NHSBT “Change Programme” board approved the initial prototype and testing phase. NIC then supported NHSBT to conduct a ‘WIBGI’ workshop to identify, validate and rank the concrete clinical needs of the new chair. Using this interactive approach allowed NHSBT to firstly specify requirements in a step-wise, iterative process that more fully reflected the various needs for the chair. NIC further conducted a formal needs assessment review, including a review of the existing and upcoming market solutions. Based on the evidence, NIC concluded that there was no technology already available on the market that could meet NHSBT’s need, and this enabled NHSBT to move on to the next step of getting a bespoke product designed.

¹⁴ Pre-commercial procurement approaches, like the UK Small Business Research Initiative, are programmes of open competitions whereby a “challenge” is set to stimulate the creation of innovative new products and services. They result in a fully funded development contract between the winning company and government department and give vital funding for the critical stage of product development, ideally resulting in a prototype of a commercial product or service. The actual PCP does not include the manufacturing and buying of the innovation (and thus PCP schemes as such are not procurement of innovation), but the basic idea of PCP is to lead build up sufficient interest in the prototype that was developed leading to demand and purchase. For more information see Rigby (2016).

NIC then approached two design houses with the new specification on behalf of NHSBT, and each was invited to produce several designs for a chair that would meet the requirements as specified so far. Subsequently, NHSBT commissioned one design from each company to be turned into a prototype to be tested. A project manager was employed by NHSBT to oversee the management of this testing phase and undertake any other work necessary, e.g. preparing a business case, to proceed to the commercial procurement stage. After a series of feedback loops with the design house that won the competition, one prototype was successfully finalised. Subsequently, NHSBT conducted a commercial procurement for a small-scale order, which was trialled by three teams over 12 weeks. The process and outcomes were managed by the NHSBT project manager. This was followed by a final delivery for the full order of chairs in December 2011, and the new chairs were rolled out to all donation teams and are now fully operational in all units.

This entire process was new to NHSBT, where previously products were chosen in traditional procurement procedures and rolled out through the organisation without a proper trial and improvement phase. Through separating the design phase and the procurement phase of the new donation chair, this approach allowed multiple specific service contracts to compete for the best designs, established a close interaction between the public agency and those working on a solution, and led to sharing the risks and benefits.

4. Analysis

4.1. Understanding intermediation

The two cases have illustrated the need for intermediation as well as the benefits and shortcomings of different intermediation modes. Both cases have shown various different intermediation roles throughout the procurement process, which were performed not by one intermediary, but by different actors over time. Following our initial framework of intermediation (Section 2.1) and the challenges of innovation procurement (Section 2.2), the two cases now allow us to understand and conceptualise intermediation in the public procurement of innovation more systematically, with implications for intermediation on the demand side of innovation more generally.

In the case of *procuring an existing innovation* – the *Doppler case* – we see an interplay of external and internal intermediation at different levels. The procurement and adoption challenge in the Doppler case stemmed from the severe disruption in internal processes and skills, and thus high adaptation costs. First, the iTAPP programme created awareness among the potential user community about the availability of solutions and mobilised this community to react to the solution offered. This was achieved mainly by creating a forum and entry point for suppliers. Further, there was an element of trust building which was based on an internal peer review procedure for the technologies on offer and through the link to the activity of NTAC. The NTAC pilot provided the data and demonstration needed to reduce the risk (NTAC, 2010). This intermediary function produced codified, standardised references and a process manual as a public good to be taken up by all (potential) buying organisations to be used in their business case and it enabled internal communication about the added benefit of new technology. In a next step, NTAC provided more direct, one-to-one support for a bundle of buying organisations within one Strategic Health Authority. The attempt here was to insert technology, market and process related competencies into the process. It also supported an internal project management team that sought to link and coordinate different constituencies across the different levels within the public organisation and to act as process facilitator.

Following the established seven-step model of intermediation in the innovation purchase process as outlined by Bessant and Rush (1995, see Fig. 1), intermediation through NTAC and iTAPP in the Doppler case helped to recognise the requirements of the technology, explore the market and create awareness, compare solutions and selected a solution on the basis of a business case and a risk assessment. In the Doppler case, intermediation supported a discourse across levels and between units in the NHS region, combined with some strong leadership at trust level and buy-in at the regional (SHA) and national (DH) level.

Yet, acquisition, the next step, did not take place as broadly envisaged. The inbuilt institutional obstacles to innovation adoption as outlined above still stood in the way of diffusion on any meaningful scale. While no longer a market novelty, the Doppler still required considerable change in actor capabilities and behaviour and presented challenges for organisational practice and financial management in the adopting organisation. The main bottleneck lay in the limited adjustment of user (i.e. clinicians) capabilities and user learning. The structural problem was that the intermediation could not overcome the gaps produced by internal functional differentiation, as the actual users were not involved in the broader intermediation process. Furthermore, there was an inability to define a widely shared holistic business case that gave the overall net benefit of the Doppler priority over the learning and adaptation costs in various different departments. Together, this resulted in insufficient pressure on budget holders to actually make a purchase.

In the case of *procurement that triggered innovation* there were additional challenges for the functions of intermediation. The challenges here stemmed not so much from internal disruption in using the new solution, but from the difficulty to define the concrete need, to convince the internal procurement function about the need to have a new solution defined and to interact with the market. When procuring the blood donation chair, the main challenge was a sound understanding of the need as a prerequisite to send signals to suppliers. Intermediation here meant using market players for the specification of the need. Specification of the need involved not just a clear cut technical list of requirements, but a process that allowed for joint learning between the design company and the various actor groups within the buying organisation (NHSBT). Intermediation through the NIC brought together the relevant stakeholders in a session that resulted in an explicit definition of the clinical needs. On that basis, the NIC further conducted due diligence and identified suitable companies for what essentially was a design contest. The NIC provided process expertise linked to the technical expertise available in the marketplace rather than providing it themselves. Furthermore, managed the early phase of interaction between the buyer and designer (and subsequent producer). Importantly, this first phase was complemented by an internal project manager in NHSBT who took over the external intermediation with the design company. He also intensified the internal intermediation by establishing a series of feedback loops and intra-organisational interactions that helped to refine the design, bundle expertise and create further awareness across the buying organisation. The main feature in this intermediation process was process learning that resulted in a change of procurement practice more generally. As a result of working in this new way with NIC, NHSBT saw an opportunity to use the NIC process to procure other pieces of kit to support blood donation. The result was the development of a Session Environment Design Authority (SEDA) within NHSBT, which subsequently took on some of the intermediary functions through testing of innovations and trust building exercises. An external intermediation not only succeeded in delivering a new technology, it also led to institutional learning for future processes.

4.2. Conceptualising intermediation needs

The analysis above in conjunction with the initial conceptualisation (Sections 2.1 and 2.2) allows us to synthesise more systematically the requirements for intermediation in PPI. In any concrete case of public procurement of innovation, the intermediation need and the success of procurement depend on a large number of idiosyncratic conditions as well as the existing capabilities and governance processes within the buying organisation to fulfil the learning and linkage requirements.

We have seen from *both* cases, that buying something that is novel to the organisation necessitates some basic level of *cross-organisational communication* and *co-ordination* about the *added overall benefit of the innovation* and *need for internal organisational adaptations*, sufficient evidence of its *technical reliability* and its long term *advantageous value for money proposition* and *basic adjustment of user capabilities*.

The discussion of our two cases, however, suggests that the learning and adaptation costs, and thus the nature of the concrete intermediation needs, are strongly influenced by two conditions: (1) the degree of internal organisational disruption and (2) the need to specify internal needs and interact with the market to find new, tailored solutions.

The case of the Doppler best illustrates a *high degree of internal organisational disruption* caused by the purchase and use of the innovation. A market solution already existed, with demonstrated technical feasibility and an established business case and thus little demands for additional external intermediation. However, the adoption and use of the Doppler was disruptive for the organisation. This posed some severe internal challenges¹⁵ in terms of:

- high demand on changes of *role descriptions, routines and practices* across parts of the organisation,
- correspondingly high demand on *internal coordination* at all levels of the organisation to prepare for that change and re-define interactions and interfaces,
- access for all units and individuals affected to the *available intelligence* about the reliability and the business case of the solution and *translation* into the conditions of the organisation,
- help to reduce the risk of organisational adoption failure.

The limits of intermediation in cases of high internal disruption have been shown in the Doppler case. The multiple intermediation efforts did not overcome the adoption bottlenecks stemming from deeply rooted institutional features in multi-layered organisations, such as a disconnect between strategic guidance (SHA, DH), budget holders/decision makers, users (clinicians) and beneficiaries (patients), compounded by a lack of adjustment pressure that would have to be exerted by binding authoritative power. Internal linkages, support for learning and some additional pressure on the actor groups involved, e.g. performance indicators that force budget holders and clinicians to adopt, would have been needed to overcome the “normative and cognitive gaps” (Howells, 2006) and turn around the innovation-hampering incentive structures within public organisations.

The second condition that determining intermediation requirements is the need to *define internal needs* and master *technical and economic uncertainty associated with market novelties*. This ranges from established products and services that are nonetheless novel to the buying organisation (*procurement responding to innovation*)

¹⁵ To be sure, the blood donor case also needed some basic internal adjustment of routines of nurses and technical staff responsible for setting up mobile blood donor processes, but those adjustments were relatively minor and did not necessitate a re-definition of internal functions.

Table 1
Four roles of intermediation in PPI and different procurement situations.

Roles of intermediation in PPI		Procurementresponsive to innovation
		...triggering innovation	...innovation
(1) Performer:	Performing procurement through the cycle (or parts thereof) for and with public bodies, conducting project management	In cases of little or no internal experience, capacity and willingness	More important in cases of high internal disruption
(2) Broker	External brokering: linking to external market players (suppliers) Internal brokering: linking functions and constituencies within the public organisation	Search for solution and potential providers of solutions, signal to suppliers	Formulating internal adaptation needs, translating of business case.
(3) Content Expert	Provision of specialist technology or market expertise to support search process and business case Provision of specialist diagnostic expertise , supporting the definition of needs (for innovation) and procedural bottlenecks for implementation	Need definition, translation into tender, adoption.	Business case and support of adoption process
(4) Trainer:	Activities performed are also intentionally geared to the build-up of capabilities for future procurement processes within the buying organisation, over time transferrable expertise through the system	Very broad market knowledge for open search Need definition as the most important step. Implementation and adaptation support depending on the complexity of organisational change Build-up of process and management capability and market knowledge	Specialised market knowledge Differentiating the business case across the organisation internally Build-up of skills for business case definition
		Build-up of process capabilities for organisational change	

to situations in which the needs of the buying organisation can only be met if suppliers generate a novel solution altogether (procurement *triggering* an innovation). The blood donor chair case illustrates the *specific demands* on intermediation if an organisation seeks a *solution that is not yet available on the market*. This case was characterised by:

- a demand for *high sophistication* to understand one's (future) need and market options already available;
- a process of pro-active, *sustained interaction between buyer and suppliers* (both established and potentially new), with feedback loops and de facto a co-construction of the solution;
- repeated *interaction with citizens/patients* to support internal learning;
- development of a *tailored business case* justifying the purchase,
- a process of *internal coordination* sustained over time, including the various functions involved in *defining the need* for a novel solution and those responsible for the actual procurement process,
- all of which helped to reduce technical, performance and economic risks (in addition to internal adoption risks as outlined above).

These observations now allow us to conceptualise the different roles of intermediation in different procurement situations.

4.3. Conceptualising intermediation roles

Based on the case discussions and a more systematic understanding of intermediation needs, four different roles for intermediation in public procurement of innovation can finally be distinguished (Table 1).¹⁶ Again, the importance for those roles is slightly different between triggering and responsive procurement, and it will depend on the level of existing abilities to learn and link within the buying organisation and on the level of disruption the innovation would cause. Further, these intermediation roles can be played by different intermediaries.

First, intermediaries can actually *perform* the procurement process, partly or entirely. As in the case of the donor chair, this will be reasonable for disruptive innovations that need to be generated by suppliers and necessitate sophisticated market interaction that cannot be provided by internal capabilities and structures. Second, intermediaries as *brokers* provide linkages as the classic “middleman” (Howells, 2006) between the buyer and the (potential) suppliers and – often neglected – between organisational units within the organisation. In our donor chair case, the project manager employed had this function through the latter stage of the process. Third, the intermediary as content expert would not link actors, but provide the necessary intelligence especially for the buying organisation to define needs, to assess options, and to inform their business case and the internal and external interactions. This was the case with the NTAC and iTAPP process in the Doppler case. Fourth, the intermediary can be a *trainer*, empowering the organisation that is supported to build up the process capacities which subsequently allow the buying organisation to learn and to link more independently. This transfer of intermediation capability through the system, provided through intermediation processes, means in essence that external intermediation would work best if it renders itself redundant in the process.¹⁷ While this was not

¹⁶ This typology of intermediation roles is based on, but exceeds Bessant and Rush (1995, pp. 101–102).

¹⁷ As our cases are confined to individual organisations, we have not expanded the concept to situations of cooperative procurement, whereby intermediation would have to support the coordination of a group of purchasers, and requirements and

the explicit remit of the NIC in the donor chair case, the transfer of procurement skills is exactly what happened.

5. Conclusions

In this paper we have analysed intermediation to link demand and supply in the procurement of innovation and further conceptualised the needs for and roles of innovation intermediation. We have focused on public procurement and on the perspective of the public buyer. We have initially claimed, based on existing empirical literature, that intermediation is crucial for procuring innovation, but entirely underdeveloped in the existing literature both on innovation intermediation and on public procurement of innovation.

Our discussion has shown that we need to broaden our understanding of intermediation to support the initiation and diffusion of innovation in the marketplace. When analysing and when supporting the procurement of products (or services) that are novel for the buying organisation, we need to differentiate on various dimensions: we need to look carefully if the purchase is about an existing solution that is new to the public organisation, or if the procurement triggers the generation of an innovation, and we need to understand how disruptive the innovation that is bought is for the practices across the buying organisation. Our cases have shown that the challenges increase if the procurement triggers the generation of an innovation and with increasing level and breadth of internal disruption it causes. We also need to distinguish the different roles intermediation can play and match those roles against the organisational capabilities that exist in the buying organisation and the internal diversity and complexity of that organisation. Only if we take all those dimensions into account can we assess the need for intermediation both externally and within the organisation. Our discussion has also emphasised that intermediation is not only about the linking of actors, but also about the enabling of actors to link.

The multi-dimensional differentiation of intermediation needs and functions that we have offered here complements the general literature on intermediation that has as yet failed to zoom in sufficiently into procurement processes (e.g. Howells, 2006; van Lente et al., 2003) or to differentiate between different types of innovation and demand situations (Bessant and Rush, 1995). The next step would be to test and further develop the intermediation function in the process of asking for and buying an innovation more generally, especially with regards to large private organisations.

The intermediation requirements identified in this article are manifold, and public organisations can be supported through policy initiatives. In both cases we have seen that public procurement of a product (or a service) that is novel to the buying organisation is characterised by *capability gaps* and *poor linkages*. The technological, economic and process capabilities that public bodies require to *understand what their need is* (as demonstrated especially in the donor chair case), and to be able to *ask for, adopt and use* an innovation (as demonstrated especially in the Doppler case) are considerable, and they change over time. We have seen that buyer organisations need to *link different internal stakeholders*. In both cases, the buying organisation needed support to *link with the market actors* which (potentially) supply the innovation. Even if organisations in principle were willing to procure more innovation, and even if individual actors and units have sophisticated capabilities, they are overwhelmed by the linkages and capabilities challenges faced.

Against this background and given the stated political intention in many OECD countries to improve the ability and willingness of

challenges would multiply. For a complex – and largely failed – example see Rolfstam et al. (2011).

public sector organisations to ask for, buy and adopt innovation in the public sector (OECD, 2011; Edquist et al. 2015), the policy consequences out of all this are compelling. Public procurement of innovation needs an intermediation structure that is appropriate to support public bodies across the various procurement situations and their corresponding challenges as defined above. These supporting structures would have to adhere to a set of design principles, such as impartiality and neutrality in the marketplace, accessibility and trustworthiness and would need to have access to the sources of expertise and knowledge needed (Klerkx and Leeuwis, 2009; Winch and Courtney, 2007). This infrastructure could provide specialised process capabilities and technological, economic and market knowledge across different technologies and sectors, and support for interaction. It would have to be designed as an enabler, and provisions would be needed to avoid potentially counter-productive effects such as a simple “outsourcing” of procurement. Such a structure would have to be made up of a limited set of flexible organisations that could accommodate the different situations and challenges as already illustrated in our two cases, not one “super-intermediator”. Not only could this then support organisations on the demand side, it could also act as a transmission belt of good practice and, above all, by supporting concrete procurement processes it could support the learning process in organisations to build up capacity for self-managed procurement in the future, as successfully demonstrated in the donor chair case.

One of our examples, the Doppler case, has shown that even a set of complementary intermediation efforts can be insufficient. Intermediation is not a panacea, as attitudes, incentive structures and capabilities would still need to be changed more generally across the public sector. However, the lack of such a supporting intermediation structure across OECD countries surely is a major reason for the poor practice when it comes to buying innovation in the public sector. Investing in it could have a lasting catalytical effect across the public sector. To do so, the next step is to work towards a better understanding of the conditions that determine the effectiveness of intermediation between demand and supply of innovation.

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References

- Allman, K., Edler, J., Georghiou, L., Jones, B., Miles, I., Omidvar, O., Ramlogan, R., Rigby, J., 2011. *Measuring Wider Framework Conditions for Successful Innovation: A System's Review of UK and International Innovation Data*. NESTA, London.
- Aschhoff, B., Sofka, W., 2009. *Innovation on demand – can public procurement drive market success of innovations?* Res. Policy 38, 1235–1247.
- Bergek, A., 2014. *Technological Dynamics and Policy: How to Derive Policy Prescriptions*. Presentation at the Lundvall Symposium, Aalborg.
- Bessant, J., Rush, H., 1995. *Building bridges for innovation: the role of consultants in technology transfer*. Res. Policy 24, 97–114.
- Bonaccorsi, A.C., Molinari, F., 2011. *The Challenges of Bringing Innovation through Public Procurement at Regional Level*. Early Experiments in Italy.

- Chapain, C., Cooke, P., De Propis, L., MacNeill, S., Mateos-García, J., 2010. *Creative Clusters and Innovation – Putting Creativity on the Map*. NESTA, London.
- Chesbrough, H.W., 2003. *Open Innovation – The New Imperative for Creating and Profiting from Technology*. Harvard Business School Press, Boston, MA.
- DH, 2009. National Innovation Procurement Plan. http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_109969 (accessed 30.06.10).
- DH, 2011. Innovation, Health and Wealth, Accelerating Adoption and Diffusion in the NHS. <http://www.institute.nhs.uk/images/documents/Innovation/Innovation%20Health%20and%20Wealth%20-%20accelerating%20adoption%20and%20diffusion%20in%20the%20NHS.pdf> (accessed 15.02.12).
- Díaz-Puente, J.M., Cazorla, A., de los Ríos, I., 2009. Policy support for the diffusion of innovation among SMEs: an evaluation study in the Spanish Region of Madrid. *Eur. Plan. Stud.* 17, 365–387.
- Edler, J., Gee, S., 2013. *Public Procurement and the Co-production of Process Innovation*, Manchester (unpublished manuscript).
- Edler, J., Georghiou, L., 2007. Public procurement and innovation – resurrecting the demand side. *Res. Policy* 36, 949–963.
- Edler, J., Ruhland, S., Hafner, S., Rigby, J., Georghiou, L., Hommen, L., Rolfstam, M., Edquist, C., Tsiopouri, L., Papadokou, M., 2005. *Innovation and Public Procurement. Review of Issues at Stake. Study for the European Commission Final Report*. European Commission, Brussels.
- Edler, J., Uyarra, E., 2013. Public procurement of innovation. In: Brown, L., Osborne, S. (Eds.), *The Handbook of Innovation and Change in Public Sector Service*. Edward Elgar, Cheltenham, pp. 224–237.
- Edquist, C., 1997. *Systems of Innovation: Technologies, Institutions and Organisations*. Routledge, Abingdon.
- Edquist, C., Hommen, L., 1998. *Government Technology Procurement and Innovation Theory*, Paper for the project “Innovation Systems and European Integration (ISE)”, Linköping.
- Edquist, C., Hommen, L., Tsiopouri, L., 2000. *Public Technology Procurement and Innovation*. Kluwer Academic Publishers, Norwell, MA.
- Edquist, C., Zabala-Iturriagaitia, J.M., 2012. Public procurement for Innovation as mission-oriented innovation policy. *Res. Policy* 41, 1757–1769.
- Edquist, C., Vonortas, N., Zabala-Iturriagaitia, J.M., Edler, J. (Eds.), 2015. *Public Procurement for Innovation*. Edward Elgar.
- Fagerberg, I., 2014. *Innovation Policy: In Search for a Useful Theoretical Framework*. Presentation at the Lundvall Symposium, Aalborg.
- Ferlie, E., Fitzgerald, Z., Wood, M., 2000. Getting evidence into clinical practice: an organisational behaviour perspective. *J. Health Serv. Res. Policy* 5, 96–102.
- Ferlie, E., Fitzgerald, Z., Wood, M., Hawkins, C., 2005. The (non) spread of innovations: the mediating role of professionals. *Acad. Manag. J.* 48, 117–134.
- Freeman, C., 1995. The ‘national system of innovation’ in historical perspective. *Camb. J. Econ.* 19, 5–24.
- Georghiou, L., Edler, J., Uyarra, E., Yeow, J., 2013. Policy instruments for public procurement of innovation: choice, design and assessment. *Technol. Forecast. Soc. Change*, <http://dx.doi.org/10.1016/j.techfore.2013.09.018>.
- Geroski, P.A., 1990. Procurement policy as a tool of industrial policy. *Int. Rev. Appl. Econ.* 4, S182–S198.
- Gibbons, M., Limoges, C., Nowotny, H., Schwartzman, S., Scott, P., Trow, M., 1994. *The New Production of Knowledge*. Sage, London.
- Greenhalgh, T., Robert, G., Bate, P., Kyriakidou, O., Macfarlane, F., Peacock, R., 2004. *How to Spread Good Ideas: A Systematic Review of the Literature on Diffusion, Dissemination and Sustainability of Innovations in Health Service Delivery and Organisation*. National Co-ordinating Centre for NHS Service Delivery and Organisation R&D, Southampton.
- Hargadon, A.B., 1998. Firms as knowledge brokers: lessons in pursuing continuous innovation. *Calif. Manag. Rev.* 40, 209–227.
- Hargadon, A.B., Sutton, R.I., 1997. Technology brokering and innovation in a product development firm. *Adm. Sci. Q.* 42, 716–749.
- Hekkert, M., Suurs, R.A.A., Negro, S.O., Kuhlmann, S., Smits, R., 2007. Functions of innovation systems: a new approach for analysing technological change. *Technol. Forecast. Soc.* 74, 413–432.
- HITF, 2004. *Better Health Through Partnership: A Programme for Action*. Final Report. Department of Health, London.
- Howells, J., 2006. Intermediation and the role of intermediaries in innovation. *Res. Policy* 35, 715–728.
- Izask, K., Edler, J., 2011. Trends and Challenges in Demand-Side Innovation Policies in Europe: Thematic Report 2011 Under Specific Contract for the Integration of INNO policy Trendchart with ERAWATCH (2011–2012), Brussels.
- Klerkx, L., Leeuwis, C., 2008. Matching demand and supply in the agricultural knowledge infrastructure: experiences with innovation intermediaries. *Food Policy* 33, 260–276.
- Klerkx, L., Leeuwis, C., 2009. Establishment and embedding of innovation brokers at different innovation system levels: insights from the Dutch agricultural sector. *Technol. Forecast. Soc.* 76, 849–860.
- Kline, S.J., Rosenberg, N., 1986. An overview of innovation. In: Landhu, R., Rosenberg, N. (Eds.), *The Positive Sum Strategy: Harnessing Technology for Economic Growth*. National Academy Press, Washington, DC, pp. 275–305.
- Kyratsis, Y., Ahmad, R., Holmes, A., 2010. *Understanding the Process of Innovation Adoption in 12 NHS Trusts – Technology Selection, Procurement and Implementation to Help Reduce HCAs*. CIPM, London.
- Lember, V., Kalvet, T., Kattel, R., 2011. Urban competitiveness and public procurement for innovation. *Urban Stud.* 48, 1373–1395.
- Lember, V., Kalvet, T., Kattel, R., Penna, C., Suurna, M., 2007. *Public Procurement for Innovation in Baltic Metropolises – Case Studies*, Tallinn.
- Lichtenthaler, U., Ernst, H., 2008. Intermediary services in the markets for technology: organizational antecedents and performance consequences. *Organ. Stud.* 29, 1003–1035.
- Liddell, A., Adshead, S., Burgess, E., 2008. *Technology in the NHS: Transforming the Patient's Experience of Care*. The King's Fund, London.
- Lundvall, B.-A., 1988. Innovation as an interactive process: from user–producer interaction to the national innovation systems. In: Dosi, G., Freeman, C., Nelson, R.R., Silverberg, G., Soete, L. (Eds.), *Technical Change and Economic Theory*. Lynx, L.H., Reddy, N.M., Aram, J.D., 1996. Linking technology and institutions: the innovation community framework. *Res. Policy* 25, 91–106.
- Mantel, S.J., Rosegger, G., 1987. The role of third-parties in the diffusion of innovations: a survey. In: Rothwell, R., Bessant, J. (Eds.), *Innovation: Adaptation and Growth*. Elsevier, Amsterdam, pp. 123–134.
- Miles, I., Kastrinos, N., Flanagan, K., Bilderbeek, R., den Hertog, P., Huntink, W., Bouman, M., 1995. *Knowledge-Intensive Business Services: Users, carriers and sources of innovation*. DG13 SPRINT-EIMS.
- Miles, I., Wilkinson, C., Edler, J., Bleda, M., Simmonds, P., Clark, J., 2009. *The Wider Conditions for Innovation in the UK: How the UK Compares to Leading Innovation Nations*. NESTA Index Report. NESTA, London.
- Morgan, E., Crawford, N., 1996. Technology brokering activities in Europe – a survey. *Int. J. Technol. Manag.* 12, 360–367.
- Nelson, R.R., Winter, S., 1982. *An Evolutionary Theory of Economic Change*. Harvard University Press, Cambridge, MA.
- NICE, 2011. *CardioQ-ODM Oesophageal Doppler Monitor*, NICE Medical Technology Guidance 3. <http://guidance.nice.org.uk/MTG3/Guidance/pdf/English>.
- NTAC, 2010. *Doppler Guided Intraoperative Fluid Management. Improving Surgical Outcomes, Reducing Hospital Stay*, Available from: www.technologyadoptionhub.nhs.uk/doppler-guided-intraoperative-fluid-management/executive-summary.html.
- OECD, 2011. *Demand Side Innovation Policy*. OECD, Paris.
- 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.
- Prandelli, E., Sawhney, M., Verona, G., 2008. *Collaborating with Customers to Innovate: Conceiving and Marketing Products in the Networking Age*. Edward Elgar, MA.
- Rigby, J., 2016. Review of pre-commercial procurement approaches and effects on innovation. In: Edler, J., Cunningham, P., Gök, A., Shapira, P. (Eds.), *Handbook of Innovation Policy Impact*. Edward Elgar (forthcoming).
- Rigby, J., Boekholt, P., Semple, A., Deuten, J., Apostol, R., Corvers, S., Edler, J., 2012. *Final Report: Feasibility Study on Future EU Support to Public Procurement of Innovative Solutions* [Contract Notice 2010/s 103-155769].
- Robert, G., Greenhalgh, T., McFarlane, F., Peacock, R., 2009. *Organisational Factors Influencing Technology Adoption and Assimilation in the NHS: A Systematic Review of the Literature*. Report for the National Institute for Health Research Service Delivery and Organisation Programme, London.
- Rolfstam, M., 2005. *Public Technology Procurement as a Demand-side Innovation*. Rolfstam, M., 2013. *Public Procurement and Innovation: The Role of Institutions*. Edward Elgar, Cheltenham.
- Rolfstam, M., Phillips, W., Bakker, E., 2009. *Public Procurement of Innovation Diffusion: Exploring the Role of Institutions and Institutional Coordination*. CIRCLE Working Paper No. 2009/07. Lund University, Lund, Sweden.
- Rolfstam, M., Phillips, W., Bakker, E., 2011. Public procurement of innovations, diffusion and endogenous institutions. *Int. J. Public Sector Manag.* 24, 452–468.
- Rosen, R., Mays, N., 1998. The impact of the UK NHS purchaser–provider split on the ‘rational’ introduction of new medical technologies. *Health Policy* 43, 103–123.
- Rye, C.B., Kimberley, J.R., 2007. The adoption of innovations by provider organizations in health care. *Med. Care Res. Rev.* 64, 235–278.
- Shohet, S., Prevezer, M., 1996. UK biotechnology: institutional linkages, technology transfer and the role of intermediaries. *R&D Manag.* 26, 283–298.
- Tsiopouri, L., Edler, J., Rolfstam, M., Uyarra, E., 2009. *Risk Management in the Procurement of Innovation. Concepts and Empirical Evidence in the European Union*. European Commission, Brussels.
- Uyarra, E., 2010. *Opportunities for Innovation through Local Government Procurement A Case Study of Greater Manchester*.
- Uyarra, E., Review of Measures in Support of Public Procurement of Innovation, In: Edler, J., Cunningham, P., Gök, A., Shapira, P., (Eds.), *Handbook of Innovation Policy Impact*, Edward Elgar (forthcoming).
- Uyarra, E., Edler, J., Gee, S., Georghiou, L., Yeow, J., 2013. *UK public procurement of innovation: the UK case*. In: Lember, V., Kattel, R., Kalvet, T. (Eds.), *Public Procurement, Innovation and Policy: International Perspectives*. Springer-Verlag, London, pp. 233–258.
- Uyarra, E., Edler, J., Garcia-Estevéz, J., Georghiou, L., Yeow, J., 2014. *Barriers to innovation through public procurement: a supplier perspective*. *Technovation*, <http://dx.doi.org/10.1016/j.technovation.2014.04.003>.
- Uyarra, E., Flanagan, K., 2010. Understanding the innovation impacts of public procurement. *Eur. Plan. Stud.* 18, 123–143.
- Uyarra, E., Ramlogan, R., 2012. *The Effects of Cluster Policy on Innovation*. NESTA Working Paper March 12/05.
- van Lente, H., Hekkert, M., Smits, R., van Waveren, B., 2003. Roles of systemic intermediaries in transition processes. *Int. J. Innov. Manag.* 7, 1–33.

- Von Hippel, E., 1986. Lead users: a source of novel product concepts. *Manag. Sci.* 32, 791–805.
- Wanless, D., 2002. *Securing our Future Health: Taking a Long-Term View*. HM Treasury, London.
- Watkins, D., Horley, G., 1986. Transferring technology from large to small firms: the role of intermediaries. In: Webb, T., Quince, T., Watkins, D. (Eds.), *Small Business Research*. Gower, Aldershot, pp. 215–251.
- Wilkinson, R., Georghiou, L., Cave, J., Bosch, C., Caloghirou, Y., Corvers, S., Dalpe, R., Edler, J., Hornbanger, K., Mabile, M., Montejo, M.J., Nilsson, H., O'Leary, R., Piga, G., Tronstin, P., Ward, E., 2006. *Procurement for Research and Innovation. Report of an Expert Group on Measures and Actions to Assist in the Development of Procurement Practices Favourable to Private Investment in R&D and Innovation*, Brussels.
- Winch, G., Courtney, R., 2007. The organisation of innovation brokers: an international study. *Technol. Anal. Strateg. Manag.* 19, 747–763.
- Wolpert, J.D., 2002. Breaking out of the innovation box. *Harvard Bus. Rev.*, 77–83.
- Yeow, J., Uyarra, E., Gee, S., 2011. Sustainable Innovation through Public Procurement: The Case of 'Closed Loop' Recycled Paper. *Manchester Business School Working Paper Number*, pp. 615.
- York Health Economics Consortium, 2009. *Organisational and Behavioural Barriers to Medical Technology Adoption*, Warwick.