

Intensity of innovation in public sector organizations: The role of push and pull factors

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Abstract

The public sector is under pressure to provide new public services with increasingly scarce resources. In response, practitioners and academics have called for more innovation in the public sector. Our understanding of sources of innovation within public sector organizations, however, is inadequate. Motivated by this gap, we develop a conceptual model of how push and pull sources enable innovation within public sector organizations. Key to our theory is that push and pull sources of innovation are enabled by innovation capabilities. Five hypotheses are tested using cross-country survey data from European public sector organizations. Empirical analysis offers strong support for the central role played by innovation capability in enabling push and pull sources of innovation within public sector organizations. This article advances knowledge of the sources of innovation in the public sector and extends theorizing on push and pull mechanisms by examining their relevance to innovation in a public sector context.

1 | INTRODUCTION

In many countries, the public sector is under severe pressure from various new challenges, such as ageing populations and growing debt. Further, this sector faces increased demands for new and/or better services, more cost-efficient solutions and alternative ways to interact with its citizens (Walker 2006; Albury 2011; de Vries et al. 2016). Many scholars agree that innovation is central to the public sector's ability to deal with these challenges

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(Osborne and Brown 2011; Torfing and Triantafyllou 2016; Demircioglu and Audretsch 2017). Innovation has the potential to improve not only the effectiveness but also the problem-solving capacities of organizations in the public sector (de Vries et al. 2016). Further, innovation can increase organizational performance (Damanpour et al. 2009) and productivity (Arundel et al. 2015), and thereby the legitimacy and trust of public organizations (Verhoest et al. 2007; Lægneid et al. 2011).

Our understanding of innovation in the public sector context, however, is underdeveloped (e.g., Potts and Kastle 2010; Osborne and Brown 2011; Sørensen and Torfing 2011; Gonzalez et al. 2013; Torfing and Triantafyllou 2016). Moreover, a recent systematic review of studies on innovation in the public sector concluded that the literature lacks a 'clear theoretical underpinning' and does not relate to existing theories on innovation within organizations (de Vries et al. 2016, p. 161). Similarly, Demircioglu (2017, p. 87) states that studies on public sector innovation have made very limited contributions so far. Scholars have called for studies that develop new theories on innovation in public sector organizations and relate to extant theorizing on sources of innovation (de Vries et al. 2016). This is consistent with Bloch and Bugge's (2013, p. 134) claim that 'the insights derived from other strands of theory may be relevant and help shape thinking about public sector innovation'.

This study heeds these calls by examining the role of different sources in influencing the intensity of innovation within public sector organizations. To guide our analysis, we draw on classical theorizing in the innovation literature on the distinction between: (1) supply-side factors related to advances in science and technology 'pushing innovation' and (2) demand-side factors 'pulling' innovation from the focal organization. The relative importance of technology-push vs. demand-pull has been one of the classic debates in the literature on industrial innovation, and this debate has been fundamental to scholarly understandings of the sources of innovation for organizations in the private sector (Di Stefano et al. 2012). However, this literature has largely overlooked public sector organizations. Hence, it is currently unclear whether and how knowledge on technology-push and demand-pull are relevant to understanding sources of innovation within public sector organizations.

The public sector is very different from the private sector, such as the latter's lack of markets and the need for democratic/public accountability (Potts and Kastle 2010; Nählinder 2013), which can influence how push and pull factors should be conceptualized and how they influence innovation. Thus, examining push and pull within the context of the public sector may advance theoretical understanding of the role of push and pull factors in generating innovation more generally. To accomplish this, it is not sufficient to apply extant theorizing to a new context. Rather, we should first develop a conceptual understanding of how push and pull mechanisms relate to sources of innovation in the public sector context. This article conceptualizes technology-push and demand-pull within the public sector with an eye toward recent developments concerning innovation in the literature on the private sector. Moreover, we offer theorizing on how push- and pull-related sources of innovation enter public sector organizations' innovation processes. In so doing, we take an organization-centric perspective on how technology-push and demand-pull act as enabling sources of innovation within public sector organizations.

Key to this study is the concept of 'innovation capability', which highlights the role of organizations' capabilities in enabling both technology-push and demand-pull as sources of innovation, and thus constitutes a key source of innovation in itself (Lichtenthaler and Lichtenthaler 2009; Klein et al. 2013). Thus, this article not only seeks to bridge the literatures on innovation in the private and public sectors but, more importantly, seeks to integrate different theoretical perspectives on the sources of innovation within organizations (i.e., integration of technology-push/demand-pull with theorizing on organizational capabilities). We ask the following research question: What is the interplay between technology-push, demand-pull, and organizational capabilities in promoting innovation within public sector organizations? We develop five hypotheses that are empirically tested using a comprehensive dataset on innovation in European public sector organizations.

The present study adds to existing scholarship in several ways. First, we contribute a better understanding of the sources of innovation within public sector organizations, as has been called for in the literature (de Vries et al. 2016; Demircioglu and Audretsch 2019). Second, we extend the classical theorizing in the innovation literature on push

and pull factors to a new context, the public sector. In so doing, we take into account that the public sector has unique characteristics that require a reinterpretation of our understanding of push and (particularly) pull factors for innovation. Studies have debated whether and to what extent innovation differs across the public and private sectors (e.g., Borins 2001, 2014; de Vries et al. 2016). Our article highlights both similarities and differences in relation to how push and pull act as sources of innovation within public sector organizations. Moreover, this article contributes to more general theorizing on push and pull, providing further insight on these mechanisms from a neglected but still important context.

Third, we theorize on how technology-push and demand-pull (two key sources of innovation) interplay with another key factor, organizational capabilities, which we examine in its empirical manifestation as innovation capability. Thus, we use the context of the public sector and its organizations as a point of departure to theoretically integrate research on public sector innovation with existing theories on innovation within organizations, as called for by scholars (de Vries et al. 2016). We use factor analysis to refine measures for theoretical concepts and an advanced structural equation model to test hypotheses derived from our conceptual model. Finally, the combined framework of technology-push, capabilities-push and demand-pull may constitute a practical framework for managers and policy-makers discussing how to stimulate innovation within public sector organizations. As noted, there is little research to guide managers and policy-makers looking for research-based insight into how public sector organizations actually innovate.

2 | PUSH AND PULL THEORIZING AND THE PUBLIC SECTOR

2.1 | Innovation: push, pull and the organization

Two perspectives—technology-push and demand-pull—originate from attempts to explain innovation—in particular, technological innovation—in the 1950s and 1960s (Peters et al. 2012). Related to technological innovation, the concept of technology-push takes a linear supply-side perspective on the innovation process. It assumes that technical change starts with advances in science and technology, resulting in the development of new products and processes that are subsequently diffused within the business sector (Brem and Voigt 2009). As a reaction to the technology-push perspective, Schmookler (1966) put forth what became known as the demand-pull hypothesis, which postulates that technological innovation is fundamentally driven by (expected) market demand that influences the direction and rate of innovative activity. The demand-pull perspective subsequently identified a broader set of market-related factors and features that influence innovation (Di Stefano et al. 2012). While the relative explanatory power of these two alternatives has been hotly debated (Kleinknecht and Verspagen 1990), the contemporary literature views them as two driving forces that may have a joint effect on innovation (Brem and Voigt 2009; Di Stefano et al. 2012).

A substantial part of the analysis of technology-push and demand-pull in technological change has been macro-oriented (e.g., Kleinknecht and Verspagen 1990). Consequently, both technology-push and demand-pull perspectives lack an understanding of firms as heterogeneous organizations reacting to market signals or investing in response to advances in science and technology in different ways (e.g., Barney 1991; Teece 2007). After all, advances in science do not automatically become apparent, even for the most innovative of organizations (Rosenberg 1990). In a similar vein, signals of unmet market demand do not simply enter the firm effortlessly and guide investment in innovation (Narver and Slater 1990). The firm is more than an empty shell converting freely available innovation inputs into innovation outputs. We suggest that organizational capabilities—and innovation capability in particular—crucially influence the innovation process.

While the organization and strategic management literature has recognized the importance of the organization—its characteristics, resources and management—in the innovation process (e.g., Teece 2007), the organization is largely missing from technology-push and demand-pull perspectives of innovation. Nelson and Winter (1977) argued that when seen from the perspective of the firm, firms should adhere to both supply and demand sides when

selecting which innovation projects to pursue. They pointed to the role of the organization's capabilities and strategies in matching technology and markets in organized attempts to pursue innovation.

A recent bibliometric analysis of the literature on sources of innovation (De Stefano et al. 2012) supports Nelson and Winter's (1977) contention as they argue that 'in addition to confirming the importance of technology as a source of innovation and clarifying the role of demand, our contribution has identified resources, competences, and knowledge as a crucial dimension in providing a synthesis of the two' (p. 1292). However, this insight has been extracted from an analysis of scholarly papers not directly related to technology-push and demand-pull. Few studies have incorporated organizational capabilities and push and pull sources of innovation at the organizational level within the same empirical analysis.

In this article, we actively seek to bridge these areas of study. Following Nelson and Winter (1977) and subsequent theorizing, we pursue an organization-centric perspective on technology-push and demand-pull influences on the innovation process. We suggest that organizational capabilities—and particularly those related to innovation capability—enable demand-pull and technology-push sources of innovation to enter the organization and its innovation process. Moreover, it is the interplay of push factors, pull factors and organizational capabilities that drives innovation within organizations, as will be elaborated in the following section.

3 | HYPOTHESES

3.1 | Capability and innovation

Public sector organizations need to innovate in order to create public value in more efficient or better ways, often in response to resource scarcity (Moore 1995; Pablo et al. 2007). This may be particularly difficult for public sector organizations as they lack feedback mechanisms provided by market signals, such as declining sales and profits (Klein et al. 2013; Sahni et al. 2013). Thus, 'Public organizations ... are particularly dependent on evolved organizational capabilities' (Klein et al. 2013, p. 76). However, while theorizing highlights the central role of resources and capabilities in innovation, research on this issue has mostly been conducted in the private sector (Pablo et al. 2007; Klein et al. 2013). The importance of capabilities for innovation may be even greater among organizations in the public sector, but in this context their importance has not been examined systematically (Klein et al. 2013).

The resource-based view (RBV) explains how organizations can reap higher levels of organizational performance through the use of internal resources and capabilities (Barney 1991). While the RBV was originally developed for the study of for-profit organizations in the private sector (Barney 1991), it can also be used to study public sector organizations (Pablo et al. 2007). The reason for this is chiefly that RBV (1) focuses on the role of internal resources and capabilities in driving value creation and organizational performance, and (2) that performance can be understood more broadly and is not limited to profit competition, the traditional performance metric in studies of organizations.

The role of specific organizational processes and routines that allow organizations to become adaptable and change has been highlighted in RBV's recent theoretical developments (e.g., Teece et al. 1997; Teece 2007; Klein et al. 2013). The role of such processes and routines is to create new resources, achieve new resource configurations and improve effectiveness. Such routines and processes are sometimes referred to as dynamic capability (DC), first defined by Teece et al. (1997, p. 516) as 'the firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments'. While the nature and definition of DC is a hotly debated topic in the private sector (e.g., Barreto 2010), there are relatively few studies on innovation and dynamic capabilities in the public sector. Important for the perspective of this study is the general agreement in the RBV/DC literature that organizations have specific routines and processes conceptualized as capabilities whose role is to improve organizational functioning (e.g., Pablo et al. 2007; Klein et al. 2013). Moreover, organizations' internal ability to generate novel and useful knowledge—often referred to as innovative capability—is crucial in this regard. Not only can organizations with a better developed innovation capability have more success in the innovation process, but they may also

be better at successfully sourcing external resources, further enhancing the organization's ability to innovate and positively influence performance.

Using the lens of capability to examine public sector organizations and their effectiveness is useful because public organizations control a major part of the resources in society, such as land, buildings, infrastructure and budgets. Moreover, an important aspect of their *raison d'être* is that they have the capabilities to govern and administer these valuable resources. Thus, the creation of public value—or putting resources to their best use—is a fundamental task of public organizations (Jørgensen and Bozeman 2007), a task governed by capabilities (Klein et al. 2013). However, while public sector organizations control resources, they vary in their capacity to deploy these in ways that create value for society (Moore 1995), implying that these organizations differ in their innovation capability. While the literature largely agrees on the importance of innovation capability for the evolution and performance of public sector organizations, it is less clear on what actually constitutes this capability. Inspired by DC theorizing, the innovation capability within public sector organizations can be defined as the ability of public sector managers and other key stakeholders within the organizations to make ongoing adjustments in resource allocation and build new thinking (Eisenhardt and Martin 2000; Pablo et al. 2007).

More specifically, a close reading of the literature reveals that there are some salient aspects of innovation capability that are also applicable to the public sector. For instance, scholars have highlighted that leadership, experimentation and involvement of employees are important aspects of innovation capability (e.g., Borins 2001, 2014; Pablo et al. 2007; Fernandez and Moldogaziev 2013; Demircioglu 2017). Moreover, by systematically reviewing 181 publications on public sector innovation, de Vries et al. (2016) found that 'trial-and-error in exploring new ideas', 'leaders who have a vision' and 'empowered employees' are among the most important organizational antecedents to innovation in the public sector. Reflecting this work, we suggest that:

H1 There is a positive relationship between innovation capability and intensity of innovation within public sector organizations.

While H1 suggests a direct relationship between innovation capability and actual innovation within public sector organizations, the role of innovation capability may be more multifaceted. Drawing on Nelson and Winter (1977), we argue that push and pull sources of innovation are mainly enabled by the organization and its capability for innovation. Without innovation capability, external sources of innovation will not 'enter' the focal organization and therefore not influence innovation therein. Likewise, capabilities are needed to detect and interpret signals from demand-pull sources of innovation. Without capabilities, such signals will go unnoticed and will not be activated as a source of innovation. We discuss our integration of theorizing on push/pull mechanisms and the organization and its innovation capability in more detail below.

3.2 | Capability and push sources of innovation

The technology-push perspective has traditionally been synonymous with the argument that advances in science and technology stimulate innovation. A more recent conceptualization is the view that sources of knowledge relevant for innovation are distributed externally to the organization and generated and diffused by a range of actors (Cohen and Levinthal 1990; von Hippel 1988; Chesbrough et al. 2006), an insight shared with the literature on collaborative innovation (e.g., Sørensen and Torfing 2011; Torfing and Triantafyllou 2016). We interpret technology-push as knowledge relevant for innovation that is generated externally to organizations in the public sector and which may enable innovation if taken in and used by the organization. However, the literature on private sector innovation has recognized that advances in science and technology, as well as the external knowledge relevant for innovation more broadly, is not automatically transferred to the organization. External knowledge sourcing and transfers are facilitated by organizational capabilities (Cohen and Levinthal 1990; Lichtenthaler and Lichtenthaler 2009). We argue that public sector organizations are no different in this regard, leading us to suggest that:

H2 Innovation capability has a positive effect on the use of external knowledge within public sector organizations.

Although the framework of push and pull factors for innovation was developed in the private sector context, we argue that pull factors may also enable innovation within public sector organizations. This knowledge can be generated and diffused through many types of actors, organizations and institutions, such as industry stakeholders, governmental agencies, members of the public and other public organizations and universities (Demircioglu 2017; Torugsa and Arundel 2016). Indeed, studies have found that innovative ideas emanating from external sources such as private firms, industry stakeholders, government agencies and universities can increase innovation in public organizations (e.g., Borins 2001, 2014; Demircioglu and Audretsch 2019) if they enter the focal organization. The key theoretical rationale behind this logic is that organizations need to complement internal ideas with external ideas and knowledge in order to make new combinations between previously unconnected ideas and knowledge, broadening the scope and possibilities for innovation (Teece 2007). We therefore suggest that:

H3 The use of external knowledge has a positive effect on intensity of innovation within public sector organizations.

3.3 | Capability and pull sources of innovation

A central tenet in demand-pull theorizing is that firms innovate in response to some expected future state of the environment. Although market demand may not work in the same way for organizations in the public sector, public organizations may be motivated by other types of external factors demanding innovation, such as government policy (Luke et al. 2010), ability, motivational factors such as a mandated decrease in the organizational budget (Sahni et al. 2013), or more generally the institutional environment (Verhoest et al. 2007; Fernandez and Wise 2010). Despite the lack of a market in the classic sense, we also expect that organizations in the public sector will react to external needs, demands and changes in expectations in society, and that sensitivity to these factors may require innovation through distinct mechanisms (Naranjo-Gil 2009; Gonzalez et al. 2013).

Public sector organizations are expected to be sensitive to external political signals, including legislation, which sometimes directly demand changes and the introduction of innovation among public sector organizations (Luke et al. 2010). External/political factors and the introduction of new policies are conditions for successful innovations in the public sector (Sahni et al. 2013; Demircioglu and Audretsch 2017). Hence, we interpret pull mechanisms for innovation in public sector organizations—such as laws and legislation—as external factors requiring or ‘demanding’ the implementation of innovation from public sector organizations. However, demand in the form of laws, legislation, policy reforms, etc. will not automatically pull innovation from public sector organizations. Organizations need to notice, proactively react to and take advantage of such external demands (Teece 2007). Therefore, we suggest that:

H4 Innovation capability has a positive effect on identified demand for innovation within public sector organizations.

Moreover, innovation in the public sector has been conceptualized as a normative good (Osborne and Brown 2011), and public organizations may perceive normative expectations to innovate. To gain legitimacy, public organizations can introduce innovations motivated from expected changes in the institutional and task environments (Fernandez and Wise 2010; Verhoest et al. 2007). Likewise, testing survey data on 84 Flemish public organizations, Verhoest et al. (2007) found that institutional pressures for innovation had a positive effect on organizational innovation in the public sector. Moreover, recent analyses suggest a positive relationship between demand for innovation and the innovativeness of public sector organizations (Edler and Yeow 2016; Demircioglu 2017, 2018). However, the theoretical nature of this relationship remains poorly understood, and there is little quantitative analysis of this

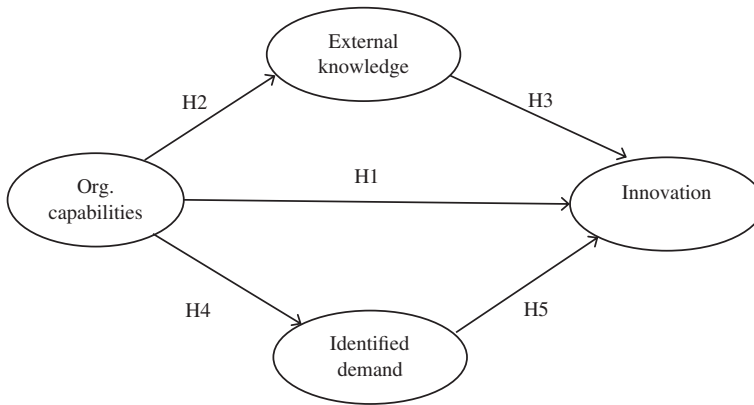


FIGURE 1 Theoretical model

issue. This study proposes that while innovation capability drives public sector organizations' capacities to identify external demands for innovation (H4), the perception of such demand will act as an additional mechanism for innovation. We therefore propose that:

H5 Identified demand for innovation has a positive effect on intensity of innovation within public sector organizations.

Figure 1 illustrates our organization-centric view of the interplay between the organization (including its capabilities) and technology-push factors, conceptualized as organizations' use of external knowledge. Demand-pull is conceptualized as organizations' identification of demand for innovation. We hypothesize that organizational capability—manifested as innovation capability—has a direct effect on intensity of innovation (H1) and affects both organizations' use of external knowledge (H2) and organizations' identification of demand (H4). In addition, while the use of external knowledge and identified demand for innovation may promote innovation (H3 and H5, respectively), these two sources are also dependent upon the capabilities of the focal organization being activated. Thus, innovation capability has both a direct and an indirect relationship with the intensity of innovation within public sector organizations.

4 | METHOD

4.1 | Sample and data collection

To test these hypotheses, we use the Innobarometer 2010 survey.¹ The objective of the survey was to study the introduction of innovations in the European public administration sector in response to changing constraints and opportunities. The survey was administered to public sector institutions in 29 European countries (27 EU member states in addition to Norway and Switzerland). The sample was selected randomly within each of the participating countries among organizations in the public sector employing ten or more persons. Data were collected through structured telephone interviews with the Executive Director responsible for strategic planning and decision-making or the Chief Executive. In total, 4,063 interviews were conducted (of employees in central, regional or local organizations) between 9 October and 17 October 2010 using phone calls, varying between ten and 400 per country

¹(Some of) the data applied in the analysis in this publication are based on the European Commission's Flash Eurobarometer 305 (Innobarometer 2010). The data are provided by TNS GALLUP Organization, Brussels and prepared and made available by the Norwegian Social Science Data Services (NSD). Neither the TNS GALLUP Organization, Brussels nor the NSD are responsible for the analysis/interpretation of the data presented here.

depending on country size (further details about the survey can be found at http://ec.europa.eu/commfrontoffice/publicopinion/flash/fl_305_en.pdf). Because senior managers are responsible for decision-making and are familiar with the innovative activities in their organizations, they were asked to participate in the phone interview.

For the purpose of this study, we excluded organizations that were not public sector organizations. Further, questions on sources of innovation were relevant only for organizations with a least one type of innovation. Finally, due to non-random missing variables, the final sample size is reduced to 2,157.

4.2 | Measures

The Innobarometer 2010 survey was inspired by the Oslo Manual (OECD 2005) but adapted to a public administration context (Arundel et al. 2015). Therefore, the survey is relevant to a public sector setting. The dependent variable, intensity of innovation, is operationalized as eight binary (0 = No, 1 = Yes) survey items. The measures of all variables are reported in appendix 1. Sample items are 'Since January 2008, did your organization introduce any new or significantly improved services?', 'Since January 2008, did your organization introduce any new or significantly improved methods of communicating your activities to the public such as new or improved methods of promoting your organization or your service?' and 'Since January 2008, did your organization introduce any new or significantly improved process or organizational methods such as new or improved management systems?' The Cronbach's alpha value is 0.74, suggesting that the scales are reliable. Table 1 shows descriptive statistics of all variables used in this study where mean-summative indexes are used for all except the control variables.

The key independent variable, innovation capability, is operationalized as seven three-scale survey items. Sample items include the importance of ideas from staff for the development of innovations since January 2008 (1 = not important, 2 = somewhat important, 3 = very important) and 'Managers support trial-and-error testing of new ideas' (1 = not at all, 2 = partly, 3 = fully). The Cronbach's alpha value is 0.7, suggesting that scales are reliable and consistent.

The use of external knowledge and identified demand are mediators in this study. Use of external knowledge is operationalized as six three-scale (1 = not important, 2 = somewhat important, 3 = very important) survey items. Sample items include 'Since January 2008, how important were the following information sources for the development of your innovations': 'professional organizations' and 'citizens as clients or users'. The Cronbach's alpha value is 0.75. Identified demand is operationalized as five three-scale (1 = not important, 2 = somewhat important, 3 = very important) survey items. Sample items include 'How important were the following political or legislative factors in driving the development and introduction of your innovations since January 2008', 'new laws or regulations' and 'new policy priorities'. The Cronbach's alpha value is 0.68. Although the alpha values are adequate, low alpha values are not problematic, particularly when using structural equation models (DeHart-Davis et al. 2015).

In the analyses we controlled for organization size and geographical areas served (Arundel et al. 2015). Organizational size was measured as the number of employees in the organization on a scale ranging from 1 = 10–49

TABLE 1 Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Innovation	2,157	0.63	0.28	0	1
Organizational capabilities	2,157	2.23	0.41	1	3
External knowledge	2,157	1.95	0.48	1	3
Identified demand	2,157	2.11	0.52	1	3
Organization size	2,157	2.39	1.72	1	6
Local	2,157	0.78	0.41	0	1
Regional	2,157	0.16	0.37	0	1
National	2,157	0.06	0.24	0	1

employees to 6 = 1,000 or more. Geographic area was measured with three dummy variables indicating that the organization mainly served a local, regional or national area. Correlations among variables are reported in Table 2. We conducted collinearity diagnostics by calculating Variance Inflation Factors (VIF). The results reveal that the highest VIF value is 3.16 and the mean VIF is 1.86. The correlation matrix and the reported VIF values do not indicate that multicollinearity distorts the regression models. In addition, the Cronbach's alpha values are considered adequate. Finally, Principal Component Analysis (appendix 2) shows that overall the first component represents organizational innovation, the second represents organizational capabilities, the third represents use of external knowledge, and the last represents identified demand. Thus, four latent factors emerged from the factor analysis.

4.3 | Modelling

Structural equation models (SEM) with confirmatory factor analysis (CFA) are used as model selections and to test hypotheses. SEM with CFA consists of latent and observed constructs. Latent constructs in this study such as innovation capability, use of external knowledge, identified demand and intensity of innovation are not directly observable, so several survey items measure and capture them. Currivan (1999, p. 507) states that 'The measurement model specifies a confirmatory factor analysis (CFA) of proposed relationships between the manifest (observed) indicators and latent (theoretical) constructs, while the structural equation model (SEM) specifies hypothesized relationships among latent constructs.' Thus, SEM is particularly suitable for testing hypotheses in this study.

As a modelling approach, SEM is preferable for several reasons, as evidenced by methodologists and statisticians (e.g., Byrne 2013; Bollen 2014; Kline 2016). The use of SEM is also supported by recent studies in public management (e.g., Kim et al. 2014; DeHart-Davis et al. 2015; Favero and Bullock 2015; Demircioglu 2018). First, SEM is consistent with the theoretical model used in this article (Figure 1). The theoretical model states that innovation capability is positively associated with intensity of innovation (H1), use of external knowledge (H2), and identified demand (H4). In addition, use of external knowledge and identified demand are positively associated with intensity of innovation (H3 and H5, respectively). Therefore, SEM measures all these effects simultaneously. Second (and related to the first point), SEM are advanced and complex models for dealing with mediators (use of external knowledge and identified demand) more efficiently and effectively while reporting both the direct and indirect effects. Third, SEM corrects for measurement error, as observed variables measure underlying latent constructs. Fourth, SEM provides model fit indices, which show whether a selected model has a valid and better fit compared to other models (Byrne 2013; Bollen 2014; Kline 2016). Fifth, SEM can be a remedy for identifying common source bias, which is an issue for cross-sectional data sets (Favero and Bullock 2015). As a result, SEM has many theoretical and methodological advantages. The following section will discuss the results.

TABLE 2 Correlation coefficients

Variable	1	2	3	4	5	6	7	8
1 Innovation	1							
2 Organizational capabilities	0.38	1						
3 External knowledge	0.36	0.43	1					
4 Identified demand	0.29	0.25	0.34	1				
5 Organization size	0.31	0.22	0.16	0.17	1			
6 Local	-0.11	-0.08	-0.03	0.00	-0.18	1		
7 Regional	0.08	0.05	0.04	0.03	0.15	-0.82	1	
8 National	0.07	0.07	-0.01	-0.05	0.07	-0.47	-0.11	1

N = 2,157.

5 | RESULTS—PUSH AND PULL FACTORS FOR INNOVATION

The results of SEM using maximum likelihood estimation are reported in Table 3. For a better visual expression, Figure 2 also shows the results without the control variables and factor loadings. In addition to reporting standardized coefficients, standard errors and the *p*-values of effects of variables and factor loadings, Table 3 reports fit indices. These are the comparative fit index (CFI), the Tucker-Lewis index (TLI), and the root mean squared error of approximation (RMSEA) tests. Typically, RMSEA below 0.08 (or 0.05) and a CFI and TLI above 0.9 usually indicate a good fit (Hu and Bentler 1999; Kline 2016). The CFI and TLI in this study are over 0.9 and the RMSEA is below 0.05, suggesting that the reported model with expected directions has a good fit.

TABLE 3 Results

		Coefficient	SE	<i>p</i> -value
<i>Effects</i>				
H1	Capability → Innovation	0.42	0.05	***
H2	Capability → Knowledge	0.63	0.03	***
H3	Knowledge → Innovation	0.09	0.05	*
H4	Capability → Demand	0.51	0.04	***
H5	Demand → Innovation	0.18	0.05	***
	Org. size → Innovation	0.18	0.03	***
	Regional → Innovation	−0.03	0.04	<i>ns</i>
	Local → Innovation	−0.09	0.04	**
<i>Factor loadings</i>				
	Capability → Capability1	0.56	0.02	***
	Capability → Capability2	0.44	0.03	***
	Capability → Capability3	0.47	0.02	***
	Capability → Capability4	0.56	0.02	***
	Capability → Capability5	0.24	0.03	***
	Capability → Capability6	0.43	0.03	***
	Capability → Capability7	0.42	0.03	***
	Knowledge → Knowledge1	0.58	0.03	***
	Knowledge → Knowledge2	0.63	0.03	***
	Knowledge → Knowledge3	0.49	0.02	***
	Knowledge → Knowledge4	0.54	0.03	***
	Knowledge → Knowledge5	0.63	0.04	***
	Knowledge → Knowledge6	0.57	0.04	***
	Demand → Demand1	0.39	0.04	***
	Demand → Demand2	0.36	0.03	***
	Demand → Demand3	0.42	0.04	***
	Demand → Demand4	0.55	0.05	***
	Demand → Demand5	0.58	0.04	***
	Innovation → Innovation1	0.41	0.02	***

(Continues)

TABLE 3 (Continued)

	Coefficient	SE	p-value
Innovation → Innovation2	0.40	0.02	***
Innovation → Innovation3	0.43	0.02	***
Innovation → Innovation4	0.55	0.02	***
Innovation → Innovation5	0.53	0.02	***
Innovation → Innovation6	0.42	0.02	***
Innovation → Innovation7	0.71	0.02	***
Innovation → Innovation8	0.53	0.02	***
<i>Fit indices</i>			
χ^2	1155.826		
Comparative fit index (CFI)	0.93		
Tucker-Lewis index (TLI)	0.91		
Root mean squared error of approximation (RMSEA)	0.035		

N = 2,157. Standardized coefficients are reported.
 *** p < .01, ** p < .05, * p < .1, ns = not significant.

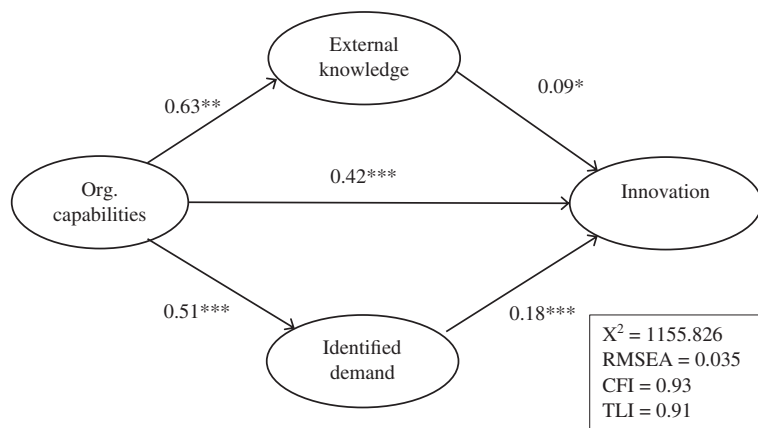


FIGURE 2 SEM results of the theoretical model

Figure 2 also shows the results for latent variables. The results support all hypotheses. Below, we will discuss these results in more detail.

The first three hypotheses were related to push factors for innovation intensity in public sector organizations. With respect to hypothesis 1, the results reveal that innovation capability has a direct, positive and statistically significant relationship with intensity of innovation within public sector organizations (Beta = 0.42, p < .01). Thus, the first hypothesis (H1) is supported. Other findings indicate that innovation capability has a positive and statistically significant effect on use of external knowledge (Beta = 0.63, p < .05), supporting the second hypothesis (H2). Finally, the effect of use of external knowledge on intensity of innovation is in the expected direction, but in terms of the statistical significance it is moderately significant (Beta = 0.09, p < .1). This moderately supports the third hypothesis (H3).

Overall, the results related to hypotheses 1–3 indicate that push factors strongly influence the intensity of innovation in public sector organizations. Hence, the way these organizations are organized to utilize the capacity for innovation seems to play an important role. The level of competence among employees, their use of knowledge

sources and the extent to which employees are supported by the organization to act innovatively are important push factors to implement public sector innovation.

The final two hypotheses were related to pull factors. Conceptualizing pull in the form of external demands and requirements, hypotheses 4 and 5 stated that identified demands (e.g., political and legislative demands) are enabled by innovation capability, which subsequently influences the intensity of innovation within public sector organizations. The results show that innovation capability is positively associated with identified demand for innovation (Beta = 0.51, $p < .01$). In addition, identified demand is positively associated with intensity of innovation (Beta = 0.18, $p < .01$). The results indicate that pull factors play an important role as drivers of innovation within organizations in the public sector.

As a robustness check, we also tested only the indirect effects of organizational capability on intensity of innovation (omitting the first hypothesis). However, the fit indices are worse than the original model (e.g., higher RMSEA and χ^2), suggesting that the theoretical model (Figure 1) is preferable.

6 | DISCUSSION AND CONCLUSIONS

The results from this study shed light on the external and internal forces driving innovation in public sector organizations and the role of organizational capabilities in this process. Responding to calls for more theoretical development on innovation in public sector organizations (Bloch and Bugge 2013; Demircioglu and Audretsch 2017), we have developed an organization-centric conceptual model by integrating theorizing on push and pull sources of innovation (Di Stefano et al. 2012) with organizational capabilities for innovation within public sector organizations (e.g., Klein et al. 2013).

Our model argues that in order for public sector organizations to take advantage of push and pull sources of innovation, they need to have the innovation capabilities to enable this process. The results confirm the importance of capabilities for enabling innovation in public sector organizations (Pablo 2007; Klein et al. 2013). Innovation capability is an important push factor in itself as well as an enabler of other push and pull sources of innovation. The results show that innovation capability has a direct and positive relationship with intensity of innovation (H1) as well as an indirect and positive effect through the use of external knowledge (push) (H2) and identified demand (pull) (H4). Meanwhile, the use of external knowledge (H3) and identified demand (H5) is also positively associated with intensity of innovation. These empirical results validate our organization-centric conceptual model of how innovation capability enables push and pull sources of innovation within public sector organizations.

These findings nuance and extend the existing literature in several ways. First, the conclusions from this study contribute to research on open and collaborative innovation in the public sector. While the findings support the arguments in this literature that public organizations can benefit from external factors 'pushing' innovation (Sørensen and Torfing 2011; Torfing and Triantafillou 2016), they also clearly show that such push sources of innovation are enabled by the innovation capabilities of the organization itself. While similar results have been found in the private sector (Lichtenthaler and Lichtenthaler 2009), this study indicates that this same process takes place in the public sector. Consequently, our findings support arguments that the pursuit of open and collaborative approaches in the innovation process for public sector organizations can be facilitated by developing the organization's innovation capabilities.

Second, the finding that pull factors matter for generating innovation within public sector organizations confirms the expectation in the literature that innovation can also be 'pulled' from organizations by implementing political and legislative actions in this context (Naranjo-Gil 2009). Moreover, this supports the general expectation in the literature on innovation that external factors may extract innovation from organizations even when controlling for push factors (Di Stefano et al. 2012). While the pull factors examined in our study differ substantially in their details from those examined in the literature on innovation within market-based organizations, our analysis nevertheless shows that organizations in the public sector are influenced by their environment and demands to innovate. However, pull

sources of innovation are also enabled by an organization's innovation capability. Innovation capability may help the organization to identify the demand for innovation, as well as to use this demand to produce innovations within the organization. Hence, these results modify the New Public Management (NPM) inspired literature on innovation in the public sector that emphasizes that innovation is enhanced by pull factors, such as NPM-driven goals and measurements related to innovation performance in the public sector (Lægreid et al. 2011; Arundel et al. 2015).

Consequently, policy-makers seeking to enhance public sector innovation should consider how they can stimulate the development of innovation capabilities within the organizations alongside enacting legislative changes and policy reforms that create requirements or incentives for innovation. These results testify to the practical relevance of the organization-centric pull and push factor framework introduced in this article, as it represents a conceptual tool that policy-makers and public sector officials can draw on in discussions about how to best nourish innovation within public sector organizations.

This study utilized the framework of push and pull drivers of innovation developed to explain technological innovation in the private sector and adapted this framework to a public sector context. Although caution should be used when applying theories developed in a market-based context to the public sector, the results from this study indicate that theoretical insights from a business context are to some extent also relevant to the public sector. Hence, theorizing from the literature on innovation in the private sector can be adapted to better understand the drivers of innovation in the public sector. However, this requires adapting these theories in a way that acknowledges the specific characteristics of public sector organizations. In the framework we utilize here, such adaptations include different interpretations of push and pull mechanisms to take into account the peculiarities of a non-market context. As such, the study supports an assimilation perspective in which theorizing on innovation in the private sector should be examined and tested in a public sector context (Nählinder 2013). Thus, our research is in line with prior studies arguing for the similarities in innovation processes across public and private sector organizations (e.g., Borins 2001, 2014) and suggesting that studies in these two sectors may cross-fertilize on another.

However, the results also support a synthesis view (Nählinder 2013) arguing that both the public and private sectors have specific features that need to be taken into consideration in order to arrive at a more generic understanding of innovation that is also sensitive to context (e.g., Matthews and Shulman 2005; Felício et al. 2013; Gonzalez et al. 2013). Contextual differences do not mean that theorizing from the public sector cannot be used in the study of innovation in the private sector (and vice versa), but that it is important for the study of innovation in general to be aware of when contextual differences matter and why (Damanpour et al. 2009; Arundel et al. 2015; Demircioglu 2017). Such awareness can take the study of innovation within organizations in different sectors to another level, offering a synthesis of what is known about innovation in general and an understanding of when and why driving forces for innovation differ across contexts. As such, this study helps to establish the public sector as a new research frontier that can further advance our theoretical understanding of innovation emerging from pull and push factors, a classic issue for the study of innovation.

This study has some limitations that should be acknowledged, particularly related to cross-sectional data and self-reported measures. First, the data for this study come from a cross-sectional design (EU Innobarometer 2010). Thus, we cannot argue for any causal claims. Second, because the survey was conducted on public sector organizations in Europe, the findings may not be generalizable to other countries (particularly developing countries). Nevertheless, the survey includes data from a representative sample of organizations in several countries, indicating relevance beyond specific country contexts. The large sample and cross-national data ensure the robustness of the findings. As there is an increasing demand for cross-country studies and these types of studies offer important insights and a comparative approach (Suzuki and Hur 2019), we believe that one of the strengths of this study is using and testing data from 29 European countries. Still, future studies may collect data in other settings to test the effects of push and pull factors on organizational innovation.

A well-developed public sector is an important characteristic within modern societies. New public sector services and ways of communicating and distributing these services to the public are crucial for the further development of a well-performing public sector. Because innovative activity is associated with improved organizational performance

(Damanpour et al. 2009), higher quality public services (Salge and Vera 2012), legitimacy (Verhoest et al. 2007; Læg Reid et al. 2011), and with public sector organizations that are more sensitive to environmental factors (Naranjo-Gil 2009), understanding of the push and pull factors that increase the ability of organizations to introduce innovations is needed for the development of an efficient and successful public sector. Future research may analyse the effects of push and pull factors on types of innovation and organizational performance. We believe that more research on this issue is warranted, and this study represents one important step in this direction.

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REFERENCES

- Albury, D. (2011). Creating the conditions for radical public service innovation. *Australian Journal of Public Administration*, 70, 227–235.
- Arundel, A., Casali, L., & Hollanders, H. (2015). How European public sector agencies innovate: The use of bottom-up, policy-dependent and knowledge-scanning innovation methods. *Research Policy*, 44, 1271–1282.
- Barney, J. (1991). Firm resources and sustained competitive advantage. *Journal of Management*, 17, 99–120.
- Barreto, I. (2010). Dynamic capabilities: A review of past research and an agenda for the future. *Journal of Management*, 36, 256–280.
- Bloch, C., & Bugge, M. M. (2013). Public sector innovation: From theory to measurement. *Structural Change and Economic Dynamics*, 27, 133–145.
- Bollen, K. A. (2014). *Structural equations with latent variables*. New York: John Wiley & Sons.
- Borins, S. (2001). *The challenge of innovating in government*. Arlington, VA: PricewaterhouseCoopers Endowment for the Business of Government.
- Borins, S. (2014). *The persistence of innovation in government*. Washington, DC: Brookings Institution Press, Ash Center for Democratic Governance and Innovation.
- Brem, A., & Voigt, K.-I. (2009). Integration of market pull and technology push in the corporate front end and innovation management: Insights from the German software industry. *Technovation*, 29, 351–367.
- Byrne, B. M. (2013). *Structural equation modeling with Mplus: Basic concepts, applications, and programming*. New York: Routledge.
- Chesbrough, H. W., Vanhaverbeke, W., & West J. (2006). *Open innovation: Researching a new paradigm*. Oxford: Oxford University Press.
- Cohen, W. M., & Levinthal D. A. (1990). Absorptive capacity: A new perspective on learning and innovation. *Administrative Science Quarterly*, 35, 128–152.
- Curran, D. B. (1999). The causal order of job satisfaction and organizational commitment in models of employee turnover. *Human Resource Management Review*, 9, 495–524.
- Damanpour, F., Walker, R. M., & Avellaneda, C. N. (2009). Combinative effects of innovation types and organizational performance: A longitudinal study of service organizations. *Journal of Management Studies*, 46, 650–675.
- De Vries, H., Bekkers, V., & Tummers, L. (2016). Innovations in the public sector: A systematic review and future research agenda. *Public Administration*, 94, 146–166.
- DeHart-Davis, L., Davis, R. S., & Mohr, Z. (2015). Green tape and job satisfaction: Can organizational rules make employees happy? *Journal of Public Administration Research and Theory*, 25, 849–876.
- Demircioglu, M. A. (2017). *Three essays on public sector innovation*. PhD Dissertation, School of Public and Environmental Affairs, Indiana University, Bloomington, IN.

- Demircioglu, M. A. (2018). Examining the effects of social media use on job satisfaction in the Australian public service: Testing self-determination theory. *Public Performance & Management Review*, 41, 300–327.
- Demircioglu, M. A., & Audretsch, D. B. (2017). Conditions for innovation in public sector organizations. *Research Policy*, 46, 1681–1691.
- Demircioglu, M. A., & Audretsch, D. B. (2019). Public sector innovation: The effect of universities. *Journal of Technology Transfer*, 44, 596–614
- Di Stefano, G., Gambardella, A., & Verona, G. (2012). Technology push and demand pull perspectives in innovation studies: Current findings and future research directions. *Research Policy*, 41, 1283–1295.
- Edler, J., & Yeow, J. (2016). Connecting demand and supply: The role of intermediation in public procurement of innovation. *Research Policy*, 45, 414–426.
- Eisenhardt, K. M., & Martin, J. A. (2000). Dynamic capabilities: What are they? *Strategic Management Journal*, 21, 1105–1121.
- EU Innobarometer (2010). *Innobarometer 2010. Innovation in public administration*. Analytical report. Flash Eurobarometer no. 305, January. European Commission.
- Favero, N., & Bullock, J. B. (2015). How (not) to solve the problem: An evaluation of scholarly responses to common source bias. *Journal of Public Administration Research and Theory*, 25, 285–308.
- Felício, J. A., Martins Gonçalves, H., & da Conceição Gonçalves, V. (2013). Social value and organizational performance in non-profit social organizations: Social entrepreneurship, leadership, and socioeconomic context effects. *Journal of Business Research*, 66, 2139–2146.
- Fernandez, S., & Moldogaziev, T. (2013). Using employee empowerment to encourage innovative behavior in the public sector. *Journal of Public Administration Research and Theory*, 23, 155–187.
- Fernandez, S., & Wise, L. R. (2010). An exploration of why public organizations 'ingest' innovations. *Public Administration*, 88, 979–998.
- Gonzalez, R., Llopis, J., & Gasco, J. (2013). Innovation in public services: The case of Spanish local government. *Journal of Business Research*, 66, 2024–2033.
- Hu, L., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling: A Multidisciplinary Journal*, 6, 1–55.
- Jørgensen, T. B., & Bozeman, B. (2007). Public values: An inventory. *Administration & Society*, 39, 354–381.
- Kim, S., Egan, T. M., & Moon, M. J. (2014). Managerial coaching efficacy, work-related attitudes, and performance in public organizations: A comparative international study. *Review of Public Personnel Administration*, 34, 237–262.
- Klein, P. G., Mahoney, J. T., McGahan, A. M., & Pitelis, C. N. (2013). Capabilities and strategic entrepreneurship in public organizations. *Strategic Entrepreneurship Journal*, 7, 70–91.
- Kleinknecht, A., & Verspagen, B. (1990). Demand and innovation: Schmookler re-examined. *Research Policy*, 19, 387–394.
- Kline, R. B. (2016). *Principles and practice of structural equation modeling* (4th ed.). New York: The Guilford Press.
- Lægreid, P., Roness, P. G., & Verhoest, K. (2011). Explaining the innovative culture and activities of state agencies. *Organization Studies*, 32, 1321–1347.
- Lichtenthaler, U., & Lichtenthaler, E. (2009). A capability-based framework for open innovation: Complementing absorptive capacity. *Journal of Management Studies*, 46, 1315–1338.
- Luke, B., Verreynne, M. L., & Kearns, K. (2010). Innovative and entrepreneurial activity in the public sector: The changing face of public sector institutions. *Innovation: Organization & Management*, 12, 138–153.
- Matthews, J. H., & Shulman, A. D. (2005). Competitive advantage in public sector organizations: Explaining the public good/sustainable competitive advantage paradox. *Journal of Business Research*, 58, 232–240.
- Moore, M. H. (1995). *Creating public value: Strategic management in government*. Cambridge, MA: Harvard University Press.
- Nählinger, J. (2013). Understanding innovation in a municipal context: A conceptual discussion. *Innovation: Management, Policy & Practice*, 15, 315–325.
- Naranjo-Gil, D. (2009). The influence of environmental and organizational factors on innovation adoptions: Consequences for performance in public sector organizations. *Technovation*, 29, 810–818.
- Narver, J. C., & Slater, S. F. (1990). The effect of a market orientation on business profitability. *Journal of Marketing*, 54, 20–35.
- Nelson, R. R., & Winter, S. G. (1977). In search of a useful theory of innovation. *Research Policy*, 6, 36–76.
- OECD (2005). *Oslo manual: Guidelines for collecting and interpreting innovation data* (3rd ed.). Paris: OECD Publishing.
- Osborne, S. P., & Brown, L. (2011). Innovation, public policy and public services delivery in the UK: The word that would be king? *Public Administration*, 89, 1335–1350.
- Pablo, A., Reay, T., Dewald, J. R., & Casebeer, A. (2007). Identifying, enabling and managing dynamic capabilities in the public sector. *Journal of Management Studies*, 44, 687–708.
- Peters, M., Schneider, M., Griesshaber, T., & Hoffmann V. K. (2012). The impact of technology-push and demand-pull policies on technical change: Does the locus of policies matter? *Research Policy*, 41, 1296–1308.
- Potts, J., & Kastle, T. (2010). Public sector innovation research: What's next? *Innovation: Organization & Management*, 12, 122–137.

- Rosenberg, N. (1990). Why do firms do basic research (with their own money)? *Research Policy*, 19, 165–174.
- Sahni, N. R., Wessel, M., & Christensen, C. M. (2013). Unleashing breakthrough innovation in government. *Stanford Social Innovation Review*. Available at: https://ssir.org/articles/entry/unleashing_breakthrough_innovation_in_government#
- Salge, T. O., & Vera, A. (2012). Benefiting from public sector innovation: The moderating role of customer and learning orientation. *Public Administration Review*, 72, 550–559.
- Schmookler, J. (1966). *Invention and economic growth*. Cambridge, MA: Harvard University Press.
- Suzuki, K., & Hur, H. (2019). Bureaucratic structures and organizational commitment: Findings from a comparative study of 20 European countries. *Public Management Review*. <https://doi.org/10.1080/14719037.2019.1619813>
- Sørensen, E., & Torfing, J. (2011). Enhancing collaborative innovation in the public sector. *Administration & Society*, 43, 842–868.
- Teece, D. J. (2007). Explicating dynamic capabilities: The nature and microfoundations of (sustainable) enterprise performance. *Strategic Management Journal*, 28, 1319–1350.
- Teece, D. J., Pisano, G., & Shuen, A. (1997). Dynamic capabilities and strategic management. *Strategic Management Journal*, 18, 509–533.
- Torfing, J., & Triantafyllou, P. (2016). *Enhancing public innovation by transforming public governance*. Cambridge, MA: Cambridge University Press.
- Torugsa, N., & Arundel, A. (2016). Complexity of innovation in the public sector: A workgroup-level analysis of related factors and outcomes. *Public Management Review*, 18, 392–416.
- Verhoest, K., Verschuere, B., & Bouckaert, G. (2007). Pressure, legitimacy, and innovative behavior by public organizations. *Governance: An International Journal of Policy, Administration and Institutions*, 20, 469–497.
- von Hippel, E. (1988). *The sources of innovation*. New York: Oxford University Press.
- Walker, R. M. (2006). Innovation type and diffusion: An empirical analysis of local government. *Public Administration*, 84, 311–335.

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APPENDIX 1

MEASURES FOR VARIABLES

Dependent variables: innovation	Values
Since January 2008, has your organization introduced any new or significantly improved services?	0 = no
Since January 2008, has your organization introduced any new or significantly improved methods of communicating your activities to the public, such as new or improved methods of promoting your organization or your services?	1 = yes
Since January 2008, has your organization introduced any new or significantly improved methods of communicating your activities to the public, such as new or improved methods of influencing the behaviour of users, citizens or others?	
Since January 2008, has your organization introduced any new or significantly improved processes or organizational methods, such as new or improved methods of providing services or interacting with your users?	
Since January 2008, has your organization introduced any new or significantly improved processes or organizational methods, such as new or improved delivery or logistics systems for your inputs?	
Since January 2008, has your organization introduced any new or significantly improved processes or organizational methods, such as new or improved supporting activities such as maintenance systems, purchasing, accounting, or computing systems, etc.?	
Since January 2008, has your organization introduced any new or significantly improved processes or organizational methods, such as new or improved management systems?	
Since January 2008, has your organization introduced any new or significantly improved processes or organizational methods, such as new or improved methods of organizing work responsibilities or decision-making?	
Cronbach's alpha: 0.74	

Independent/mediator variables	Values
<p><i>Organizational capabilities</i></p> <p>The extent to which each of the following knowledge sources were important as source of the development of innovations: (1) ideas from management, (2) ideas from staff</p> <p>How well do the following apply to your organization since January 2008?</p> <p>a) Managers support trial-and-error testing of new ideas</p> <p>b) Managers take an active role in developing and implementing innovations</p> <p>c) Staff have incentives to think of new ideas and take part in their development</p> <p>d) Users are involved in the design or planning of new or improved services</p> <p>e) New or improved services are evaluated after completion</p> <p>Cronbach's alpha: 0.7</p>	<p>1 = not important</p> <p>2 = somewhat important</p> <p>3 = very important</p> <p>(summated scale)</p> <p>1 = not at all</p> <p>2 = partly</p> <p>3 = fully</p>
<p><i>Use of external knowledge</i></p> <p>The extent to which each of the following knowledge sources were important as source of the development of innovations: (1) professional organizations, (2) visits to conferences, (3) enterprises as suppliers, (4) enterprises as clients or users, and (5) citizens as clients or users</p> <p>Cronbach's alpha: 0.75</p>	<p>1 = not important</p> <p>2 = somewhat important</p> <p>3 = very important</p>
<p><i>Identified demand</i></p> <p>The importance of the following five political or legislative factors for driving the development and introduction of innovations since January 2008:</p> <p>a. Mandated decrease in the organization's budget</p> <p>b. Mandated increase in the organization's budget</p> <p>c. New laws or regulations</p> <p>d. New policy priorities</p> <p>e. Mandated introduction of new e-government or online services</p> <p>Cronbach's alpha: 0.68</p>	<p>1 = not important</p> <p>2 = somewhat important</p> <p>3 = very important</p>
Control variables	Values
<p>Organizational size: How many employees does your organization have?</p>	<p>1 = between 10 and 49</p> <p>2 = between 50 and 99</p> <p>3 = between 100 and 249</p> <p>4 = between 250 and 499</p> <p>5 = between 500 and 999</p> <p>6 = 1,000 or more</p>
<p>Local: Which of the following best describes the geographic area served by the organization where you work?</p>	<p>0 = otherwise</p> <p>1 = local</p>
<p>Regional: Which of the following best describes the geographic area served by the organization where you work?</p>	<p>0 = otherwise</p> <p>1 = regional</p>
<p>National: Which of the following best describes the geographic area served by the organization where you work?</p>	<p>0 = otherwise</p> <p>1 = national</p>

APPENDIX 2

FACTOR SCORES

Variable	Factor1	Factor2	Factor3	Factor4
Innovation1	0.4026	0.0187	0.1145	0.0327
Innovation2	0.4659	0.0962	0.0002	0.1189
Innovation3	0.4682	0.1029	0.0471	0.1179
Innovation4	0.5542	0.1083	0.0767	0.0653
Innovation5	0.4851	0.1194	0.1506	0.1037
Innovation6	0.4177	0.1043	0.0252	0.0794
Innovation7	0.6052	0.1538	0.1981	0.0776
Innovation8	0.4852	0.1339	0.2115	0.0314
Capability1	0.1758	0.3101	0.3363	0.123
Capability2	0.0153	0.3876	0.3866	0.0563
Capability3	0.2152	0.0991	0.4814	0.0647
Capability4	0.2289	0.0609	0.6411	0.0878
Capability5	-0.0385	0.0475	0.4835	0.0195
Capability6	0.1115	0.1538	0.4444	0.0488
Capability7	0.2066	0.1538	0.388	0.0787
Knowledge1	0.1001	0.4339	0.2144	0.1394
Knowledge2	0.1353	0.5119	0.1903	0.1171
Knowledge3	0.1177	0.502	0.0461	0.124
Knowledge4	0.1816	0.6138	0.0032	0.0749
Knowledge5	0.1898	0.642	0.109	0.0839
Knowledge6	0.0744	0.5168	0.1614	0.1562
Demand1	0.0951	0.0664	0.0657	0.5125
Demand2	0.0461	0.1381	-0.008	0.4795
Demand3	0.0758	0.0612	0.1006	0.6598
Demand4	0.1366	0.1288	0.1513	0.5331
Demand5	0.1931	0.208	0.0232	0.4456

Rotated factor loadings (pattern matrix)