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What kinds of regional innovation systems occur around federal agencies?

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Abstract

Scholars in innovation studies increasingly highlight that federal governments on the demand side spur innovation activities of government contractors. While government contractors tend to concentrate in capital cities, the kinds of regional innovation system (RIS) that occur around federal agencies remain poorly understood. Drawing on the RIS approach, this paper examines the actors and activities that are placed at the interface between public demand and private supply. The analysis draws on 122 interviews with RIS actors in Bern, The Hague, Ottawa and Washington, D.C. The results indicate that intermediaries play crucial roles in stimulating knowledge exchange between public demand and private supply. One important role relates to getting involved in policy formulation in order to enhance interactive learning in federal procurement practices. In interaction inspiring federal procurement policies, government contractors generate technical knowledge that they also can exploit through private sector clients.

1 Introduction

There is an increasing interest among academics and policymakers in how to leverage federal procurement power for innovation (Edquist et al. 2015). The focus is on understanding facilitators and barriers to innovation (Edler et al. 2015; Georghiou et al. 2014), rather than on geographical patterns of innovation. Yet, government contractors strongly concentrate in capital cities (Wood 2006). They co-locate in close proximity to federal agencies on the demand side. Government contractors in Greater Washington, D.C., for example, captured $71.1 billion or 16% of federal procurement spending in 2015 (Fuller, 2016). In the development of complex government information technology (IT) systems, government contractors need to combine internal capabilities with external ones. They participate in knowledge exchange and interactive learning with other organizations (Landry, Amara, and Doloreux 2012). In this regard, a lot of emphasis is put on the region as the favorable geographical level for seeking innovation partners (see, e.g. Feldman 2000). Spatial proximity fosters trusted relationships through repeated face-to-face interaction and facilitates knowledge spillovers. This suggests that capital cities play a crucial role in federal procurement of innovation. Thus, it is important to analyze knowledge dynamics in capital cities if we want to understand the spatial dimensions of federal procurement driven innovations.

The Regional Innovation System (RIS) concept is among the most prominent ones to explain knowledge dynamics at the regional level (Asheim, Smith, and Oughton 2011; Doloreux and Parto 2005). However, since the concept has not yet been applied in the context of federal procurement, there are several shortcomings. RIS literature has ignored the fact that the state, here in the form of federal agencies, is a large buyer of services as well as products and therefore drives innovations from the demand side. Our understanding of territorial shaping of knowledge dynamics is almost exclusively derived from economic interactions to take advantage of private sector business opportunities (Strambach and Dieterich 2011). Thus, it remains unclear how the specific interaction patterns that are derived from federal business opportunities shape regional information flows and knowledge sharing. Moreover, while the RIS concept emphasizes that buyer-supplier interactions are embedded in a specific regional context with several knowledge sources (Trippl and Tödtling 2011), it is unknown what actors support buyer-supplier interactions in the distinct context of capital cities.

In response to these limitations, the concentration of government contractors in capital cities (Vence-Deza and González-López 2014) is taken as a starting point to investigate the kinds of RISs that occur around federal agencies. Specifically, this paper focuses on the ways in which government contractors benefit from federal procurement shaped RIS in capital cities (CC-RIS). It emphasizes the complex interaction patterns between public demand and private supply. Public demand, on the one side, is often associated with constraint procurement procedures, culture of bureaucracy, arm's length relationships, non-profit incentives, and risk-averse government officials (Mergel and Desouza 2013; Roodhooft and Van den Abbeele 2006). Private supply, in the form of IT government contractors, on the other side, is usually associated with rapidly changing technologies, collaborative strategic relationships, and risk-taking entrepreneurs (Trippl, Tödtling, and Lengauer 2009). In federal procurement, capital cities become crucial places where both sectors encounter one another. CC-RISs need to

function as bridges between both sectors and need to help to overcome gaps between both paradigms.

The intensity of complex interaction patterns between public demand and private supply is special to capital cities, yet the interaction is not expected to unfold in the same ways in different cases. The formation of CC-RIS is highly interrelated with federal procurement innovation policies. Federal procurement policies strive to stimulate either competition or cooperation (Edquist and Zabala-Iturriagagoitia 2012). Competition, as a policy goal, leads to arm's length relationships in order to not favor any government contractors. Cooperation is based on the perception that innovative outcomes can be achieved when federal agencies share information and ideas with government contractors. Innovation is not only discussed in regard to making government services more effective and efficient but also in regard to making the private sector more innovative and competitive (Rolfstam 2008). Federal procurement projects empower government contractors to exploit knowledge through private sector clients (Uyarra et al. 2014).

This paper examines the kinds of RISs that occur around federal agencies in capital cities by raising the following questions:

- What actors and activities are placed at the interface of public demand and private supply in capital cities?
- How exactly do government contractors benefit from being located in the capital city?
- How does federal procurement contribute to a more diversified regional economic base?

In order to address these research questions, the paper makes use of an extensive multiple-case study methodology (Stake 2006). Washington, D.C., Ottawa, Bern and The Hague provide interesting cases in order to study CC-RISs. The four cases are so called secondary capital cities (SCC) because they are not the economic center of their nation (Mayer et al. 2016). As such, they lack a more diversified regional economic base and are fairly dependent on federal government spending. Thus, regional policymakers are particularly challenged to leverage the presence of federal agencies for private sector jobs by improving CC-RIS functions. The four cases have been enriched through a total of 122 semi-structured, face-to-face interviews with regional key informants.

2 Conceptualizing regional innovation systems of capital cities

The analysis of innovation activities that take place around federal agencies on the demand side draws on the concept of RIS. A RIS can be defined as "a set of interacting private and public interests, formal institutions, and other organizations that function according to organizational and institutional arrangements and relationships conducive to the generation, use, and dissemination of knowledge" (Doloreux and Parto 2005, 134). The definition strongly emphasizes knowledge processing. Thus, for the purpose of this paper, an innovation is defined as "the visible result of knowledge dynamics" (Strambach and Dieterich 2011, 4).

Federal procurement and innovation

Federal procurement policies highly influence knowledge dynamics in CC-RIS. While being the driver for knowledge dynamics at the regional level, federal procurement is regulated at the federal level. Federal procurement policies change the regulatory framework as well as shape behavior of government officials and thus create the conditions under which interactive learning in CC-RIS takes place (Gertler 2002).

Federal procurement policies encourage either competition or cooperation (Roodhooft and Van den Abbeele 2006). In competition inspiring policies, detailed requirements and specifications in request for proposals lead to very similar proposals and therefore government contractors mainly compete based on price as opposed to innovation. Stringent competition is also achieved through as few interactions as possible between government contractors and federal agencies in order to not favor any government contractor. In cooperation inspiring policies, federal agencies and government contractors develop a mutual understanding about the agency's need (Bovaird 2006). In PPI studies, cooperation is seen as a necessary precondition for the development of innovation through federal procurement (Edquist et al. 2015). Obviously, there is tension between both policy goals since intensive interactions and trustful partnerships are favorable for innovation but provide a competitive advantage for the involved government contractors.

Innovation policies in federal procurement aim to widen the regular federal procurement process toward cooperation and alternative solutions (Edquist and Zabala-Iturriagagoitia 2012). The stylized regular open federal procurement process can be divided into the following stages:

- Federal agency defines technical requirements in detail
- Federal agency publishes request for proposals online
- Proposals are selected based on predefined criteria (with a strong focus on price and references)
- A contract is awarded based on the proposal of the government contractor
- Development of the service

While this process has been developed in the context of standardized products and services, it is not appropriate for complex IT government systems (Burnett 2009). Originating from this regular process, there are many policies that focus on transforming this process into a more interactive, innovation-oriented one. Through the implementation of additional steps in the early phases, public demand and private supply is better coordinated. Moreover, public demand can be combined with other innovation policies (Edler and Georghiou 2007). For example, a federal agency provides R&D funding to a government contractor and holds out the prospect of buying the result, so called pre-commercial procurement. It is also important to avoid over-detailed technical requirements as they constrain the possibilities for alternative solutions. Instead, outcome-based specifications enable the introduction of innovations (Timmermans and Zabala-Iturriagagoitia 2013). Moreover, policies address the behavior of government officials since there are incentives for government officials to behave in ways that hamper innovation (Boyne 2002). Too close of relationships between government officials and government contractor may cause the unsuccessful contractors to file a bid protest, whereas arm's length

relationships do not create any problems for the individual. So it creates an incentive for government officials to behave in a rejecting and risk-averse manner.

Another set of policies aims to increase the participation of small- and medium- sized enterprises (SMEs) in federal procurement. Strong participation of SMEs in federal procurement increases the number and variety of proposals and thus leads to a higher chance of innovative solutions (Uyarra and Flanagan 2010). SMEs are also seen as drivers of more disruptive technological changes (Acs 2009). Yet, SMEs face many barriers in federal procurement including size of contracts, the need to provide track records, and the costs for preparing proposals (Loader 2013). Thus, any policy that aims to increase the participation of SMEs in federal procurement can be seen as an innovation policy.

Actors and linkages

A CC-RIS encompasses a unique set of actors (Gordon 2013). To understand knowledge dynamics in a CC-RIS, it is important to precisely point out the actors that engage in knowledge mediation between government contractors and government clients (Markusen 2003).

First, government contractors mediate knowledge between other government contractors and government clients in the form of partners and competitors. A common practice in federal procurement of IT services is that projects are developed in teams of government contractors (Grabher 2002). A prime contractor collaborates closely with one or more subcontractors and solutions are developed as a team effort. Teams are organized around a particular problem and include individuals and firms with different capabilities and skills (Hearn, Rodrigues and Bridgstock 2014). As a result, federal procurement projects provide a stimulating environment for collective learning processes (Ibert 2004). The selection of partner firms, therefore, is a critical activity that affects a government contractor's business success (Sedita and Apa 2015).

Second, associations are key actors at the interface between government contractors and federal agencies (Koschatzky et al. 2014). CC-RISs are full of associations such as chambers of commerce, trade unions, employers' associations, and national sector associations (Gerhard 2007). The latter, in particular, provide intermediary functions relevant to the context of federal procurement. National sector associations stimulate regional linkages through conferences, meetings, exhibitions, and social gatherings (Smedlund 2006). In bringing together actors that are relevant to federal procurement, national sector associations help to exploit the resources that exist in a region in order to spur innovation activities (Tura and Harmaakorpi 2005). The organization of federal procurement in project-teams intensifies the need for coordination among potential partner firms (Sedita and Apa 2015). When searching for partner firms, government contractors face substantial transaction costs due to information asymmetries. For example, information asymmetries relate to how partner firms balance their own interests and their commitment to the federal procurement project over the course of time (Teng 1998). In the field of IT services, information asymmetries are particularly high, as they provide services which cannot fully be evaluated a priori (Aarikka-Stenroos and Jaakkola 2012). National sector associations help government contractors to reduce uncertainties by stimulating the formation

of trusted relations among their member firms (Glückler and Armbruster 2003; Maennig and Ölschläger 2011).

Third, regional public and semi-public development organizations facilitate knowledge dynamics between federal agencies and government contractors. They support government contractors by providing the "soft infrastructure of innovation" (Cooke 2001, 946). They do so by initiating linkages between CC-RIS actors, fostering knowledge circulation, and shaping regional development strategies (Lagendijk and Cornford 2000). Activities that stimulate and harness knowledge dynamics between government contractors and federal agencies can create conflicts between regional and federal interests (Howells 2005). Development organizations act on behalf of regional interests, whereas federal agencies act on behalf of federal interests. The extent to which regional knowledge dynamics create benefits for the country as a whole influences the degree to which federal agencies are willing to engage in regional knowledge dynamics. Thus, development agencies need to demonstrate how regional knowledge dynamics lead to a more innovative, efficient, and effective public sector.

Fourth, knowledge organizations support innovation activities of government contractors (Caniëls and Bosch 2010). Federal research laboratories, think tanks, and university institutes, for example, generate and pool knowledge that is relevant to the context of federal procurement. This includes not only knowledge about developments in technology but also knowledge about developments at the federal marketplace (Broekel and Boschma 2011). Spillovers between knowledge organizations and government contractors are facilitated through iterative processes of interaction rather than linear technology transfer. Traditional boundaries between organizations blur and "each actor should take the role of another, for example, knowledge organizations play a role as source of firm formation, and industry plays a role as developer of training and research" (Caniëls and Bosch 2010, 274).

The setting of actors and linkages can be imperfect in CC-RISs (Tödtling and Trippl 2005). CC-RISs can lack relevant actors, a situation referred to as organizational thinness. The organizational set-up is weakly developed. Federal procurement is perceived as a supplier-buyer interaction that does not require any support and intermediation functions. Thus, there are only a few organizations that are devoted to federal procurement. Moreover, CC-RISs can lack regional linkages and knowledge circulation, a situation referred to as fragmentation (Blažek et al. 2011). In this case, relevant actors of a CC-RIS exist, but they do not share ideas and knowledge.

Spatial proximity & knowledge generation

As many relevant actors in federal procurement are localized in the capital city, so are federal procurement knowledge dynamics. Most important, government contractors benefit from spatial proximity to federal agencies on the demand side. The development of government IT systems is a complex knowledge-intensive process that often results in intangible technologies such as software (Miles 2012). For the development of such systems, government contractors need to mobilize and combine codified and tacit knowledge that is embodied in both the contractor and client (Bettencourt et al. 2002; Landry, Amara, and Doloreux 2012). Spatial

proximity facilitates the mobilization of tacit knowledge through trusted relationships derived from repeated face-to-face interactions (Jones 2007). Moreover, face-to-face interactions enable government contractors to learn about the government client's preferences and expectations.

Aside from being close to government clients, government contractors benefit from spatial proximity to other CC-RIS actors (Landry, Amara, and Doloreux 2012). The thick endowment of CC-RISs with relevant federal procurement actors provides many opportunities for information and knowledge sharing. Spatial proximity facilitates flows of information through frequent, intended as well as unintended, face-to-face encounters. In this regard, the idea of local buzz (Bathelt et al. 2004; Storper and Veneblas 2004) is well incorporated in the RIS approach (Doloreux and Parto 2005; Trippl and Tödtling 2011). Local buzz refers to regional circulation of "messages, information, news, rumours, gossip, and trade folklore" that actors automatically receive just from being there (Bathelt and Gräf 2008, 1947). As such, CC-RISs are unique places of constant federal procurement information flows.

It is crucial for government contractors to transform such information flows into federal procurement knowledge. Federal procurement knowledge refers to the competence to position a firm at the federal marketplace. It requires absorptive capacity to tap into local information flows and to filter economically-useful information from the rest (Sternberg 2007; Trippl, Tödtling, and Lengauer 2009). In the generation of federal procurement knowledge, it is necessary for contractors to integrate various pieces of information and knowledge. This includes information about the unique regulatory procurement context and specific procedures such as procurement vehicles (Thai 2001). It includes knowledge about how procurement regulations unfold and shape procurement practices (Thai 2009). It includes client specific information such as preferences, budgets, schedules, and procurement plans (Aarikka-Stenroos and Jaakkola 2012). Finally, it includes project management competencies in the specific context of federal procurement which is often associated with risk-averse clients, culture of bureaucracy, and specific fiscal year-driven investment cycles (Boyne 2002). In federal procurement, the need to constantly gain and process federal procurement knowledge derives from the size of the contracts rather than high dynamics of the market. Since procurements of IT services are often bundled into large projects that are worth several million dollars, there are enormous business opportunities, but they do not occur so frequently.

For the introduction of innovation, it is important to combine federal procurement knowledge with technical knowledge (Sammarra and Biggiero 2008). Tödtling and Grillitsch (2014) point out that most innovation studies provide a limited perspective on knowledge networks as they only focus on the generation and transfer of technical knowledge. Knowledge sources that government contractors use to acquire federal procurement knowledge differ in terms of geographic distribution from those that are used to acquire technical knowledge (Alberti and Pizzurno 2015). Exchange of federal procurement knowledge, on the one hand, is facilitated through spatial proximity because of constant information updates due to the local buzz effect. Technical knowledge, on the other hand, is exchanged with innovation partners who are located in greater geographical distances (Tödtling and Grillitsch 2014).

It should be recognized that while stressing the importance of knowledge flows within the capital city, a too narrow focus on regional knowledge sources can result in regional lock-in (Tödtling and Trippl 2005). CC-RIS actors are strongly oriented toward activities that take place within CC-RISs and ignore relevant external developments. They become "overembedded" as the selection process of innovation partners is biased toward previously successful regional partnerships (Woolthuis, Lankhuizen, and Gilsing 2005).

Nevertheless, it is important to note that federal procurement implies distinct mechanisms that decrease the importance of spatial proximity in the supply-demand relationship (Thai 2009). First, spatial proximity does not play a role in reducing uncertainty about the quality of the outcome in federal procurement. Federal agencies select government contractors based on pre-defined criteria (Bovis 2012). This is a very rationalized selection process that federal agencies need to be able to explain to unsuccessful bidders. A lack of transparency can cause lawsuits. In contrast, private market actors can try to reduce transaction costs through partner selections that are partially based on instinct, gut feelings, and trust (Scarso and Bolisani 2012). In this case, face-to-face interactions are a important mechanism in convincing other parties (Maskell, Bathelt, and Malmberg 2004). Second, federal agencies must publish federal business opportunities. Every government contractor has open access to such information. In contrast, private market actors communicate business opportunities in networks which are governed by trust (Glückler and Armbruster 2003).

Diversification

A major policy challenge for CC-RISs is to become less dependent on federal government spending – this is particularly relevant to secondary capital cities. If the regional economy is anchored in several different sectors, CC-RISs are more robust against downturns in federal procurement spending and job losses in one sector can be compensated for with job growth in other sectors. CC-RISs develop more independent regional economies through diversification (Aldrich 1999).

Diversification relates to the ability to broaden the regional economy "into new applications and new sectors while building on their current knowledge base and competences" (Tödtling and Trippl 2013, 313). To explore how CC-RIS achieve the development of new application and new sectors, one need to look at how federal procurement enables government contractors to exploit their knowledge through new clients (Markusen 1994). The underlying ratio is that cumulative diversification activities of government contractors cause a change in the CC-RIS as a whole (Tödtling and Trippl 2013).

At the government contractor level, government contractors become less dependent on a single federal agency by diversifying their client base (Greenwood et al. 2005). Government contractors translate knowledge generated in federal procurement projects into the context of new clients. This requires them to identify knowledge that might be relevant to other clients, extract it from client-specific contexts, and reconfigure it with preexisting internal knowledge (Strambach 2008). Castaldi and Giarratana (2011) note that the first step, the identification of knowledge that might be relevant to other clients, is a particular difficult step because

government contractors in IT services have "heterogeneous and sometimes scattered competences" and thus diversification is a deliberate and costly process (Castaldi and Giarratana 2011, 3).

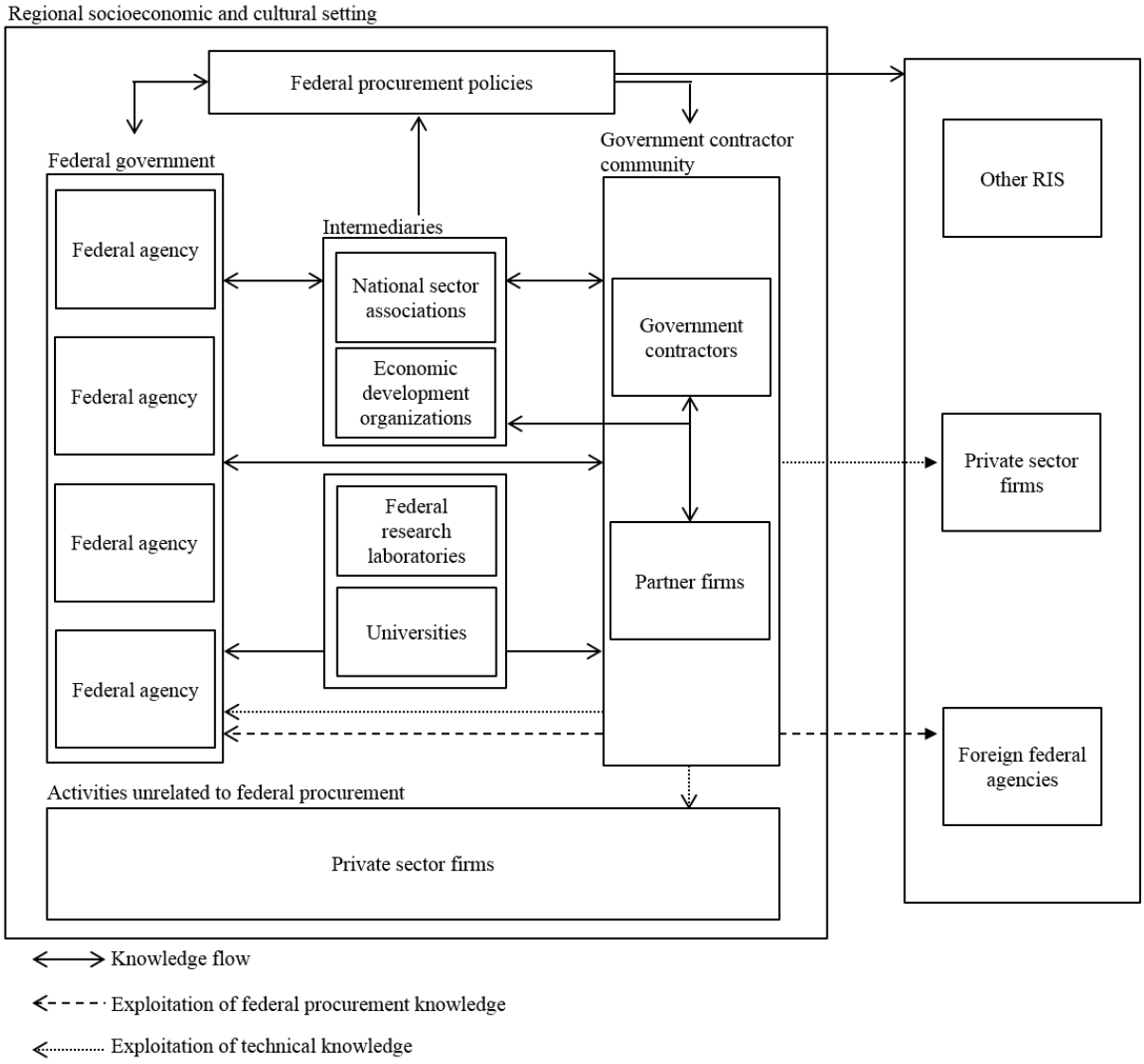
To trigger diversification of government contractors, federal procurement needs to enhance the government contractors' knowledge stock (He and Wong 2009). Government contractors increase their knowledge stock if demand goes beyond state-of the art products and systems (Lember, Kalvet, and Kattel 2010). They engage in interactive learning processes to generate and acquire missing knowledge components. Since the federal agency is the first user of the respective service or product, the federal agency co-invests costs for interactive learning (Edler and Georghiou 2007). Government contractors learn about user experiences and further improve functionalities. As a result, government contractors can exploit the enhanced knowledge stock through new clients.

Government contractors in IT are particularly well positioned for diversification. The development of IT services is a knowledge-intensive and costly process. But once a solution is developed, the replication is relatively straightforward and in fact many IT solutions include components that are "recycled" as they have been developed in the context of prior projects (Ibert 2004, 1530).

Integrated framework

It is important to pay attention to the relations between the four analytical categories in CC-RIS (federal innovation policies, actors and linkages, spatial proximity as well as knowledge generation, and diversification) (Edquist 2005). The arrangement of one category is likely to reinforce or discourage the arrangements of other categories. The complex interrelationships of CC-RIS can be specified as follows.

First, we may expect correspondence between sophisticated federal procurement innovation policies and a strong endowment of intermediaries in CC-RISs. Federal procurement innovation policies are designed to stimulate knowledge interactions between public demand and private supply. Knowledge interactions are necessary to identify and discuss exact needs and possible solutions. The willingness of federal agencies to interact with government contractors leads to the emergence of intermediaries that coordinate and mediate interactions. Once intermediaries have emerged, they get involved in policy formulation and lobby for better use of innovation-targeted instruments instead of the regular constrained federal procurement procedures. As such, they reinforce the correspondence between innovation policies and intermediaries. On the contrary, if federal procurement is neglected as a tool to stimulate innovation, strong intermediaries have not emerged yet. The lack of key intermediaries means that the CC-RIS is missing actors that drive change in federal procurement innovation policies. There is a weak endowment of actors that advocate on behalf of government contractors, that express problems in federal procurement practices, and that lobby for federal procurement policies that enable government contractors to innovate.



Source: Author's analysis, inspired by Tödtling and Trippl (2005)

Figure 1 Main structure of federal procurement driven CC-RIS

Second, we may expect that the presence of intermediaries in CC-RISs increase the generation of technical knowledge. Government contractors generate technical knowledge if they face technically challenging demands, flexibility in solution development, and constant user-producer interactions in the procurement process. Federal procurement projects are technically challenging particularly if federal agencies demand products and services that are not only new to the buying organization but new to the world (Edquist and Zabala-Iturriagagoitia 2012). PPI literature highlights that the success of such federal procurement projects depends on active intermediation between supply and demand (Rolfstam 2008). Edler and Yeow (2016), for example, note that intermediaries foster awareness about federal procurement projects and their technological opportunities in the government contractor community. Moreover, intermediaries help federal agencies to better understand private sector technologies, evaluate functional improvements, and assess technological options. In stimulating knowledge dynamics and facilitating collective interaction, "intermediaries are not so much brokers between distinct parties, but instruments to support systematic functions in innovation systems" (Edler and

Yeow 2016, 415). Thus, CC-RISs that deliver active intermediating functions provide a stimulating environment for government contractors to gain technical knowledge.

Third, we may expect that the type of knowledge that the contractor gains in the interaction with a government client constraints the firm's ability to diversify (Strambach 2008). Federal procurement knowledge, on the one hand, relates to the specific context of government clients. Thus, systematic generation of such knowledge increases the firm's capacity to win new government clients. Since federal procurement knowledge can hardly be de-contextualized from the public sector, valorization of federal procurement is at the same time also limited to the context of government clients. There is no use of federal procurement knowledge outside this specific context. Technical knowledge, on the other hand, can be abstracted from the specific federal procurement context and recombined in other domains (Strambach and Dieterich 2011). Government contractors that generate technical knowledge increase their capacity to reconfigure and exploit their knowledge through private sector clients.

3 Data and Methodology

This study investigates federal-procurement driven CC-RISs that occur around federal agencies. To address this issue, this paper follows the design of a multiple-case study (Yin 2009). The design is appropriate since one might expect to find differences between CC-RISs in several countries in terms of federal procurement policies, involved actors, knowledge dynamics, and diversification. Moreover, the multiple-case study design leads to robust findings (Stake 2006).

The analysis draws on rich descriptions of four cases, namely Bern, The Hague[1], Ottawa, and Washington, D.C. The four cities are interesting cases to study CC-RISs since their regional economy is dominated by capital city functions (Zimmermann 2010). While multi-functional capital cities such as London or Paris show higher national and international economic functions that are not related to hosting the federal government, secondary capital cities lack a more diversified economic base (Hall 2006). Thus, policymakers are expected to actively stimulate knowledge dynamics in CC-RISs to make the regional economy less dependent on the federal government. The study defines the boundaries of CC-RISs by drawing on statistical units that are based on the principle of regional economic integration. Such a definition is beneficial as it cuts through political boundaries such as municipalities or states and displays economic realities (Romanelli and Feldman 2006).

The research presented draws on 122 semi-structured, face-to-face interviews with key actors in CC-RIS. Interview partners were sampled using the snowball technique[2] (Patton 1990). Initially, government contractors were identified using official federal procurement databases from each country for firms that a) deployed knowledge-intensive IT solutions to a government client and b) that are located in the capital city. Based on the assumption that contract volume

[1] For the purpose of stylistic clarity, the term federal procurement is consistently used in the four case regions, although the Netherlands do not constitute as a federalization.

[2] In the case of Bern, government contractor interviewees were identified through social network analysis methods (see Paper No. 2)

positively corresponds to the complexity of IT government systems, contractors with the highest contract volume were contacted first. From there, the study snowballed to people and organizations that have repeatedly been pointed to as important actors in the CC-RIS (Patton 1990). Since such an approach is biased toward very well connected CC-RIS actors, another point of departure has been academics in the field of regional economic development. Interviews lasted between 40 and 90 minutes for the most part and were typically conducted in meetings rooms but a few also took place in coffee shops because of limited facility access due to security requirements.

Table 1 Overview of conducted interviews

Category	Bern	The Hague	Ottawa	Washington, D.C.
KIBS firms in federal procurement	12	10	20	10
Regional development organizations	2	3	3	1
University institutes	1	4	2	3
Sector associations	0	2	2	4
Federal procurement officials	1	2	2	2
Regional policymakers	2	4	1	3
Financial organizations	1	1	0	3
Major employing firms other than KIBS	4	2	2	0
Law firms	0	1	1	1
Others	2	2	3	3
Total	**25**	**31**	**36**	**30**

Source: Author's analysis.

4 Findings

4.1 Bern

Swiss federal procurement policies

The federal procurement policy context in which Bern takes place is shaped by policies that try to increase competition between potential government contractors. Many initiatives in federal procurement try to harmonize the regulatory frameworks between different levels of government in order to reduce entrance barriers. However, federal procurement is not considered as a policy instrument that spurs innovations (Haldimann, Walter, and Brenzikofer 2015). There are no formal mechanisms that stimulate knowledge sharing between public and private actors or that reward government officials for taking risks.

An exception in this regard is the implementation of the competitive dialogue procedure into the Swiss federal procurement framework in 2010. Originally created by EU Public Procurement Directives in 2004, the competitive dialogue procedure is explicitly designed for demanding innovative IT systems. Compared to regular procurement procedures, the competitive dialogue procedure is more flexible in the ways in which it allows federal agencies and (potential) supplying government contractors to interact. As an outcome-based procedure, it specifies the need without limiting innovative solutions through detailed technical specifications. As expected, interviewees that were involved in the competitive dialogue

procedure regarded it as conducive for interactive learning. However, the federal government has used the competitive dialogue only a few times so far.

Actors and linkages

There are a couple of development organizations at the regional level that could facilitate the interaction between government contractors and federal agencies. Capital Region Switzerland (CRS, *Hauptstadtregion Schweiz*), for example, is dedicated to highlighting and enhancing the region's role as a place where public and private sector interests are negotiated to benefit of Switzerland as a whole. CRS was founded in 2010 in direct response to an external shock: In the revision of the federal spatial concept, the Swiss Federal Office for Spatial Development designated Zurich, Basel and Geneva/Lausanne as economic engines whereas Bern was neglected in this regard. Covering a rather large perimeter, policy makers at the municipal and cantonal levels of government formed CRS to emphasize that the status of the greater region as a regular urban agglomeration is not content with the important political functions that the region provides. While having been politically successful (Kaufmann et al. 2016), CRS has not occupied a relevant position in stimulating communication between government contractors and federal agencies yet. In the same vein, semi-public regional development organizations and cluster managers advertise the seat of the federal government as a regional advantage but they do not provide significant bridging functions in this regard.

Regarding the role of sector associations, there are only a few organizations and events that facilitate knowledge interactions between federal agencies and the government contractors' community. Some government contractors considered that *swissICT* contributes to a federal procurement agenda that makes innovation possible (B16, B19, B23). The organization advocates for the use of agile software development in federal procurement. Reports and blogs illustrate advantages and disadvantages of certain procurement practices. SwissICT's role can be described as providing knowledge inputs and promoting the issue of innovation in federal procurement more than providing network opportunities. While being headquartered in Zurich, swissICT's federal procurement-related activities are mostly virtual but when they take place they occur in Bern.

One of the few events where relevant actors in the field of IT federal procurement come together and discuss how federal procurement practices affect the issue of innovation is the "Conference for IT Procurement" (*IT-Beschaffungskonferenz*). The conference is an annual event co-organized by the regional university, the federal IT steering unit, two sector associations, and a public sector organization that coordinates IT projects between different cantonal and federal levels of governments. The conference provides an opportunity to establish new contacts, share experiences, and exchange best practices.

In general, the knowledge support system seems to be important in providing education but unimportant in providing contract research and technology transfer for government contractors. Many government contractors find it difficult to find new employees that are qualified in IT and stressed the importance of university programs that address this issue. For particular federal procurement projects, interviewees reported neither an example where the supplying firm

cooperated with a university nor an example where the supplying firm commercialized research outcomes. Government contractors seem to not depend on the kind of knowledge that universities supply in research collaboration.

The examples of intermediation remain single activities. Bern's CC-RIS can be characterized as organizationally thin in the context of federal procurement. From a government contractor' perspective, there are relatively few private and public sector organizations that get involved in innovation policy formulation in federal procurement, bring forward perceived barriers, lobby for mutual interest, or address practices that hinder innovation. Moreover, there is no relevant organization that initiates a larger debate about what challenges federal agencies are facing, technologies they are looking at, and private sector technologies could be adopted to federal agencies' needs or vice versa.

Government contractors have trusted one-on-one relationships with government officials. Almost all government contractors reported that they do not submit a proposal if they hear a federal business opportunity through the central database for the first time. Several individuals stated that they have been involved in federal procurement for decades and have developed strong personal relationships with government officials (B19, B20, B24). As federal procurement information is largely communicated through trusted one-on-one relationships that are developed through repeated interactions, it is difficult and costly for new firms to gain federal procurement knowledge and to enter the federal marketplace. Arguably, Bern's CC-RIS is threatened by lock-in.

Spatial proximity and types of knowledge

Government contractors primarily benefit from spatial proximity to their government clients in acquiring federal procurement knowledge as opposed to technical knowledge. Government contractors try to get as much face-time as possible with government officials in order to create trusted relationships. They try to supplement formal meetings by adding informal meetings over lunch or coffee. Government contractors get an understanding of what challenges the particular federal agency is facing and what their requirements and preferences are. Government contractors try to shape the request for proposals by advertising what a good solution might look like. These are constant conversations before the procurement process even has started yet. On the contrary, once the procurement procedure has started many technical decisions have already been made. So it is through informal, face-to-face meetings that take place before a request for proposal is published, when contractors and federal agencies exchange ideas.

In terms of technical knowledge, federal procurement provides a difficult environment. The Swiss federal government mainly uses regular procurement procedures for demanding goods and services, including complex government IT systems. In regular procurement procedures, there is little room for experimentation. The process of service or product development is described in detail and pre-defined outputs of one stage lead to the next stage and so on. As such, this is a rather rigid process that disregards new ideas and alternative solutions and thus is not conducive for generating technical knowledge.

Government contractors benefit from being located in Bern mostly through co-location with federal agencies as opposed to co-location with additional CC-RIS actors. As the CC-RIS is not shaped toward federal procurement activities, government contractors are weakly integrated into the wider CC-RIS.

Diversification

Government contractors in Bern stated that there are limited opportunities to generate new technical knowledge in federal procurement projects. The constraining federal procurement framework gives very little room for alternative solutions and - from the suppliers' perspective - government officials do not appreciate new ideas. Thus, diversification through exploitation of technical knowledge barely takes place.

Nevertheless, government contractors benefit in terms of diversification through an enhanced reputation derived from federal procurement projects. Reputation is an important mechanism that facilitates the diversification of a government contractor's client base. In particular, it is beneficial for winning new government clients because governments clients attach great importance to whether a firm has provided a similar service to another government client before. In addition to price, references help to set them apart from competitors. Multi-national government contractors tap into firm-internal databases and see whether they have done something similar for another government client around the world. The interviewees indicated that international references are more often leveraged for Swiss government clients than the other way around (B19, B24). Thus, government contractors primarily diversify their client base through other Swiss government clients. Government contractors become less dependent on single federal agency through new government clients. Nevertheless, the region as a whole does not become less dependent on federal procurement spending.

Moreover, an enhanced reputation derived from federal procurement projects is helpful in winning new private sector clients. References coming from government clients are specific as the federal government is expected to be an objective player. This means federal agencies are not expected to give any complimentary references as opposed to private sector clients. Thus, a good reference from a federal agency is perceived as trustworthy information that signals competences to potential private sector clients. It is in particular SMEs that benefit from an enhanced reputation as they lack other signals of competencies such as a well-known firm brand or a prime location within the city center.

In summary, the case of Bern illustrates a CC-RIS that is characterized by a rather weak endowment of intermediary actors but strong personal relationships between contractors and government officials. Government contractors act individually and try to build many one-on-one meetings with government officials from several agencies. Since inter-firm networks are not considerably formalized and have not led to the emergence of strong associations that speak on behalf of the government contractor community, a considerable engine for change in federal procurement innovation policies is absent. Benefits of spatial proximity are largely limited to co-location of federal agencies.

4.2 Ottawa

Canadian federal procurement policies

As of recently, Canada's federal government has identified federal procurement as a vehicle to stimulate innovation. An important program in this regard is the Build in Canada Innovation Program (BCIP) which encourages federal agencies to become first purchasers of private sector innovations. Starting as a pilot in 2010, Canada's federal procurement arm Public Works and Government Services Canada (PWGSC) released the program to close the gap between pre-commercial innovations and the market place. Federal agencies take the risk of being the first user and give detailed feedback to enable government contractors to further improve the service or product. After a period of five years, federal agencies have awarded 183 contracts to innovative projects (O6).

Among the many contract vehicles that federal agencies use to procure IT services, Solutions-Based Informatics Professional Services (SBIPS) is one that provides the flexibility that is associated with innovation. SBIPS defines the functions that a solution must fulfill but does not describe the product itself. So it creates an incentive for government contractors to look for new ways to develop a more efficient solution.

The interaction between supply and demand was further improved through the implementation of "smart procurement". The procedure was developed for major transformations such as when the federal government transforms their e-mail system. It includes many steps in the early phases before the request for proposals is published to ensure that government contractors gain intelligence about what exactly is needed and that government officials gain intelligence about what solutions are feasible. Additional steps include, for example, industry days, informal discussions, focus groups, one-on-one consultations, and request for information.

In 2006, the Canadian government established the Office of Small and Medium Enterprises (OSME) to promote participation of SMEs in federal procurement. OSME informs SMEs about procurement regulations and procedures and puts them in touch with purchasing agencies. As part of the central federal procurement agency, OSME also directly addresses procurement practices that discriminate against SMEs. Nevertheless, since SMEs are defined as firms with up to 500 employees, critical voices have been raised saying that the range of represented firms is too wide and is associated with conflicting interests in federal procurement.

Actors and linkages

Partner firms constitute an important group of Ottawa's CC-RIS both in terms of federal procurement knowledge and technical knowledge. There are many procurement practices that facilitate cooperation among government contractors specifically between SMEs and large government contractors. Federal agencies encourage SMEs to partner with large firms to ensure large project capacity. Since SMEs consider the preparation of proposals time and cost intensive, they partner in order to share the risk of unsuccessful bidding. One of the selection criteria is whether a government contractor can demonstrate a good track record. So SMEs often

compensate for missing track records by partnering with government contractors that can provide the required information.

In the search for suitable partner firms, national sector associations play an important role. They provide many opportunities for initiating and maintaining relationships with other government contractors through social network events, member meetings, podium discussions, and guest speaker presentations. Moreover, associations coordinate federal procurement practices with private market knowledge. An example is the Information Technology Infrastructure Roundtable where associations and government officials discuss how certain federal procurement practices affect the development of IT systems. About three times a year they hold advisory meetings where sector associations' representatives get together with government officials from the end-client agencies, Shared Services Canada (central IT government agency), and PWGSC (central procurement arm). At these meetings, they discuss the progress or lack of progress in moving toward proper federal procurement reforms. This includes issues such as how the government should roll out procurement for major transformational initiatives or how they should use the limitation of liability within procurements.

Semi-public organizations have a strong tradition in fostering regional cooperation and networking in Ottawa. Most important, the Ottawa Centre for Research and Innovation (OCRI) was founded to facilitate knowledge interactions among private and public actors across the region in 1983. Initially founded by 14 organizations such as local universities, municipality, high-tech firms, and federal research laboratories, OCRI consistently grew and by 1998 they had reached 400 member organizations and 50 employees (Wilson 1999). Several studies that analyzed knowledge dynamics in Ottawa acknowledged OCRI as an important facilitator of cooperation (Doloreux 2004; Gordon 2015; Wolfe 2002). The crash of the internet bubble in 2001 and the financial crisis in 2008 hit the region dramatically and much of the talent left the region (Spigel 2011). Knowledge dynamics and regional cooperation dramatically dropped during this period of time (O16). To revitalize the regional economy, OCRI was relaunched under the new name "Invest Ottawa" in 2012.

Activities of Invest Ottawa are weakly linked to government contractors. The organization focuses more on providing start-ups with support services, branding the city as an entrepreneurial place, and attracting international investments. One of the few attempts of Invest Ottawa to stimulate knowledge dynamics in the government contractors' community is through an online database that shows federal business opportunities. In cooperation with the Economic Development and Innovation Department at the City of Ottawa, Invest Ottawa collects federal business opportunities from various state and national procurement databases in Canada and the USA. Designed to grow the regional economy, Invest Ottawa's database only shows federal business opportunities that match their regional clusters such as software development, wireless technologies, and security networks.

Ottawa's strong knowledge support subsystem, plays a minor role as an innovation partner in the context of federal procurement. Linked to the city's status as the capital city, Ottawa hosts 44 federal research laboratories. In addition, there are two universities, University of Ottawa and Carleton University, that have a strong research focus. Particularly the latter puts much emphasis on creating knowledge in the fields of software engineering, network security, and

pervasive computing. Carleton Computer Security Lab, for example, conducts research about security issues in networked information systems and illustrates that the knowledge support subsystem can be considered to correspond to the needs of government contractors. Nevertheless, government contractors did not regarded the knowledge subsystem as relevant to technical and federal procurement knowledge. Regional policymakers show awareness of the absence of links between federal research laboratories and the CC-RIS. It is a policy goal to better take advantage of federal research laboratories in terms of commercialization (O9), but this has not led to powerful instruments or initiatives yet.

A possible explanation for the absence of linkages between government contractors and knowledge organizations can be the character of federal procurement projects. Interviews indicate that federal procurement projects are often not very sophisticated in terms of technical knowledge. As the complexity of projects arises from bureaucratic environments rather than from technical requirements, government contractors do not heavily rely on cutting-edge research that is provided by federal research laboratories. However, the two universities are important in providing human capital. Some government contractors stated that part of their workforce graduated from the regional universities and students often stay in the region because of the high quality of life.

Spatial proximity and knowledge generation

Government contractors considered the location in the CC-RIS as crucial for their success in federal procurement. One reason is that government clients use spatial proximity to achieve a time advantage in the federal procurement process. They constantly interact with government officials to know about potential procurement projects as early as possible. As soon as they know about procurement plans they start to search for partners. Government contractors try to condition the federal agency to look for a certain kind of solution in informal and formal meetings. One interviewee explained: *"If you are sitting there and wait for requests for proposals to suit your solution, then you are going to die. You have to be out there cultivating the need that creates the requirements."* (O30). Another reason why spatial proximity is important is that there are many people involved on the client side, and government contractors have to maintain many personal relationships. Knowledge and decision-making power about fiscal budgets, IT infrastructure, legal aspects, priorities, end-user preferences, and federal procurement strategies are distributed on many people from different federal agencies. Government contractors invest much time and money in relationship building and face-to-face meetings are important factors in deepening such relationships. Finally, government contractors benefit from spatial proximity in the actual development of the service. Government IT systems can often only be accessed from the client side due to security issues. Ongoing federal procurement projects also provide a good opportunity to learn about future federal procurement projects.

In addition, government contractors benefit from spatial proximity to partner firms. Since many government contractors are concentrated in the downtown business district next to Parliament Hill, there are many opportunities to have an "*ear to the wall to see what everybody is doing*" (O31). One mechanism that puts much emphasis on the geographical level in searching for

partner firms is the requirement of security clearance. Government contractors that are involved in the provision of federal government IT systems largely interact with federal agencies in the field of defense and security. Therefore, government contractors are required to hold security clearances at the employee level. While pretty much all specialized government contractors in CC-RIS are equipped with the required forms, firms that are not specialized in federal procurement mainly lack security clearance. As a result, government contractors seek partner firms mainly at the regional level.

The strong localization of federal procurement activities may cause regional lock-in to some extent. For example, one interviewee noted that *"it tends to be a very incestuous pool of people that just keep moving around and around and around"* (O23). In the same vein, another interviewee noted that Ottawa is a "*very small town in terms of IT. Everyone knows everyone and it's the same individuals who are always rotating through the different jobs"* (O27). While the interviews indicated that extra-firm linkages are highly localized, intra-firm linkages are more global. Many government contractors are multi-branch firms. They use intra-firm linkages to channel knowledge to its place of demand on regional, national and international levels.

Diversification

Most government contractor interviewees traced the question of diversification back to the ways in which the federal government procures. The use of solution-based procurements (e.g. SBIPS), specific innovation-oriented instruments, and open dialogues between government contractors and federal agencies enable firms to generate knowledge and technologies that can be commercialized in other markets. To give but one example, an Ottawa-grown firm that participated in BCIP developed a cybersecurity platform that empowered them to win new private sector clients nationally and internationally. The Ottawa firm had been developing security solutions for federal agencies for over two decades. Due to their knowledge and experience in federal procurement, the firm identified a need for a medium assurance system. Information had been either not protected or had high assurance, which is expensive. The firm came up with an idea of how to develop a medium assurance software solution. As a first contact partner, the firm shared their idea with OSME who had been open to the idea and supported the development of a proof of concept with 200.000 CAD. As part of BCIP, OSME linked the firm to a federal agency that procured that technology solution. Having a first client, the firm turned the proof of concept into a prototype and finally into a product. Today the product generates more revenue than any of the firm's other products. While the process of developing the knowledge-intensive product has taken place in the context of federal procurement, the firm was able to diversify their client base by reselling the product to major technology firms in Canada, the USA, the UK, and Mexico.

On the contrary, the use of time-based procedures and narrow technical specifications creates few incentives to innovate and little knowledge is gained that can be exploited through private sector clients. In this light, it seems rather problematic that most government contractors described an increasing use of federal agencies to procure through time-based procedures. For federal agencies, the use of time-based procedures is much easier to handle since they do not need to figure out what exactly they are looking for but can use predefined templates. Thus,

government contractors mainly generate federal procurement knowledge that creates competitive advantages in winning new Canadian government clients.

In summary, the case of Ottawa illustrates a CC-RIS in which federal agencies increasingly facilitate knowledge dynamics through federal procurement instruments that are dedicated to innovation. Many government IT system components are developed in teams of partnering government contractors. Therefore, government contractors benefit from being located in Ottawa not only through co-location with federal agencies but also through localized interactive processes with other government contractors. At the interface between federal agencies and government contractor, national sector associations foster knowledge sharing.

4.3 The Hague

Dutch federal procurement policies

The Dutch government shows clear awareness of the potential to stimulate innovation through federal procurement. It becomes most apparent when looking at the main procurement agency, that is Professional and Innovative Tendering Network for Government Contracting Authorities (PIANOo). About half of PIANOo's workforce is dedicated to find ways in which procurement regulations and practices can enable innovative solutions (TH18). PIANOo accelerates the use of outcome-based specifications and interactive behavior of government officials. However, Dutch federal procurement is highly decentralized and every federal agency is responsible for their own purchases. Thus, PIANOo's capability to leverage purchasing power is limited to providing consultancy to federal agencies.

The Small Business Innovation Research (SBIR) program is a prime example of how the Dutch government uses pre-commercial procurement to stimulate technical innovation. Inspired by how the U.S. government uses programs to leverage federal procurement power, the Dutch government created their own in 2005. Up to 2012, seven federal agencies had used SBIR and have awarded 650 contracts (Ministry of Economic Affairs 2014). Based on a need that a federal agency faces, firms can propose a solution. While the need is very clear, there are no technical specifications and firms can submit any solution regardless of underlying technologies. Based on pre-defined criteria, a small group of firms are awarded a contract to conduct a feasibility study of their innovative solutions. During the next step, the most promising solutions receive a research and development contract. As soon as a prototype exists, federal agencies have the opportunity to procure the outcome of this process and become the first user of that technology. As an early adopter of that technology, federal agencies encourage other users to follow. Finally, firms can start to commercialize their product with other clients in the public and private sector. To ensure compliance with the regulatory framework, Dutch SBIR is neither limited to SMEs nor to national firms, which differs to the U.S. case.

Actors and linkages

Federal procurement driven knowledge interactions primarily take place within the field of security. The municipality of The Hague is one of the main actors that foster knowledge

generation in the security sector. The most important initiative in this regard is The Hague Security Delta (HSD). Thus, the question of what actors are involved and what role they play becomes most apparent when looking at the development of HSD.

Although there has been a strong concentration of security firms in the region, the municipality failed to develop the security cluster for a long time. Interviewees reported a tendency of the municipality to treat the field of security as part of the field of justice (TH7, TH9). As such, the municipality primarily focused on lawyers, and other legal service providers but refrained from stimulating technology-based entrepreneurship in security. Interviewees indicated that the lack of the municipality's recognition of security as a sector with peculiarities was also reflected in the city branding. When the municipality launched a new slogan, the involved actors came up with the idea "The Hague - City of Peace, Justice *and Security*". However, the municipality felt no need to include security and cut the word "security" from their slogan.

In 2010, the city was increasingly challenged to implement new initiatives that were supposed to develop the regional economy. The Hague faced a decline of jobs in the public sector, as well as in the telecommunications sector, and saw a stagnation in the oil industry. To identify the economic potential of the region, the municipality launched a study and found that the regional innovation capacity could be increased through stimulation of knowledge dynamics in security. The study pointed to the fact that The Hague hosts many relevant actors in security at different levels of governments. Despite the presence of relevant security actors, there was no venue for contractors, researchers, procurement officials, or regional economic developers to meet and share ideas. One interviewee of a think tank described that the linkages between relevant actors in security were almost non-existent and noted that "actors were just like grains of sand, they were not glued together" (TH7).

In response, the municipality launched The Hague Security Delta (HSD) to link relevant actors and to take more advantage of the presence of federal agencies. HSD is a cluster organization that facilitates knowledge dynamics, provides research infrastructure, and coordinates projects in the field of security. To ensure that the organization meets different requirements from various actors, the municipality launched HSD as a public-private partnership. Co-founders included major government contractors (i.e. Thales, Siemens), federal agencies (i.e. Ministry of Security and Justice), and knowledge organizations (i.e. TU Delft, TNO). In the first three years, the municipality's 5 million euro investment has leveraged additional funds from the federal government and network partners as well as 1.5 million euro from the European Regional Development Fund (TH9). HSD facilitates knowledge dynamics by providing physical space where different security actors meet, the so called HSD Campus. There are many shared facilities such as living labs, classrooms, flexible office spaces, meeting rooms.

One important way in which HSD adds value to the location is that HSD coordinates public demand and private supply. For example, HSD coordinated the National Innovation Agenda for Security 2015 (NIAS). It is an agenda that aligns R&D projects of government contractors and knowledge organizations with requirements of federal agencies. HSD invited all relevant stakeholders to identify and discuss the main challenges and developments in security that they projected would be important over the next couple of years. At the federal level, the Ministry of Security and Justice and the Ministry of Defense have been involved in the process. As a

result, 16 key innovation focus areas were identified in the report. In these areas, the agenda intends to give government contractors some reliability for investments in R&D since they can better predict what the federal agencies are going to need in the near future. HSD links NIAS with the procurement agenda of several federal agencies. As a result, federal government contractors get an idea of how much and what federal agencies are going to buy in the next couple of years. In brief, HSD allows government contractors to match their innovation activities with the future demand of federal agencies.

The Hague's knowledge organizations can be divided into two groups based on the roles that they play in the CC-RIS. On the one hand, there are organizations that supply technical knowledge. For example, Netherlands Organization of Applied Scientific Research (TNO) is devoted to provide technical expertise in defense and security as well as other government-dominated industries such as urbanization, energy, and health. As a consequence of the specialization in this intersection, some interviewees mentioned that TNO is better prepared to manage projects in which federal agencies are involved. Such projects can unfold their own dynamics that differ from purely private sector projects. For example, government officials may face restrictions about what items they can spent their budgets on, what data validation processes is required, or information they can disclose.

On the other hand, there is a group of knowledge organizations that provide expertise that is needed in developing a more general understanding of societal and administrative trends in the field of security. For example, The Hague Center for Strategic Studies (HCSS) is a think tank that focuses on temporary global crisis from a policy point of view. HCSS emerged out of a project in which also TNO, Clingendeal (a think tank in the field of international relations that is also located in The Hague) and the Ministry of Defense were involved. Large international system integrators benefit from HCSS by receiving advice about their business strategies and how to generally position themselves for future challenges.

What both groups of organizations have in common is that they explicitly focus on the intersection between federal agencies and government contractors. They act as an important link not only between federal agencies and contractors but also between university institutes and other research organizations. In addition, they link regional with extra-regional actors because they are very well connected with international security communities. Even interviewees from contracting firms who did not tap into the available knowledge, highlighted that these organizations nevertheless are important as they brand the region as a knowledge hub for security (TH24, TH31).

Spatial proximity and knowledge generation

Government contractors indicated that they benefit from being located in The Hague particularly in those projects that are dedicated to innovation. The sophisticated demand in such projects fosters localized interactive learning processes between government contractors and federal agencies. "CSI The Hague" is an example of a project that were dedicated to innovation and that was realized through pre-commercial procurement. The project was initiated by the Netherlands Forensic Institute (NFI), an agency of the Ministry of Justice, in 2009. The

Municipality of The Hague and the Ministry of Economic Affairs co-financed the five million euros project costs. The idea was to develop technology that enables NFI investigators to digitize and visualize a crime scene. NFI drove innovation dynamics from the demand side by describing the government contractors what exactly the needs are without predefining possible solutions. A consortium of 9 government contractors and 4 knowledge organizations developed and re-combined technologies from different domains in order to meet NFI's needs. While the project involved not only government contractors from The Hague but different parts of the Netherlands, much of the work required face-to-face interaction that took place in The Hague. In the beginning of the project, NFI gave several seminars that aimed to develop a common understanding about the domain of forensic in general and the project requirements in particular. During the development of the project, much of the work took place in the CSI laboratory which is a facility that was particularly created for the CSI The Hague project and is located next to the NFI building. A The Hague-based government contractor that developed the stimulation software for this project noted that the CSI laboratory was the central place for all consortium members to meet and spin ideas (TH29). Along the line, a program manager of NFI noted that:

"*CSI laboratory was where all companies came with their technology, so you get a very innovative place where people inspire each other, where you are celebrating new things, and if there are problems, you were also there to fight with each other. It was a very, very tense environment where people are creative*" (TH22)

In regular federal procurement, a similar picture emerged like in the other case study regions: Government contractors benefit from being located in the capital city primarily through generating federal procurement knowledge. There are many occasions when government contractors learn about federal business opportunities and start to interact with purchasing agencies. For generating technical knowledge, however, the regular procurement process gives very little flexibility since overly detailed pre-defined requirements limit the possibilities for alternative ideas.

Diversification

HSD is an initiative that explicitly aims to diversify the regional economy. Ever since the foundation, the municipality emphasized that an innovation system in security has great potential for firms to win new clients in the private sector (TH20). The main argument is that security has traditionally been a topic that the federal government has to deal with. So there is some knowledge and experience pooled not only in federal agencies but also in contractors that have co-produced security systems. Since (cyber-)security has become increasingly important for firms, they are more willing to spent their budgets on security. Thus, government contractors that have gained security knowledge through interactive learning with federal agencies have great potential to exploit their knowledge in the interaction with private sector clients. HSD is a recent initiative and has yet to materialize and noticeably impact the regional economy. Nevertheless, in the first three years, more than 500 new jobs in the field of security have been created and 18 firms have re-located from other regions to The Hague (TH9).

At the firm level, interviews suggest that government contractors exploit knowledge derived from federal procurement to a large extent through international agencies. The Hague clearly has a strong regional advantage in hosting international security agencies. Examples include Europol, European Cybercrime Centre, NATO Communications and Information Agency, Allied Joint Force Command Brunssum, and European Air Transport Command. Europol, for example, is a member organization of HSD and flourishes the regional security network. To the extent that international agencies are part of regional networks, it makes it easier for government contractors to approach international agencies and to collaborate.

Nevertheless, there are also several cases in which government contractors were able to exploit knowledge through private sector clients. To give but one example, in 1999, two employees of the Netherlands Forensic Institute (NFI) who dealt with digital forensic and cybersecurity left NFI to start a firm. While NFI was at the forefront in cybersecurity, the private sector was not concerned with this topic. In addition to winning Dutch government clients, the firm was successful in exploiting their knowledge through international agencies and private sector clients. Yet, it was only in recent years that the increasing demand of security services in the private sector boosted the development of the firm (O23). They diversified into markets that deal with highly sensitive data and won clients such as banks, telecommunication firms, as well as multi-national law firms and therefore grew to 240 employees.

In summary, CC-RIS in The Hague is characterized by high knowledge dynamics in the field of security. Despite the lack of an outstanding federal procurement budget, The Hague increased its innovation capacity by fostering knowledge exchanges between public demand and private supply. It was a proactive municipality that fostered the emergence of a dynamic security cluster by acting as a connecting link between federal agencies, government contractors, and specialized knowledge organizations.

4.4 Washington, D.C.

U.S. federal procurement policies

The link between federal procurement and innovation is very strong. There are several initiatives and instruments that aim to leverage federal procurement for innovation. The Small Business Innovation Research (SBIR) program is the prime example of how R&D funding and public demand are combined as a powerful instrument that catalyzes innovation activities in small firms (see e.g. Feldman, Francis, and Bercovitz 2005; Keller and Block 2013). Moreover, there have been considerable initiatives to create a collaborative environment for federal agencies and government contractors. For example, in 2009, the Office of Federal Procurement Policy noted that many procurement officials had become uncertain about how to interact with contractors in the field of IT. Increasing uncertainty was mainly caused by the shift of purchasing products to purchasing complex services that took place over the last decade. As purchasing activities became more complex, procurement officials became more reluctant and increasingly risk-averse. They were afraid of causing legal proceedings against them and often neglected to interact with IT government contractors (W4). To re-establish a collaborative culture, the Office of Federal Procurement Policy initiated the “myth busting” memorandum in

2011. The memorandum explicitly encouraged government officials to interact with contractors, initiated training of the government officials, and addressed barriers that needed to be removed to further improve the interaction.

The U.S. federal government strongly facilitates participation of SMEs in federal procurement. The most effective way of doing this is by reserving federal business opportunities for SMEs, so called set-asides. The U.S. government aims that at least 23% of the annual federal procurement budget goes to SMEs. In this regard, only contracts in which SMEs act as prime contractors are taken into account so that the actual participation is much higher. In addition, federal agencies give SMEs preferential treatment by handling the price of a SME's bid lower than the price technically is. Moreover, federal agencies remove barriers for SMEs in federal procurement by "unbundling" large procurements into smaller ones and by providing trainings about regulations and procedures. Moreover, there are formal protegee programs that encourage large firms to mentor SMEs. Large firms then get funding for their time and effort in building relationships with SMEs.

Actors and linkages

Partner government contractors play an important role in circulating knowledge. The interviews indicate that government contractors partner with other firms in most of the federal procurement projects. For example, government contractors partner with minority-owned businesses to increase the chances of being awarded a contract since federal agencies need to meet certain minority participation goals. Government contractors constantly acquire knowledge from partner firms in federal procurement projects. During the projects, they also share knowledge beyond the scope of a particular project and become important sources of federal procurement knowledge and technical knowledge for each other. The managing of partnerships is therefore a critical task for government contractors. They need to acquire knowledge from partner firms to constantly update what developments take place in the federal marketplace. Yet, they need to protect their own knowledge to secure their competitive advantages (Jiang et al. 2016). Partner activities create unique processes of knowledge circulation in Washington, D.C. One interviewee explained *"It has this weird ecosystem where you and I could be competing this morning on one opportunity. We could be teaming this afternoon on another opportunity. And tomorrow you might be trying to buy me*" (W15). Many interviewees highlighted that no aggressive rivalry occur between two or three major firms in Washington, D.C. On the contrary, federal procurement creates complex partnerships in which competition takes place in a more subtle and covert manner. As one interviewee explained: "*In this town, you have to learn to take 'no' for an answer, … it is, of course, a competitive town, but somebody will be your opponent today, it's just as likely he could be your ally tomorrow*" (W13).

Public and semi-public regional development organizations facilitate the interaction between government contractors and federal agencies. Since the national capital region spans over 17 counties and six independent cities, there are many development organizations. Their activities are tailored to the type of government contractors they host. Arlington, for example, is a county that is dominated by the homeland security industry (Mayer and Cowell 2014). The regional development agency, Arlington Economic Development, therefore tries to grow their business

community by matchmaking government contractors with federal agencies in the field of security such as DARPA or DHS (W14). A good example in this regard is the Tandem National Security Innovations (TandemNSI) program. The program provides a platform for innovative firms to showcase their solutions to security challenges. They bring innovative firms together with program managers of the relevant federal agencies, allowing them to connect personally. Moreover, federal agencies visit TandemNSI events to present security challenges that they are facing and to establish good relationships with firms that have potential solutions.

In Washington, D.C., there is an abundance of national sector associations that act as knowledge mediators between federal agencies and member firms. One of the most important associations in the context of government IT systems is the Professional Service Council (PSC). Founded in 1972, PSC grew to about 390 IT service firm members which all are active in federal procurement and many of them are located in the capital city region in 2015. One key theme of PSC is to address issues in which the procurement practices do not keep pace with changes in the demand structure. While the demand structure experienced a shift from buying products to acquiring services and thus require different practices and capabilities (Gordon 2012), the procurement practices and trainings of the government officials did not change in many areas. PSC addresses resulting problems from the suppliers' perspective and discusses them with acquisition policy leaders. This includes close collaboration with the General Service Administration (GSA) which is an independent agency that advises other federal agencies in how to purchase products and services. In order to get more attention and strength, PSC coordinates some of their activities with the "Acquisition Reform Working Group" (ARWG). ARWG is a group of eight national sector association that all exclusively deal with federal procurement.

When it comes to very large procurements, federal agencies also use large national sector associations to tap into market knowledge before entering the tendering process (W18). Government officials present how they plan to procure a specific service in front of member firms. Government officials present timelines and answer what they understand to be industry concerns about that procurement. During the following ten days, member firms discuss feasibility and advantages as well as disadvantages of how the federal agency plans to procure. After obtaining the views of the member firms, the association puts together a set of recommendations for the purchasing agency. Some weeks later, the government officials come back to the association's office and respond to the recommendations.

Knowledge organizations are well shaped and linked to federal procurement. The Basic Research Innovation and Collaboration Center (BRICC) is a good example of correspondence of knowledge organizations and other parts of the CC-RIS. BRICC is a non-for profit corporation of the Virginia Tech Research Center in Arlington. As part of a Partnership Intermediary Agreement (PIA) with the Air Force Office of Scientific Research, they are explicitly dedicated to creating knowledge spillovers between knowledge organizations, government contractors, and federal agencies. Specifically, BRICC plays three roles. They identify technologies in federal agencies that could be useful for government contractors, they identify technologies in the government contractor sector that could be useful for federal agencies and they facilitate joint research projects. Thus, a major challenge for BRICC is how to identify technologies that could unleash innovation through application in new contexts. To

address this question, BRICC started a series of events where program managers from DARPA, NIH, NSF, Air Force and many more agencies shared experiences. Thus, BRICC has act as a platform to enhance knowledge sharing.

Spatial proximity and knowledge generation

Government contractors stressed the importance of face-to-face interactions with federal agencies in all but one stage of the procurement process in case of multi-million dollar projects. In the beginning, informal meetings are used to exchange ideas and to gain an understanding of "*what keeps the federal agency up at night*" (W29). Such informal meetings include lunch and coffee meetings. The conversations eventually become more specific about particular needs and requirements. Government contractors try to steer discussions toward specific opportunities and how the government contractor could be of service to that opportunity. Such meetings are formal and often held in offices of federal agencies. If government contractors want to showcase new technologies, they also invite government officials to their side. At this stage, government contractors start to search for potential partner firms. Face-to-face meetings allow them to assess "*how badly*" the other firm wants to be their partner (W25). Due to trusted relationships, they also share gossip about what teams are chasing the same opportunity. Government contractors then try to shape the request for proposals in their favor and position themselves. On the government contractor's side, such conversations include team members with backgrounds from multiple disciplines. Teams include "deal shapers" that know very well how the client ticks, program managers, solution architects, computer programmers, technology consultants, lawyers, and business administrators. There is typically a counterpart for each of the team positions on the government client's side.

The composition of teams shows that both federal procurement knowledge as well as technical knowledge is exchanged during these formal and informal meetings. Although no contract has been awarded, government contractors start to search for potential solutions. Solution architects spin ideas about what software components could be deployed, what underlying technology could be used, and how potential solutions could be integrated within the existing government IT systems. At this stage, solution architects from prime and subcontractors go back and forth between the purchasing federal agency and the proposing team. Simultaneously, deal shapers, lawyers, and business administrators work on how to make it easy for the federal agency to award a contract. This includes, for example, issues such as what procurement vehicles could be used or how the contract contributes to the agency's minority goals. This stage of the process is characterized by intensive team interactions. Communications that aim to put every team member on the same level of information is mainly conducted by emailing and phoning. Discussions about how a change in the technical solution could potentially affect strategic and legal aspects take place in frequent physical team meetings.

Once the request for proposals is published, federal agencies "*shut the door*" and there are neither formal nor informal meetings at this stage (W25). After viewing the proposals, some short-listed government contractors are invited for "orals", meaning that three key team members defend their solution in person to the purchasing agency. Orals can be followed by negotiations which are, again, face-to-face meetings. In the actual development of the service,

government contractors benefit from spatial proximity as solutions are often deployed onsite in the offices of the government clients.

The importance of being located in Washington, D.C. not only arises from spatial proximity to the government clients but also from spatial proximity to other CC-RIS actors. Spatial proximity to procurement partner firms is clearly important. Large government contractors have SMEs subcontracting programs and they organize many networking events such as "speed dating", where SMEs can pitch their ideas and establish relationships with large government contractors. In some cases, federal agencies organize pre-bid conferences where interested government contractors come together in one place and can ask questions about the upcoming procurement project. During such conferences, government contractors observe what competitors are present, how competitors position themselves and with whom they collaborate. In addition, spatial proximity helps to collect information on competitors. For example, one interviewee described how two government contractors are currently battling for becoming the "*top dog*" in content management capabilities in Washington, D.C. (W29). So it was an important strategic decision whether to go in that race and build that capability or to position themselves as a subcontractor. The firm benefited from the location in Washington, D.C. to collect opinions and views that provided a sound basis for the decision not to compete but to position itself as a partner firm.

Spatial proximity helps government contractors to better attune to federal procurement budget shifts. Interviewees stressed the importance of constantly interacting with relevant actors in the CC-RIS in order to see financial developments in the federal marketplace. For example, federal procurement of IT systems of the Department of Defense decreased by $1.1 billion (-3.1%) from fiscal year 2014 to 2015, while federal procurement of IT systems of non-defense agencies increased by $3.5 billion (7.9%) in the same period of time (PSC 2015). The relevance of following budgets is also reflected in many commissioned work for think tanks and specialized consulting firms. Resulting from these interactions, firms get a clear picture of where the money is going. Government contractors react to shifts in federal procurement spending, for example, by adjusting partner relationships. According to many interviewees, firms that are located outside the region are typically less involved in such knowledge sharing. When certain budgets decline, contractors try to cut back on subcontractors and those firms that are located outside the region are less involved in knowledge networks and suffer the first (W28).

Regarding the threat of lock-in, interviews indicate that there is not much change in the set of actors. When talking about CC-RIS, interviewees often used terms such as "*usual suspects*" or "*same set of players over and over again*" (W6, W16, W30). One government official was talking about restricted procurement procedures, when he noted:

"Even if you open up the competition to the entire world, you're probably only going to get three, four, five bids. The fact that in theory, a company in Minnesota, Montana or Switzerland could submit a bid is irrelevant. They are not going to. You're going to get bids from Northtrop Grumman, BAE Systems, Lockheed Martin and Raytheon." (W4)

The quote illustrates the threat of lock-in. Since Washington, D.C. has such a huge power of attraction for federal procurement activities, federal procurement activities are strongly

concentrated in the capital city. In this regard, the term "bubble" was used from a few interviewees which may point to overembeddedness.

However, the interviews indicate that this holds true for extra-firm linkages, whereas intra-firm linkages act as important pipelines. Indeed, many of the large government contractors have a specialized division for government clients whereas the rest of the firm is focused on private market industries. One interviewee from a multi-national government contractor used the metaphor of a spear to describe the relation between the several firm divisions (W30): The federal government specialized division is the spearhead that is completely shaped to do business with the federal government. However, once they have acquired access, the firm reaches back to the larger firm to leverage capabilities and talent. Nevertheless, the exchange of information between the firm divisions can be problematic due to strict security guidelines.

Diversification

The development of the Internet is the most prominent example of where regional actors were able to translate knowledge derived from federal procurement into the private sector (Ceruzzi 2008; Mowery and Simcoe 2002). The general challenge to replicate such a success story turned into a heated discussion in 2010. Federal procurement spending has been declining since 2010, after decades of rapid growth with a peak at $550 billion in 2009 (Gordon 2012). The recent decline has drawn much attention to the issue of diversification.

Interviewees from firms and regional economic development agencies concurred that cyber security and health IT are the sectors that are best for generating knowledge and winning new government clients as well as private sector clients. Both sectors are endowed with risk-taking and innovation-oriented agencies such as Defense Advanced Research Projects Agency (DARPA), Department of Homeland Security (DHS), National Institutes of Health (NIH), and National Telecommunications and Information Administration. Describing different government clients, one interviewee noted that "*there are pockets of the federal government that are leading edge technologies and there are pockets of the federal government that are 20 years laggards*" (W15). Thus the U.S. federal government is by no means uniform in terms of federal procurement and the commitment to innovation differs radically across federal agencies (Vonortas 2015).

Government contractors bring knowledge derived from federal procurement into the private sector through corporate spin-offs. Government contractors expand their knowledge stock through federal procurement but lack the capacity to exploit it through private sector clients in the same business unit. "*Commercial and federal are very hard to marry*", explained one interviewee who highlighted different cultures between the two sectors (W15). The business model of government contractors is highly adjusted to federal procurement. They have built the capacities and resources they need to shape, move and finance federal procurement contracts as well as develop, subcontract, and integrate the required technical solutions. However, due to their specialization in federal procurement, they are not well equipped to serve private sector clients from the same business unit. This holds in particularly true for "the elephants", as

sometimes referred to the very large system integrators. Thus, they create corporate spin-offs that exclusively serve private sector clients.

To promote employee spin-offs in cybersecurity, regional economic agencies have set up specific accelerators and incubators. The Entrepreneur Center at the Northern Virginia Technology Council (NVTC) is a prime example of a program that targets employees of government contractors who want to form a new firm in cybersecurity. The Center provides mentoring programs, events, and contacts to enable individuals to leave the bigger firms and start their own firms. The typical entrepreneur of this program is not the 20-something year old coming right out of school but a federal procurement experienced, mid-aged person who has gained technical skills through many years of work in federal procurement (W7). However, while some new firms penetrate private sector industries, the majority of new firms sell to the parent government contractor. Thus, employee spin-offs do not contribute per se to the region becoming less dependent on federal government spending, but can sometimes rather be seen as a way to keep subcontracting activities in the region.

Exploitation through private sector clients often takes place outside of Washington, D.C. Both promising employee spin-offs that have demonstrated their innovation capacity as well as corporate spin-offs of government contractors very often get bought from firms external to the region and much of the talent and knowledge leaves Washington, D.C. Several interviewees mentioned that Washington, D.C.'s CC-RIS is not well equipped with the appropriate environment as well as actors for private market growth (W15, W16). For example, regional venture capitalists and equity firms are rather long-term focused and not that experienced with short holding periods and growth accelerations in the more aggressive "buy and build" practices in some private sector industries. Spatial proximity to the new clients is important to apply acquired knowledge in the new domains, but new clients are often located outside the region.

In summary, the case of Washington, D.C. illustrates a CC-RIS that is characterized by many specialized private and public sector organizations that stimulate cooperative and joint activities between government contractors, knowledge organizations, and federal agencies. The strong endowment of intermediaries has strengthened the link between federal procurement policies and innovation. Yet, a major challenge for regional policymakers is to keep innovation in the region, because the exploitation through private sector clients partly takes place outside the region.

5 Synthesis and analysis

The four case regions show that government contractors benefit from spatial proximity through access to federal procurement information. In all four cases, government contractors evaluated spatial proximity to government clients as critical for their success in winning federal procurement projects. This is a counter-intuitive result. One might expect that publishing of federal business opportunities, transparent selection of proposals, and publicly available reports and studies decrease the importance of co-location. To the contrary, it seems that the fact that a lot of information is publicly available rather increases the importance of spatial proximity since it is one of the few possibilities of gaining competitive advantage. Almost all government

contractors used this phrase in one form or another: "*If you are identifying opportunities based on when they become publicly available, you are already starting behind the game"* (W15). The time advantage is used to look for partners, gain knowledge about what solutions the government client expects, and prepare possible solutions "*since you still have to have a better solution as determined by a jury*" (W15).

The study supports the expected relationships between federal innovation policies, endowment of intermediaries, and capability to diversify: The more sophisticated the federal procurement innovation policies are, the stronger the endowment with intermediary organizations is. Correspondence is strengthened through positive reinforcement. Intermediary organizations improve federal procurement practices from a supplier's perspective. Through improved procedures, government contractors are better positioned to generate technical knowledge since there is more flexibility in the procurement process. The exploration of technical knowledge in federal procurement enables government contractors to exploit their knowledge through private sector clients.

It was expected that if government contractors generate only federal procurement knowledge they improve their possibilities of winning other government clients but they do not improve their possibilities of winning private sector clients. While this can be confirmed from a strict knowledge-based view, they still benefit from federal procurement through an enhanced reputation. Federal agencies are expected to be objective so that references provide trustworthy information (Glückler and Armbruster 2003). Even if government contractors have exclusively generated federal procurement knowledge, they nevertheless improve their possibilities of winning private sector clients through an enhanced reputation.

There are significant differences in terms of knowledge dynamics between the four cases (see table 2). In Bern, there is a lack of intermediaries and government contractors have mainly one-on-one relationships with government officials. In Ottawa, national sector associations facilitate collective knowledge dynamics to some extent. In The Hague, the proactive municipality stimulates innovation activities between various CC-RIS actors. In Washington, D.C., a strong endowment of public and private actors has led to many instruments which have stimulated regional knowledge exchange.

Table 2 Summary of key findings

Case study region	Federal procurement policy context	CC-RIS actors and linkages			Spatial proximity and knowledge generation		Diversification	
	Link between federal procurement and innovation	Endowment of intermediating actors	Knowledge support system	System failures	Proximity to whom	Main type of know-ledge generated	Factors stimulating diversifi-cation	Main new clients
Bern	Weakly developed (competitive dialogue)	Weak endowment of intermediaries; interactions occur in form of direct personal one-on-one relationships	University of Bern important as educator, platform for exchange of experiences (IT-Beschaffungs-konferenz)	Organizational thinness (absence of intermediaries); lock-in	Almost exclusively to federal agencies	Primarily federal procurement knowledge	Reputation derived from government clients	Exploitation through other Swiss government clients
Ottawa	Moderately developed; emergence of innovation support (BCIP, OSME, smart procurement)	National sector associations facilitate knowledge spillovers between public and private sectors	University of Ottawa and Carleton University have importance as educators	Fragmented (lack of linkages to federal laboratories and university research institutes); lock-in	Federal agencies, partner firms, national sector associations	Primarily federal procurement knowledge	Instruments that spur generation of technical knowledge (BCIP, SBIPS)	Exploitation through other Canadian government clients, foreign government clients, private sector clients
The Hague	Strongly developed (PIANOo, SBIR, pre-commercial procurement, NIAS)	HSD as an important platform for stimulating and coordinating knowledge exchange	Public-sector specialized knowledge providers (TNO, HCSS); local universities take part in joint research projects (CSI The Hague)	Fragmentation (overcoming); lock-in	Federal agencies, partner firms, think tanks, knowledge organizations, international organizations	Federal procurement and technical knowledge	Increasing demand of cyber-security in the private sector	Exploitation through other Dutch govern-ment clients, international agencies (i.e. Europol, NATO), and private sector clients

Table 2 (continued)

Case study region	Federal procurement policy context	CC-RIS actors			Spatial proximity and knowledge		Diversification	
	Link between federal procurement and innovation	Endowment of intermediating actors	Knowledge support system	System failures	Proximity to whom	Main type of knowledge generated	Factors stimulating diversifi-cation	Main new clients
Washing-ton, D.C.	Very strongly developed (Myth-busting, SBIR, set-asides, prefer-ential price treatment and training for SMEs,...)	Strong endowment of specialized private and public organizations that facilitate knowledge dynamics	Universities involved in joint research projects; universities act as platforms for enhancing co-operation among federal agencies, government con-tractors, research institutes (BRICC)	Lock-in	Federal agencies, partner firms, national sector associations, think tanks, university research institutes	Federal procure-ment and technical knowledge	Risk-taking agencies in cyber-security and health IT (DARPA, DHS, NIH); contractor-tailored accelerators (NVTC)	Exploitation through other U.S. govern-ment clients, foreign govern-ment clients; exploitation through private sector clients often realized in form of spin-offs

Source: Author's analysis.

While it was expected to see lock-in as a distinct deficiency of strongly developed CC-RIS, it seems that all CC-RISs are threatened by lock-in to some extent (Tödtling and Trippl 2005). Firms that are new to the region help a CC-RIS to remain or become innovative (Sternberg 2007); however, federal procurement provides many barriers for new firms (in particular for SME) to enter the marketplace (Loader 2013). Firms need to invest in training the workforce to cope with the complexity of procurement processes and are likely to have some unsuccessful bids before they win the first federal procurement contract. Federal procurement information is channeled through trusted relationships, in addition to publicly available information. Since a single federal procurement project typically involves several agencies and several units within these agencies, contractors need to invest a lot of time in relationship building. Entering the federal marketplace, thus, requires considerable upfront costs that lead to the same set of government contractors.

6 Conclusions

The purpose of this study has been to examine and present original evidence about CC-RISs that are driven by federal procurement. The findings demonstrate that federal procurement causes unique knowledge dynamics in capital cities. First, capital cities provide important intermediary functions that are beneficial for the development of innovation in federal procurement. Intermediary functions are primarily provided by actors such as partner firms, national sector associations, and semi-public development organizations. These actors provide opportunities for collective learning (Asheim 2007). They organize cumulative knowledge sharing among different actors and coordinate collective actions. As such, their contribution consists of stimulating systemic knowledge flows rather than linking individual actors (Edler & Yeow, 2016). Second, spatial proximity supports trusted relationships and an ongoing share of ideas between government contractors and government officials which in turn favors the development of more innovative solutions. Aside from co-location to government clients, government contractors benefit from constant circulation of federal procurement information in capital cities. Third, the extent to which federal procurement contributes to regional economic diversification depends on the way federal procurement is organized. Federal procurement in which government contractors generate technical knowledge enables them to exploit their knowledge through private sector clients. Federal procurement in which government contractors generate federal procurement knowledge mainly enables them to exploit their knowledge through other federal government clients. In this case, the region still depends on federal government spending.

This study contributes to the theoretical discussion about RIS in at least two major ways. First, the study suggests that knowledge dynamics derived from federal business opportunities unfold in distinct ways. Intermediaries are critical for carrying out innovation activities. Being located in the capital city provides decisive time advantages in the procurement process. Selecting of partner firms is restricted due to security requirements. The extant literature about knowledge sourcing patterns found that spatial distribution of knowledge sources is influenced by underlying knowledge bases, types of innovation, and competencies of firms (Blažek et al. 2011; Martin 2013; Tödtling and Grillitsch 2014). The research at hand suggests that the type

of client (public/private) constitutes another key dimension for explaining knowledge sourcing patterns. Second, the degree to which the predominant regional industry is interwoven with federal innovation policies constraints innovation activities in RIS. The study shows how federal innovation policies shape interaction patterns in capital cities. It also shows how in return regional actors influence federal innovation policies. The interplay between regional and federal innovation policies might also be of key importance in other types of RIS that host government-dominated industries such as biotechnology, energy, or transportation. The concept's focus on regional innovation policies bears the risk of underestimating the mutual influence of policies between regional and federal levels. Specifically, it downplays the fact that regions are not only "receivers" of federal innovation policies but that they participate in the formulation of federal innovation policies (Howells 2005).

The study also provides implications for the theoretical discussion about federal procurement as a driver of innovation. Although PPI draws on the general innovation system concept (Edquist et al. 2015), this study is the first that applies the *regional* innovation system concept. This comes as a surprise given the overall acknowledgement of regions as important places of innovation. The study shows that knowledge sharing between government contractors and government officials takes place beyond the scope of a particular project. PPI literature heavily uses case study methods in which particular federal procurement projects constitute cases (Edler et al. 2005). Therefore, PPI literature underrates the importance of ongoing interactions, including phases, when no federal procurement project is in sight.

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