Open Strategies for Innovation in the Public Sector: Challenges and Opportunities

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DOCTORAL THESIS

Title	**Open Strategies for Innovation in the Public Sector: Challenges and Opportunities**
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"It is the long history of humankind (and animal kind, too) those who learned to collaborate and improvise most effectively have prevailed."

- Charles Darwin

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Abstract

Collaboration with external partners provides a means of expanding a firm's knowledge base, decreasing product development timelines, increasing innovation, and providing competitive advantage. This thesis contributes to the research in open innovation and user innovation by exploring these strategies in the context of the public sector. By examining nascent innovation endeavors in European and American cities, the thesis seeks to understand the underlying drivers of civic innovation, how civic organizations foster communities of collaborators and civic platforms, and how governments access tacit user information by leveraging context and technology to provide innovative solutions. An Integrated Ecosystem Approach is proposed, expanding current conceptualizations of business ecosystems. An emphasis on desorptive capacity in civic organizations is considered as a circumvention of lockout, due to civic deficits in absorptive capacity. The importance of innovation processes situated in real-world environments is examined in living labs, as compared to other methodologies. And an enhanced utility of technology as a tool for accessing tacit user information is proposed in the context of Open Public Policy Innovation.

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1 Introduction

Companies are motivated to collaborate with actors outside of their organization as a means of providing innovative products, solutions, and services (Chesbrough, 2003; Laursen & Salter, 2006; Weisenfeld, Reeves, & Hunck Meiswinkel, 2001). These boundary-less collaborations often operate without formal agreements, structured direction, or guaranteed compensation (Raymond, 2001; Lerner & Tirole, 2001; Bonaccorsi & Rossi, 2006). Loosely connected partners become integral resources to an organization as they provide much of the innovation and value, and likewise, influence the trajectory of the firm as a whole (Iansiti & Levien, 2004; Moore, 1993). Following the success of openness in the private sector, governments seek to implement similar strategies to increase innovation (Susha & Grönlund 2012; Mahrer & Krimmer 2005; Wattal, Schuff, Mandviwalla, & Williams, 2010; Bertot, Jaeger, & Grimes, 2010). These initiatives have not been as readily embraced in the public sector, as cities face challenges adapting organizational processes and fostering ecosystems of collaborators. Competition can explain firms' willingness to experiment with openness, but the lack of competitive concerns in government provides an opportunity, as the constraints that firms face are removed.

This thesis explores strategies leveraged in the public sector and examines the mechanisms and contexts that influence their success. Analysis of innovation initiatives at the intra-organizational, organizational, inter-organizational, and extra-organizational levels (Bogers et al., 2017) considers how each contributes to successful outcomes and should be managed in concert. The thesis seeks to understand the underlying drivers of civic innovation, how civic organizations leverage the contributions of external collaborators, and how governments access tacit user information to guide solution development. An Integrated Ecosystem Approach is proposed, expanding current conceptualizations of business ecosystems and the utility of openness. An emphasis on knowledge transfer and desorptive capacity in civic organizations is considered as a circumvention of lockout, caused by civic deficits in internal innovation capabilities and absorptive capacity. The context of real-world environments for capturing lead users in processes of co-creation is explored in living labs. And an enhanced utility of technology as a tool for accessing tacit user information is proposed for guiding innovative public policy development.

1.1 Objectives and Research Problem

Collaboration with external partners provides a means of expanding a firm's knowledge base, increasing innovation, decreasing product development timelines, and providing competitive advantage (Rigby & Zook, 2002; Cassiman & Veugelers, 2006; Lichtenthaler, 2011; Chesbrough, 2003; Rivette & Kline, 2000). Such collaboration, between firms or with external individuals, involves the transfer of knowledge across organizational boundaries (Chesbrough & Bogers, 2014). Firms develop so-called absorptive capacity in order to value external knowledge, and then assimilate and utilize that information within the organization (Cohen & Levinthal, 1990; Zahara & George, 2002; Lane & Lubatkin, 1998). Absorptive capacity enables an organization to recognize the value in the external knowledge and leverage it to take advantage of emerging opportunities ahead of the competition (Zahra & George, 2002; Lane, Koka, & Pathak, 2006). However, external knowledge is often difficult to identify, express, and transfer (Von Hippel, 1994; Nonaka, 1994; Bogers, Afuah & Bastian, 2010). Scholars have examined open strategies of firms (Chesbrough, 2003; Van de Vrande, Lemmens, & Vanhaverbeke, 2006) and methods for leveraging users as collaborators (Von Hippel 1998; Bogers, Afuah & Bastian, 2010) in the private sector, but less attention has been paid to open strategies for innovation in the public sector. The main objective of this thesis is to examine the development of civic innovation ecosystems and open strategies in government to better understand the contexts and mechanisms that influence outcomes. Analyses at the intra-organizational, organizational, inter-organizational, and extra-organizational levels seek to understand the factors contributing to success and how activities at various levels are related (Bogers et al., 2017). The thesis considers the ability of a civic organization to recognize and capture value from external agents, its absorptive capacity, as a critical capability in open strategies. Mechanisms for leveraging tacit citizen knowledge to guide solution development are also considered central to the success of civic innovation strategies.

Six cities were selected for the research setting of Chapters 3 and 4, based on their leadership in civic innovation initiatives. Barcelona, Amsterdam, Helsinki, Boston, Philadelphia, and New York have been involved in open innovation activities for at least four years and continue to champion the movement. 52 semi-structured interviews were conducted in order to understand a broad variety of the open innovation initiatives in each city, how city managers coordinated contributors and structured their processes, the participation of collaborators, and the usage of solutions. Interviews were conducted with various stakeholders including chief technology officers, open data managers, policy makers and administrators in all of the civic administrations, as well external actors such as application developers, innovation intermediaries, and startups resulting from developed applications. The European Network of Living Labs was the research setting for Chapter 5. An investigation using

secondary sources revealed a list of 48 living lab organizations that were considered potential candidates for the study. Interviews were conducted with 38 senior managers and researchers including the directors of living labs corresponding to 26 different living lab organizations. For Chapter 6, case studies, selected in alignment with central policy areas and used to illustrate the Open Public Policy framework, were developed through secondary sources.

1.2 Contribution of Research

This thesis contributes to research streams in open innovation (Chesbrough, 2003) and user innovation (Von Hippel, 1998) by exploring these strategies in the public sector, distinguished from private business by less competition and a substantially larger user base. By examining nascent innovation endeavors in European and American cities, the thesis explores innovation initiatives at different levels of analysis to understand the mechanisms and contexts for success, and how they interact. The concept of a business ecosystem (Moore, 1993) is enhanced in Chapter 3 though the proposed Integrated Ecosystem Approach, expanding the potential for openness and collaboration among firms. Realizing civic organization deficits in absorptive capacity, an emphasis on desorptive capacity in civic organizations is considered as a circumvention of lockout in Chapter 4. This workaround suggests alternatives for firms experiencing similar challenges. Chapter 5 finds the real-world environment and living labs processes tools for accessing highly valued lead users for civic innovation, suggesting opportunities to recruit previously absent users, in both the public and private sectors, in processes of co-creation. In Chapter 6, an advanced utility of technology as a tool for accessing tacit user information for innovative solutions is proposed in the Open Public Policy framework. The ubiquity of modern digital technologies suggests their applicability in diverse contexts to provide transparency to civic and consumer decision-making. These four central considerations and related contributions of the thesis are discussed further, below.

1.2.1 How the underlying drivers of civic innovation influence the selection of strategy and ecosystem resources

Collaboration and openness, seemingly antithetical concepts to competition, seem well suited to the lack of competitive forces inherent in government (Lane, Koka, & Pathak, 2006; Rigby & Zook, 2002; Cassiman & Veugelers, 2006; Lichtenthaler, 2011). But instead of pioneering open strategies, cities are the latecomers, behind private business. Chapter 3 explores the selection of strategy and resources within open innovation ecosystems. The chapter considers whether firm-level differences mirror those realized in private business, or if shared characteristics across civic initiatives suggest

distinct considerations for public sector strategy. Exploration of civic innovation ecosystems in European and American cities informs the Integrated Ecosystem Approach, which tests the assumptions regarding the limits of openness in collaboration, just as the concept of a business ecosystem (Moore, 1993) once did. This expanded conceptualization encourages organizations to prioritize the ecosystem over organizational concerns, without sacrificing value capture. This chapter further contributes to open innovation literature by showcasing the heterogeneity that open governance of ecosystem collaborators can foster (Bogers et al., 2017). Though challenging to manage without an Integrated Ecosystem Approach, the diversity of collaborator manifest through these open strategies creates an equally rich diversity of ecosystem resources, which organizations can leverage in future endeavors.

1.2.2 How cities foster innovation without internal innovation capabilities and integration mechanisms

Lacking internal innovation departments analogous to corporate R&D labs (Rigby & Zook, 2002; Cassiman & Veugelers, 2006; Lichtenthaler, 2011), cities seek strategies to exploit external sources of information. Modern digital technologies facilitate information exchange, enabling platform strategies that connect consumers with producers and removing the need for an organization to function as the main engine of innovation (Gawer, 2011; Boudreau & Lakhani, 2009; Altman, Nagle, & Tushman, 2015). Chapter 4 explores the evolution of civic platform strategies and suggests strong governance to facilitate knowledge transfer and incentivize participation, investment, and sustainability of initiatives. Individual-level characteristics, including risk aversion and NIH syndrome, contributed to many of the challenges that defined early initiatives. That those characterizations also came to define the organizations suggests interdependency between levels of analyses. This interdependency contributes to open innovation research by suggesting that individual-level attributes, including acceptance of organizational openness, influences organizational-level identity and capabilities (Bogers et al., 2017).

Absorptive capacity describes a firm's ability to value, assimilate, and utilize knowledge sourced from external partners, within the organization (Cohen & Levinthal, 1990; Zahara & George, 2002; Lane & Lubatkin, 1998). This organizational capability first enables a firm to recognize the value in external knowledge and to then take advantage of emerging opportunities ahead of the competition by further developing or capitalizing on innovation (Zahra & George, 2002; Lane, Koka, & Pathak, 2006). However, when an organization's internal knowledge base does not match the external environment, transferring external information or innovation into the firm proves challenging (Cohen & Levinthal, 1990). Lacking internal investments in innovation developments, cities lag

behind innovative firms and face challenges recognizing and exploiting external solutions. By exploring civic innovation strategies in Chapter 4, the thesis proposes the utility of intermediaries as boundary spanning agents that bridge the knowledge gap in civic innovation, facilitating information sourcing and assimilation. These agents also facilitate outbound knowledge sharing, from firm to collaborator, or desorptive capacity. Realized more commonly in civic, rather than private strategies, this tendency suggests a possible circumvention to lockout when organizations fail to match the speed of their environment (Cohen & Levinthal, 1990).

1.2.3 How cities access tacit user information to develop innovative civic solutions

Consumers are valuable partners in open strategies, leveraged for their insights into user needs and to predict emerging trends (Von Hippel, 1998; Lane, Koka, & Pathak, 2006). Firms strategize to identify these users and incorporate their innovations into existing products and solutions (Baldwin, Hienerth & Von Hippel, 2006; Lettl, Herstatt, & Gemuenden, 2006; Lilien, Morrison, Searls, Sonnack, & Von Hippel, 2002). Citizen needs are equally essential for informing the development of civic solutions, yet these users are often difficult to engage in the context of public services. Further, their tacit knowledge, which is personal and not easy to express or articulate, is often difficult to identify, assimilate, and exploit (Nonaka, 1994; Bogers, Afuah & Bastian, 2010). Chapter 5 explores the importance of context as a tool for accessing lead users. Through a comparison of innovation methodologies, a focus on living labs reveals the potential for situating innovation processes in the urban environment to reach lead users, gaining insights into tacit citizen knowledge to inform solution development, and involving users in the co-creation of innovative civic solutions.

1.2.4 How digital technologies facilitate collaboration and information exchange in civic open innovation

Digital technologies make the exchange of information more efficient and effective, enabling firms to expand their reach to new actors and facilitate novel partnerships between contributors in the resulting ecosystem (Lusch, & Nambisan, 2015; Gawer, 2011). The generative mechanism for innovation of such digitally-enabled crowdsourcing is the expertise diversity of the external crowd (Majchrzak & Malhotra, 2013; Smedlund, 2012; Baldwin & Von Hippel, 2011). Access to the knowledge of these actors can inform firms of consumer preferences and emerging trends ahead of rivals (Lane et al, 2006). Chapter 6 considers how digital technology can be leveraged in civic innovation. In addition to providing channels for communication and collaboration between ecosystem participants, the

characteristics of digital technologies that facilitate information exchange are explored. Chapter 6 contributes to open innovation research by suggesting the affordance of technology in providing transparency in civic innovation (Bogers et al., 2017). Uncovering citizens' tacit knowledge including biases and heuristics is proposed as a critical utility considering the breadth of diversity that defines a civic population. The pervasiveness of digital technology in modern society also provides access to difficult-to-recruit users in the context of public services, further enhancing the utility of digital technology in facilitating civic innovation.

1.3 Structure of the Thesis

This thesis is a monograph composed of four main essays and additional discussion, comprised as follows. Chapter 2 corresponds to the theoretical framework of open strategies and related concepts including business ecosystems, absorptive capacity, and tacit information. The objective of Chapter 3 is to study civic innovation at the inter-organizational level of analysis, including the development of civic innovation ecosystems, their underlying drivers and motivations of collaborators. The objective of Chapter 4 is to explore strategies on the organizational (and intra-organizational) level by examining the evolution of civic innovation from its modern inception to second-generation strategies, to better understand variables influencing the successful exploration and exploitation of external innovation. Chapter 5 is devoted to the study of living labs as a civic innovation strategy to understand the processes and context for accessing tacit user information and citizen co-creation at the extra-organizational level. The objective of Chapter 6 is to explore the novel application of digital technology to enable open collaboration in the context of public policy design, also with external stakeholders. Chapter 7 offers an overview of the thesis with theoretical and managerial implications, limitations and future research. Following, table 1.3.1, is a summary and findings of thesis chapters.

	Chapter 3	*Chapter 4*	*Chapter 5*	*Chapter 6*
Publication	Business Horizons	Technology Innovation Management Review	Communications of the ACM	Research Policy (*Under Review*)
Chapter Title	Open Innovation Requires Integrated Competition-Community Ecosystems: Lessons Learned from Civic Open Innovation	Open Data & Civic Apps: 1st Generation Failures – 2nd Generation Improvements	Mapping Living Labs in the Landscape of Innovation Methodologies	IT-enabled Transparency in Policy Making: Designing and Enabling Effective Policies in Complex Decision Environments
Research Question	How do the underlying drivers of civic innovation influence the selection of strategy and ecosystem resources?	How do cities foster innovation without internal innovation capabilities and integration mechanisms?	How do cities access sticky user information to develop innovative civic solutions?	What characteristics of digital technologies facilitate collaboration and information exchange in civic open innovation?
Level of Analysis ***(Most emphasis)***	Inter-organizational	Intra-orgamizational & Organizational	Extra-organizational	Extra-organizational
Contributions	In the proposed Interated Ecosystem Approach, global reuse and standardization increases audience and financial gain.	Platforms as facilitators of civic innovation in 2nd generation strategies. Intermediaries as boundary spanning agents; desorptive capacity practiced to overcome internal innovation deficits.	Living lab methodologies leverage a context-specfiic environment to engage lead users and access tacit inforrmation for feedback and citizen co-creation.	The Open Public Policy framework offers mechanisms for gathering tacit information. Technologyprovides transparency to sticky information, particularly heuristics and biases that guide behaviour, informing innovative policy solutions.
Implications	The concept of a business ecosystem is expanded in the Integrated Ecosystem Approach, suggesting a global ecosystem perspective.	An emphasis on desportive capacity in civic organizations can be considered as a circumvention of lockout, due to lack of absorptive capacity.	Hard-to-reach lead users and sticky, tacit informtion can be accessed by engaging users in co-creation in context-specfic environments.	Leveraging the pervasiveness of digital technologies can maintain channels of engagement and customer feedback to reach those hard-to-access consumers previously unavailable to organizations.

Table 1.3.1 *Summary and findings of thesis chapters*

2 Theoretical Framework

For much of the 20th century, R&D labs in large corporations were the models of innovation and firms mainly focused on building their internal capabilities for innovating and bringing improvements to market (Chandler, 1977; Chesbrough, 2003; West, 2014). Retaining the best employees and keeping company information and innovation within firm boundaries was essential as companies generated, developed, and commercialized their own ideas. But towards the end of this period, a number of factors, including workforce mobility, began to erode this internal model of corporate innovation (Chesbrough, 2006). Companies realized that rich talent and knowledge often remained outside of firm boundaries and they began to consider how to leverage those external resources.

Henry Chesbrough (2003) coined the term "open innovation" to describe the new corporate model of innovation that developed, in which firm boundaries become more permeable to flows of knowledge between organizations and individuals. The open innovation framework includes inbound innovation, termed exploration, in which firms bring external knowledge into the organization for further development, as well as outbound innovation, or exploitation, when firms realize returns from licensing out internal knowledge (Chesbrough, 2003; Van de Vrande, Lemmens, & Vanhaverbeke, 2006). An embodiment of this trend, Procter & Gamble, in 2000, made it a goal to acquire 50% of their innovations from outside of the firm (Huston & Sakkab, 2006) and to find partners interested in the 90% of their patented technology which remained unused and "sitting on the shelf" (Sakkab, 2002). Scholars have studied open innovation in varied industries such as semiconductors (Chesbrough, 2003), software (West & Gallagher, 2006; Boudreau, 2012) mobile phones (Dittrich & Duysters, 2007; Stuermer, Spaeth, & Von Krogh, 2009), and textiles (Spithoven, Clarysse, & Knockaert, 2011). Collaboration with external partners provides a means of expanding a firm's knowledge base, increasing innovation, decreasing product development timelines, and providing competitive advantage (Rigby & Zook, 2002; Cassiman & Veugelers, 2006; Lichtenthaler, 2011; Chesbrough, 2003; Rivette & Kline, 2000).

The benefits of openness are realized through a distributed structure, rather than the traditional hierarchical governance within an organization (Adler, Kwon, & Heckscher, 2008; Von Hippel, 2007; Garud, Tuertscher, & Van de Ven, 2013). As strategic decisions increasingly involve external collaborators, the locus of competition shifts from within the firm to outside of its boundaries (Dyer & Singh, 1998; Gulati, Nohria, & Zaheer, 2000). Just as the "firm as a body" once did, the idea

of a business ecosystem (Moore, 1993) has become the concept used to examine open strategies and the boundaryless organizations they create (Lane & Lubatkin, 1998). Defined as "a collection of firms engaged joint production whose choices and actions are independent", this analogy better guides organizations as they engage external partners in an exchange of information and ideas (Boudreau & Haigu, 2009, p. 168). Although "firms" is most often used to reference the partners in the ecosystem, this term is not restricted in meaning to commercial businesses. It can include any contributor engaged in the joint production of a given asset, including individuals such as software developers (Boudreau, Lacetera & Lakhani, 2011; Boudreau, 2010), as well as government and other not-for-profit organizations (Ansell & Gash, 2008; Klijn, Steijn, & Edelenbos, 2010; Un, Cuervo-Cazurra, & Asakawa, 2010).

The independence granted to ecosystem collaborators allows them to pursue those endeavors they believe will bring the most value (Adner & Kapoor, 2010; Jacobides & Billinger, 2006), which result in simultaneous and even potentially conflicting paths to innovation (Boudreau, 2010; Baldwin & Von Hippel, 2011; MacCormack & Iansiti, 2009). Though any one contributor generally remains narrow in scope and focused within a given genre or expertise, a roughly linear relationship between the number of collaborators and the variety of contributions demonstrates that new and distinctive ideas are manifest in allowing more collaborators, not by relying on a small group of individuals with great range (Boudreau, 2012). This breadth of innovation contributes to organizations in myriad ways. Collaboration with external actors contributes to the health of an organization and its partners by enabling the development of a diversity of complementary assets and the ability to test multiple solutions at the same time. In winner-take-all scenarios, having contributors work simultaneously on a host of options increases the likelihood that a solution will be found, especially when the solution trajectory is highly uncertain (Boudreau, Lacetera, & Lakhani, 2011). And in the case that an organization can support a number of products or solutions, having contributors develop a range of assets can expand the total market for the firm and its offerings. (Gawer, 2010; Moore, 2006). Multiple, simultaneous trajectories also provides flexibility to the organization, allowing it to better respond to external shocks (Baldwin & Woodard, 2010; Iansiti & Levien, 2004; MacCormack & Iansiti, 2009; Moore, 1993). The availability of a host of assets readies the ecosystem for multiple paths, which can be selected for depending on changes in the environment. Further, as contributors work independently within their specific domains of expertise they provide a steady rate of development, signifying innovation for the organization as a whole (Iansiti & Khanna, 1995). Though the improvements are spread over time and across a range of a firm's offerings, a steady rate of development overall can keep the firm ahead of its competitors and help to maintain the dominance of a given product, technology, or service. These strategies are leveraged to build a dynamic

capability that helps business ecosystems survive changing environments (Eisenhardt & Martin, 2000; Helfat & Winter, 2011; Teece, 1986).

2.1 Absorptive Capacity

Absorptive capacity forms the basis for a dynamic capability relevant to managing open strategies and ecosystems (Lichtenthaler & Lichtenthaler, 2009; Lichtenthaler, 2011; Teece, 2007; Amit & Zott, 2001). Absorptive capacity describes a firm's ability to value, assimilate, and utilize external knowledge within the organization (Cohen & Levinthal, 1990; Zahara & George, 2002; Lane & Lubatkin, 1998). Absorptive capacity enables an organization to recognize the value in external knowledge and take advantage of emerging opportunities ahead of the competition (Zahra & George, 2002; Lane, Koka, & Pathak, 2006). Scholars examining this component have demonstrated that an organization's command of prior knowledge greatly impacts its ability to value and assimilate new knowledge (Cohen & Levinthal, 1989, 1990). In other words, an organization's internal knowledge base is a necessary tool for leveraging external information (Dodgson, Gann, & Salter, 2006). A degree of prior knowledge should be similar enough to the new information in order to facilitate assimilation, while some portion should be related, but more diverse, in order for the organization to effectively capitalize on the new knowledge (Cohen & Levinthal, 1990). Firms' internal knowledge engines, R&D units, are therefore a complementary asset to external knowledge exploration and utilization (Cassiman & Veugelers, 2006). Investment in R&D builds prior knowledge, making it easier to recognize and appropriate external knowledge, thereby enhancing absorptive capacity (Lane, Koka, & Pathak, 2006). Failure to develop an effective absorptive capacity can create a situation in which a firm "may never assimilate and exploit new information in that field, regardless of the value of that information", creating path dependence solely aligned with internal competencies (Cohen & Levinthal, 1990, p 136).

2.2 Tacit Information

While absorptive capacity facilitates the flow of information between permeable firm boundaries, characteristics of the information can impede the process. Tacit knowledge, which is personal and not easy to express or articulate, is difficult for companies to identify and valuate (Nonaka, 1994; Bogers, Afuah & Bastian, 2010). User needs, recognized as tacit knowledge, are "sticky", or difficult and costly to transfer (Von Hippel, 1994). Stickiness is defined as "the incremental expenditure required to transfer that unit of information to a specified locus in a form usable by a given information seeker" (Von Hippel, 1994, p. 430). The difficulty in transferring sticky information is a combination of its tactiness and the absorptive capacity of the firm (Cohen & Levinthal, 1990; Bogers, Afuah & Bastian, 2010).

Scholars have shown that when information is sticky, users (the "owners" of the information) are more likely to perform innovation activities as compared to when the information is more technical and easily transferable (Von Hippel, 1994; Ogawa, 1998). This provides an alternate view of the locus of innovation. In earlier models, firms searched outside of their boundaries for external information, bringing it into the firm to incorporate into new products. When information is tacit and costly to transfer, users become the innovators instead of information purveyors (Von Hippel, 1998; Bogers, Afuah & Bastian, 2010). User innovation (Von Hippel, 1998) and its modern genesis in the open source movement (Von Krogh & Von Hippel, 2003, 2006; Haefliger, Von Krogh, & Spaeth, 2008; Lakhani & Von Hippel, 2003; Shah, 2006) has been researched across diverse industries such as scientific instruments (Von Hippel, 1976), industrial machinery (Foxall & Tierney, 1984), applications software (Voss, 1985), residential construction (Slaughter, 1993), mountain biking (Lüthje, Herstatt, & Von Hippel, 2005), kite surfing (Tietz, Morrison, Lüthje, & Herstatt, 2005), and retail and commercial banking (Oliveira & Von Hippel, 2009). Scholars demonstrate that user innovation has contributed to incremental and breakthrough innovations, even affecting whole industries by giving rise to dominant designs (Baldwin, Hienerth & Von Hippel 2006; Lettl, Herstatt, & Gemuenden, 2006; Lilien et al., 2002).

2.3 Research Gap

Though significant scholarship has examined open strategies of firms (Chesbrough, 2003; Laursen & Salter, 2006; Weisenfeld, Reeves, & Hunck Meiswinkel, 2001) and user communities (Von Hippel 1998; Bogers, Afuah & Bastian, 2010) in the private sector, less attention has been paid to open strategies for innovation in the public sector (Lee & Kwak, 2012; Misuraca et al. 2012; Nam, 2012). Part of this deficit can be attributed to government's more recent entry into this area, with less mature processes for leveraging external actors. Early endeavors in civic openness were not primarily focused on innovation, but began with the aim of increasing transparency. Starting with the Freedom of Information movement and spurred by President Obama's Memorandum on Transparency and Open Government, governments on both the local and national levels, aimed to release more internal information previously hidden from the public (Sieber & Johnson, 2015; Janowski, 2015; Lakhani, Austin, & Yi, 2010). These efforts were intended to increase citizens' awareness of governmental activities and decisions (Bertot, Jaeger, & Grimes, 2010; Meijer & Thaens 2010; Rabina, 2011; Larsson & Grönlund, 2014).

The subsequent emergence of new research fields such as e-Participation (Susha & Grönlund, 2012), e-Democracy (Mahrer & Krimmer, 2005; Wattal, et al., 2010), and e-Government (Bertot et al., 2010), examined the role of digital technologies in opening government for more involvement from the public. Scholars also examined ways that openness increases accountability (Azad & Faraj,

2008; Chan, Lau & Pan, 2008) and better involves citizens in the democratic decision-making process (Macintosh, 2004; Sæbø, Rose, & Skiftenes, 2008; Medaglia, 2012; Susha & Grönlund, 2012). However, a large focus of openness in the public sector remained on the political process and the incentives and motivations for achieving greater participation of citizens in the political dialogue.

Some recent exploits have seen governments and policy makers embrace openness to foster innovation (Lee & Kwak, 2012; Misuraca et al., 2012; Nam, 2012; Ferro et al., 2013). The disclosure of governmental data becomes more focused on innovation as governments take measures to motivate citizens and entrepreneurs to turn data into novel applications that address governmental and societal challenges. In addition, they actively tap into citizen-generated information and leverage technological solutions developed by entrepreneurs to spur innovation. Like the corporate model of open innovation, governments use external information with the aim of developing novel solutions (Lee & Kwak, 2012; Brunswicker & Johnson, 2015). To foster such civic openness, governments engage with a large number of users, or citizen collaborators, to address societal issues and public service needs (Nam, 2012; Ferro et al. 2013). As these strategies in government mature, scholars have an opportunity to explore how the mechanisms of open innovation vary in a civic context.

Two critical differences exist between the private and public spheres that inform comparisons between the two. First, unlike private business, governments do not innovate to gain competitive advantage (Lane et al., 2006; Rigby & Zook, 2002; Cassiman & Veugelers, 2006; Lichtenthaler, 2011). Studies on civic innovation demonstrate cities' willingness to promote knowledge spillovers and freely share innovative solutions, resources closely guarded in traditional firms (Stuermer, Spaeth, & Von Krogh, 2009; Chesbrough, 2003; Rivette & Kline, 2000). Though cost reduction could be a driver of value capture in government, researchers suggest cost savings represent a secondary and very infrequent motivation in innovation strategy. Scholars have yet to identify how the underlying drivers of civic innovation influence the selection of strategy and ecosystem resources. Chapter 3 explores how cities realize their unique innovation model and strategize to capture value in non-competing ecosystems.

Competition spurs investment in innovation, traditionally realized in corporate R&D labs (Chesbrough, 2003; West, 2014). Though companies are increasingly leveraging external sources of information, internal knowledge is a complement to absorptive capacity, which facilitates knowledge transfer across organizational boundaries (Cohen & Levinthal, 1990). Cities have not invested in developing internal knowledge or the complementary absorptive capacity to exploit innovation. Researchers have yet to explore the mechanisms for knowledge transfer in civic innovation ecosystems, especially considering the absence of competition as an inhibiting force. Chapter 4 explores the role of intermediaries as boundary-spanning agents that enhance a city's ability to explore and assimilate external innovation.

A second distinction between the private and public sectors is that civic solutions, the outcome of innovation processes, are different than those typically sought in private firms. A city must address all of its residents in myriad ways, necessitating the need to service a more heterogeneous population with more numerous solutions than any given company. Citizens cannot opt-out of most civic services, nor can a city afford to target only a segment of the population. Citizen needs - sticky, user information - are essential for informing the development of civic solutions, yet lead users responsible for user innovation are often difficult to engage in the context of public services. Researchers have not identified how cities access users and their tacit information. Chapter 5 explores mechanisms cities leverage for accessing user needs to better guide and develop civic innovation. Chapter 6 considers the ways technology can uncover the specific tacit information of biases and heuristics that guide individual decision-making, providing insights that inform the development of innovative policy solutions.

2.4 Research Questions

This thesis seeks to understand the development of civic innovation ecosystems and open strategies in government to better understand the contexts and mechanisms that influence their outcomes. Analyses at the intra-organizational, organizational, inter-organizational, and extra-organizational levels explore the factors contributing to success and how activities at various levels are related (Bogers et al., 2017). The level of analysis begins with inter-organizational open innovation, as firms, networks, and communities collaborate and form innovation ecosystems. The first research question considers how civic ecosystems are fostered and flourish without competitive concerns stifling collaboration. Strategy selection and sharing between actors within the ecosystem are explored. The following research question primarily focuses on the organizational level of analysis, by exploring strategies for fostering innovation without internal innovation capabilities, but continues one level of analysis down to explore intra-organizational activities, suggesting interdependency between the two. The final two research questions explore the extra-organizational level of analysis by considering how user/stakeholders are engaged as innovators. The third research question tackles the context and processes for leveraging external actors by asking how organizations access tacit information for innovative solutions. The fourth research question considers the tools organizations use to access users by examining the characteristics of digital technologies that facilitate information exchange.

- How do the underlying drivers of civic innovation influence the selection of strategy and ecosystem resources?
- How do cities foster innovation without internal innovation capabilities and integration mechanisms?
- How do cities access tacit user information to develop innovative civic solutions?
- What characteristics of digital technologies facilitate collaboration and information exchange in civic open innovation?

2.4.1 How do the underlying drivers of civic innovation influence the selection of strategy and ecosystem resources?

Despite its increasing popularity, many firms still face challenges in actively managing the process of open innovation (Lichtenthaler, 2011; Van de Vrande, de Jong, Vanhaverbeke, & de Rochemont, 2009; Laursen & Salter, 2006; Sieg et al., 2010). Scholars have noted that there is not one single "best" way of fostering an innovation ecosystem, though factors internal and external to the firm should be considered (Lichtenthaler & Lichtenthaler, 2009). The motivations of external collaborators can affect the ecosystem and a firm's strategy for managing participants affects the level of effort and investment they devote (Belenzon & Schankerman, 2008; Boudreau & Lakhani, 2009). Firms can foster a competitive environment that emphasizes the profit motive for participation and maintains partner relationships with arm's length contracts. Conversely, organizations can promote a range of extrinsic and intrinsic motives, which characterize more collaborative communities, along with informal relationships and substantial technology sharing within the ecosystem. Scholars suggest that these considerations be matched to innovation outcomes and the business model of the firm (Chesbrough, 2006; Boudrea & Lakhani, 2009). Firms with clearly defined innovation outcomes can develop solutions internally, if internal resources exist, or engage in traditional external contracting (Pisano & Verganti, 2008). When the innovation trajectory is less certain, loosely governed external collaborators can innovate a larger number of extreme solutions (Wijnhoven, Ehrenhard & Kuhn, 2015; Boudreau, 2012). When unknown outcomes require extensive integration or technical sophistication, stricter governance that emphasizes extrinsic rewards produce solutions by incentivizing the investment of a smaller group of more highly qualified participants (Boudreau, Lacetera & Lakhani, 2011; Lakhani, Lifshitz-Assaf, & Tushman, 2012). As firms align their business model with ecosystem strategy, they should define their role in appropriating value and managing collaborators (West & Bogers, 2013; Chesbrough, 2006; Zott, Amit, & Massa, 2011). The location of income streams and communication channels inform the governance strategy of the ecosystem.

Organizations aiming to maintain control over innovation outcomes and customer relationships should govern more centrally with stricter controls (Boudreau & Lakhani, 2009). Firms that allow high autonomy, free transaction between collaborators, and forgo solution ownership can practice more relaxed management of the ecosystem. Just as firms differ in the strategic management of innovation, so do cities. In addition to organization-level differences, research has yet to identify the drivers behind public sector engagement as compared to the profit motives and overarching threat of competition that pushes private firms to seek external sources of innovation. Chapter 3 seeks to address these issues.

2.4.2 How do cities foster innovation without internal innovation capabilities and integration mechanisms?

Firms that do not invest in building internal knowledge may lack the ability to valuate external knowledge and opportunities (Dodgson, Gann, & Salter, 2006; Cassiman & Veugelers, 2006; Zahra & George, 2002). This absorptive capacity allows firms to take advantage of emerging opportunities ahead of rivals as they explore external knowledge (Lane et all, 2006). Initial failure to invest in emerging trends may make later investments even more costly. Missing an early opportunity can cause subsequent opportunities to appear less attractive, creating the situation of being "locked-out" of advancements in quickly moving fields (Cohen & Levinthal, 1990). This can create a situation of path dependence solely aligned with internal competencies. R&D departments traditionally represent investments in knowledge creation within firms, but cities do not invest in analogous internal departments (Leydesdorff & Etzkowitz, 1998; Chesbrough, 2003; West, 2014). Research has yet to explore mechanisms that might augment outward facing absorptive capacity in civic organizations to compensate for poor internal capabilities. Chapter 4 explores those mechanisms in various civic innovation strategies.

Platform strategies are leveraged to connect consumers with producers, removing the need for an organization to function as the engine of innovation (Gawer, 2011; Boudreau & Lakhani, 2009; Boudreau, 2010). Digital technologies and Internet connectivity enable this process by reducing the cost of information exchange between platform participants (Altman, Nagle, & Tushman, 2015; Van Alstyne, Parker, & Choudary, 2016). As cities seek to expand their capabilities to keep pace with the evolving needs of society, platform strategies leverage the knowledge diversity and contributions of external collaborators to better serve the public (Linders, 2012; Bertot, Jaeger, & Hansen, 2012). Chapter 4 explores the development of civic platforms and considers the governance of these strategies in the public sector. Scholars have shown that the degree of control practiced by the managing firm can vary, affecting the community of collaborators and solution trajectory of the

resulting innovations (Boudreau, 2010). Degrees of openness can be managed on both the supply-side and the demand-side (Eisenmann, Parker, & Van Alstyne, 2008; Van Alstyne, Parker, & Choudary, 2016) Firms can foster unrestricted participation from producers and promote a variety of mechanisms such as toolkits, community engagement, and funding opportunities to incentivize participation. The managing firm can govern access and commercialization of solutions, or provide channels that connect producers directly to consumers (Boudreau & Lakhani, 2009). Chapter 4 explores how the management of civic apps platforms fosters communities of citizen collaborators and innovation in cities.

Once external innovations are sourced, the inward facing component of absorptive capacity facilitates the assimilation and exploitation of those solutions or knowledge internally (Cohen & Leninthal, 1990). Firms encourage positive "buy-in" attitudes towards externally sourced information to build absorptive capacity, even establishing incentive systems to promote acceptance (Menon & Pfeffer, 2003). However, many firms encounter managerial challenges when negative attitudes towards externally sourced information are pervasive throughout the organization. The "not-invented-here" mentality limits absorptive capacity, constituting a barrier to effectively implementing open strategies (Katz & Allen, 1982; Chesbrough, 2003; Lichtenthaler, Ernst, & Hoegl, 2010). These attitudes can stem from prior negative experiences or inexperience with external collaboration and the advantages openness can confer. Scholars have called for further research into integration considerations for absorptive capacity including organizational culture, incentive systems, intellectual property concerns, and political barriers (Nahapiet & Ghoshal 1998; Garvin, 1993; Lichtenthaler, 2011.) Chapter 4 explores the mechanisms for absorptive capacity that civic organizations promote to facilitate innovation integration.

2.4.3 How do cities access tacit user information to develop innovative civic solutions?

Users, leveraged as external sources of information, have been shown to produce emerging, innovative, and breakthrough solutions that firms seek in open innovation strategies (Lettl, Herstatt, & Gemuenden, 2006; Lilien et al., 2002; Zahara & George, 2002). When information is tacit and sticky, users are more likely to perform innovation activities as compared to when the information is more easily transferable to the organization (Von Hippel, 1994; Ogawa, 1998). Von Hippel suggests that complementary to the idea that the locus of innovation rests with users because of sticky information (Von Hippel, 1994), is the realization that users innovate because they are the most likely beneficiaries of the solutions (Von Hippel, 1988, 2005). That users have a strong incentive to experiment to solve their own needs is a complementary explanation for user innovation. Scholars

find that users are more likely than firms to innovate if their expectation of benefits is higher (Riggs & Von Hippel, 1994); "the appropriability of the innovation benefit (serves) as a determinant of the locus of innovation" (Bogers, Afuah, & Bastian, 2010, p. 862.). Users therefore become innovators because of their unique knowledge base and direct benefit from innovation.

"Lead users" are identified as those that experience the need for a given innovation ahead of others. Motivated by this need and the expectation of significant benefit, lead users' innovations represent a majority of solutions resulting from user innovation (Von Hippel, 1986; Urban & Von Hippel, 1988; Shah, 1999; Luthje 2000). Von Hippel suggests that lead users experience needs months and even years before mainstream users (Von Hippel, 1986, 1988, 2005). These innovators are rich targets for open strategies. They can be tapped to provide insights into user needs to better forecast emerging trends and be relied upon to innovate on those needs. Firms leverage lead users across industries including industrial products, consumer goods, and services (Urban & Von Hippel, 1988; Skiba & Herstatt, 2009; Skiba, 2010; Lilien et al., 2002). Research has shown lead users are more identifiable in some industries than others, for instance, lead users can be identified more readily in industrial versus consumer goods (Lilien, Morrison, Searls, Sonnack, & Von Hippel, 2002). Citizen needs - sticky, user information - are essential for informing the development of civic solutions, yet lead users responsible for user innovation are often difficult to engage in the context of public services. Researchers have not identified how cities access sticky, citizen information. Chapter 5 considers living labs as a methodology for capturing users in real-world contexts to elicit domain-specific information. Further, by leveraging civic innovators in living lab environments as co-creators, the viability of civic solutions are tested and better match the needs of a diverse population.

2.4.4 What characteristics of digital technologies facilitate collaboration and information exchange in civic open innovation?

Early IS scholarship examined how computing technology was used to increase efficiency in vertically integrated firms. The role of modern technology has since evolved, facilitating new business models around digital platforms that support open collaboration in place of traditional hierarchies. Digital technologies make the exchange of information more efficient and effective, expanding firms' reach to new consumers and facilitating novel partnerships between actors in the resulting ecosystem (Lusch, & Nambisan, 2015; Gawer, 2011). Apple, Facebook, and airBnB, some of the most highly valued companies in their respective industries, leverage digital platforms for collaboration and innovation (Schultz, Wulf, Zarnekow, & Nguyen, 2011; Malhotra & Van Alstyne, 2014). Replacing internal development or co-creation with few, trusted partners, information technology provides the network and software that enable firms to make open calls for input,

harnessing the expertise and diversity of the external crowd (Estellés-Arolas & González-Ladrón-De-Guevara, 2012; Majchrzak, & Malhotra, 2013; Howe, 2006). Such digitally-enabled crowdsourcing for innovation is made effective through two mechanisms. First is the ability to recruit and leverage external collaborators (Smedlund, 2012; Baldwin & Von Hippel, 2011). Research has shown that distinctive ideas are manifest in the participation of more collaborators, not by relying on a small group of individuals with great range (Boudreau, 2012; Brabham, 2008). Digital technologies provide channels of connectivity and platform scaffolding that enable spontaneous collaboration between those actors. Second, characteristics of the information exchanged influence its translation across the platform. Modularity, or task decomposition, permits external contributors to more easily collaborate by allowing for backwards or forward integration in a platform or ecosystem without extensive concerns (Lakhani, Lifshitz-Assaf, & Tushman, 2012). New ideas and innovations can then be more easily shared as ecosystem resources. Mobile apps, for example, are one of the most popular open strategies, owing to their high degree of modularity. Chapter 6 considers how technology can be leveraged in civic innovation strategies. It considers the characteristics of digital technologies that facilitate the collaboration and information exchange cities seek to provide innovative policy solutions for citizens.

3 Open Innovation Requires Integrated Competition - Community Ecosystems: Lessons Learned from Civic Open Innovation[1]

3.1 INTRODUCTION

Open innovation has been defined as a strategy that uses "purposeful inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for the external use of innovation, respectively" (Chesbrough, 2003, p. 1). This strategy has been proposed as a way to develop innovative products beyond the internal capacity of the company as firms recognize that great talent often resides outside of their employ (Von Hippel, 2005). A critical capability for open innovation that has been identified in the literature is the way that external providers of innovation are organized. Boudreau and Lakhani (2009) propose a framework for organizing external innovation providers, offering two alternative organizing approaches - collaborative and competitive. When external innovators are organized into competitive markets, the profit motive of the players is emphasized, the relationships are governed by arm's length contracts, and there is little sharing among external participants. In contrast to competitive markets are collaborative communities. When external innovators are organized into collaborative communities, a range of extrinsic and intrinsic motives are emphasized, the relationships are informal, and there is substantial technology sharing. The authors argue that competitive markets are more appropriate with players that prefer extrinsic rewards and when the innovation problem is best solved by broad experimentation; the opposite conditions indicate the need for a community-based organization of external sources. Despite the attention given to open innovation in the business press, companies have struggled with how to manage the external providers of their innovations (Boudreau & Lakhani, 2009; Sieg, Wallin, & Von Krogh, 2010). One sector that has embraced open innovation is the public sector, in which many cities have undertaken transformations involving externalizing their innovation processes. These cities provide a wealth of experience in how to organize external sources of innovation. We

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used Boudreau and Lakhani's (2009) framework to study how six cities organized their external sources. We found, unexpectedly, that while cities often started with either a competitive or a collaborative community approach to organizing their external sources, each approach was inadequate in ways that could potentially be addressed by the addition of the other approach. Thus, we conclude with the need for an integrated approach in which external sources of innovation are organized to address *both* competitive and community needs. Moreover, we find that organizing only the immediate sources of innovation, as has been recommended, is inadequate for effective open innovation since the sustainability of an innovative idea requires support from a number of less innovative sources. We conclude that open innovation is likely to succeed only when the needs of the entire ecosystem of sources and supporters of innovation are organized in ways that foster both competition and collaboration.

3.2 CIVIC OPEN INNOVATION

The public sector is learning to embrace open innovation. On his first day in office, President Obama signed the Memorandum on Transparency and Open Government with the aim to empower the public to influence the decisions that affect their lives, track how government spends money, and reduce the influence of special interests. The data catalog that was created, the most comprehensive at the time, included real time crime feeds, school test scores, and demographic information by neighborhood. These efforts were rapidly replicated in the UK and translated to many European cities and governments, which started efforts in what was referred to as "Open Data", and resulting in the Public Sector Information Directive of the European Parliament in 2013. Open innovation in the public sector is often driven by multiple motives, only one of which is a cost-reduction (i.e., "profit") motive. Other motives include: increasing citizen involvement in city decision-making, bringing improved services to the public, and improving economic opportunities for citizens. Cities that have publicized their open innovation efforts include: New York, Philadelphia, Boston, Chicago, Austin, Baltimore, Amsterdam, Helsinki, London, Barcelona, Berlin and many others. We selected six cities that had been involved in open innovation activities for at least four years to study in depth, in order to determine how the cities managed their external innovation sources. The six cities we studied were: Barcelona, Amsterdam, Helsinki, Boston, Philadelphia and New York. Semi-structured interviews were conducted to understand the types of software applications that were created as a result of the open data/open innovation initiative in each city, the success and usage of the software applications, and how city managers organized actors involved in the open innovation initiative. Individuals interviewed included chief technology officers, open data city managers, and policy makers, as well as application developers, commercial open innovation intermediaries, open

innovation platform developers, startups resulting from applications developed, and companies using the open data and applications. In total, 52 interviews were conducted. We also examined a range of secondary sources to validate the interview data and attended conferences to identify the latest practices and trends. The six cases are briefly described in Table 3.2.1.

	Civic Open Innovation Approaches	**Managing Civic Department(s)**	**Civic Open Innovation Intermediaries**
Amsterdam	Open Data Crowdsourcing Hackathons Application Dev Contests Embedded Change Agents	Economic Affairs Dept	Waag Society Amsterdam Innovation Motor Code for Europe
Barcelona	Open Data Hackathons Application Dev Contests Embedded Change Agents Urban Labs	Barcelona City Information Systems Agency Barcelona Creativity & Innovation Dept	Dotopen Bdigital Code for Europe
Boston	Open Data Crowdsourcing Hackathons Application Dev Contests Embedded Change Agents Civic Accelerator	Mayor's Office of New Urban Mechanics	Code for America
Helsinki	Open Data Crowdsourcing Hackathons Application Dev Contests Embedded Change Agents	Economic Affairs of Helsinki	Forum Virium
New York	Open Data Crowdsourcing Hackathons Application Dev Contests	Economic Development Corporation Dept of Technology & Telecommunications	Challenge Post
Philadelphia	Open Data Crowdsourcing Hackathons Application Dev Contests Embedded Change Agents Civic Accelerator	Mayor's Office of New Urban Mechanics	Technical.ly Philly Code for America

Table 3.2.1 *Civic Innovation: Cities*

3.2.1 Finding #1: Multiple Approaches for Civic Innovation

Several approaches were identified that cities used for open innovation. Some of the approaches fostered collaborative communities, with informal relationships, technology sharing, and a range of

intrinsic and extrinsic motivations. Other approaches saw competitive markets develop, with more contractual relationships, stronger profit motives, and less sharing among collaborators in the innovation community. The following is a list of specific approaches used:

Open Data. Across the six cities, we found that all the cities opened some of their city datasets for public use in developing civic software applications. However, there was substantial diversity in the types of data opened. Some cities offered real-time crime feeds, school test scores, and demographic information by neighborhoods; other cities offered data on bicycle usage and placement of fire hydrants.

Hackathons and Application Development Contests. A hackathon is typically a one to two-day event where computer programmers and others involved in software development collaborate intensively to develop a new software application that meets the challenge posed by sponsors of the hackathon. Application development contests are similar except that the challenge is hosted online and typically runs a couple of months. Application development contests removed some of the difficulties of traditional hackathons such as hosting developers for a continuous 24 to 72 hours of intense software development. They often attracted a wider range of participants than hackathons by allowing programmers in locations all over the world to collaborate. Many developers not willing to code for two days in a set location were more open to this method, which allowed them to work little by little over a period of weeks or months. Hackathons and application development contests were hosted for civic application development in all six cities, though the central organizer varied between cases. In New York's Big Apps Contest, for example, two departments from within the city, the Economic Development Corporation and Department of Information Technology and Telecommunications, were the core managers of the hackathon. External firm ChallengePost facilitated the online platform for the developers and helped to advertise and recruit developers to participate. Hackathons in other cities, such as Hack for Democracy in Philadelphia or Hack-at-Home in Barcelona, were more centrally managed by external organizations that brought added experience in hackathons and better tapped into an already-established hacker community. In these cases, the main function served by the city was in providing open datasets from which developers could create applications.

Crowdsourcing. Crowdsourcing is the use of the crowd to obtain ideas, services, or content from a large group of people, usually from an online community, rather than from traditional channels such as employees or suppliers. All six cities used various crowdsourcing methods to get citizen feedback on challenges or calls created by the city, however, crowdsourcing took different forms depending on the type of community, organizations who managed the community, and outcomes desired. Philadelphia, for example, used online platform Change By Us to crowdsource ideas for how to improve the city's neighborhoods. Citizens submitted proposals online, which were posted for

other users to see. The platform also aggregated similar ideas so that like-minded citizens could organize and initiate projects. New York used crowdsourcing in the Big Ideas challenge in which citizens submitted ideas online for applications that could be developed to improve New York civic services. In addition to citizen collaboration, platforms like Change By Us and Big Ideas connected citizens with city officials that provided feedback and guidance on proposals.

Crowdsourcing was used in other cities as a tool built into innovation projects. In Helsinki, for example, Code for Europe fellows created an application to catalog art archived in a public museum. As the citizens viewed newly available but yet uncategorized images of art, they added descriptions to the images. The application worked to aggregate this data, and after a number of descriptions matched, the application would create a permanent tag, making previously unidentified works available for public enjoyment.

Embedded Change Agents (Code for America/Europe Fellows). Two organizations, Code for America and Code for Europe, provided programmers, called "fellows", to work with cities to develop applications for their Open Data initiatives. Both organizations aimed to inject the code developer culture into cities using application development, to close the gap between cities and citizens. The fellows worked with an assigned city for a period of nine months to a year to develop applications, while also trying to break down bureaucratic processes and bring innovation to city government. The sharing of civic applications between cities was also a central component of these two organizations through the creation and development of the repositories, Code for America Commons and Europe Civic Commons. All cities were involved with either Code for America and Code for Europe, utilizing the fellows in a variety of ways. For example, Boston took advantage of the fellows to develop new applications that promoted digital citizenship, such as applications "Adopt-a-Hydrant" and "Where's My School Bus".

Urban Labs. Urban Labs describes the use of public city space (streets, buildings, or a designated neighborhood) as an active laboratory to allow companies to evaluate and pilot pre-market products and services with a civic impact. As citizens go about their daily lives, companies can learn from how they interacted with their product. One example of an Urban Labs pilot was the installation of a motion-sensing LED lighting system in Barcelona. The city hall approved the allocation of a city street where the motion sensing system was tested, and worked with companies that developed the product, Alresa, Circuitor, and Santa & Cole, to pilot its use on the designated street. Thus, citizens together with city officials and the companies were involved in the co-creation process, which resulted in a cheaper lighting model that met the needs of both citizens and the city. The resulting product has since been successfully sold to other cities.

Civic Accelerators. Civic Accelerators aim to translate the concept of a startup accelerator to the Public Sector. Traditional business accelerators offer advice and resources to fledgling firms to

help them grow. In contrast, Civic Accelerators match cities with startups, private firms, and non-profit organizations interested in partnering with government to provide better services, bring modern technology to cities, or change the way citizens interact with city hall. As Nigel Jacob, co-creator of Boston's Civic Accelerator explained,

> *We will partner with anyone. We don't care whether they are from within government or the private sector. We are certainly interested in our projects remaining viable after they leave the Office of New Urban Mechanics. We talk about business models and filter for projects that we believe will capture value and be able to sustain their development after they have left our management. (Personal interview, January 5th, 2012, Boston)*

Some Civic Accelerators, such as The Mayor's Office of New Urban Mechanics in both Boston and Philadelphia, were housed internally in city hall, while others were managed through Code for America.

In summary, open innovation is not a single strategy or approach. No single method or set of methods for organizing external actors were found.

3.2.2 FINDING #2: DIVERSITY OF ACTORS INVOLVED IN CIVIC OPEN INNOVATION

A diversity of actors were involved in all six cities' open innovation initiatives. At the core were:

a) City managers and internal civic departments who were most familiar with the data and how the city operated. For example, in Philadelphia, city officials not only worked to provide valuable open datasets to developers, but also structured hackathons in a way to incentivize development of applications likely to impact the greatest number of citizens.

b) Citizens who chose to participate. For example, in Amsterdam, the term "civic innovator" has been coined to designate citizens that, without being developers, participate in hackathons and city innovation events.

c) Developers who participated in creating applications. All cities hosted a community of developers who participated in sponsored hackathons, application development contests and crowdsourcing exercises, usually numbering in the hundreds.

In addition to the core participants of city departments, citizens, and developers, we found a number of additional actors that were included in the initiatives. These included:

d) Companies that used the open data in their existing applications (e.g., Google, Yelp). For example, Barcelona city managers put significant effort in collaborating with Google, Yahoo, and other companies involved with its transportation and tourist data efforts in order to leverage their existing platforms and large communities of users.

e) Consultants who helped the city to open their data and helped companies to use the data. For example digital creative agency iStrategyLabs advised several cities on how to open their data and how to host and promote application challenges. After initial success with the Apps for Democracy contest in Washington DC, iStrategyLabs developed a template for opening civic data, which cities used as a starting point for innovation contests.

f) Policy makers and city officials that established the guidelines of how the data should be provided to developers and determined what data will be made available. Helsinki is a leader in Europe in establishing data standardization efforts, resulting in the European project CitySDK promoting standard formats and application program interfaces for Open Data in Europe.

g) Venture capitalists who judged, incentivized, and supported the city´s efforts at application development. Many hackathons and application development contest, particularly those in New York, leveraged venture capitalists to provide feedback on the viability and impact of applications developed in the contest. Additionally, the participation of potential investors incentivized the participation of the developers interested in growing their applications into a sustainable business as many hoped to secure funding post contest. Venture capitalists were also an integral component of the Civic Accelerators, providing feedback and potential funding to those startups as well.

h) Intermediaries. These organizations provided the ability to connect to collaborators and worked between the city and those external agents. As cities have long operated with hierarchical governance, long-range goals, and traditional external contractors, they often struggle to adapt to the pace of innovation and related risk. Intermediaries are companies that substitute for this lack of ability. Some operated in almost lock-step with city hall, were funded by them, or served in defacto roles as the civic department for open data, as in the case of Forum Virium in Helsinki. Others, such as Code for America, functioned in parallel with the city, with their own motivations and goals. A summary of the functions that intermediaries fulfilled, as found in the six cases, included:

- provided structure and governance to user involvement such as Barcelona's Urban Labs and Code for Europe's fellows.
- recruited and maintained a community of developers willing to participate in civic innovation strategies such hackathons and application development contests.
- acted as change agents in the organizational structure of city halls. Involvement with a closely matched intermediary such as Forum Virium in Helsinki, allowed the city hall to see

how its operations could be improved by adapting outdated processes and lessening bureaucratic structure.

In sum, in contrast with the more common strategies in Open Innovation in the private sector that are characterized by dyadic relationships between a seeker and a solver (and sometimes an intermediary) in the six cities we studied, we found eight different categories of actors, five of which were neither seeker or solver but were actors supporting the effort. Also in contrast to the bilateral focus of Open Innovation in the private sector, the six cities sought to deliberately encourage cross-fertilization across all the actors – be they citizens, developers, venture capitalists or intermediaries.

3.2.3 FINDING #3: CHALLENGES IN MANAGING THE DIVERSITY

Managing such a mix of players in civic open innovation initiatives proved to be difficult. The different needs, motivations, and priorities created competition for the scarce resources within the city – money and time – and the attention of the developer and citizen communities. In cases where too much conflict existed, collaboration stalled. One challenge experienced by the internal civic departments responsible for open innovation was that other departments within the city who needed to provide the data often had other higher priorities. For example, encouraging city departments to open and share their data took "some begging and pleading" says Andrew Nicklin, of New York's Department of Information Technology and Telecommunications. While the open data platform for New York was a central task of his office, he had to work with other departments that did not have the same commitment and viewed data requests as an added burden. Consequently, while the cities enthusiastically pursued open innovation and were finding encouraging results, open innovation was still commonly viewed as peripheral to the more central projects of civic departments. Additionally, innovation projects were often viewed as high risk and value-added, but not mission critical. Strapped with limited time and fiscal resources, these open innovation initiatives had to compete with the mainstay projects that these departments had been committed to for decades with guaranteed results. It created a case of competing interests between civic employees who were rewarded for results and severely punished for failure, and the civic innovation champions who were willing to take a gamble. As Nigel Jacob of Boston's Mayor's Office of New Urban Mechanics explained, "many city officials, especially middle managers, are de-incentivized to take risks". To address this issue, Jacob co-founded Boston's civic innovation department which accepted the risk:

> *"Our thinking was what if we could offload their risk to us? So here, our mission is to be that place where we can take risks. If you're a director in public works and you've got an interesting idea, but you don't want to try this because*

you don't want the failure on your books, then he can come to us and we will work together to develop the product."

Thus, different functions within a city, one of which promoted open innovation, created new categories of actors that needed to be organized as much as the external sources of innovation.

A second challenge was that, while the developer community is relatively homogenous - relatively young and mostly male - motivation to participate in the development of civic applications varied substantially among the developers. Code for America, for example, fostered a community of civic-motivated developers, as its strategy worked to align developers with civic leaders but focused less on financial rewards and business development. In contrast, in hackathons and application development contests, some developers were motivated by civic-mindedness and others by the profits and rewards of winning the contest. The hackathon and application development contests tended to attract developers with more diverse motivations, especially those more interested in entrepreneurship in application development rather than pure civic engagement. Similarly, private companies varied in their alignment with civic duty. Some businesses had a mission devoted to civic improvement, while others collaborated with the city as they would any other enterprise, focusing on the bottom line. Thus, even within seemingly homogeneous actor categories, such as developers, there was a diversity of motivation that needed to be managed.

A third challenge is how to integrate intermediaries with the other actors. Intermediaries are often the most closely aligned external party to internal civic departments in the civic open innovation community. They are often non-profit and therefore less financially motivated, as in the case of Code for America, and have agendas to foster innovation. However, intermediaries experienced the same misalignment of priorities that varying divisions within the city experience. Few civic departments within a city placed as high of a priority on innovation as did the intermediaries, creating conflict when asking civil servants to prioritize those tasks over mainstay projects.

3.3 DISCUSSION: THE NEED FOR AN INTEGRATED ECOSYSTEM APPRROACH TO OPEN INNOVATION

In this section, we return to our opening framework, evaluate our findings with respect to that framework, and then suggest a new approach to organizing for open innovation.

Comparison to the Opening Framework. We started our study following the Boudreau and Lakhani (2009) framework, expecting to find some cities organizing their external innovation sources either as a competitive market, or as a collaborative community. We did not find these clear distinctions. A possible explanation may come from the framework itself. The authors suggest that,

when choosing between competitive or cooperative organizing, managers should consider (1) the type of innovation being developed, (2) the motivations of external collaborators, and (3) the business model of the core firm.

Type of Innovation Being Developed. As detailed in Finding 1, there were many open approaches that cities used to serve and provide for citizens. We believe these diverse approaches were needed because there is no single type of innovations required. Cities address the needs of a large and diverse population, providing more than a focused offering or suite of solutions than those that most companies typically develop for a targeted consumer. This range of approaches and resulting innovations make it difficult for cities, or firms with an expansive portfolio of offerings, to match the type of innovation with either a competitive or collaborative way of organizing. For example, applications are a type of innovation that benefits from cumulative development, as programmers improve applications by building on past advances. Organizations, be they public or private, using strategies such as hackathons for application creation are therefore best served by collaborative communities, which encourage cumulative development (Boudreau & Lakhani, 2009). The type of innovation developed in Urban Labs, however, suggest that collaborators organize in competitive environments. The complete solutions - products and services developed by firms that a city could purchase after a successful pilot in the urban environment - are best developed through competitive markets where competition encourages experimentation and diversity. Therefore, in order to provide a broad range of products and services to customers, matching the type of innovation to the way the community of external sources are organized may not be beneficial.

Motivations of External Collaborators. As discussed in Finding 2, there was great diversity of actors involved in city-sponsored open innovation, with equally diverse motivational needs. Cities attracted many external collaborators that were motivated by a commitment to improving their cities, similar to the motivations of civil servants also within the community. However as interest in open innovation in the public sector grew, private enterprise was more engaged in these strategies, and the vast majority of firms can be relied upon to be more profit oriented. Therefore, determining the type of community based on the motivations of a diversity of actors proved difficult. Even within a given category of actor, there were divergent motivational needs. Some developers in hackathons and application development contests participated for altruistic purposes while others saw an opportunity to gain recognition and funding for an application. Therefore, the diversity of actors in open strategies makes addressing their varying motivations through an approach of either competition or collaboration problematic.

Business Model of the Core Firm. Finally, the business model of the core firm is suggested as a criterion in deciding between collaborative or competitive innovation communities (Boudreau & Lakhani, 2009). Firms are encouraged to consider their role in managing collaborators and how they

aim to appropriate value. However, as discussed in Finding 3, this ability was a challenge for cities as they had difficulty managing the mix of players found in open innovation communities. Profit motive and technology ownership can often dictate the business model in private enterprise, but cities operated without these incentives, and were able to pass most value onto collaborators and share technology. It could be imagined that without these motives, available resources, data, and support could be more freely offered by an organization, without restrictions or strict management. However, in the cases we studied, cities found limited success alone. Therefore, the core actor in ecosystems, be they cities or firms, must work to better understand their role amongst collaborators in order to match their business model to the type of community they develop.

3.3.1 Integrated Ecosystem Approach to Open Innovation

Organizing complex open innovation initiatives then requires more than choosing between cooperation and competition. In order to address the number and diversity of actors, their varying motivations, the different approaches needed to meet these motivations, and the different types of innovations being developed, we suggest a broader strategy. We call this strategy an Integrated Ecosystem Approach to Open Innovation. We use the term, *ecosystem,* deliberately, as it defines a form of collaboration characterized by "a collection of firms engaged in joint production, [yet] whose choices and actions are independent" (Boudreau & Hagiu, 2009, p. 168)**.** The core firms or central players in ecosystems are expected to manage the ecosystem in a way that creates value and improves the overall health of the whole community (Iansiti & Levien, 2004). The ecosystem then allows for consideration of diverse actors and their respective motivations and abilities, a component not emphasized in related concepts which imply a community more tightly aligned around a product or service with a shared profit motive. We propose an *Integrated* Ecosystem Approach that combines characteristics of both competitive and collaborative communities. We describe three defining attributes of the Integrated Ecosystem Approach to Open Innovation.

Attribute #1: Global Reuse (vs City-Specific Needs). This attribute describes a best practice of the Integrated Ecosystem Approach that optimizes openness. By global, we mean that technologies are developed for global reuse rather than unique sponsor-based reuse, that data is opened for global reuse rather than unique site-specific reuse, and that the ecosystem is managed for global collaboration rather than location-bound collaboration. In the civic open innovation initiatives, this global view is manifest by expanding the ecosystem beyond the borders of any single city hall, to include joint collaborations across cities and across actors in other locations. Not only is a global view one that fosters collaboration, but also benefits competitive markets. Open data is no longer viewed from the perspective or ownership of a single city or company, but rather from the perspective of

developers and companies providing products and services tailored to a much larger audience, resulting in greater financial gain.

The coordination for this global view would mimic any multi-organization software effort but instead of including only the developers, it would include the owners of the data (e.g., cities), the application users (e.g., citizens), and the support network (e.g., intermediaries). Additional company-specific or city-specific data repositories would be replaced with global data banks, created to make data more easily available.

Similarly, the global view would also extend to coordination of approaches, such as hackathons or Urban Labs. Like data sharing, management of these approaches would be shared between sectors, companies, or cities, just as would the resulting solutions. Again, collaborators would competitively benefit from a broader audience without much additional cost. In other cases, a company or city could adopt a solution developed in a Civic Accelerator without prior involvement or collaboration. These scenarios highlight the integrated approach of competitive components with those of collaborative communities found in the Integrated Ecosystem Approach.

Attribute #2: Actions Driven by Ecosystem Value (vs Available Resources). This attribute characterizes a best practice of the Integrated Ecosystem Approach when the creation of value within the ecosystem is given priority over restriction resulting from scarcity of available resources. Just as cities are able to leverage external resources for open innovation when the ecosystem of actors is considered, so should companies. Instead of developing solutions based on a company's own available datasets, companies can engage the ecosystem to develop these solutions The vision is, then, not for a company or city to simply make data publically available, but rather, for companies, developers and other members of the ecosystem to negotiate what they need from each other. This allows for both extrinsic and intrinsic motivations to drive approaches to innovation, and therefore both types of communities, competitive and collaborative, are served by this attribute.

Attribute #3: Open Innovation Evolution Driven by Ecosystem Opportunities (vs Internal Priorities). This attribute describes a best practice of the Integrated Ecosystems Approach in which opportunities in support of the ecosystem are identified and capitalized, instead of pursuing a pre-planned path to open innovation based solely on internal initiatives. Since conflict often arises from the misalignment of priorities due to the diversity of actors and motivations, organization of these priorities must be managed with the aim of maximizing overall value to the ecosystem. Likewise, resources should be shared within the ecosystem even when it is not any single member's priority, but one that creates overall value. However, this necessitates an ecosystem view, especially among top managers, to allow flexibility to allocate the time and resources to those initiatives. This requires proactivity on the part of the major players in the ecosystem – be they city or company.

A dose of market-driven competitiveness can be introduced to the typically open and collaborative nature of cities when they seize opportunities to create value for external agents rather than acting as passive providers of data and resources. A dose of collaboration can be introduced to the typically competitive nature of companies when they seize opportunities as well in a proactive mode.

Competitive Market	**Collaborative Community**	**Integrated Approach**
Location-based, organization-specific approaches.	European projects around data standardization (CitySDK).	Ecosystem is expanded through joint collaborations across sectors, actors and location.
Fragmented marketplace because of lack of data standardization.	Civic data repositories such as Civic Commons and Europe Civic Commons	Global resue and standardization increases audience and financial gain.
Approaches use available resources, such as Open Data, as a platform for competitive innovation contests.	Approaches use Open Data for open collaboration and cumulative development.	Approaches are determined by overall ecosystem value creation rather than available resources.
Strategies focus on major players such as Google or Yahoo.	Data sharing and technology spillovers are common and encouraged.	Organizations promote a mixed approach to faciliate sharing and ensure value capture.
Pre-planned paths to innovation are pursed in line with internal firm initiatives.	A strong community focus in selecting strategies.	Approaches are selected trying to take advantage of both opportunities and synergies within the ecosystem.
Strategies such as Urban Labs focus on companies.	Innovation proposals remain local and disconnected.	Cross-fertilization and boundary expansion are sought in innovation proposals.

Table 3.3.1 *Integrated Ecosystem Approach*

3.4 IMPLICATIONS FOR BUSINESS

Companies participating in Open Innovation can learn from the experiences of leading cities involved in open innovation. First, the diversity of approaches cities used for open innovation (Finding 1) should prompt companies to also consider new and different approaches. Most open innovation strategies were first developed in the private sector and then later adapted for cities. The successful translation from the private to public sectors would suggest equal if not greater ease in adapting approaches between industries. Managers should therefore take a second look at approaches previously discarded for new opportunities. Further, cities did not commit to a singular approach but embraced a number of strategies to address the varying needs of their citizens. Companies with a wide portfolio of products or services could consider using multiple strategies. Competency in one innovation strategy would suggest the ability to successfully manage another. However, if managers feel inept with a given approach, they could again follow the lead of cities and use intermediaries to manage projects or connect to collaborators. Second, cities managed innovation ecosystems with a great number and diversity of actors (Finding 2). In most ecosystems, variety is manifest in adding more contributors, not by relying on a small group of individuals with great range (Boudreau, 2012). Companies should therefore consider expanding their community of collaborators. Though diversity brings challenges in addressing varying motivations, the payoff in increased innovation and diversity of solutions could be worth the effort. Finally, though the ecosystem view has already been introduced as a best practice in the private sector, cities offer an interesting glimpse at the potential of extreme openness. Firms engaged in open innovation already understand the gains derived from overall value creation. However, lack of proprietary information and sharing of resources and technology in the public sector should encourage businesses to push the limits of openness. Companies might consider opening previously secure datasets for external development. They might also consider opening up core systems or technology previously guarded to encourage collaborators to build on top of the existing technology, expanding market potential.

Companies could adopt the global view of the Integrated Ecosystem Approach (Attribute 1) by collaborating with similar and even competing firms in joint initiatives. If more value can be created and shared for the ecosystem as a whole, a single organization might realize greater value than when going at it alone. Companies can also learn from cities that choose strategies driven by ecosystem value rather than available resources (Attribute 2). This attribute of the Integrated Ecosystem Approach sees cities following the lead of collaborators within their ecosystem to capitalize on opportunities. This attribute highlights the diverse capabilities and corresponding opportunity that external agents bring to an ecosystem. Companies previously discouraged from expanding their portfolio of products or services because of lacking ability or resources might

reconsider. The ecosystem might contain a collaborator capable of fulfilling those needs. However, managers must be comfortable relying on those external agents and potentially relinquishing a certain degree of control in order to realize the innovation.

Therefore companies should adjust their focus on open innovation away from specific external sources of innovation to the new opportunities that an integrated ecosystem offers both in terms of value capture and value creation while minimizing the drawbacks. Furthermore, even if, in cities, the mixture is more evident because of the different nature of the incentives and motivations of participants than might be seen in the private sector, we are witnessing how it is becoming more common to some degree to integrate collaborative and competitive strategies. Therefore actively participating in these ecosystems will also be a valuable learning experience for the companies involved.

Finally companies in order to succeed should align their objectives, with the ones of the ecosystem where they aim to thrive while minimizing its existing limitations. Our analysis describes ecosystems that are in a rapid process of evolution with plenty of opportunities for innovation, networking, visibility and increasing the functionality of existing applications but still somehow many times limited in their capacity of procuring sustainable monetary inflows.

4 Open Data & Civic Apps: First-Generation Failures Second-Generation Improvements[2]

4.1 INTRODUCTION

On his first day in office in 2009, US President Obama signed the *Memorandum on Transparency and Open Government* asking government agencies to release their data to make it open and available to the public (Memorandum on Transparency, 2009). The aim of the initiative was to provide transparency in government and to improve the provision of services through new technologies developed on the backbone of civic open data (Freitas, Curry, Oliveira, & Riain, 2012). Transparency was realized through a public data catalog that was the most comprehensive at the time, providing such information as real time crime feeds, school test scores, and air quality metrics. However, few citizens would make the effort to comb through the trove of over 272,000 datasets that had been provided to the public by May 2010, only one year later (Lakhani, Austin, & Yi, 2010). In response, leaders of the open data movement sought to engage code developers to make this information not only more digestible for greater transparency, but also incorporate it into applications, services, and businesses that could better serve the public and foster economic growth.

United States CTO Vivek Kundra led the effort and enlisted the help of digital creative agency iStrategyLabs, based in Washington DC. To spur interest in the data.gov repository, iStrategyLabs launched "Apps for Democracy", a contest with cash prizes to stimulate civic app development. With an investment of only $50,000 provided for the prize-winning solutions, 47 apps were created with an estimated $2,300,000 value, based on the cost to develop the solutions via more traditional means (Federal Government Mobile Apps, 2008). Further, the brief 30-day contest significantly compressed the amount of time it would have taken to launch the government down this innovative path, estimated to be two years with normal methods. The strategy was

[2] A version of this chapter is published in Communications of the ACM by Lee, M., Almirall, E., & Wareham, J. (Volume 59, issue 1, pages 82-89, 2015).

deemed a success; New York and San Francisco soon followed with similar contests. Indeed, as momentum increased in the open data movement, cities, rather than the federal government, took control of publishing and promoting open data initiatives. In the following 2-3 years, these strategies were replicated in cities throughout the world.

However, by 2011, much of the initial enthusiasm behind the open data movement had waned. The adoption, impact, and value creation of apps developed using open civic data was far less than anticipated. In the last two years, the open data repository has been accessed through downloads of more than 2 million datasets, though few applications based on this data are widely used, nor do they have high quality ratings (Bakici, Almirall, & Wareham, 2013). For instance, none of the apps appear in the top 100 overall applications in either the Apple or Android stores. While a huge potential market for civic apps exists, these initiatives have failed to create the social or economic value that was projected.

In this paper, we examine early strategies behind the open data movement. We interviewed application developers and civic organizers in eight cities in America and Europe including Amsterdam, Barcelona, Berlin, Boston, Helsinki, New York, Philadelphia, and Rome. Throughout the course of these interviews we tried to uncover some of the reasons why these initiatives failed to meet expectations. We conclude by examining more recent adaptations to the strategies that offer pathways towards greater impact.

4.2 PROMOTING OPEN DATA THROUGH APPLICATION DEVELOPMENT CONTESTS

4.2.1 BOLD VISION – MEAGER RESULTS

Following the apparent success of the Apps for Democracy contest in 2009, cities all over the world began hosting application contests to capitalize on their newly open data catalogs. These contests continue to be the predominant strategy to foster transparency and economic development provided by civic open data. However, these initiatives suffered from a lack of impact, both within government and the public. To begin, though efforts were made to open data throughout all divisions of government, developers tended to incorporate only a small range of this data, with an overuse of certain datasets. A multitude of apps targeted similar solution spaces such as transportation and mobility with limited use or impact. Organizers began to recognize that neither data quality nor general interest were the cause of the meager impact of the apps. Rather, the limited public knowledge of the significant operational challenges facing city governments generated a portfolio of somewhat anemic apps targeting a predominantly consumer space. Developers, with similar social demographics, were guided by personal experience or interests to develop apps centered on

restaurants, parks, or public transportation. As Betsy Scherzer, an organizer of New York's Big Apps Contest explained,

> *"I think a lot of it depends on what developers are interested in and what seems useful. For example, we get a lot of data from the Office of Management and Budget. That data does not match or lend itself easily to apps. Not too many people want a city budget app. Whereas the parks department, which has all the info on park WiFi and stuff you can see, pull out your phone and use the info - those datasets get used first."*

Even within those datasets that received attention, developers often failed to envision solutions that greatly complemented the provision of municipal services. Tourism apps, for example, represented almost 12% of the apps in Amsterdam's 2013 Apps for Amsterdam contest. But the utility of the solutions were anchored in mobility and consumption, not in an increased level of service provided by the city. Applications that had real impact for citizens or government were few. App "donteat.at", exemplifies an exception, demonstrating a better integration of open data and civic services. Donteat.at was created as part of the New York Big Apps competition. Donteat.at integrated restaurant health inspection information provided by New York City's sanitation department with restaurant location and ratings data. Upon entering an eatery, Donteat.at recognized the locale and determined its inspection status. If that restaurant had been flagged for a sanitation or heath inspection violation, the app would send the patron a text message alerting them to the notice. In addition to providing a service to citizens that greatly affected their actions, this app also provided impact by affecting the role of the sanitation department. Previously, health inspections would go virtually unnoticed until egregious and final violations called for public notices and restaurant closure. Donteat.at worked to reinforce even minor violations by making the public more aware of infractions. Health inspectors began to see cleanup happening more quickly and without repeated visits because patrons were leaving after receiving the alerts. The app demonstrates the time and cost savings that civic apps can provide to a city and citizens, though few apps coming from the contests had this level of impact.

Lastly, apps developed in city-sponsored contests failed to make an impact because developers often came with ready-made solutions. Contest organizers hoped that the range of datasets would spur new and innovative apps to improve internal city processes, provide better civic services, or facilitate government-to-citizen interaction. But because the requirement for participation in the contests was often the simple inclusion of a city-provided open dataset, most developers submitted previously developed apps with minor adjustments to accommodate civic data. So where numerous

re-cycled apps exploited the civic datasets, deeply novel business innovations or improvements in the provision of civic services were rare.

4.2.2 Failure to Provide Value Capture

In addition to a lack of impact, the open data initiatives were not managed in a way that guaranteed value capture. Contest organizers did not fully understand the motivations of external participants to ensure their continued involvement, nor did they expect real savings to be accounted for in city hall. Initially, contest organizers reasoned that prize money was a strong motivator for developer participation, providing a foundation for them to jumpstart and sustain development of their apps. Some contests offered tens of thousands of dollars for prize winners. However, though prize money was never refused, most developers believed the amount garnered through contest participation was not enough to provide complete application support, maintenance, and sustainability over time. They were instead looking for much larger amounts. As Jonathan from Cab Corner, an app that provides a cab-sharing utility noted,

> *"Our reason for participating is to be recognized enough to get serious funding. Not ten or twenty thousand but someone who will give you a quarter of a million dollars or so and really get involved and bring more people in. The prize money is not a game changer. The real reward is when someone calls you of the blue and says they have real venture capital for you - then you can get things done."*

Developers did not chase the prize money but participated in civic apps contests as they would non-city-sponsored contests – for exposure, reputation, and evaluation. Coders sought exposure to potential funders, which in contrast to one-time winnings, could be a sustained source of income for those looking to start a business from their app.

As contest organizers became more aware of developers' motives, greater efforts were made to include entrepreneurs and venture capitalists on the panel of judges. They also hosted events and closing ceremonies that included potential funders. A few developers found success with this model. *My City Way* was an app and platform developed to allow businesses to connect to their customers in real time as they are mobile throughout a city. *My City Way*'s exposure in New York Big Apps won them over seven million dollars in venture capital. News of their success spread through the developer community and increased participation for others looking for funding through contest exposure. *My City Way*, though, was an exceptional case, and as a whole, developers could not expect this amount of funding to be the norm in city-sponsored contests. This left developers struggling with financial constraints that often led to the abandonment of apps.

Aside from external funding, participants still hoped to capture value through the exposure gained from participation in the contest; exposure not to potential investors, but to a larger citizen market for the app. Developers hoped that citizens would become aware of the civic apps through the cities' websites, or through concerted efforts of city organizers to showcase participating solutions. These efforts fell short of expectations. As Marco Cavalli, a developer in the Apps for Italy contest stated,

> *"If only we had more exposure leading to more users that eventually paid for the premium version. We hoped to get more subscribers just to start with a small base so that we could continue with our development. But without more initial awareness through the city or other advertising, we were not able to grow."*

Lastly, cities did little to advertise their new collection of apps. Unsurprisingly, citizens did not flock to city websites to discover them. The usual outlets for finding apps, the Apple or Android stores, do not feature categories that highlight city apps, making it difficult to gain awareness in the largest marketplaces. Instead, creating awareness was mostly left to app developers, who found this difficult without additional funding. Though the market for city services remains more than enough to provide continued value to thousands of civic apps, actual adoption remains low and fails to sustain their development.

4.2.3 Failures within Government

Failures in early open data challenges also stemmed from issues within city government and the expectations of participating departments. The first step of these initiatives involved persuading internal agencies to open their data and provide it in useable formats. With strained budgets, overworked employees, and other, more critical responsibilities expected on a daily basis, releasing data was not only a chore with no tangible benefit, but also subjected city departments to unwanted scrutiny. Employee reluctance delayed city halls in publically opening data repositories. Most cities eventually introduced legislation to force data publication, but departments were still slow to move.

Additionally, the managing department for most open data contests within city hall was usually the Innovation, IT, or Economic Development department. Beyond data publication, the managing department had little interaction with more core city agencies regarding the apps challenges championed by the organizational periphery. This created a great disconnect between city operations and the open data initiatives, which greatly hampered their success.

The involvement by civic departments directly requesting specific solutions beneficial to city operations was prohibited by procurement legislation. As Betsy Scherzer from New York's Department of Economic Development explained,

> *"We had a few agencies that came to us and said 'We are from the Department of X and we would love to have the following guide made for us that does XYZ'. But that's actually a specific enough request that it would be considered something you would have to procure for, and so we're not allowed to accept them because if we did, it would be like procuring something for free."*

Not only were agencies prohibited from requesting focused solutions, but general communication between the relevant departments and developers was limited. If involvement of city departments was stifled in development phases, their potential for adoption or support further in the app lifecycle was highly unlikely. There were no instances of popular or useful apps being adopted or partially managed by a city agency. As such, civic apps suffered because the departments for which they were created failed to integrate them into the central services provided by the city.

4.2.4 First Generation Failures

Because the management of open data initiatives was handled outside of the core departments, these agencies were not asked to make any financial investment in the solutions. Likewise, the accountability for the impact of the open data and the success of the resulting apps was also dispersed. Managers, therefore, did not expect dramatic returns from the contests, especially in terms of savings that might accrue to their department directly. Central organizers attempted to quantify the value saved by the contest with metrics measuring the comparable cost of in-house development. But as these savings were not accounted for in any departmental budgets, there were no reviews or measurements of the actual benefits. Instead, the rationale provided for contests became focused outside of city hall and on the economic development within the community, stemming from new businesses based on the apps. Unsurprisingly, few sustainable businesses have managed to materialize. The number of participants, number of datasets opened, and number of apps developed have become the metrics upon which contests are evaluated. However, these numbers poorly reflect any municipal savings, entrepreneurial or social value. Following is a table summary of first generation failures in civic application development.

1st Generation Failures – What Went Wrong?
• Excessive use of popular datasets • Overcrowding – numerous similar apps in same solution space • Apps originated from developers with homogeneous interests and demographics • Data published with no commensurate changes in city services • Pre-existing apps tweaked for inclusion in coding contests • Prize monies symbolic – insufficient for long-term sustainable operations of app • Limited adoption and support by civic governments – city involvement ends with data publication • Resistance to data transparency by public administrations

Table 4.2.3 *1st Generation Failures*

4.3 SECOND GENERATION OPEN DATA INITIATIVES MAKE IMPROVEMENTS TO MAINTAIN MOMENTUM

As open data initiatives continued to gain popularity, cities and developers began to recognize which strategies worked best and how to improve upon others. Though many of the initial efforts continue, some second generation initiatives have incorporated new mechanisms and included additional actors to increase the impact of civic open data and provide value capture for those involved. These improvements represent some best practices and lessons to encourage the momentum behind the open data movement.

4.3.1 Increased Exposure to Civic Needs in Open Data Challenges

As mentioned, early challenges often lacked impact because developers had limited experience with the full suite of civic services and instead created an abundance of solutions with popular consumer appeal. In order to redirect developer focus, organizers sought to educate developers about struggles in government or the plight of other citizen groups. *Hack-at-home* is a strategy that exemplifies the improvements built into apps contests to enlighten developers about the need and potential for solutions.

Hack-at-Home is an apps contest model developed by DotOpen, an open innovation and digital media company based in Barcelona. The *Hack-at-Home* model provides developers more information about the problems that could be better addressed through open data solutions by increasing the involvement from civic agencies early on. Instead of simply requesting governments'

open data, DotOpen works closely with those departments needing solutions to formulate the issues relevant and solvable with information and apps. The result is that in addition to the data repositories, developers are presented with "Problem Statements". These short descriptions include the following: the *Crisis Statement* describes the current situation or process that is failing; the *Needs Statement* describes, generally, what utility an app would provide without specifically detailing a developed solution; and the *Impact Statement* explains the expected outcome and benefit the developed solution would provide to citizens and the government, if successful. These 500 to 1,000 word outlines add incredible impact by simply guiding developer attention to problems faced by governments. Apps developed in these challenges have, amongst other things, increased awareness of sanitation problems while educating citizens about access to available resources and solutions (Open Government Initiative, 2013).

Another method for increasing the impact of open data also involves working with intermediaries to better educate developers about the situations faced by city halls (FixMyStreet, 2015). This strategy, developed by non-profit organization Code for America, abandons the contest model and greatly enhances the direct relationship between coders and civil servants. Code for America chooses roughly 30 developers and eight to ten cities a year to create solutions based on civic open data. These developers must make a full time commitment to Code for America for an 11-month period, and relocate to San Francisco for that time. Developers engage directly with relevant city workers to better understand needs from their perspectives, as well as engaging with citizens that are affected by those problems within the community. This model has spread internationally with Code for Europe, Code for Africa, Code for the Caribbean, and more.

4.3.2 Stronger Management of Open Data Initiatives

Second generation open data initiatives have also increased impact through better and stronger management. Where simple contest-driven strategies were disappointing for the first generation, the increased involvement of internal agencies and external partners has yielded superior results for the second wave of open data. Boston's Office of New Urban Mechanics provides an example of an internal agency that has strong management of its open data initiatives. The Office of New Urban Mechanics (NUM) is an internal innovation department within the mayor's office. NUM is strictly focused on creating solutions through technology that increase the provision of civic services and provide value to government. To begin, NUM invites needs and suggestions for improvements from all actors in a city: citizens, government employees, academia, non-profits, and private businesses. NUM then evaluates these inputs based on their potential for impact on civic services and filters them on targeted areas such as urban development or education. NUM ultimately considers their potential for impact and resource use to guarantee success when selecting which projects to support. NUM has

a short, five to seven month timeline for the development of solutions, whether the outcome is a mobile app or a more complete business based on the technological solution. This model of strict, top-down management, in contrast to the early apps contests, has demonstrated lasting impact, value capture, and sustainability of the solutions.

One example of an app developed through Boston's NUM is Street Bump. Street Bump collects data about road conditions as users drive. The city then aggregates this data, which informs them about real time road deficiencies that can be fixed more quickly, saving the cost of deploying civil servants to comb the streets for places needing repair. However, the success of the app would not have been realized without NUM's strong involvement. Incredible expertise was needed to develop a solution with an algorithm sophisticated enough to translate the data from a smartphone into bumps on a street. NUM partnered with software company Connected Bits and design company IDEO to come up with the innovative product. The results of these more sophisticated collaborations can have had real impact throughout a city.

Street Bump. Application homepage showing cities where it is deployed and the number of bumps recorded.

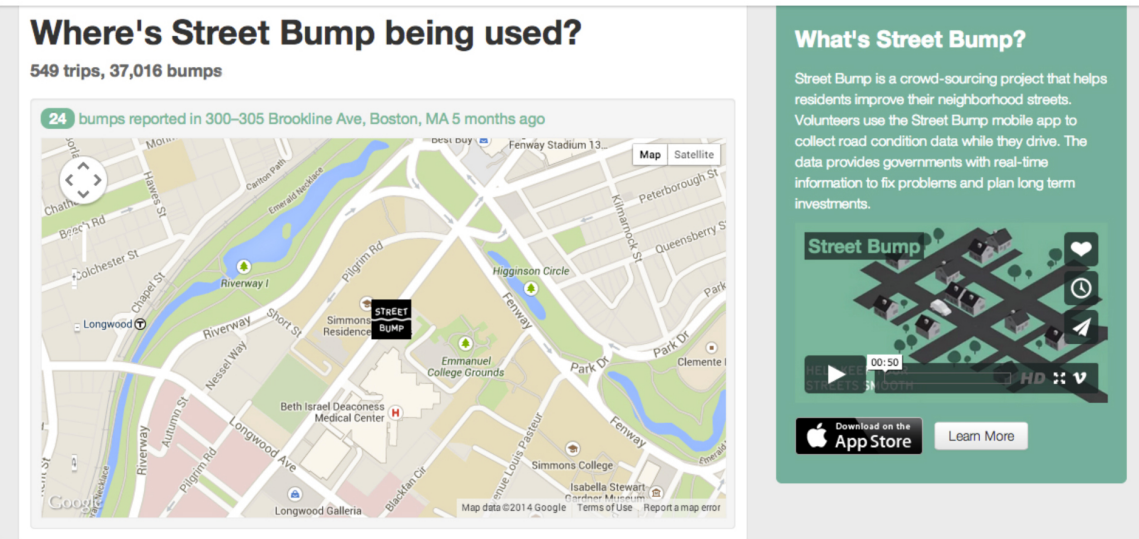

Figure 4.3.2 Street Bump

4.3.3 Common Platforms for Open Data Initiatives

The market for civic apps is virtually limitless as civic needs are shared across city, regional, and national borders. However, most apps are targeted towards specific cities. This problem is mainly caused because managers within government choose to procure their solutions, whether developed in-

house or through open innovation initiatives, as custom-tailored for their city. They imagine their needs to be unique and want to showcase equally bespoke solutions. Yet starting from scratch takes time and resources well beyond those needed to adapt existing apps. And targeting software for a specific city decreases the potential market available for that app. Small cities, in particular, do not have a population that can support a large community of civic app developers on their own, let alone justify the investment in redundant functionality offered by existing software.

Application repositories, or marketplaces, provide a venue for civil servants or developers to source existing solutions. Civic Commons is such a marketplace, created to facilitate code sharing. This collection of civic apps promotes their use and reuse, providing value capture for developers as their markets increase, and savings for cities as the choose to adapt, rather than create completely new solutions. Other repositories have been developed, such as Europe Commons, which not only showcase civic apps, but also offer best practices and case studies in an effort to provide more value capture to developers and savings to cities.

FixMyStreet is a solution hosted on Civic Commons that exemplifies the benefits of city-sharing and modularized solutions (Opsahl, 2009). Developed by MySociety, a UK-based charity promoting e-democracy, FixMyStreet was originally developed to allow UK citizens to monitor and report street and road problems to their local councils. Realizing its universal applicability, MySociety developed the solution as an easy-to-adapt platform for others. The FixMyStreet website provides simple instructions for citizens looking to implement the solution locally. FixMyStreet therefore not only provides a case for city-sharing and modularization, but also demonstrates the potential for real bottom-up, citizen-led impact. In contrast to earlier, government-led initiatives, FixMyStreet requires little from city governments to be enabled. Citizens interested in hosting FixMyStreet in their locality need only the email addresses of civil servants or departments responsible for the issues on which one might report. A greatly enhanced channel of communication between cities and their constituents is therefore created directly through fellow citizens able to adapt the platform, or recruit others with the basic technical skills to customize the code and run the site. FixMyStreet has been used to report on broken streetlamps, potholes, garbage collection, and even crime. It has been implemented in more than 15 counties across the globe.

FixMyStreet now also provides an easy-to-implement platform to cities. The same functionality and customization are provided along with training, maintenance, support, and web and mobile app development. Average installation cost to a metropolitan area is $15,000 with an annual maintenance and support fee averaging $2500 (Ramm, Topf, & Chilton, 2010). FixMyStreet demonstrates how an adapted, modularized solution can provide benefits with relatively modest costs. UK councils reported up to a 300% shift from phone calls to online reporting after integration. FixMyStreet also reaches a new demographic that would have not been as likely to report through

traditional channels. Further, its customization allows some cities, such as Zurich, to respond directly to each citizen report and track its progress through its completion.

OpenStreetMap is another open data platform that makes a bottom-up initiative even more impressive by crowdsourcing the original content rather than working from city-provided open data. OpenStreetMap was developed in the UK in 2004. Frustrated by the restrictions on proprietary map data yet inspired by the success of Wikipedia, Steve Coast developed OpenStreetMap to encourage its over 1.6 million registered users to contribute, augment, and edit geographical map data. However, the greatest value created by OpenStreetMap is not the output of a crowd-sourced map, but an open data platform from which other applications (including aforementioned FixMyStreet) can source their map data. Initiatives like FIxMyStreet and OpenStreetMap show how engaged communities and open, crowdsourced content repositories can fuel civic application development.

Data standardization between cities remains an area for improvement, restricting the potential marketplace for a given developer's app and limiting potential value capture. Progress has certainly been made considering that the early efforts of open data were static PDF's published on the city's website. Civic departments have caught up and are now adopting current World Wide Consortium (W3C) standards promoting the semantic web and linked data, which not only allow for machine-readable formats, but also allow the information to be connected, queried, and shared more easily. The data can then be used and collated across borders, in ways envisioned by developers, and independent of the original structure or intention of the data provider. However, until these standards become more universal coders must write numerous interfaces for each city and maintain them individually.

The transportation app Roadify, for example, provided transit schedules for New York commuters. Interested in increasing app adoption, the developers realized that other cities would need the same information, which was also provided through local open data repositories. However, as co-creator Dylan Goelz explained,

> *"The trouble is that data is provided differently in every market. Google tried to standardize the data, but there are still discrepancies. San Francisco may do something that Boston doesn't, and it makes aggregating the data difficult. We had to develop our own solutions to be able to shift and adapt, which has cost time and money."*

As most city managers do not yet realize the benefit of sharing apps between cities, they also fail to understand that government databases can grow beyond a city's borders. Data standardization requires coordination and procedural changes that are both technical and political. W3C standards are

greatly enhancing developers' potential to more easily integrate information from multiple cities. Efforts such as these promote standardization and not only further sustain the lifetime of solutions, but would also leverage network effects towards greater developer participation and user adoption.

Below is a depiction of the complete civic application development timeline (Figure 4.3.3), illustrating the diversity of actors and their respective contributions to the process. Following that is a table summary (Table 4.3.3) of the improvements realized in second generation initiatives and a concluding section.

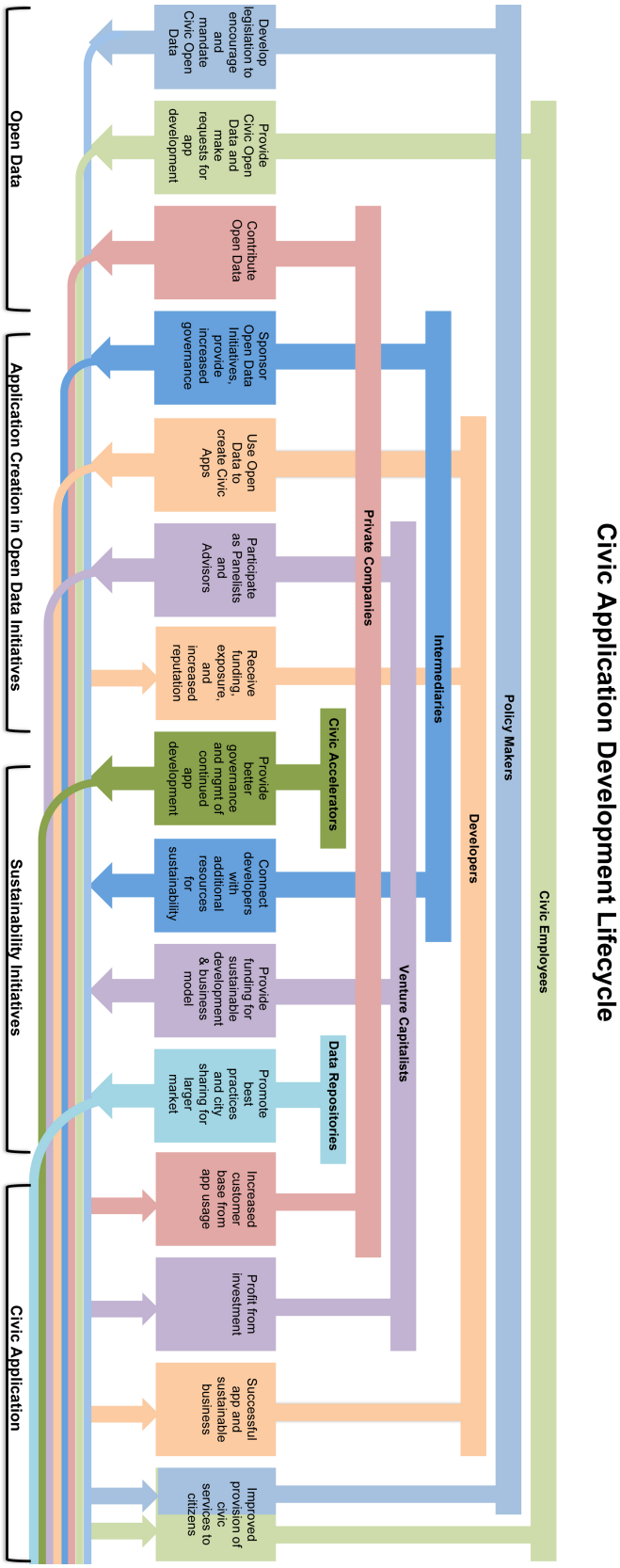

Figure 4.3.3 *Civic Application Development Lifecycle*

2nd Generation Improvements – What was Learned?
• Invitation of entrepreneurs and venture capitalists to judging panels to court funding opportunities • Legislation to force civic bodies to publish data in timely manner • Problem statements published by cities to direct developer attention towards significant operational challenges • Developers embedded in city organizations for substantial time periods to better understand operations and build reciprocal engagement • Stronger management and direct coordination from city administration • Ex-ante commitments for financial support of specific apps • Common app and crowd-sourced data repositories along with bottom-up, engaged communities • Open source, coding practices and coordination of data standardization

Table 4.3.3 *2nd Generation Improvements*

4.4 CONCLUSION

Momentum behind open data and its potential to provide cost savings to cities and better service to citizens remains. Early efforts focused on application contests with low governance failed to produce the results most expected, though these early iterations provided insights into some potential fixes. Second generation initiatives have incorporated better management and knowledge transfer into the strategies to provide increased value capture and impact. Bottom-up initiatives, crowdsourced content, and shared open data repositories and apps also fuel these efforts. However, room for improvement remains.

Three main problems exist involving mechanism coordination. First, progress needs to continue towards the standardization in data formats and APIs to allow for effective sharing in app marketplaces. Second, application discovery remain problematic, as no effective discovery and diffusion channels beyond the most popular one hundred applications exist. And finally is the need for an efficient code reuse among public organizations that would allow not only a better use of taxpayers' money, but which leverages network effects towards incremental and cumulative innovation.

Effective incentive management for all types of actors in such heterogeneous ecosystems is certainly more complex than in traditional markets. Three main problems remain here. First, market fragmentation render standard business models based on advertisement or usage fees impractical, forcing app developers to resort to reputation or signaling as alternative modes of value capture. Second, there is a need for trust in the stability, continuity and availability of open data streams and APIs that are not always secure in politically turbulent municipalities. And third, the inherent tension between collaboration and competition manifests a managerial challenge in these complex and diverse ecosystems.

Open data strategies in the public sector should continue to evolve, and with continued ingenuity, increase in their efficacy, impact and social value. What open data and civic app contest designers have learned is not unique to the world of government data, but extendible to other of spheres of distributed, collective creativity so common in alternative software development platforms.

5 Mapping Living Labs in the Landscape of Innovation Methodologies[3]

5.1 INTRODUCTION

When Time magazine (Grossman, 2006) selected "the user" as the person of the year for its front page, it was publicly acknowledging the increasing importance of individual user collaboration and involvement in producing content and, ultimately, in driving innovation. User involvement can take a variety of forms. Some instances position the user as the main creator, in the case of lead users (Von Hippel, 1986) or open source communities. Others see participants operating as co-creators in practices such as design thinking (Brown, 2008). On the other end of the spectrum, participatory or user-centered design treats users as passive subjects whose insights are captured and introduced in the innovation process, such as in applied ethnography, usability, human interaction, or market validation exercises. Living labs are situated in the fertile, middle ground of user involvement. The term "living labs" often refers to both the methodology and the instrument or agency that is created for its practice. Living labs are driven by two main ideas: i) involving users as co-creators on equal grounds with the rest of participants and ii) experimentation in real-world settings. Living labs provide structure and governance to user participation in the innovation process (Almirall & Wareham, 2008). Understanding the merits of this methodology is highly relevant, because agents involved in innovation must select the requisite methodologies to appropriately address their respective challenges.

5.1.1 RESEARCH DESIGN

The authors participated in two EU projects and one national project oriented to support living lab activities, with work packages devoted to the collection of methodologies and best practices. The research took the European Network of Living Labs, a large network of organizations in the EU self-

[3] A version of this chapter is published in Technology Innovation Management Review by Almirall, E., Lee, M., & Wareham, J. (Volume 2, issue 9, 2012).

defined as living labs, as the point of departure. An investigation using secondary sources revealed a list of 48 living lab organizations that were considered potential candidates for the study. Interviews were conducted with 38 senior managers and researchers including the directors of living labs corresponding to 26 different living lab organizations. The four living lab organizations were selected for further study to represent variance in processes, diversity in focus, and longevity within the methodology. The four cases offer insight into representative living labs methodologies that cover a wide spectrum of practices in the community. Although each one has a distinctive flavor, the authors aim to provide a comprehensive view of living labs through these case studies before situating them into the landscape of innovation methodologies.

5.2 LIVING LABS METHODOLOGIES

TestBed Botnia

TestBed Botnia, founded in 2000, originated in the Centre for Distance-Spanning Technology, a research center in the Luleå University of Technology. TestBed Botnia specializes in mobile services. A sizeable community of 6,500 users from all over Sweden actively participates in TestBed Botnia living labs. Users have collaborated in a wide range of trials, such as mobile queues at banks, traffic updates through SMS, targeted, location-based commercials, and streamed sporting events over the Internet. Most methods used are qualitative, often focusing on needs-finding, participatory design, and lead-user involvement. FormIT, the most-used living lab methodology in TestBed Botnia, has three states of product/service development: the design of concepts, the design of prototypes, and the design of the final system (Bergvall-Kåreborn, Ståhlbröst, Holst, & Mirijamdotter, 2006). The methodology evolves in spiral through these three stages (Figure 5.2.1).

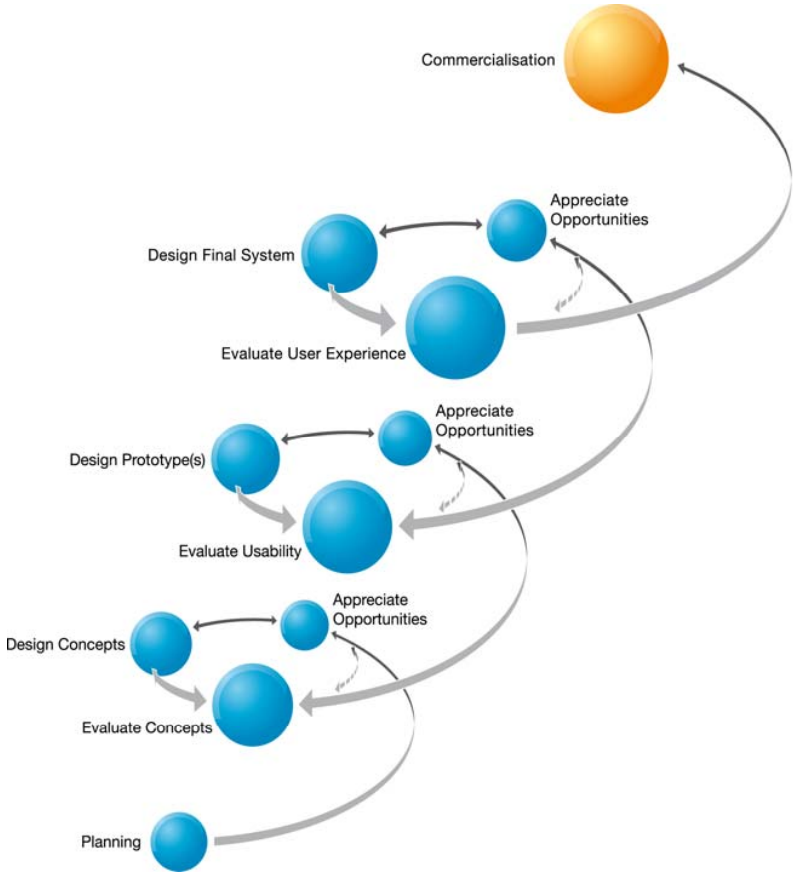

Figure 5.2.1 *FormIT Living Labs methodology*

The first phase (Design Concepts) is aimed at eliciting and prioritizing needs. Using rich narratives, users strive to find the best of "what is" and dream of "what could be". Interaction with users seeks to identify requisites and new possibilities while situated in real-life contexts. Based on the narratives developed, needs are categorized and prioritized, and initial concepts are formed. The second phase (Design Prototypes) is aimed at developing rough mock-ups and building on the results of the previous phase. The third phase (Design Final System) is aimed at concept valuation. In this phase, users test and evaluate in real-life contexts the prototypes developed in the previous phases. The iterative process often leads to changed or refined user needs with a focus on "what will be" and shaping the end product or service.

Within each stage, we can find a three-step process that begins with the appreciation of existing characteristics. Once these attributes are clearly established, the process continues with a collaborative design of concepts, prototypes and the final product/service. Real-life environment

validation is maintained through the process as much as possible. This three-step process is repeated until the results are satisfactory.

iLab.o

iLab.o, in Belgium, has played an important role in the living labs community, reinforced by the presence of the Secretariat of the ENoLL in Flanders. iLab.o is the living lab division of the innovation research institute IBBT, which was founded by the Flemish government. iLab.o provides a methodology for living lab initiatives while supplying services that facilitate their implementation.

iLab.o's methodology is based on the social construction of technology (Bijker, 1987) framework, which suggests that technology is shaped by the user and highlights the importance of context in the process of endowing technologies with social meanings. Users are considered the central focus and facts and meanings are the results of social processes (Sretenova, 2002).

iLab.o formalized its living lab methodology in 2005 (Pierson and Lievens, 2005) and subsequently published experiences on concrete implementations of it (Ballon, Pierson, & Delaere, 2005). The methodology consists of four phases aimed at understanding the context where the technology will be adopted and emphasizing the changes in meanings that this adoption will produce (Figure 5.2.2).

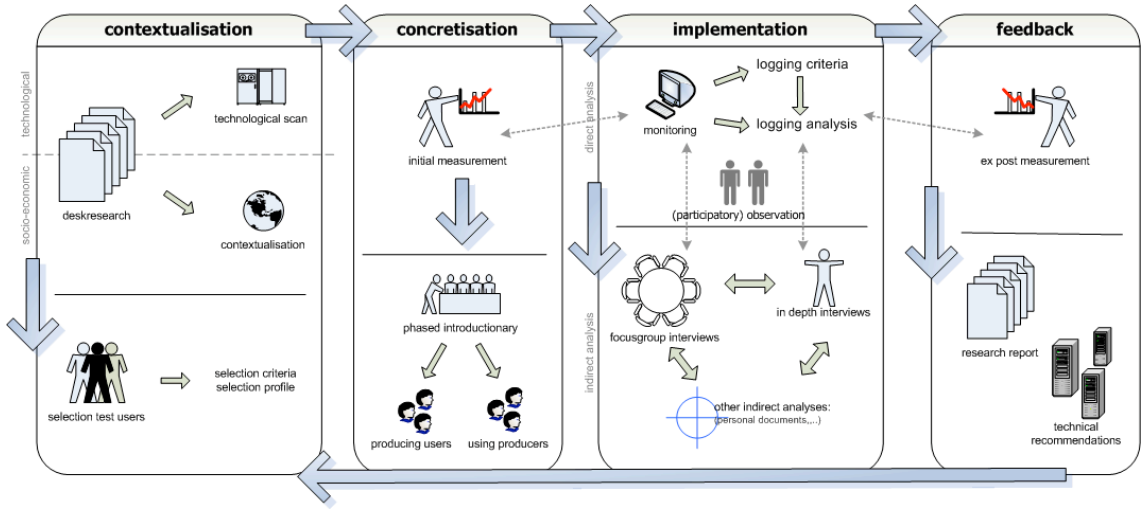

Figure 5.2.2. *iLab.o Living Labs methodology*

Contextualization. The contextualization phase aims to capture the relevant background information and insights around the subject of research. This information is then used to select a group of users for participation in the project.

Concretization. The key element of this phase is obtaining an initial, ex ante, snapshot of the user panel that can be later compared with one ex post measurement, after the introduction of the new technology or the innovation to be validated.

Implementation. The actual test and validation process is carried out in the implementation phase. Direct measurements are embedded in the device or in the platform and are implemented by means of logging, thereby reflecting patterns of use. Indirect measurements aim at capturing the meanings and context of use are carried out by a combination of ethnographic observation and qualitative analysis such as in-depth interviews or focus group exercises.

Feedback. Ex post measurement is conducted in this phase. The results are compared with those obtained in the contextualization and implementation phases and used to infer and produce recommendations on the concrete diffusion and implementation of the technology.

Helsinki Living Labs

Helsinki Living Labs was launched in 2007 to act as a connector between companies and the public sector interested in collaborating with living labs. The organization facilitates activities in Helsinki and surrounding cities, encompassing eight living labs, together with associated organizations of developers, enablers, and utilizers.

Helsinki living labs follows a three-phase methodology that evolves in a spiral (Figure 5.2.3). In the first phase (Grounding), stakeholders are identified and users from the community are selected. The second phase (Interactive and Iterative Co-Design) sees users explore the definition of concepts and work in the co-design of prototypes. Finally, in the third phase (Appropriation and Implementation), the final outcome is tested and feedback is gathered.

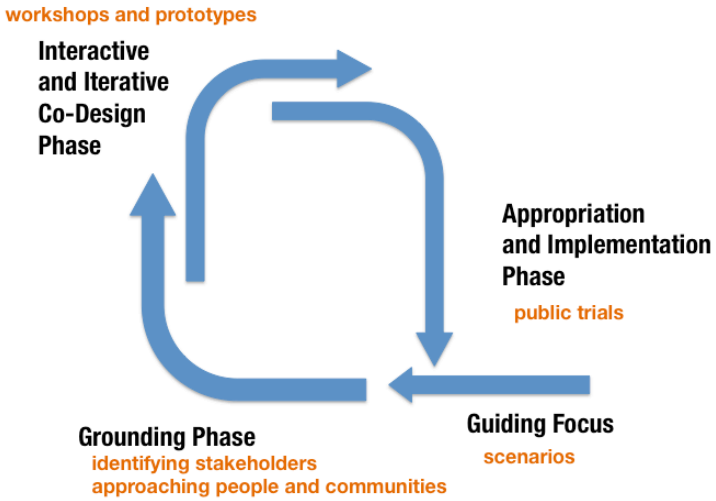

Figure 5.2.3. *Helsinki Living Labs methodology*

Catalan Living Labs

A living labs network was formed in Catalonia, Spain in 2006 to coordinate the different experiences and work of several research institutions using living labs methodologies. The majority of projects in Catalan are business to business. From Catalan Living Labs cases (Almirall & Wareham, 2008), we can infer a reliance on a three-phase methodology conducted in a spiral, but with an important shift in focus from needs-finding and context assessment towards implementations in real-life environments that serve not only as a proof of concept but as a starting point for a public or commercial venture (Figure 5.2.4).

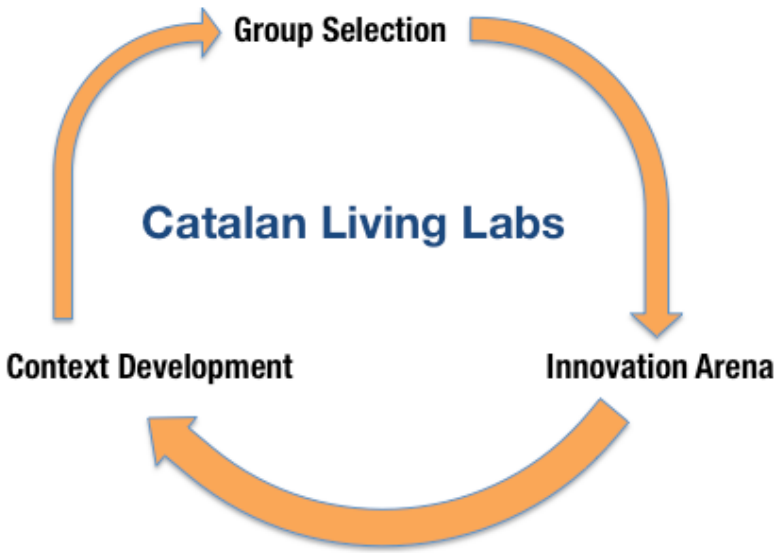

Figure 5.2.4 *Catalan Living Labs methodology*

The first phase of Catalan Living Labs is devoted to group selection. Great care is taken to involve the relevant set of users, not only because their insights could contribute to the development of a better product or service but also because they could help in creating a wave of momentum once it has been taken to market.

The second phase is devoted to the creation of an innovation arena. This is a distinctive characteristic of the Catalan model that supports the objective of reducing uncertainty and risk by demonstrating the solution's viability in real-life environments and by fostering early demand. This often involves the use of advanced infrastructure not generally available for public use. For example, the Catalan Living Labs network relies extensively on the use of Internet2 (high-speed Internet) research networks and state-of-the-art sensor networks for experimentation.

The final phase is devoted to context development and consists of experimentation in real-life environments, with an emphasis on developing business models that could make the project sustainable.

5.3 LIVING LABS METHODOLOGY CONTRIBUTIONS

These four cases provide a description of some representative living lab methodologies that cover a wide spectrum of practices in the living labs community. Although each one has its distinctive flavor, they share some common characteristics.

In all cases, we observe the engagement of users in the early stages of the innovation process. In the case of TestBed Botnia, this engagement has a well-defined objective: to collect user needs and engage them early in a co-design exercise. A similar approach can be found in the case of the Helsinki Living Labs, however a greater emphasis is placed on the selection of users. iLab.o shares the emphasis on selecting the "right" subset of users. Additionally, they emphasize involving a large number of participants so that the emergent solutions will ultimately be favored by the target population of end users. And, in Catalan Living Labs, selection is focused on users that best express the relevant domain expertise, providing concrete insights when interacting with the solution implementation.

Therefore, in all cases, we can find clear initiative to involve users early on in the innovation process in order to capture either market knowledge about preferences, suitability of the implementation, or more specialized domain-based knowledge. Living labs methodologies aim to incorporate and evolve this knowledge in products and services through co-creation.

Proposition 1. Living lab methodologies engage a select group of users in the innovation process to capture market and domain-based knowledge and involve them iteratively through a co-creation process.

The most distinctive characteristic of living labs methodologies is the focus on real-life environments as the locus of research. Again, we find some differences in how various living labs seize the opportunities that this choice provides.

In TestBed Botnia and Helsinki Living Labs, proposals are derived from user needs and transposed to real-life situations, ranging from scenarios to the actual environment as research progresses. iLab.o places even more importance on the selection and appropriateness of the context in order to allow for the emergence of new uses and meanings. And, with their focus on capturing domain-based knowledge, Catalan Living Labs see context as important because the expertise that is often tacit becomes codified when applied to a certain environment.

Real-life contexts are therefore much more than a more realistic scenario for validating proposals; they form an arena where new meanings can emerge, tacit knowledge can be captured, and the whole ecosystem can be validated.

Proposition 2. Living labs elicit new understandings and meanings, and capture tacit and domain-based knowledge by situating and evolving innovation projects in real-life contexts and taking the opportunity to involve the whole ecosystem.

The third distinctive characteristic of living lab methodologies, especially when compared with close siblings such as participatory design, is the presence of public-private-partnerships. In TestBed Botnia and iLab.o, institutional support is provided through policy measures that encourage public institutions to foster and develop initial demand for products and services coming out of living lab exercises. The Helsinki Living Labs offer a similar case in which there is public involvement in the trials of products and services, and if successful, their adoption is encouraged by public organizations. Catalan Living Labs goes even further by leveraging partnerships in the living lab to penetrate highly regulated and complex environments, such as the public health sector.

Proposition 3. Living labs take advantage of public-private partnerships for generating an initial demand and often involve other actors such as small and medium-sized enterprises to lower barriers of entry in complex multi-stakeholder or highly regulated environments.

Table 5.3.1 summarizes how living labs are differentiated on the basis of three main characteristics (Almirall & Wareham, 2008): user involvement, real-life contexts, and public-private partnership.

	User Involvement	Real-Life Contexts	Public-Private Partnership
TestBed Botnia	• capture of user needs • co-design and participatory design • gathering domain and market-based knowledge	• locus for appreciation of opportunities • evaluation and validation of prototypes	• living lab is a public-private partnership • facilitates multi-stakeholder involvement in projects
iLab.o	• contextualization of prototypes for new products and services • selection of the "right users" is a key element	• focus on data gathering • attempts to capture insights from a large group of users	• living lab is a public-private partnership • facilitates multi-stakeholder involvement in projects
Helsinki Living Labs	• needs finding • co-design and participatory design	• use of geographical context for selecting users • public, open trials • validation of prototypes	• living lab is a public-private partnership • collaboration with town and local authorities facilitates trials and the uptake of new products and services
Catalan Living Labs	• selection of "relevant users" • fostering social entrepreneurs and lead users • gathering of domain and context-based knowledge	• specialized contexts: hospitals, opera theatres, etc. • large public trials together with small specialized ones • unexpected opportunities because of the real-life context	• living lab is a public-private partnership • creation of initial demand, especially in the public sector, ensuring sustainability • facilitates trials in public contexts, very relevant in highly regulated environments

Table 5.3.1 *Living Labs Characteristics*

5.4 MAPPING USER INVOLVEMENT IN INNOVATION

Understanding living labs methodologies requires recognizing their unique contributions and positioning these practices in the landscape of other user-contributed methodologies for innovation (Figure 5.4.1).

The first dimension of interest is taken from the main characteristic of living labs: the involvement of users in a co-creative process. We can observe a diversity of practices along that dimension. On one end of the spectrum, users are regarded as subjects of observation, such as in human factors, ergonomics, or applied ethnography. On the other extreme, users are co-creators, such

as in the case of lead users or open source communities. In the middle, we find the majority of methodologies, such as co-design, design thinking, and design-driven innovation.

The second dimension of interest speaks to a key aspect of living labs methodologies as well as other user-oriented innovation methodologies: whether the project is carried out in a lab-like environment or in the real-life settings in which users would typically conduct their activities.

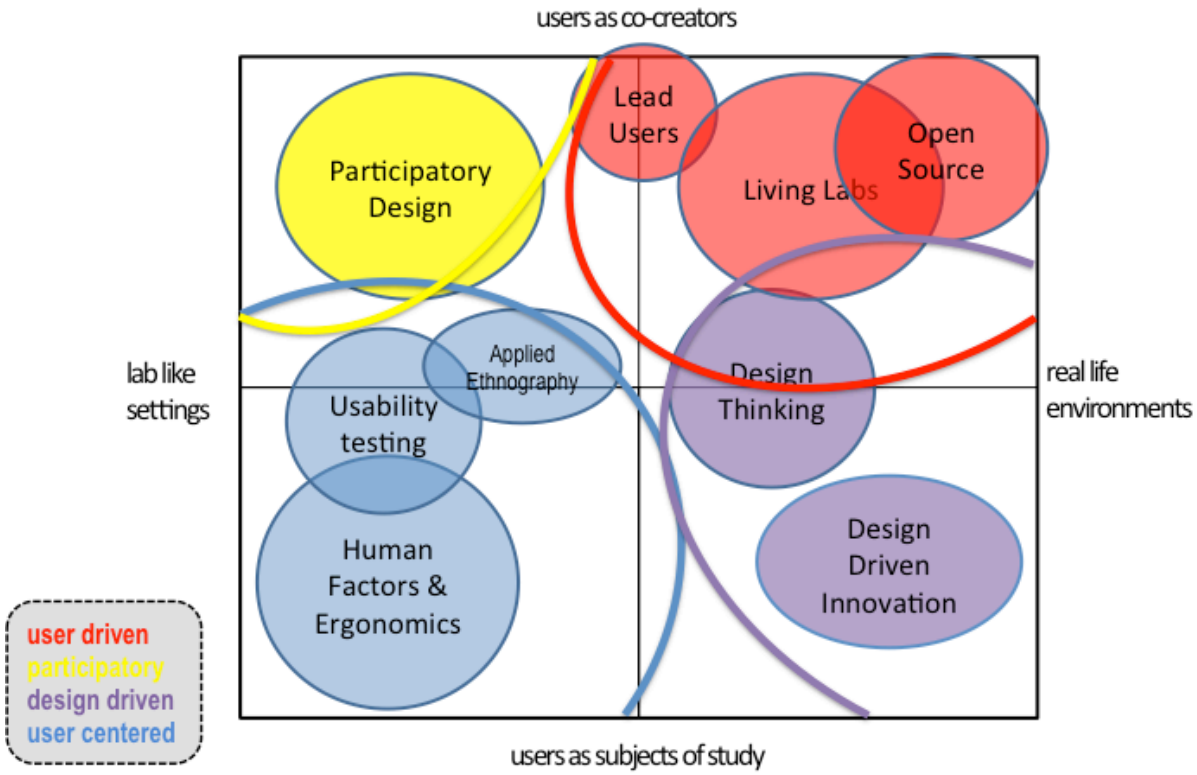

Figure 5.4.1 *Mapping user-innovation methodologies*

Following the first axis – the level of user involvement in the innovation process – we divided methodologies in four different categories:

1. **User centered**. Users are mostly passive subjects of study. This is the case of usability testing, human factors, and applied ethnography.

2. **Design driven.** Designers take the lead. Design-driven methodologies normally work in real-life environments; however, they are led by designers who seek to find novel solutions.

3. **Participatory.** Users are considered on equal ground with the rest of the partners in a co-creative process. Participatory design, particularly the Scandinavian tradition, and generative design research belong to this category.

4. **User driven.** Where the user is the one who drives the innovation process. Such is the case of open source, lead users and living labs.

The second dimension of interest refers to the locus of innovation. Traditionally, experiments have been carried out in laboratory-like settings that allow for more control and easier data gathering. However, more recent practices favor real-life environments in spite of the loss of control that they exhibit.

Determining the best context is largely based on the type of knowledge that living labs seek from users. On one hand, if the result of user participation is the capture of domain-based knowledge, then a closed group of selected users will work well. On the other hand, a real-life environment will be more beneficial if the aim is to capture market-based knowledge, forecasting the preferences of users towards a new solution that would benefit from multiple contributions and points of view.

5.5 CONCLUSIONS

The primary conclusion drawn from our investigation of living labs is that this methodology is a process of fit. That is, living labs will be an appropriate choice of innovation methodology where the fit of a particular technology or set of technologies to a precise context is more significant. Therefore, products and services that depend more on their soft characteristics for user acceptance and economic viability seem to be more appropriate.

The second conclusion is that living labs will be more relevant where the fit is unique to a given set of users. Indeed, if the fit is more trivial, it can possibly be inferred using other methodologies, perhaps from observing users without having to involve them. At any rate, in situations with multiple stakeholders, conflicting interests, and a large space of solutions, the innovation problem may only be adequately addressed by involving all constituencies and through their active participation. Living labs provide the solution by tapping into tacit knowledge to be incorporated into products and services, and validated in real-life environments.

6 IT-enabled Transparency in Policy Making: Designing and Enabling Effective Policies in Complex Decision Environments[4]

6.1 INTRODUCTION

The flourishing scholarly discourse on e-government, e-participation, and information policy points to the importance of 'openness' in policy making: Policy makers increasingly use IT to open the process of developing policies to the public (Ferro, Loukis, Charalabidis, & Osella, 2013; Larsson & Grönlund, 2014; Nam, 2012). In this paper we refer to public policies as "courses of actions, regulatory measures, laws, principles, funding priorities, guidelines and interventions promulgated by a government or its representatives for changing, maintaining or creating living conditions that are conductive to human welfare" (Shafir, 2013, p. 1). IT-enabled transparency is an essential dimension of openness in public policy, in short 'open public policy' (Bertot, Jaeger, & Grimes, 2010; Ferro et al., 2013). Transparency describes the condition of keeping *all* actors involved in public policy informed about any policy related decisions (Bertot et al., 2010; Meijer, 2013). In essence, transparency provides access to and awareness of information about the process of public policy making (Harrison & Sayogo, 2014).

Much of the existing literature on open public policy examines how transparency promotes greater *accountability* of policy making as it provides access for everybody about how and why policy makers design policies in a certain way (Harrison & Sayogo, 2014). Such 'inward' transparency - inward in the sense that it informs citizens about the policy design process inside governments - can also foster *civic participation* as it motivates others to engage in the dialogue with policy makers (Bélanger & Carter, 2008; Harrison & Sayogo, 2014; Irani, Love, & Jones, 2008; Larsson & Grönlund, 2014; Medaglia, 2012; Noveck, 2010; Sæbø, Rose, & Skiftenes Flak, 2008; Susha & Grönlund, 2012). But recently, scholars have begun to investigate how a more 'outward' focused transparency may lead to more *effective* policies; that is, to policies of greater ability to deliver

[4] A version of this chapter is currently under review in Research Policy. A previous version was presented at the 2015 Annual Meeting of the Academy of Management in Vancouver, British Columbia.

benefits for citizens as a whole, providing greater collective welfare (EC, 2015; Noveck, 2015). Such welfare can represent economic benefits as well as other measures related to a certain policy's goal, for example 'less CO2 emission'. Outward transparency provides access to information about how policies function outside government. It creates awareness of how policies shape citizens' choices and their welfare (Lansky, 2007; Lee & Kwak, 2012; Noveck, 2015; Scott & Copeland, 2016).

Digital technologies play a pivotal role for outward transparency because they provide access to data and information about how policies impact citizen decision. For example, Facebook posts, Twitter tweets, mobile device data, and sensor data of other smart devices trace citizens' opinions and behaviors, and can create insights into citizens' choices in response to a set of policy instruments (Eliasson & Jonsson, 2011; Ferro et al., 2013). They provide access to information about how policy instruments such as taxes, regulations, as well as recommendations, or information (such as product labeling), shape an individual's choice. They can also provide insight into the decision complexity, that is the interdependencies between policy instruments and other factors (such as the income level of a citizen) that underpin a certain choice of an individual citizen (Simon & Cilliers, 2005). In essence, having transparency about how citizens arrive at certain policy-related choices may enable policy makers to refine their policy instruments in a way that they untangle the complex interplay between different decision factors in order to facilitate an individual in aligning with the policy's goal.

However, having transparency about the complexity of individual choices fails to make visible that the choices and actions of different citizens are co-dependent upon each other. In fact, a new policy instrument might create benefits for one citizen, but might have negative implications for the other, or even the overall group of citizens. This dilemma describes a collective aspect of citizens' decision complexity and the challenges that policy makers face when trying to create benefits for citizens as a whole (Ferro et al., 2013; Glance & Huberman, 1994; Noveck, 2010, 2015). To tackle this conundrum of the role of transparency for effective policies, the central question of this article is: *How can transparency enable effective open public policy in complex decision environments?*

Scholars of Strategic Information Systems (SIS) have remained relatively silent on resolving the conundrum of transparency in open policy making and the coordination of collective choices and actions. This is surprising given the central role of digital technologies in affording transparency, and the call of SIS scholars for the consideration of the complex, dynamic nature of strategy and policy making (e.g. Merali, Papadopoulos, & Nadkarni, 2012). In this article, we turn to complexity theory in order to develop new theoretical grounds on the role of transparency in open public policy (Kauffman, 1993; McKelvey, 1999). In particular, we draw upon the influential ideas of Levinthal and Warglien (1999) using the concept of the fitness landscape as a theoretical lens to articulate a dynamically complex view of policy design. Following this view, effective policies accommodate

welfare for a collective group of citizens, thereby coordinating their actions in alignment with the policy goal. This entails designing their decision environment by offering appropriate decision choices, or in more abstract terms, by 'tuning' the fitness landscape that they search (Levinthal, 1997; Levinthal & Warglien, 1999). Policies are not directing individual behavior through alignment of incentives towards equilibrium. Instead, they provide the environments upon which collective patterns of the citizens self-organize in dynamic ways.

We use the NK(C) fitness landscape model, a co-evolutionary model of complex search and decision making, as a metaphor to develop a framework of dynamic policy design (Kauffman, 1993, 1995; Levinthal & Warglien, 1999; Merali et al., 2012; Vidgen & Wang, 2006). A central conceptual tool of this framework is a citizen fitness landscape model that articulates the complex properties of the decision environments of a group of citizens, or in more abstract terms, of the search across a 'landscape' that represents the various policy-related decision alternatives. Using our framework, we derive a multi-dimensional view of transparency. Three propositions articulate how different kinds of transparencies may lead to effective open public policy because they facilitate the coordination of the citizens in alignment with the policy goal. These propositions articulate the need to shift from an individualistic view of transparency towards a collective-oriented one. The latter creates awareness of the co-dependencies of actions and choices of different citizens. Case examples illustrate how different kinds of transparencies unfold in open public policy practice.

In the next section, we will establish a dynamic framework for effective public policy design. We then expand this framework and articulate the role of transparency for effective policy design. In this section we also develop our propositions. Following, we discuss the three major contributions of this article to the SIS literature and point to limitations to be addressed by future research. The final section concludes with the broader implications.

6.2 A DYNAMIC FRAMEWORK FOR EFFECTIVE PUBLIC POLICY DESIGN

Traditional approaches for policy making regularly take a deterministic view and assume that policy solutions can be developed with the help of mathematical models emphasizing *predictability* (Brewer & DeLeon, 1983; Ferro et al., 2013; Morcoel, 2005). The underlying assumption is that policies 'direct' behavior and overlook that the behaviors of those targeted by a policy can only be influenced and indirectly shaped (Brewer & DeLeon, 1983); citizens adapt and their decisions evolve in a very context-dependent way. Thus, we put forward a *dynamic* view towards public policy design (Benbya & McKelvey, 2006; Levinthal & Warglien, 1999; Merali et al., 2012; Woolthuis, Lankhuizen, & Gilsing, 2005). Policy design requires the consideration of the dynamic decision-making processes of

diverse citizens that are embedded in different local contexts. A goal of effective policy is the *coordination* of the decisions and actions of citizens with the policy objective by designing the context in which these actors search for a better individual welfare. The dynamic process is best described "as a co-evolutionary and emerging process" that requires adaptation (Benbya & McKelvey, 2006).

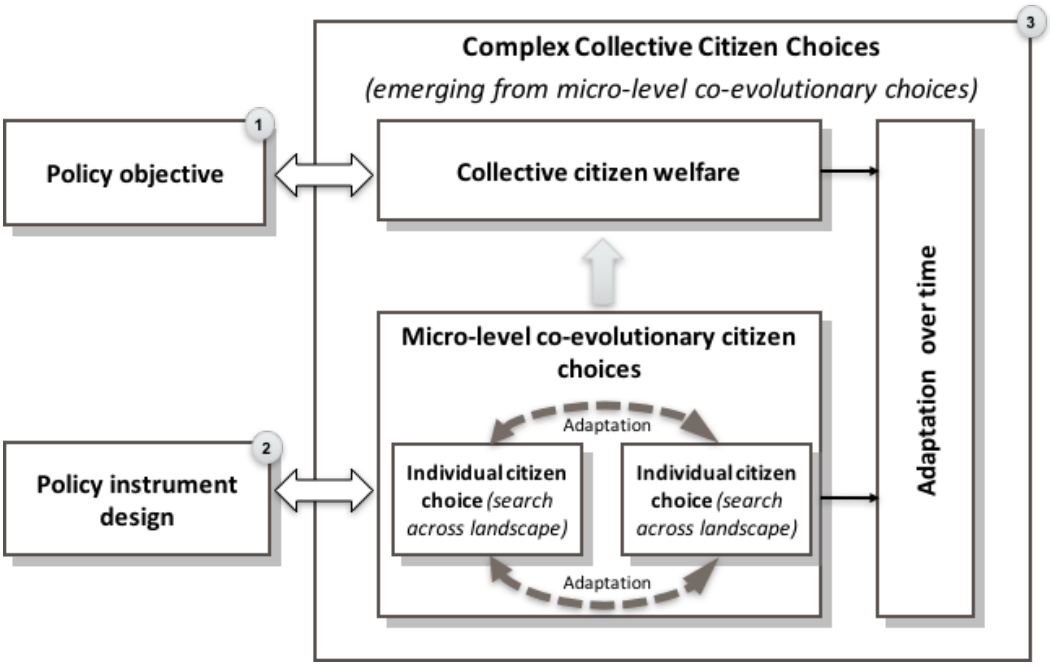

Figure 6.2.1 *Dynamic Framework for Effective Public Policy Design*

6.2.1 Policy Design for Greater Policy Effectiveness

Policy makers design policies to achieve defined policy objectives (box 1) which support citizens in reaching higher collective welfare related to that particular policy objective. We therefore define *policy effectiveness* as the success in coordinating citizen choices towards a higher collective payoff (or welfare). To realize a policy objective, policy makers introduce new policy instruments (box 2) that affect the behavior of the individual citizens (or a group of citizens). Examples of policy instruments are regulations (often referred as 'hard' instruments), the design of directives or recommendations that might trigger the creation of new social norms and practices, the support of technical standards (through national and international standardization committees), and the design and dissemination of information such as product labeling (EC, 2015; Jacobsson & Lauber, 2006; Jaffe & Stavins, 1995; Lewis & Wiser, 2007; Majchrzak & Markus, 2014). When designing these

instruments, policy makers have to consider a variety of other parameters, such as the scope (e.g. are we trying to target all citizens with this instrument), and also the particular citizen behavior (e.g. are we only focusing on people owning a house or all tenants including renters, when creating incentives for waste reduction). Often policy instruments are tied to legal and geographic boundaries (e.g. a region, a city or a state).

Policy instruments are designed to shape, rather than direct, the adaptive search processes and responses of individuals in a way that they aggregate towards optimal collective welfare (box 3). Following the influential work of Simon (1955) and successive work that builds upon it, we assume that the individual behavior of the citizens is adaptive (Levinthal & Warglien, 1999; March & Simon, 1958; Simon, 1955). Citizens (explicitly or implicitly) search for a higher welfare, in economic and social terms. The outcome of these individual decisions aggregates into the overall collective welfare, emerging 'bottom-up' to form the aggregate whole (Sawyer, 2005).

However, though the outcomes of individual actions are often co-dependent, citizens do not usually make a particular choice by considering the welfare of other citizens, or even the overall group to which they belong. Indeed, in some cases, the behavior of one group of citizens has unexpected effects on the welfare achievable for others. Such cases are of particular concern for policy makers (Glance & Huberman, 1994; Levinthal & Warglien, 1999; Ostrom, 1990). It is very difficult to align a policy objective with the collective welfare of a target population of actors who are not 'collectively' aware and act not as a cooperative group, but individually. Because of such co-dependencies, the adaptive behavior of citizens is best described as co-evolutionary, as one group of citizens reciprocally influences the adaptation of the other group of citizen (see box 3). Overall, the process of policy design needs to account for the fact that citizens behave dynamically, and their actions and decisions *co-evolve* over time.

Thus, referring back the figure 6.2.1, policy design can be best described as the design of the conditions that create the path of the citizens that search and co-evolve. To articulate the nature and properties of complex co-evolutionary citizen behavior to be shaped by policy design, we draw upon the theory of complex adaptive systems (Anderson, 1999; Gell-Mann, 1994; Haken, 1977; Holland & Miller, 1991; Kauffman, 1993; Prigogine & Stengers, 1984), and in particular, the idea of adaptation upon fitness landscapes proposed by Stuart Kauffman (1993) in his NK model. The idea of a fitness landscape was born in biology to map the structure of a genetic organism onto its fitness level (Wright, 1932). We will next explore the idea of a citizen fitness landscape to explicate how dynamic decision processes lead to a certain collective outcome over time (see box 3).

6.3 A CITIZEN FITNESS LANDSCAPE MODEL OF SEARCH ACROSS DECISION SPACES

In recent years, the NK model, originally focused on the role of interdependencies in the fitness landscapes of genetic organisms and their evolution, has gained popularity in management research. It has become the canonical approach to model adaptive search processes, such as those pursued by citizens when searching for greater individual welfare (Levinthal & Warglien, 1999; McKelvey, 1999). Recently, it also gained interest among IS scholars (Benbya & McKelvey, 2006; Curşeu, 2006). Management scholars use the NK model in two ways: as a computational model that represents complex adaptive search in executable code to simulate complex adaptive behavior (Almirall & Casadesus-Masanell, 2010); and as a theoretical tool used to explicate dynamic behaviors by drawing upon the foundational mechanism of the NK model. Scholars have used the second approach in the context of virtual teams (Curşeu, 2006), strategic IT alignment (Benbya & McKelvey, 2006), collective action (Levinthal, 1997), and crowdsourcing (Afuah & Tucci, 2012). We follow the latter approach, and use the NK(C) model, a particular form of the basic NK model, as theoretical tool.

There are three parameters that characterize the NK(C) model: N, K, and C. These parameters are important to computationally represent the co-evolutionary adaption of citizens. N describes the number of decision variables from which an agent can choose. K describes interrelation in the fitness function. C captures the co-dependencies across different individuals, activities, and their 'payoff' (in our case, welfare) (Kauffman, 1993; Levinthal & Warglien, 1999; Vidgen & Wang, 2006). We will refer back to these three parameters throughout the discussion. However, since we are not parameterizing a computational algorithm, we will not parameterize the NK(C) model in detail in this paper but only use it to explicate the theoretical mechanisms.

In accordance with the NK(C) logic, a *citizen fitness landscape* represents all potential decisions that a citizen can make related to the specific policy area on which a policy instrument is focused (Frenken, 2006; Kauffman & Levin, 1987). NK(C) treats individual adaptation as search processes of individual citizens across their individual citizen fitness landscapes. The citizen fitness landscape spans a large number of decision possibilities from which the citizens can choose. In essence, the landscape represents the 'decision space'. Since we are concerned with policy design, we focus on those decision options that are influenced by the policy makers through the design of the policy instruments. For example, as a citizen commutes to work, he can choose to use public transportation (city funded), bike (city mandated bike lanes), or drive (incentives for fuel-efficient vehicles); he can use highways (government funded) and use the carpool lane (city sponsored) or drive through residential roads and follow the speed limit (regulations) or speed (fines for speeding).

These decision alternatives illustrate the prevalence of policy instruments in the decision space of the citizens.

In the NK(C) model, there are N decision parameters. A particular decision represents a combination of these different decision parameters. These different decision options (or combinations) are mapped out in the N-dimensional decision space. If we simplify the illustration of a fitness landscape and assume the N decision parameters are binary, there are 2^N decision choices available to citizens (Billinger, Stieglitz, & Schumacher, 2013; McKelvey, 1999). This implies that if there are 10 decision parameters, the citizen fitness landscape spans 1024 combinations. For 15 parameters, the size is 32768 choices. This illustrates the wide range of potential decision options available to the citizens, or the 'space' that they could potentially search if they know about all the different combinations.

The citizen fitness landscape has an N+1 dimension, the fitness of each combination. From a citizen's perspective, the fitness of a particular decision in the citizen fitness landscape is best described as the *individual* welfare associated with a particular choice. Visually speaking, the fitness dimension is best described as the height of the 'peak' in the citizen fitness landscape. The higher the peak, the higher the potential individual citizen welfare associated a particular decision.

The citizens search the citizen fitness landscape in order to achieve a higher individual payoff. Following the logic of the NK(C) model, they have a large space of options available. However, the broader work on adaptive search and dynamic decision-making (Levinthal & Warglien, 1999; Rivkin, 2000; Rivkin & Siggelkow, 2007) argues that individuals search locally and are often not aware of the large variety of alternative choices. Such local search, often referred to as hill-climbing, assumes that citizens are focused on the immediate, neighboring solution (Holland & Miller, 1991; Kauffman, 1993). For example, when engaging in a local search, an agent changes his position from (0,0,1,0) to (0,0,1,1). He changes only one decision variable. In information theory, such a move is only one hamming distance away. This local search is an abstract representation of the decision moves that draw upon local knowledge. They are path-dependent. For example, in the area of healthcare or energy consumption, citizens usually base their decisions on past behavior and established routines. They rarely move away quickly from what is familiar. When moving locally, the agents can often assess the fitness associated with a decision alternative that is just one hamming distance away because they have so-called 'local' visibility: they can assess the height of a peak that is only one decision change away. This analysis follows the concept of local intelligent search (Cyert & March, 1992; Levinthal & Warglien, 1999; March & Simon, 1958).

With this logic of an individual citizen fitness landscape, we now turn to the question of how a collective group of citizens emerge towards a certain fitness value - collective welfare level - over time. Indeed, this is the central question of policy design: how to leverage policy instruments to

coordinate a large multitude of locally embedded actors so that they self-organize and emerge in a desired way towards higher welfare level. Following the logic of the NK(C) model, this depends on the co-evolutionary complexity in the NK(C) fitness landscape that causes dynamic action and emergence. We will next articulate these sources of complexity that cause potential policy inefficiencies. They prevent the collective alignment of citizen choices with the overall policy objective.

6.4 Dimensions of Co-Evolutionary Complexity of Citizen Choices

A co-evolutionary view towards policy design reveals three essential properties of the complexity of the citizens' decision making. These properties are potential sources for ineffective policies because they prevent the citizens from evolving towards a higher collective welfare when searching their citizen fitness landscapes (Gell-Mann, 1994; Levinthal & Warglien, 1999; Nan, 2011). The three properties of decision complexity relate to (1) the typology of the citizen fitness landscape (2) the rules and heuristics that guide the search across the landscape, and (3) the interactions between the citizens.

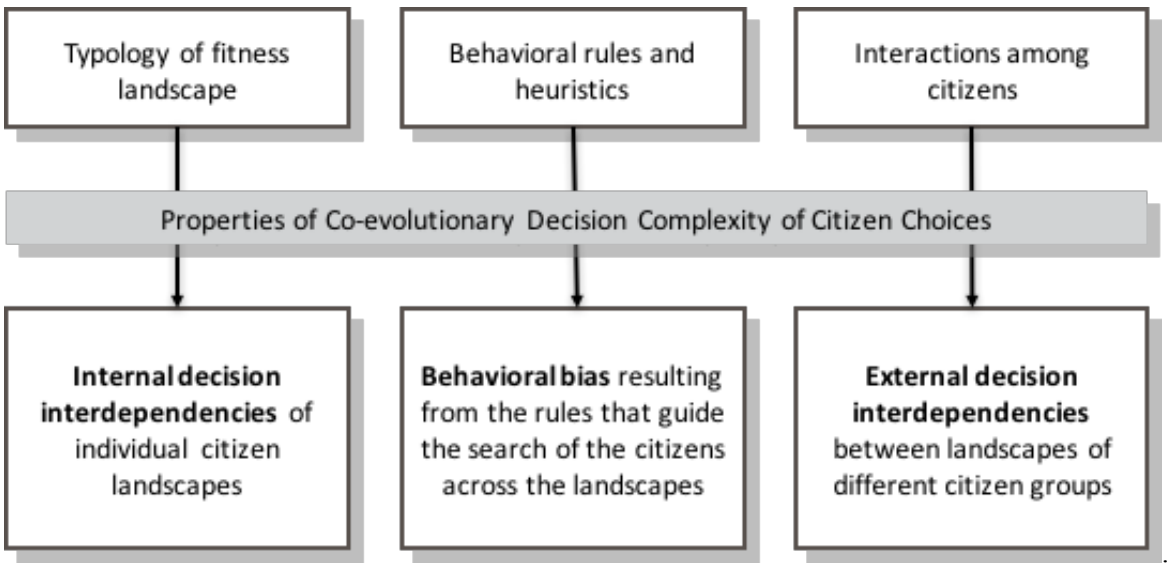

Figure 6.4.1 *Properties of Co-evolutionary Decision Complexity*

6.4.1 (Internal) Decision Interdependencies

An individual's ability to find a decision choice with a greater fitness value is affected by the typology of the fitness landscape in which they are embedded. Citizens search their fitness

landscapes, representing all potential decision options, using their local knowledge to find maximum payoff (also referred to as hill climbing). A fitness landscape that represents a high decision interdependency implies that a change in one decision variable not only has an immediate effect on the 'fitness' of that particular choice, but that a change also affects how other decision parameters individually effect the payoff. In that sense, high interdependency implies a *non-linear relationship* between a change in one parameter (the move by only one hamming distance), and the change in the fitness value associated with the peak that is only on hamming distance away. For example, the decision to move from the city center to a suburb has immediate implications on whether a citizen can realize his goal of flexible, affordable, and safe transportation. However, it also changes the effect of other variables, such as gas price, tax incentives for using public transportation, and so forth, on the welfare of the citizen. In essence, a change in one variable does not lead to a linear increase or decrease of the citizen's welfare (Kauffman 1993). In the NK(C) model, the parameter K defines the interdependencies of the decisions in the citizen fitness landscape (k=1,0,…, K): The higher K, the greater the non-linear implications of the change in the pay-off structure when moving only linearly (that is, only one hamming distance).

Such non-linear changes in the height of the 'peaks' of neighboring solutions are reflected in the shape of the landscape that the citizens search. A fitness landscape with high internal interdependencies is rugged. A rugged landscape has a more pronounced profile because there are large differences in the heights of two neighboring peaks. In order to illustrate the N-dimensional landscape and ruggedness, we have collapsed N dimensions into three dimensions (see Annex for the details on the visualization approach). Figure presents two landscapes. The left landscape presents a landscape with low ruggedness (K=0). There are 6 decision parameters p (p_1,…p_6), and they are not dependent upon each other.

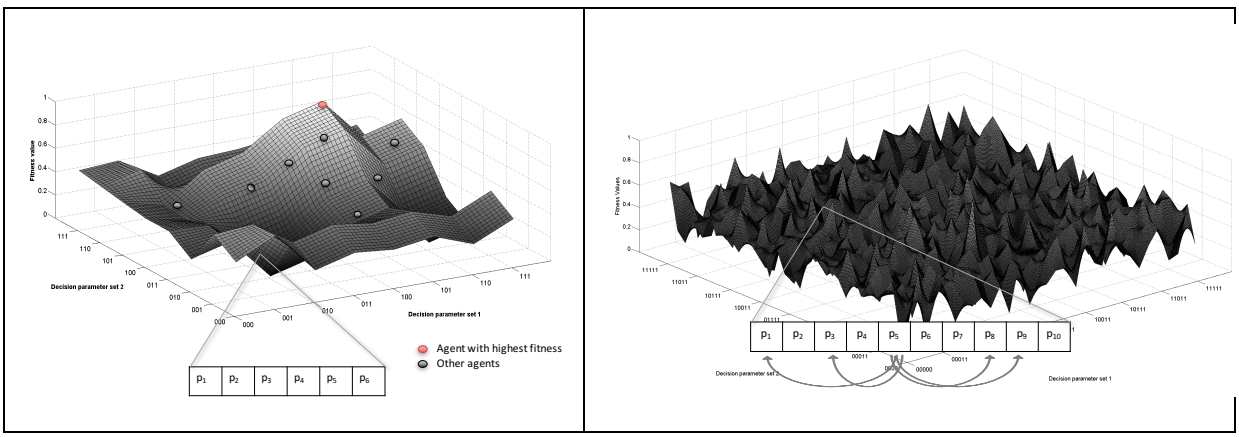

Figure 6.4.2 *A Fitness Landscape with Low Complexity (K=0) and Medium Complexity (K=9)*

The right landscape shows a medium level of decision interdependency (K=9). It is defined by 10 decision parameters p (p_1,…p_{10}) and they are highly dependent upon each other. When comparing the two landscapes, we can observe the differences in the ruggedness of the landscape that the agents search. The left one has only one peak; on the contrary, the right one has multiple peaks and deep valleys adjacent.

To describe the implications of decision interdependencies on the search processes of citizens, let's imagine that a citizen searches across his landscape using local search moves. He can only assess the immediate, neighboring decision alternatives (those that are only one hamming distance away). If the landscape is rather smooth (like the left on in Figure 6.4.2) the probability that the agent reaches the global maximum using local search is relatively high, as each move should get him closer to the global maximum. Along the way he will also realize gradual improvement in welfare as he approaches the peak. However, if the landscape is very rugged (such as the right one in Figure 6.4.2), the citizen gets easily trapped in a local maximum. A local search move does not provide any benefits, and thus he decides to settle on a local maximum. His individual welfare is rather low. As he and others remain settled in local maximums, the implications for the collective welfare are immediately understandable.

Internal decision interdependencies only account for dynamic complexity of the search across an individual landscape. They do not account for the sources of complexity that result from co-dependencies among the different citizens and their decisions. We will address such co-dependencies later.

6.4.2 Decision bias

Following the NK(C) logic, the second source of ineffective search stems from the rules that guide the citizens' choices when searching the landscape for an optimal decision alternative (Kauffman, 1993, Gell-Mann, 1995, Anderson, 1999, Nan, 2011). Behavioral rules can be perceived as a set of input/output statements that guide how the individual agents search the landscapes (Gell-Mann, 1995). Human agents, like our citizens that search their individual fitness landscapes, have limited processing capacity, which makes it impossible for them to process all input information related to a particular decision (Foss & Weber, 2016; March, 1991; Simon et al., 1987). Because of this, humans try to economize their search processes buy using heuristics. Heuristics are behavioral rules of individuals that use 'shortcuts' in order to make decisions without processing all relevant input information (Gigerenzer & Todd, 1999). The use of heuristics regularly leads to cognitive biases (Foss & Weber, 2016; Kahneman & Tversky, 1979; Shafir, 2013; Tversky & Kahneman, 1986). Such biases cause systematic errors and unconscious misinterpretation of the input information. There are numerous types of cognitive biases that cause distorted decisions. For example, humans make errors

when attributing attitudes to a person (Jones & Harris, 1967), and they are biased to conform with established assumptions and hypotheses (Wason, 1960).

The existence of cognitive biases may render the search of the agents across their landscape in a negative way. As citizens are cognitively biased, they may not find a higher fitness in the landscape, even though they could find it in their immediate neighborhood through local search. When moving locally and assessing the fitness of the neighboring solutions, they do not perceive the actual value of a peak. Their view is distorted and they perceive values that are lower (or higher) than the real values. In essence, cognitive bias creates 'perceived' or 'fictional' individual landscapes that guide the search of the agent. If there are fictional landscapes because of cognitive bias, citizens may adopt a certain choice that they assume to have a higher fitness value. However, they actually land on a lower fitness value than they had anticipated. Only after a certain time will they learn about the real value and start searching again. In essence, decision biases render the search processes of the citizens inefficient. Citizens may misinterpret the quality of a particular decision alternative for their own welfare. For example, policy makers may design a particular policy for e-health using tax incentives to foster the adoption of telemedicine as a central policy instrument. However, the citizens' biases may cause individuals to underestimate the healthcare quality delivered using telemedicine (Ferro et al., 2013). Because of this, tax incentives have little effect and the citizens do not move to a higher peak. They perceive a valley because of assumed negative effects of telemedicine, where there is actually a smooth landscape and peak nearby, representing the positive gains the instrument could actually provide. In sum, decision bias may render local search inefficient, even on smooth landscapes, as depicted in Figure 6.4.2. Decision bias shapes the dynamic adaptive search process of the agents in a way that might cause ineffective policies because the citizens are guided by the wrong 'fictional' landscape.

6.4.3 External Decision Interdependencies

A third source of ineffective policy design results from the co-dependency between the actors and their decision space, their landscapes. Following the logic of NK(C), citizens might be exposed to situations where their own payoff changes because of the search activities of other citizens to which they are connected (Levinthal & Warglien, 1999; McKelvey, 1999). In the abstract logic, the landscapes of the citizens are co-dependent; the shape of an individual citizen fitness landscape changes because of the moves of another citizen. They are not fixed, but dynamic.

In the NK(C), co-dependency relates to the C parameter. C specifies the number of decision variables that are interdependent, and in policy design, C is normally larger than zero. For example, if C=2, one decision variable in the landscape of a citizen co-evolves with two decision variables of another citizen. This co-dependency aspect of complexity is evident in transportation planning. As

cities grow and traffic increases, cities realize the need for new infrastructure. A citizen burdened by traffic during his daily commute might anticipate the opening of a newly widened interstate and the free flow of traffic it will allow. However, historical patterns have demonstrated that new thoroughfares do not improve congestion as anticipated (Duranton & Turner, 2011). The singular agent is not acting alone in capitalizing on a newly widened route, but must realize that others are choosing the same alternative. These shifts change the landscape, illustrating the co-dependencies between citizens acting within the same context and the overall group of citizens living in the neighborhood.

Such co-dependencies between the individuals and the overall group regularly occur in so-called 'social dilemmas', which are of particular importance in policy design (Glance & Huberman, 1994; Levinthal & Warglien, 1999). Central concerns such as the protection of our environment, the reduction of CO2 production or the reduction of population growth are in essence social dilemmas (Glance & Huberman, 1994; Levinthal & Warglien, 1999). They require individuals to align with the overall collective group goal because their individual choices shape the pay-off of the group as a collective, and vice-versa. This often implies that everybody has to give up some immediate individual benefits in order to ensure that the group is better off overall. For example, when it comes to the issue of resource conservation, citizens are required to invest additional resources to protect public goods such as water and air (Olson, 2009; Ostrom, 1990). In this case, the individual and the collective as a whole (e.g. a neighborhood) search mutually dependent landscapes. The individual landscapes dynamically change as the whole group moves to a different peak on the landscape. External interdependencies as a third source of co-evolutionary complexity might cause policies to be ineffective. They can lead to unexpected negative collective welfare development when citizens or policy makers are unaware of the mutual dependencies between the decisions of the citizens.

In light of the three sources of co-evolutionary complexity in open public policy, we next turn to the role of outward transparency in open public policy.

6.5 TRANSPARENCY FOR EFFECTIVE OPEN PUBLIC POLICY

Through the lens of our dynamic framework of policy design that aims to shape, rather than direct, collective citizen welfare, we next address the role of transparency for effective open policy design. Such transparency is afforded through digital technologies. We first integrate transparency in our dynamic framework and articulate its role. Afterwards, we derive a tripartite view of decision transparency to articulate which *kinds of transparencies* are needed to foster effective open public policy. We articulate the mechanisms behind these different kinds of transparencies that support citizens in co-evolving in a way that they increase the overall collective welfare in alignment with the

policy objective. To do so, we refer back to our citizen fitness landscape model established earlier and summarize the mechanisms of each type of transparency in a set of propositions. Case studies illustrate how these three transparencies are empirically realized and how certain mechanisms unfold.

6.5.1 Transparency in a Dynamic View of Open Public Policy

Our view of policy design established in the prior section highlights the dynamic and co-evolutionary nature of open public policy. For transparency to facilitate policy effectiveness, digital technologies need to afford those kinds of transparencies that address the sources of co-evolutionary complexity. In essence, digital technologies should provide access to actionable data and information about the shape of the citizen fitness landscape and the processes of how citizens adapt and search their landscapes. Table 6.5.1 provides an overview of open public policy case studies in which transparency is afforded through digital technologies. They relate to various policy areas such as transportation, healthcare, economic development, and energy. Inspired by Noveck (2015) we refer to these digital technologies as smart policy technologies. The most widely leveraged smart policy technology is *social media* (Chun & Luna Reyes, 2012; Ferro et al., 2013; Kavanaugh et al., 2012; Lee & Kwak, 2012; Linders, 2012). However, as more and more objects become embedded with sensors, transparency is increasingly afforded through *Internet of Things* (IoT) technologies including embedded systems, smart phones, wearable devices, and other smart gadgets, which complement social media technologies in affording transparency. Further, *analytics technologies* are used to extract meaning from an increasingly large volume of behavioral or textual data. The cases presented in Table 6.5.1 provide insight into the nature of transparency that these technologies can yield for both citizens and policy makers.

Example of Transparency in Open Public Policy Project	Technologies Used
Transportation	
Stockholm Congestion Tax: Stockholm relied on smart devices and data mining to understand the behavioral implications of a traffic congestion tax (Börjesson, Eliasson, Hugosson, & Brundell-Freij, 2012)	IoT, Data Analytics: Digital charging points, automatic cameras, emission detectors, data mining
Newcastle City, UK Smart Traffic Technologies: Digital devices and analytics monitor and report traffic and congestion throughout city for improved transportation options (Scott & Copeland, 2016)	IoT, Data Analytics: Digital sensors, data analytics
Los Angeles's High Injury Network: Smart devices and analytics allow drivers and pedestrians to navigate more safely in the city (Goldsmith, 2016)	IoT, Data Analytics: Smart devices, big data analytics
Economic Development	
YouCut Citizens Review: Citizens review and vote on weekly spending cuts in the US House of Representatives (Longo, 2011)	Social Media: Online crowdsourcing platform
ChileCompra: E-procurement system allows policy makers and citizens to compare the costs of bids and services purchased by the government (Shim & Eom, 2008)	Social Media: Digital platform for data analytics and reporting
President's SAVE Award: Federal employees from across the US government submit ideas for efficiencies and savings as part of the annual Budget process and vote on submitted ideas. (Warner, 2011)	Social Media: Online crowdsourcing platform
Healthcare	
Italian Telemedicine Pilot Remote Italian province used statistical analysis of communicative data across social media to learn about opinions and policy reactions (Ferro et al., 2013)	Social Media, Data Analytics: Social media platforms (Facebook, Twitter, blogs); statistical data (text & behavior) analysis
Chicago's Predictive Approach Combats Rodents Better reporting data and analytics target and prevent rodent problems (Thorton, 2013)	IoT, Data Analytics: Sensors, geospatial reporting, predictive analytics
Linked Social Information Quantitative analysis of social media communication within online communities (eating disorder and gender identity groups) provides insights into complex issues rarely shared in traditional settings (Kaschesky & Riedl, 2011)	Social Media: Cross- social media platforms; semantic text analysis
Energy	
Kansas City Smart Grid Integrated water, electricity, gas smart grid allows city to monitor usage, develop customized plans, and validate policy implementation (Optimization, 2015)	IoT, Data Analytics: Smart energy grid; real-time analytics
Deepwater Horizon Oil Spill Topic and opinion detection of the top 10% of blogs, government and political news are used to analyze positive or negative reactions to inform clean energy legislation (Sobkowicz, Kaschesky, & Bouchard, 2012)	Social Media: Cross-social media platform approach; semantic text analysis

Table 6.5.1 *Use of Smart Policy Technologies for Open Public Policy By Policy Area*

In light of the importance of transparency in open public policy practice, we next integrate transparency in our dynamic view of policy design to articulate how transparency may lead to more effective policies.

Figure 6.5.1 extends our earlier framework to illustrate how transparency can shape the co-evolutionary processes in a favorable way. Transparency needs to support two major mechanisms in order to shape the co-evolutionary search processes of the citizens in a favorable way. First, it should make policy makers aware of 'actionable' information that facilitates them in *'tuning'* the citizen fitness landscape - using the language of Levinthal and Warglien (1999) - by refining their existing policy instruments (or introducing new ones). By doing so, they modify the existing landscape (or as we will discuss later, create fictional ones) in a way that the citizens evolve towards a desirable outcome. In policy design, desirable means that the citizens collectively achieve a higher welfare. To make such tuning actions, policy makers need to be informed about the shape of the citizen fitness landscape and also the way the citizens search it. The actual height of a particular peak is of little value; instead, transparency needs to create awareness of meta-information such as the overall typology (e.g. the degree of ruggedness).

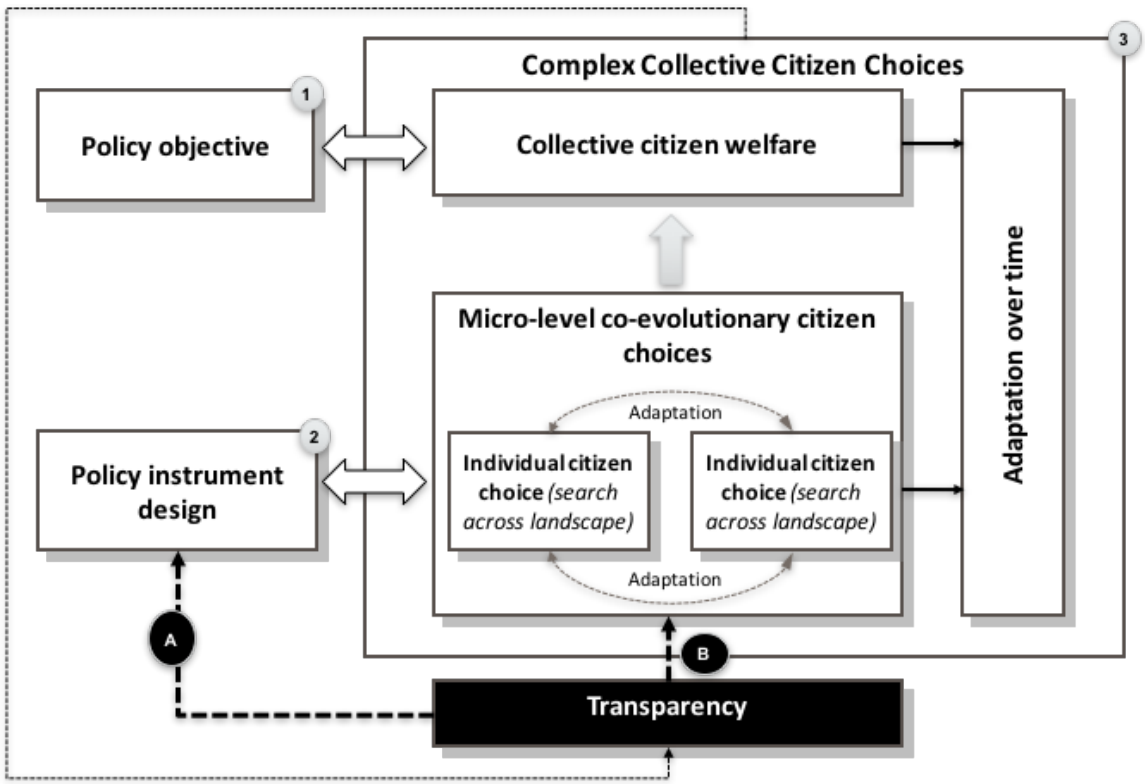

Figure 6.5.1 *Transparency in Open Public Policy*

Second, transparency should allow citizens to better *'self-organize'* in a favorable way (see label B in figure 6.5.1). Transparency of the citizen fitness landscapes should support citizens in self-organizing through learning from others, often through observations rather than through actual reinforcement, and re-use of others' experiences (Argote, 2011; Bandura, 1965; Levinthal & Warglien, 1999). For this to happen, the citizens need to have transparency about each other's citizen fitness landscapes and also their co-dependencies.

We next articulate in more detail the kinds of transparencies needed to address each of the three properties of co-evolutionary decision complexity.

6.5.2 Three Types of Transparencies for Effective Open Public Policy

In prior sections, we articulated three dimensions of a co-evolutionary of decision complexity: *Internal decision interdependencies*, *decision bias*, and *external decision interdependencies*. Transparency needs to provide access to information about each of these dimensions of decision complexity. Figure 6.5.2 provides an overview of the three properties of decision complexity and the corresponding types of transparencies. Each transparency supports mechanisms of informed policy design and collective learning of citizens.

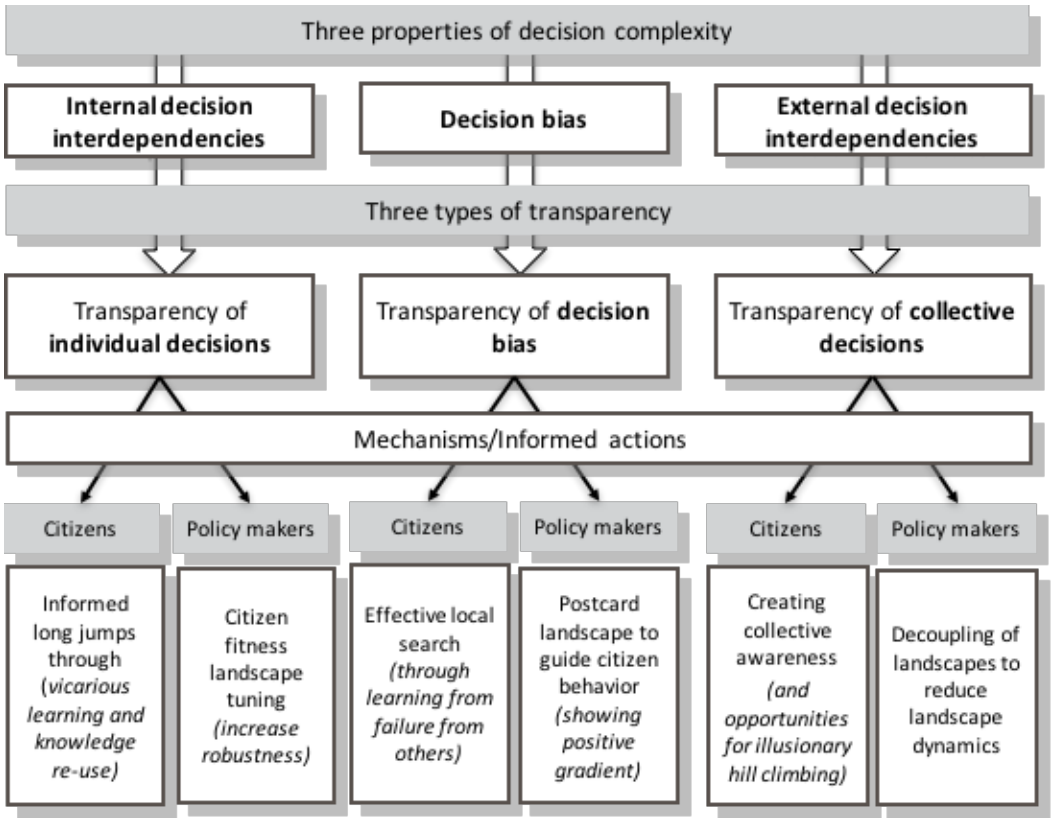

Figure 6.5.2 *Three Kinds of Transparency and Their Mechanisms*

We will discuss each type of transparency. We first theoretically articulate how each kind of transparency may trigger the mechanism that ensures that effective policies emerge. We then use a case example to illustrate our theoretically developed type of transparency in open public policy practice.

Individual decision transparency

Drawing upon our citizen fitness landscape model and the first dimension of decision complexity, decision transparency should provide information about the decision interdependencies *within* an individual citizen fitness landscape. In essence, this transparency should reveal the scope and the ruggedness of one individual landscape. As discussed earlier, a highly rugged landscape might render the search of the citizens inefficient since they typically search locally and they will get trapped into local maxima if the landscape is rugged. However, transparency about the interdependencies can support a positive adaption of the citizens towards a higher welfare in two ways.

First, this kind of transparency provides policy makers with the opportunity to 'tune' the landscape and change the policy instrument so that a highly rugged landscape can become smoother by tuning down the interdependencies of the decisions for the citizens. In essence, the goal of policy makers should be to decouple the various policy instruments and simplify the choices of each individual citizen. For example, if an individual decides to change from traditional healthcare to e-health, other parameters such as the choice of her insurance provider or the choice of her doctor should not be tied to that decision.

Second, it should also allow the citizens to better search for greater fitness. Visually speaking, individual decision transparency should allow citizens to learn about other decision alternatives, including those that are further away, and to combine local search with more distant search (Levinthal, 1997; Levinthal & Warglien, 1999). Distant search, often also referred to as long jumps, implies that the citizens change more than just one decision parameter when moving across the landscape (Levinthal, 1997). They take risks and explore more distant moves. Due to the local nature of citizens' search, they are usually not informed about the potential welfare implications of such a move. However, transparency about the decision structures of others might give them the opportunity to engage in vicarious learning (Bandura, 1965; Leonardi, 2014). In that sense, they can re-use others experiences and engage in more informed long jumps. The aggregation of information into meta-knowledge is essential to provide citizens the opportunity to engage in such informed long jumps. These informed long jumps can make use of correlated structures of the landscape to translate knowledge from similar contexts.

For allowing this, the decision interdependencies and the pay-off implications of a decision change should be made available in a timely and also aggregated way (Kavanaugh et al., 2012). Indeed, affording transparency about interdependencies is not trivial because of the need of insights into the scope of decision alternatives and potential losses and gains when moving from one alternative to another. Further, it requires access to information about the search behavior of a diverse and large group of citizens who start off their search on different positions across the landscape. Access to information about decision alternatives and their associated benefits is crucial to create deep insight into the decision structures of the citizen. However, if such transparency is designed in way that it makes policy makers and citizens aware about important properties of individual landscapes, both mechanisms may trigger the citizens to evolve in a way that they achieve higher collective welfare. In sum, we derive the following two propositions.

Proposition 1a: If individual decision transparency enables policy makers to reduce the complexity of individual decisions (fitness landscape tuning), citizens may self-organize towards a higher collective welfare

Proposition 1b: If individual decision transparency enables citizens to vicariously learn from others and to make informed long jumps, they might evolve towards a higher collective welfare

Case example to illustrate the importance of individual decision transparency:

In 2008, policy makers piloted a telemedicine project in the remote Verbano–Cusio–Ossola province in Italy. Using a cross-platform approach including Facebook, Twitter, YouTube, Flickr, and LinkedIn, the pilot provided *individual decision transparency* and allowed policy makers to learn about responses to this new policy solution aiming to increase efficiency of healthcare services provision (Ferro et al., 2013). Policy makers were able to discover the opinions and policy reactions of citizens through the statistical analysis of data across various social media platforms. Whether through posts, comments, votes, and other user-generated comment, the individual decision structures became accessible. Citizens shared the parameters that shaped their decisions (e.g. price, ease of access, technical aptitude) and what options they chose or would choose given the new decision opportunities created through the healthcare policy, and the expected (or realized) welfare (e.g. cost savings). Further analysis of the data provided the policy makers with deeper insights into meta-information such as dependencies and correlations between different parameters and decision options. Based on this information the policy makers could tune their policy instruments (mostly non regulatory ones). Citizens, too, could learn about alternative choices and potential greater individual

benefits through reading user-generated content to make more informed decisions themselves. At the pilot's end, the policy idea was received very positively by 94% of the target population. Without the use of the social media and behavioral analytics instruments, the shape of the individual fitness landscapes would have remained obscure.

Decision Bias Transparency

Decision bias transparency describes the condition under which information about behavioral bias of the citizens in response to a policy instrument is made transparent. Referring back to our citizen fitness landscape model, it reveals information about 'perceived' or 'fictional' landscapes that guide behavior of the citizens. Such biases prevent citizens from seeing the real payoffs and the actual fitness landscape that they search. Because of this, they cannot recognize the real peak in their neighborhood, even using local search. As a result, they settle at a relatively lower peak. Affording decision bias transparency is not trivial and requires access to fine-grained behavioral information about actual citizen responses as well as perceptual information, such as opinions, beliefs, etc. In essence, access to behavioral information should provide insight into the breadth of the perceived decision alternatives of the citizens and the perceived payoff. Most importantly, it should afford insights into the deviation of the perceived from the actual realized payoff of the citizens.

Decision bias transparency can address this second dimension of a co-evolutionary view of complexity and allow both policy makers and citizens to trigger positive adaption towards higher welfare:

First, policy makers can use the transparency to create what Levinthal and Warglien (1999) call postcard maps that guide the citizen behavior by articulating the gradient of increase in the pay-off. Such a postcard map, if communicated successfully, can mobilize actions and prompt citizens to dismiss their existing fictional map and follow the guidance of the policy makers. Developing a postcard map for a distorted landscape is not straightforward. However, if the fictional map of the citizens is rather flat because they don't value a new design alternative higher than their existing solutions, the postcard map can help the citizens to wander around with a clear goal in mind. Therefore, the map of the policy makers allows for turning a rather flat landscape into a more differentiated one, and can trigger the citizens to move towards a higher peak.

Second, if shared with citizens, decision bias transparency can also trigger self-organized learning. Being exposed to the deviation of the actual and perceived pay-off structure can trigger citizens to engage in behavioral change and learn from failure (Argote, 2011; Baum & Dahlin, 2007). Citizens may not experience the failures themselves but observe and learn from others that they were not realizing the payoff they could potentially achieve. Such learning from 'observed' failures is

essential in the individual adaptive process, in which individuals are misguided by their perceived landscapes.

In sum, this leads us to the following two propositions:

Proposition 2a: If decision bias transparency allows policy makers to create new 'postcard maps' that re-oriented biased citizens, these 'postcard' maps may coordinate the citizens towards a higher collective welfare.

Proposition 2b: If decision bias transparency allows citizens to learn from their own or others' failure and (re-)adjust their individual, perceived landscape, the citizens may adapt towards a higher collective welfare.

Case example to illustrate the role of decision bias transparency:

Struggling with a clogged inner city, in 2006, Stockholm floated the idea of a congestion tax on traffic moving through the crowded district. The proposal incited a heated debate and was extremely unpopular from the outset. However, the city proceeded with a seven-month pilot to try to sway opinion and create a new postcard map for the citizens. Policy makers leveraged real-time data mining, digital technologies, and social media platforms to both deter and incentivize action, guiding citizens towards new alternatives for accessing downtown. Cameras and laser detectors scanned automobiles' license plates as cars passed control points and automated systems sent those bills to vehicle owners. A 25% reduction in traffic, 16% decrease in vehicle miles travelled, and substantially reduced travel time demonstrated behavioral changes the tax aimed to create, while 96% compliance in paying the tax on time showed policy makers that that the tax was high enough to influence behavior, but not so high that the penalty was neglected (Eliasson, 2014). Policy makers also guided citizens towards decision alternatives by providing incentives. Allowances made for alternative fuel cars stimulated a 12% increase in market share. Decision bias transparency was also afforded through open discussion across traditional and online media as citizens were able to see the alternatives and payoffs of others' actions. The number of passengers in the public transit system increased by approximately 4%, partly through the sharing of information online. Digital technologies that provided real-time reporting and enforcement, and social media platforms that allowed citizens and policy makers to share decision alternatives, provided the decision bias transparency necessary to make the Stockholm congestion tax an effective policy instrument. That transparency allowed citizens to reimagine their decision landscapes, guided by the new postcard map of the policy makers. The citizens' behavioral changes coupled with a shift in public support of the

tax from 34% to 72% favorability demonstrates the power of technologies for affording decision bias transparency.

Collective Decision Transparency

Collective decision transparency describes the condition of being informed about how decisions and actions of different citizens mutually influence each other. In essence, it makes the interdependencies between the different individual landscapes transparent. In our citizen fitness landscape model, it refers to the parameter C; that is, the degree to which a move of one agent on his landscape changes the typology of another citizen's landscape (Kauffman, 1993; Levinthal & Warglien, 1999; McKelvey, 1999). A very particular case of decision dynamics transparency is needed for the case of social dilemmas, in which there is a mutual interdependency between the individual landscapes and the landscape of the overall group, the whole collective.

In such cases, transparency should make so-called 'illusionary' hill climbing visible (Levinthal & Warglien, 1999). Such 'illusionary' increase of one's own payoff results from the fact that the collective achieves a relatively higher welfare if everybody contributes to the common goal. Their increase is relatively higher compared to their effort. Levinthal and Warglien (1999) discusses this mechanism of self-governance for collective action using the fitness landscape metaphor to explain the outcome of experimental studies (Ostrom, Walker, & Gardner, 1992). They articulate the phenomenon of illusionary hill climbing as follows: when two players move in the same direction (e.g. move towards a similar decision alternative), their actual payoff increases because of the interdependencies between the individual and group landscape. Each individual's move changes the typology of landscape of the group, which reciprocally also changes the shape of the individual landscapes. Because of these positive experiences, the actors are willing to cooperate more.

Against this background, collective decision transparency should support the following mechanisms. First, it should provide policy makers with the opportunity to reverse negative interdependencies into positive ones by 'tuning' the fitness landscapes accordingly. Second, decision dynamics transparency should allow citizens to become aware of the implications of their behaviour on the payoff other citizens, encouraging greater collective awareness. This applies both to situations of dependencies between two citizens, or individuals and the group.

In sum, this leads us to the following two propositions.

Proposition 3a: If collective decision transparency enables policy makers to decouple the decisions of different citizens or positively align them (tuning of co-dependencies), these tuned landscapes may coordinate the citizens towards a higher collective welfare

Proposition 3b: If collective decision transparency enables citizens to become collectively aware (so that they understand the implications of their choices on those of others), they may align their choices collectively and self-organize towards higher collective welfare

Case example to illustrate the role of collective decision transparency:

The Kansas City Smart Grid services over 14,000 consumers and includes emeters, smart switches, smart capacitators, smart thermostats, and in-home displays to monitor energy usage in a real-world setting (Department of Energy, 2015). The flow of real-time information allows for two-way communication between utility companies and consumers. Companies gain information about customer needs, energy-efficiency measures, storage needs, supply and delivery reliability, and the applications customers find most useful (Vojdani, 2008). Information from the grid also flows back to citizens, allowing them to make informed decisions about energy consumption. The interdependencies between each individual citizen and the overall group are made transparent by the automated mechanisms and digital technology built into the grid. Hourly energy consumption trends are reported, making consumers aware of collective usage patterns and providing insights into opportunities for better balancing the demand placed on the grid. Citizens are educated on the benefits of off-peak consumption (avoiding overload and outages) and further incentivized to better manage usage through dynamic pricing (peak rates during peak grid capacity, lower rates as demand decreases). Policy makers are able to tune the landscape towards energy efficiency without prohibitions or taxes; instead, real-time data reporting and dynamic pricing enable utility customers to better monitor their energy usage and align it with the overall consumption patterns. Demand on the grid (collective welfare) can be improved when citizens become aware of the benefits of cooperative consumption (Wakefield, Horst, Simmins, Green, & Green, 2013). As customers reduce electricity use during peak periods to realize cost savings, fluctuations in demand are decreased, improving the reliability of the grid. Even consumers whose behaviour remains unchanged realize improved energy efficiency and reliability. The technologies of the grid provide this collective decision transparency, allowing citizens to understand the impact of their and others' decisions on the collective welfare.

6.6 DISCUSSION

In this article we introduce a new view of transparency in open public policy. We aim to resolve the theoretical puzzle of how transparency may lead to more effective public policies that create greater benefits for citizens as a whole. To articulate how different kinds of transparencies facilitate effective open public policy, we frame open public policy design not as directive action, but as the design of the decision environments that shape the choices of the citizens, in analogy to the metaphor of fitness landscape design proposed by Levinthal and Warglien (1999). We extend this view of policy design

by articulating transparency as an essential precondition for coordinating the collective actions of a group of citizens through two generative mechanisms, (1) informed policy design and fitness landscape tuning and (2) self-organizing and vicarious learning among the citizens. In order to align the collective actions of citizens with the policy objective, transparency needs to provide access to actionable information about the co-evolutionary complexity of citizen decision-making in response to policy instruments.

In light of the co-evolutionary view of decision complexity, our framework articulates a three-dimensional view of transparency and the specific mechanisms that each transparency provides. *Individual decision transparency, decision bias transparency, and collective decision transparency* provide insight into the complexity of the choices that citizens make. If policy makers have transparency about the complexity of the search process of the individuals, they can take well-informed actions to adjust existing policy instruments or develop new ones. Being aware of the ruggedness of the landscape, they can design policy instruments in a way that they either tune the real citizen landscape or create fictional landscapes that guide the behavior of citizens in a favorable way. Transparency also equips citizens with important information that may trigger self-organized learning processes. It supports learning from the success of other individuals, those that have achieved a higher payoff, but it also fosters learning from others' failures. Most importantly, transparency may trigger learning that makes citizens aware of the co-dependency of decisions and actions that might have negative implications for the collective welfare.

As digital technologies are an essential enabler of the proposed decision transparencies, scholars of strategic information systems (SIS) are particularly well suited to build upon the propositions that explain how decision transparency can lead to more effective public policies. More specifically, the article is intended to enrich the scholarly dialogue in three ways.

First, we enrich the flourishing discussion on digitally enabled transparency in literature on e-government, open government, and information policy, mostly outside of the SIS community (Bertot et al., 2010; Harrison & Sayogo, 2014; Nam, 2012; Rabina, 2011). As digital technologies have made it more affordable and facilitated access to policy related information, our article encourages SIS scholars to contribute to this scholarly discourse with a new theoretical view and a focus on policy effectiveness rather than accountability. This paper encourages scholars to think more deeply about the different design choices for transparency in open public policy, and to acknowledge that transparency is indeed a multi-faceted concept (Harrison & Sayogo, 2014; Misuraca, Codagnone, & Rossel, 2013). The mere release of internal governmental data via an online platform may not have any positive effect on the ability of governments to design more effective policies. As previously noted, such an inward-oriented view of transparency might instead obscure open public policy because it creates a situation of surveillance rather than effectuating change (Harrison & Sayogo,

2014; Meijer, 2013). Instead, our theorizing takes an outward-focused view of transparency and articulates what type of information is actionable for both policy makers and citizens. Following this perspective, transparency should provide rich information about the shape and the ruggedness of the citizen landscape, about the differences between the perceived and biased landscapes, and about the external co-dependencies between citizen fitness landscapes. Such a multi-faceted view is essential to ensure that transparency is 'functional' and allow policy makers as well as citizens to benefit from it. New analytics technologies may play an important role in extracting information about the decision context of policy instruments, such as the evaluation of individual as well collective benefits associated with different policy-related choices (Henfridsson & Bygstad, 2013; Misuraca et al., 2013; Scott & Copeland, 2016). The three decision transparencies articulated in this article are means to increase the effectiveness of open public policy, and should not be conceptualized to assess the degree of transparency of open government projects.

Second, our article also enriches the emerging theoretical discussion among information systems scholars on digitally-enabled transparency (or visibility) and its implications for organizing knowledge workers in a corporate context (Leonardi, 2014, 2015). The main argument of this stream of research, mostly focused on social media technologies, is that communication visibility affords access to important meta-information that triggers vicarious learning among individuals participating in the digitally enabled communication activities. The 'ambient awareness' provided by message visibility and (social) network translucence increases each individual's knowledge about who knows what and who knows whom. Our metaphor of a fitness landscape suggest that the evaluation of more distant knowledge of other actors embedded in other contexts, its payoff and quality implications, is important meta-information that may further improve vicarious learning of individuals, or using the fitness landscape language, may lead to informed long-jumps (Levinthal & Warglien, 1999). Most importantly, we articulate that transparency has a collective dimension. Even in a corporate environment decision-making and learning may be characterized by co-dependencies. The choices and actions of knowledge workers of an organization may also be dependent upon each other. Our paper suggests that in order to trigger the alignment of different actors, transparency needs to make people collectively aware: they need to develop a deeper understanding how their own choices affect the choice of another, and also the overall group. In a context of corporate or public policy design, such ambient collective awareness may be essential for organizing a group of workers or citizens.

Third, our article also enriches the nascent discussion among SIS scholars on the role of datification and data-driven policy and strategy making to coordinate collectives of individuals and other stakeholders (Lansky, 2007; Merali et al., 2012; Scott & Copeland, 2016). In this article, we focused on different kinds of transparencies and the mechanism that unfold for more effective public policy. Our propositions do not focus on a particular type of technology that affords transparency.

Even though social media has been the most widely discussed technology affording both inward and outward focused transparency (Ferro et al., 2013; Lee & Kwak, 2012), other technologies, such as Internet of Things (IoT), that provide access to non-communicative behavioural data, have become increasingly important when designing transparency in open public policy (Börjesson et al., 2012). Even more importantly, analytics has become an essential technology to extract relevant meta-information and aggregate information. In our article, we articulate how such technologies can be used to develop functional types of transparencies (rather than creating an impression of surveillance or automation) and actionable information. Analytics should enable both policy makers and citizens to create awareness of individual decision complexity, decision bias, and collective decision complexity. Such awareness should facilitate open policy design and collective learning to make citizens and policy makers more intelligent.

Our paper is not without limitations. First, though we focus on digitally enabled decision transparencies, we do not articulate design principles for particular smart policy technologies. Our empirical case studies only provide a first insight into the different technologies and features used. Thus, we encourage other scholars in the field of IS to build upon our propositions to advance our understanding of the design and implementation of smart policy technologies including their features and functions that support the three proposed transparencies. Second, our propositions do not address the interactions between the different transparencies and their generative mechanisms. Thus, we invite scholars to furnish further empirical evidence of the generative mechanism of these transparencies for effective policy design by studying them individually and jointly. Third, our paper does not articulate the potential limitations and constraints of transparencies. Indeed, we focus on the generative mechanisms of decision transparency that can lead to positive alignment of citizens and greater collective welfare. However, there are also transparency limits. Thus, we encourage scholars to highlight the potential boundary conditions under which transparency can be beneficial.

6.7 CONCLUSION

Transparency is a powerful design choice in open public policy that needs to be thought about more carefully both by scholars and practitioners. Engaging citizens in the policy dialogue is not enough. Smart policy technologies need to help to extract important meta-information about the interplay between different policy instruments, the biases that shape our choices, and most importantly, help us, as individuals, to align collectively. Coordinating the collective action of citizens requires the consideration of the decision dynamics of how we mutually influence each other's welfare. In essence, the concept of transparency needs to shift from a static view towards one that is dynamic and collectively aware. Our paper, its propositions and its illustrative case studies have implications for policy practice. It suggests that policy makers should leverage all three kinds of transparencies as a

means to achieve greater policy effectiveness. Instruments like dashboards should not measure the degree of transparency in a nominal way by counting how much data was released. Instead transparency should create awareness of how policies function and shape our decisions. The information and data collected and released need to be actionable and need to support policy makers in reducing the complexity of the choices that citizens make. Further, this information should also support citizens in making more informed decisions.

There is much to learn about how these transparencies could be designed and implemented to support policy design and vicarious learning. In this article we attempted to articulate the role of transparency for effective public policy design. We hope that this article inspires other SIS scholars and also practitioners to learn more about the role of different kinds of transparencies to tackle policy challenges related to collective and complex human behaviour.

7 Conclusion

This chapter discusses the chapters of the thesis, theoretical implications, as well as limitations and future research derived from the four research questions (1) How do the underlying drivers of civic innovation influence the selection of strategy and ecosystem resources? (2) How do cities foster innovation without internal innovation capabilities and integration mechanisms? (3) How do cities access tacit user information to develop innovative civic solutions? (4) What characteristics of digital technologies facilitate collaboration and information exchange in civic open innovation?

7.1 Discussion of the Thesis

The mechanisms of open innovation (Chesbrough, 2003) and user innovation (Von Hippel, 1998) are well researched in private firms, and the spread of those strategies throughout diverse industries has been documented (Von Krogh & Von Hippel, 2006; Foxall & Tierney, 1984; Slaughter, 1993; Tietz, Morrison, Lüthje, & Herstatt, 2005; West & Gallagher, 2006; Boudreau, 2012; Dittrich & Duysters, 2007; Stuermer et al., 2009; Spithoven et al., 2010). The civic sector has been largely untouched, as a late and sometimes reluctant adopter of openness (Lee & Kwak 2012; Brunswicker & Johnson, 2015; Linders, 2012). This thesis explores the gap in research on cities' nascent exploits in openness as a means of providing innovative solutions for citizens. It further contributes to the research by considering these strategies at various levels of analysis. Chapter 3 considers inter-organizational open innovation along with the concept of a business ecosystem (Moore, 1993) in the civic space. The free-revealing and knowledge sharing between organizations which characterizes public sector strategies expand common limits to openness in business without sacrificing value capture. The proposed Integrated Ecosystem Approach enhances current conceptualizations of ecosystem openness. Chapter 4 emphasizes the intra-organizational dynamics of civic open innovation as city halls are challenged to promote and adopt external innovation, internally. Burdened with deficits in absorptive capacity, these cities work to divulge internal knowledge and culture externally, thereby embracing desorptive capacity as a circumvention of lockout. Chapter 5 finds the real-world environment and living labs processes tools for accessing highly valued lead users for extra-

organizational civic innovation. In Chapter 6, an enhanced utility of technology as a tool for accessing tacit user information, also external to the organization, is proposed, realized in the context of the Open Public Policy Framework. Together, the articles suggest civic innovation parallels, rather than contrasts, open innovation in private firms, and that the mechanisms and contexts that influence civic success can inform private firms as well.

7.1.1 How the underlying drivers of civic innovation influence the selection of strategy and ecosystem resources: An Integrated ecosystem Approach

Scholars suggest that firms should consider the motivations of collaborators, innovation outcomes, and business model of the firm when managing innovation ecosystems (Boudreau & Lakhani, 2009; Chesbrough & Bogers, 2014). Compared to private firms, Chapter 3 found that civic innovation ecosystems had greater diversity of actors with equally varied motivations; no single category of innovation outcome that served the needs of all citizens; and a business model lacking a catalyst for value capture, making these considerations through either a competitive or cooperative approach problematic. The Integrated Ecosystem Approach was proposed to address these challenges. Considering cities do not feel the threat of competition that compels firms to guard resources and protect information (Lane et al., 2006; Rigby & Zook, 2002; Cassiman & Veugelers, 2006; Lichtenthaler, 2011) this approach optimizes openness in managing ecosystems. The Integrated Ecosystem Approach replaces a focus on city-specific needs with the practice of global reuse. The global view is manifest by expanding the ecosystem beyond the borders of any single city to encourage joint collaborations with civic innovators in other locations, coordinated approaches, and global data banks. Ecosystem opportunities should be fostered in support of overall value instead of pursuing a city's pre-planned path to innovation defined by internal priorities. The Integrated Ecosystem Approach proposes actions within an ecosystem be driven by ecosystem value rather than available resources. Cities realizing scarcity in resources such as open data repositories, investments in technology, or civic engagement should leverage partners to maximize the value of innovation strategies rather than limit efforts due to these deficits. Like open innovation in firms, the Integrated Ecosystem Approach sees cities negotiating for resources in collaborative strategies.

7.1.2 How cities foster innovation without internal innovation capabilities and integration mechanisms

With the needs of a quickly-evolving society outpacing the budget and resources of city halls, governments seek to leverage the knowledge diversity of external agents to develop innovative

solutions (Linders, 2012; Bertot, Jaeger, & Hansen, 2012). Enabled by digital technologies and mobile connectivity, citizens are increasingly leveraged as co-producers, rather than mere consumers, of public services (Johnston & Hansen, 2011). The "near zero marginal cost of digital data dissemination" provides a vehicle for citizens and government to exchange information (Linders, 2012, p. 447). Leveraging civic open data and existing IT infrastructure (i.e. government websites), city halls transform into "government as a platform" models of innovation that allow for almost frictionless exchanges of information (Altman, Nagle, & Tushman, 2015; O'Reilly, 2011). Rather than traditional models involving recruitment of trusted contractors, these civic platforms facilitate innovation by limiting restrictions on participation and promoting open recruitment of citizen collaborators (Eisenmann, Parker, & Van Alstyne, 2008). The knowledge of external agents represents the breadth of diversity in society, with solutions reflecting that scope. As cities share increasing amounts of open data, network effects (Van Alstyne, Parker, & Choudary, 2016) attract more developers to participate in these civic platforms. The modularity of the resulting solutions, mobile apps, allow for easy integration back into the existing platform, enhancing the resources of the civic ecosystem as a whole. Open access to civic applications on the demand side, from citizen users, incentivizes more participation from developers on the supply side. Chapter 4 demonstrates the utility of strong management of civic innovation strategies. Though open access for collaborators was promoted, the diversity of the civic population was not matched in loosely-managed initiatives. Funding opportunities and community exposure were tools for incentivizing greater investment. Further, though the contribution of open data was encouraged across cities, popular datasets were overused and others neglected. Stronger management and direct coordination with city organizations incentivized participation and grew expanded resources within the ecosystem.

Sourcing innovation requires that firms recognize the value of external knowledge (Lane et al., 2006; Rothaermel & Alexandre, 2009; Fabrizio, 2009). Competition traditionally spurs investment in innovation in corporate R&D labs, building a foundation of internal knowledge that allows firms to valuate new, external information (Cohen & Levinthal, 1989, 1990). Cities do not have analogous internal departments (Leydesdorff & Etzkowitz, 1998) and face challenges. Chapter 4 finds cities failing to appreciate the applicability of innovation and technology within government due to lack of investment in internal knowledge building. In short, these cities have been largely "locked-out" of opportunities to innovate internally. In addition to the platform strategies that shift the locus of innovation outside of the firm, boundary-spanning agents can serve to source external innovation (Allen, 1977; Tushman, 1977; Cohen & Levinthal, 1990). A firm's outward looking absorptive capacity depends on those individuals tasked with scanning the environment for external information. When the organization's internal knowledge base does not match the external environment's, these boundary spanners can serve in bridging the knowledge gap, facilitating

information sourcing and assimilation. Such agents are pervasive in civic innovation. They were central in all strategies explored throughout the thesis. Chapter 4 explains intermediaries' many roles, particularly in accommodating discrepancies in the pace of innovation between civic organizations and private firms. The flow of knowledge transfer was also reversed as intermediaries communicated internal governmental knowledge into a digestible format for innovators. Problem, crisis, impact, and needs statements added considerable impact to innovation outcomes by guiding developer attention to challenges faced by governments.

The inward facing component of absorptive capacity complements opportunity recognition outside of the firm by facilitating the assimilation and exploitation of that knowledge internally (Cohen & Levinthal, 1990). Firms actively manage strategies to encourage positive "buy-in" attitudes towards externally sourced knowledge, though negative attitudes are pervasive in organizations (Menon & Pfeffer, 2003; Chesbrough, 2006). These attitudes can stem from inexperience with external collaborations (Katz & Allen, 1982; Lichtenthaler, Ernst, & Hoegl, 2010) and from an internal organizational language or coding scheme so specialized that it impedes the transfer of information across boundaries (Cohen & Levinthal, 1990). Also known as the not-invented-here (NIH) syndrome, this was found to be very characteristic of civic organizations. Increasing this reluctance is risk aversion, usually coupled with innovation, in civic departments. Chapter 4 explores strategies to manage the adoption of external information to build absorptive capacity. One successful strategy supported the development of an internal innovation department by placing boundary-spanning agents inside of the organization to champion projects and offload risk from partner departments. The lasting impact, value capture, and sustainability of the solutions was realized through the concerted management aligned with this strategy. Functioning as a multilevel phenomenon, innovation affects departments across an organization (Gupta, Tesluk, & Taylor, 2007). It was common to find management mechanisms at one level that were not effective at others. Chapter 4 suggests cities promote innovation strategies from both the top-down and bottom-up, echoing support for the same in private firms (Lichtenthaler, 2011, Bogers et al., 2017). The positive impact of top management's commitment to these strategies was magnified in civic innovation.

7.1.3 How cities access tacit user information to develop innovative civic solutions

Users, leveraged as external sources of information, produce emerging, innovative, and breakthrough solutions (Lettl, Herstatt, & Gemuenden, 2006; Lilien et al., 2002; Zahara & George, 2002). When information is tacit, users are more likely to become the locus of innovation as compared to when the information is more easily transferable to the organization (Von Hippel, 1994; Ogawa, 1998). Citizen

needs are essential for informing the development of civic solutions, yet users are often difficult to engage in the context of public services. Diverse civic innovation strategies for accessing tacit user information including living labs, embedded agents, crowdsourcing, and apps contests were examined in the thesis. Identifying and engaging civic users was a universal challenge for cities. The civic collaborators were found to be a homogenous group relative to the widely diverse population of a city. The breadth of solutions innovated by those actors were equally narrow and lacked impact beyond the users for whom they were tailored. Challenges realized in all cities demonstrate that government organizations hold no advantages over firms in accessing tacit user needs. Lead users, those who experience the need for innovation ahead of mainstream users, are prized partners in open strategies as they provide insights that help to forecast emerging trends (Von Hippel, 1986, 1988, 2005). Efforts to identify lead users were minimal throughout the civic strategies examined. Cities more frequently engaged collaborators for their technical expertise rather than tacit knowledge relevant to the solution. One exception is the living labs methodology explored extensively in Chapter 5. This strategy situates innovation projects in urban environments to access tacit and domain-based knowledge. Users are captured in their context, eliminating the need for exploration and recruitment of those individuals. Further, processes, though varied by context, served to access tacit information and feedback from lead users, whose roles transitioned from purveyors of information to co-creators of solutions. Innovative solutions are validated as users engaged in experiments situated the in real world.

7.1.4 What characteristics of digital technologies facilitate collaboration and information exchange in civic open innovation?

For firms leveraging collaborators outside of traditional organizational boundaries, digital technologies make the exchange of information between actors more efficient and effective (Lusch, & Nambisan, 2015; Gawer, 2011). The generative mechanism for innovation of such digitally-enabled crowdsourcing is the expertise diversity of the external crowd (Majchrzak, & Malhotra, 2013; Smedlund 2012; Baldwin & Von Hippel, 2011). Leveraging these actors enables firms to recognize opportunity ahead of the competition (Lane et al., 2006). Chapter 6 explores how technology is leveraged for innovation in government by uncovering citizen preferences and decision-making in the context of policy design. Digital technologies can be leveraged to provide transparency to tacit information, particularly the heuristics and biases that guide behaviour, which are difficult for policy makers to discover. These technologies engage lead users actively through crowdsourcing and social media platforms and collect tacit information passively through internet-of-things technologies, smart grids, and data analytics. The collection of this tacit knowledge allows policy makers to pilot public

policies, uncover the underlying decisions that guide behaviour, and innovate policy solutions. The Open Public Policy Framework suggests cities leverage technologies for iterative policy development, allowing citizens to evolve towards higher collective welfare.

7.2 Theoretical Implications

The business ecosystem (Moore, 1993) has become the concept used to examine open innovation strategies and the boundaryless organizations they create (Lane & Lubatkin, 1998). Collaboration with external partners provides a means of expanding a firm's knowledge base, increasing innovation, and providing competitive advantage (Rigby & Zook, 2002; Cassiman & Veugelers, 2006; Chesbrough, 2003; Rivette & Kline, 2000). However, competitive concerns including knowledge spillovers, supplier exclusivity, intellectual property, and product differentiation, cause firms to limit the permeability of their boundaries (West & Gallagher, 2006; Chesbrough & Crowther, 2006; Christensen et al., 2005). Unlike private business, governments do not innovate to gain competitive advantage (Lane et al., 2006; Rigby & Zook, 2002; Cassiman & Veugelers, 2006; Lichtenthaler, 2011). Studies on civic innovation demonstrate cities' willingness to share knowledge and innovative solutions (Stuermer et al., 2009; Chesbrough, 2003; Rivette & Kline, 2000). Exploration of civic innovation ecosystems informed the Integrated Ecosystem Approach, testing assumptions regarding the limits of collaboration, just as the concept of a business ecosystem once did. The Integrated Ecosystem Approach increases innovation exploitation (Chesbrough, 2003; Van de Vrande, Lemmens, & Vanhaverbeke, 2006) through competitive markets. Just as patents "sitting on the shelf" in the open innovation framework can provide value capture through licencing, so can unused resources such as open data and sidelined solutions, be shared in data banks and innovation markets (Lichtenthaler, 2011). The Integrated Ecosystem Approach reorders strategy selection with an ecosystem perspective. Because resources bound within the ecosystem are greater than those within firm boundaries, strategy selection for innovation outcomes should precede the recruitment and negotiation for necessary resources within the ecosystem. Finally, though scholars emphasize there is no "best strategy" for innovation, many propose considerations for finding a fit (Boudreau, Lacetera, & Lakhani, 2011; Boudreau & Lakhani, 2009; Boudreau, 2012). The Integrated Ecosystem Approach discourages such singular choice and suggests that multiple strategies be managed concurrently. These implications of the Integrated Ecosystem Approach expand the limits to the degree of sharing, collaboration, and strategic diversity attributed to current conceptualizations of the business ecosystem. Though open innovation is often considered as a firm-level strategy, the Integrated Approach suggests strategic decision-making from an ecosystem perspective, including other organizations, networks, and communities.

7.2.2 Absorptive Capacity

Chapter 4 explored early failures and second-generation improvements in civic innovation at both the intra-organizational and organizational level of analyses (Bogers et al., 2017). Individual-level characteristics, including risk aversion and NIH syndrome, contributed to many of the challenges that defined early initiatives. That those characterizations also came to define the organizations suggests interdependency between levels of analysis. Though absorptive capacity is considered a firm-level characteristic as it describes an organization's ability to value, assimilate, and exploit external information, this linkage echoes similar findings that individuals' ability for knowledge exploration influences the absorptive capacity of the organization (Salter et al., 2015; Bogers et al., 2017; Cohen & Levinthal, 1990). This connection could provide a means of increasing an organization's absorptive capacity beyond growing organization-level resources, such as investing in internal R&D. Firms lacking such resources might consider encouraging intra-organizational strategies for embracing open innovation as an alternative means of building absorptive capacity.

Scholars acknowledge a research deficit in desorptive capacity, the outward transfer of information that complements absorptive capacity, the internal application of external knowledge (Lichtenthaler, 2011; Cohen & Levinthal, 1990). An emphasis on the value of external information in open strategies can explain the dearth of research on internal firm knowledge and the challenges in sharing it outside of the organization. As Nelson and Winter (1982) suggest, organizations also possess tacit information relating to their innovation investments, and much of this knowledge can only be accessed through interaction with the organization. Vyssotsky (1977) suggests collaborators engage with firms to understand the problems and challenges where innovation is needed before they develop novel solutions. These coupled interactions represent the rule, rather than the exception, in civic innovation. As discussed in Chapter 4, the usual flow of knowledge from collaborator to firm was reversed as intermediaries translated internal governmental knowledge into a digestible format for innovators. Problem, crisis, impact, and needs statements added considerable impact to innovation outcomes by guiding developer attention to challenges faced by governments. The direction of knowledge transfer was similar in the embedded agents model, which greatly enhances the direct relationship between developers and civil servants. This civic model further challenges common associations with the locus of user innovation (Von Hippel 1994; Ogawa 1998). This strategy first places innovators inside government to transfer the organization's tacit information before users are challenged to innovate as independent actors. Whether collaborators remained stationed within the organization or shifted to innovate externally, these civic strategies offer unique processes for facilitating the flow of information across firm boundaries. An emphasis on desorptive capacity realized in these civic strategies also suggests a circumvention of lockout as a result of absorptive capacity deficits (Cohen & Levinthal, 1990).

7.2.3 Tacit Knowledge

Tacit user needs, though "sticky" and costly to transfer, (Von Hippel, 1994; Bogers, Afuah & Bastian, 2010) provide valuable insights that aid firms in recognizing emerging trends and innovating before rivals. When tacit knowledge is too sticky, firms avoid a costly transfer of information as users become the innovators (Nonaka, 1994; West & Bogers, 2013). User innovation explores the prevalence of leveraging users as co-creators of solutions. These solutions are often realized in industrial or consumer goods including scientific instruments (Von Hippel, 1976), industrial machinery (Foxall & Tierney, 1984), applications software (Voss, 1985), mountain biking (Lüthje, Herstatt, & Von Hippel, 2005), and kite surfing (Tietz, Morrison, Lüthje, & Herstatt, 2005). Chapter 6 takes a novel approach to user innovation for civic needs by considering how openness can foster innovative policy solutions. In the proposed Open Public Policy Innovation framework, decision complexity relating to policy choices is the tacit information hidden from policy makers in this civic context. The framework proposes the affordances of technology in uncovering decision complexity (tacit information) to both citizens and policy makers. This view considers the unique context of user innovation in policy design, and reinforces the potential for technology to become a critical tool for accessing tacit knowledge.

Complementary to the idea that the locus of innovation rests with users because of the stickyness of information (Von Hippel, 1994), is the view that users are compelled to innovate as the most likely beneficiaries of the resulting solutions (Von Hippel, 1988, 2005). The thesis found this secondary explanation of user innovation less realized in civic strategies. Efforts to identify lead users were minimal throughout the civic strategies examined as cities more frequently engaged collaborators for their technical expertise rather than tacit knowledge or expected benefit relevant to the solution. Chapter 6 contributes to this discussion by offering a novel strategy for engaging hard-to-asses beneficiaries of innovative civic solutions. Leveraging the pervasive digital technologies of today removes the primary challenge of accessing a large and diverse population - and the highly valued lead users - that rarely engage in civic innovation. These technologies provide transparency to the biases and heuristics of individuals' decision making, passively capturing that tacit information, like the sticky knowledge more actively volunteered by lead users in user innovation. Just as lead users provide insights into emerging trends for innovation in private firms, the transparency afforded by technology in open policy strategies provides insights into decision complexity, which informs innovative policy solutions for government.

7.3 Managerial Implications

The results of the thesis offer several practical implications for managing open strategies in both firms and civic organizations. The first relates to ecosystem management. Firms are compelled to soften

their boundaries as a means of accessing valuable external information (Rigby & Zook, 2002; Lichtenthaler, 2011; Chesbrough, 2003; Rivette & Kline, 2000) and innovative solutions (Baldwin, Hienerth & Von Hippel 2006; Lettl, Herstatt, & Gemuenden, 2006; Lilien et al., 2002). Managers accept this precarious tradeoff by minimizing the exposure of internal information and endeavoring to maximize the extraction of resources externally. The Integrated Ecosystem Approach (Chapter 3) expands the openness and collaboration of such strategies and suggests managers transfer their perspective and loyalties from the firm to the ecosystem. Managers should select strategy with a global view rather than prioritizing their organization. Though seemingly antithetical in a competitive environment, the implication is that value accrued in the ecosystem will benefit all participants in that ecosystem, an idea reflected in the common aphorism "a rising tide lifts all boats". Secondly, the Integrated Ecosystem Approach alleviates the challenge of finite firm resources by suggesting strategy primarily be guided by anticipated innovation outcomes. Negotiation for resources within the ecosystem can then augment any deficits for the planned strategy. This perspective reorders traditional strategic managerial decision-making by removing the emphasis on available resources. It further works in synergy with the first managerial implication, amplifying its utility.

"Locked out" (Cohen & Levinthal, 1990) of many emerging trends, civic organizations were shown to leverage intermediaries routinely. Without as great a contrast between internal and external capabilities, private firms might attempt to keep pace, while still lagging behind. If managers feel inept with a given approach, they could follow the lead of cities and use intermediaries to manage projects or connect to collaborators. These partners get the organization up to speed without having to devote internal resources to the task. Projects and strategies previously out of reach might become more easily accessible. Leveraging intermediaries also develops organizational capabilities. Effort can be made to transfer knowledge between the firm and intermediary, negating the need for their partnership for subsequent improvements. Mangers can instead choose to maintain frequent partnerships with these collaborators. Through these strategies, the absorptive capacity of the firm is improved through established mechanisms to help the organization assimilate external information and innovation routinely, instead of developing knowledge and resources internally (Lichtenthaler & Lichtenthaler, 2009; Lichtenthaler, 2011; Teece, 2007; Amit & Zott, 2001).

Chapter 6 suggested that technology can be leveraged to access citizens that are hard-to-reach or reluctant to engage in civic innovation strategies. Such users can be valuable sources of innovation for firms, yet their insights and user innovations remain untapped unless they voluntarily engage. The Open Public Policy framework offers mechanisms for gathering tacit information through more passive channels. Social media platforms and user forums provide valuable insights into user preferences and innovative product improvements. Just as digital sensors and smart grids provide

feedback mechanisms for policy development, managers might be inclined to support the creation of applications to accompany even non-technical products. Leveraging the pervasiveness of digital technologies can maintain channels of engagement and customer feedback to reach those hard-to-access consumers previously unavailable to firms.

7.4 Limitations and Future Research

Measuring innovation - value creation and value capture - remains a challenge in innovation research (West & Bogers, 2013). Civic strategies are no exception. The quantity of solutions (apps contests) or participation (crowdsourcing platforms) often serve as proxy measures of success, but these approximations are not robust enough to prove the utility of a given strategy. Only when firms and cities become more comfortable accepting the risks will innovative approaches and solutions be better understood. Innovation strategies are also generally seen as surplus and dispensable experiments in government. Benefits of new strategies are appreciated but not relied upon, and the corresponding resources, or lack thereof, are assigned to these efforts. Until civic innovation receives the investment and support of trusted, traditional processes, it will be difficult to compare and measure the outcomes of traditional versus novel solutions. Only then will managers and researchers be able to understand the mechanisms and contexts that influence the success of these strategies and persuade their diffusion.

It is both a challenge and opportunity to research such a nascent movement. Restrained competition between cities continues to provide an opportunity for researchers to expand the concept of openness in innovation ecosystems. The prevalence of desorptive capacity relative to absorptive capacity in civic strategies might inform a better understanding of these organizational capabilities. Scholars might consider if organizations experiencing lockout are more successful in engaging boundary spanners to facilitate desorptive capacity rather than develop the internal mechanisms for knowledge creation and innovation. Finally, while engagement with a firm is almost always a consumer's choice, interaction between a city and its citizens is not. The civic context should motivate researches to understand mechanisms for engagement beyond lead users, to reach mainstream and even reluctant collaborators.

7.5 Final Remarks

Open innovation has helped firms across industries to develop new products and solutions, staying ahead of the competition and better serving customers. Similar strategies have not been as readily embraced in the public sector, as cities face challenges adapting organizational processes and

fostering ecosystems of collaborators. Competition can explain firms' willingness to experiment with openness, but the lack of competitive concerns in government provides an opportunity, as the constraints that firms face are removed. For this reason, this thesis considers how open innovation in the public sector, a context ripe for knowledge exchange and value sharing, might expand current conceptualizations of organizational openness. Though not first to adopt these strategies, government could eventually champion the movement, providing innovative solutions beyond the reach of any one company, to all citizens. By examining nascent innovation endeavors in European and American cities, the thesis explores the underlying drivers of civic innovation, how civic organizations leverage the external crowd, and how governments leverage technology for collaboration. The Integrated Ecosystem Approach expands current conceptualizations of business ecosystems, enhancing the potential for openness and collaboration in firms. An emphasis on desorptive capacity in civic organizations is considered as a circumvention of lockout, due to civic deficits in absorptive capacity. This workaround suggests alternatives for firms experiencing similar deficits. And an enhanced utility of technology as a tool for providing transparency into tacit user information is proposed in the context of Open Public Policy Innovation. We hope that organizations are only beginning to realize the potential for collaboration, and that scholars will be similarly invested as these endeavors are realized.

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