Resource orchestration to scale up smart city networks

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Abstract

The purpose of this research is to identify which network resources are critical to smart city networks scaling up and how these resources are successfully orchestrated across members of these collaborative networks during for scale up. The paper is based on two exploratory case studies of interorganizational smart city networks that examine how smart city innovations are scaled up. The results are discussed through the lens of resource orchestration theory. The findings illustrate that project success to scale up can be achieved through a proper orchestration of resources in a network with respect to initial set of actors and resources involved, and activities performed.

Keywords: resource orchestration, interorganizational networks, scaling up

Introduction

In recent decades research on interorganizational networks has received increasing attention from scholars. Different perspectives have been taken in research by different disciplines (e.g. social networks, intra-, inter-organizational supply networks, and strategic networks). Public as well as private sector networks have been examined and also networks spanning the public private interface. Interorganizational networks as a unit of analysis have been demonstrated to be powerful tools in examining complex societal problems, such as healthcare (e.g. Provan et al. 2013), education (Kraatz 1998), sustainability (Worley et al. 2011), and other public sector activities (Provan et al. 1999). Literature on interorganizational networks is found mainly in operations and supply chain management, innovation, strategic management and organization studies, reflecting the different focuses on resources and their transformation, innovation and diffusion, and leadership and management. Building on these different perspectives, this research project is aimed at identifying critical resources and how they are mobilized and coordinated in these complex interorganizational networks.

Smart city networks are complex interorganizational networks comprising government actors, private sector suppliers, consultants, universities and community representative

bodies that collaborate to procure innovations to improve local businesses, economies and society. Cross-sector partnerships, such as those common in smart cities, are increasingly used forms of collaboration in tackling societal and environmental challenges – only a minority of environmental NGOs are not involved in cross-sector partnerships (Johnson et al. 2018). A lot of research has been also conducted in the area of public administration since network theories have demonstrated their applicability in studying and understanding complex relations between different actors. These studies of complex interorganizational networks have highlighted the need for the investigation and analysis of a network as a whole, so called 'whole network' studies (Provan et al. 2007).

Smart city initiatives may be focused on developing and using new technologies, for example to improve city waste management or logistics infrastructures, or improve processes, such as recycling food. Scaling up of smart city projects occurs at the interface of innovation and supply networks and is when projects are implemented and diffused at a city wide level. Smart city projects have been found to have some difficulties with scaling up after their experimentation or pilot phase; two thirds of smart city projects do not progress beyond this pilot or testing phase (Manville et al. 2014). Some smart city networks struggle to scale up diffusion of good, value for money improvements to supply across the city

The purpose of this research is to identify which network resources are critical to smart city networks ability to scale up and how these resources are successfully orchestrated across members of these collaborative networks during the scaling up phase.

Theoretical Background and Literature Overview

Studies of interorganizational networks to innovate and supply at the public-private interface reveal substantial opportunities (Amann et al. 2014) but also challenges involved in collaborating and coordinating across these complex networks (Walker et al. 2013). Building on the different perspectives offered by operations and supply chain management, innovation, strategic networks and organization studies, this paper focuses on identifying critical resources and how they are mobilized and coordinated in networks. Studies on interorganizational networks can be found in the areas of organizational design and theory (e.g. Paquin et al., 2013, Dagnino et al. 2016), learning (e.g. Knight 2002), social networks (e.g. Borgatti et al. 2009) and supply networks (e.g. (Harland, Lamming et al. 2001, Harland, Zheng et al. 2004). Supply networks can be conceived as complex adaptive systems (Fawcett et al. 2012), with tensions around change processes, trust-building, commitment-building and resource constraints.

The intersection of innovation and supply networks might be usefully informed by exploration and exploitation theories that have been widely studied in the area of organizational studies (March et al. 1991) as well as innovation management (e.g. Katila and Ahuja 2002). Exploration focuses on innovation (for example, entrepreneurial orientation and smaller businesses' involvement), while exploitation is mostly about efficiency and hence might refer to interorganizational network growth as cost minimization. Current study tries to explain how organizations can orchestrate their resources to move from exploration to exploitation.

Industrial Marketing and Purchasing (IMP) approach: ARA framework

The Actors, Resources, Activities (ARA) framework of IMP approach conceives networks in terms of these three elements. IMP approach has found itself as one of the developments of IMP group that have studied a network as a bunch of actor, resources, and activities. Companies are embedded in networks built on established actor bonds, resource ties and activity links (Hakansson and Snehota, 1995). Network actors are

organizations connected in the network to each other and through their connected resources and processes, or activities. Typical resources considered in a network could be both tangible – human, technological, financial etc. - and intangible, such as knowledge, expertise and friendships. In classic operations management terminology, actors transform resources to provide outputs of goods and services. Activities can be classified as communicating, planning, monitoring, sanctioning, using social control and rewarding (Manser et al. 2016).

The ARA framework offers a useful structuring device for examining smart city networks. On a network level ARA framework allows to depict a set of relationships between activity patterns, web of actors, and resource constellations: actors with their resources are involved in activities to deliver a service; through developing business relationships organizations that are constituted by activity links, resource ties, and actor bonds (Svahn et al. 2004).

Resource orchestration in complex networks

This study uses resource orchestration theory, rooted in a resource-based view (Sirmon et al. 2011, Hitt et al. 2011, Peuscher et al. 2016). Orchestration is important for identification and integration of resources, their configuration and combination in order to create synergies (Gulati et al. 2011). It is an orchestrator that can refer to weaknesses and strengths of the resources to reach a competitive advantage (Sirmon et al. 2011). Resource orchestration theory is showing potential for examining supply in so called 'whole network' level studies (Harland et al. 2017) and is therefore appropriate to examine issues in scaling up. A relational view of resources proposes that, due to synergies, relationships can develop capabilities beyond those within individual organizations. In the same vein, network theory proposes that networks can also develop capabilities not available to organizations working in isolation (Capaldo 2007, Mursitama 2006).

Applying resource orchestration theory to supply processes focuses attention on managerial action regarding internal resources, suppliers' resources and resources created from partnerships (Wowak et al. 2016). Application of supplier base orchestration involves structuring to gain access to most valuable resources, bundling to coordinate resources between parties to create capabilities, and leveraging to take advantage of market opportunities (Wowak et al. 2016). Each of the partners might own valuable resource that can help a development and implementation of the solution (structuring); management of these resources so that together they create capabilities (bundling); and taking an advantage of an opportunity to implement the solution (leveraging).

Different orchestration mechanisms may be more or less appropriate at different phases of network development (e.g. Gilsing et al. 2016; Dagnino et al. 2016; Paquin et al. 2013; Ritala et al. 2009; Harland et al 2017). For example, during the formation of a network powerful actors raise attention to a problem and invite initial actors; initial agreement is sought on the problem definition as a linking mechanism to connect other actors; prior positive relationships between partners (structural embeddedness) is leveraged to form the network; initial agreements, leadership building, legitimacy building, trust building, conflict management, and planning are all important activities (Bryson et al. 2006). Having common shared goals and values is another important criteria for project success (van Winden et al. 2016, Saz-Carranza et al. 2006).

At early stages of an interorganizational network based project, orchestrators have to identify and accumulate resources and expertise, ranging in behavior from encouraging serendipitous interaction to more deliberate member selection and development (Paquin et al. 2013). As network development progresses from initiation, formation to initial

collective action, it is not until this collective action matures (Harland et al 2017) that projects within networks reach the stage of 'scaling up' their output generation. To date little research has been performed to investigate this scaling up once networks mature, and how network resources are orchestrated to enable successful scaling up.

Powerful sponsors or brokering organizations can usually draw the attention to the problem in hand and force the start of the collaboration by bringing together the initial set of stakeholders (Bryson et. al 2006). Collaboration with larger and higher status firms is usually beneficial for smaller ones since it provides smaller firms an opportunity to access resources and gain legitimacy (Stuart 2000, Borgatti et al. 2003). The role of hub organizations has been explored from the perspective of their role as integrators of network members' contributions in the creation of a final product or service (Nambisan & Sawhney 2011). It is not only a hub or broker firm that can be considered as an orchestrator; other firms that can influence the ability of a network to create common goals and shared values, as well as involve partners in a project by increasing their interest in them, contribute to orchestration (Paquin et al 2013).

Scaling up could be considered as implementation output of an experiment and therefore related to diffusion of innovation (Naber et al. 2017). Scaling up can be organized in different ways: replication; expansion; accumulation, or transformation (van Winden et al. 2017; Naber et al., 2017; Ceschin 2013). Scaling up requires management of three critical processes: social network building, articulation of visions and expectations, and learning (Schot et al. 2008, Naber et al. 2017). Resource orchestration theory enables understanding of mechanisms of how scaling up could be operationalized, i.e. how these critical resources might be organized through the mechanisms of resource structuring, bundling, and leveraging (Sirmon et al. 2011).

Therefore this study aims to investigate critical resources and their management mechanisms essential for scale up in interorganizational networks. In particular, to understand better how different mechanisms of resource orchestration, such as structuring, bundling, and leveraging are used to scale up. Smart city networks represent a good setting since scaling up requires, from one side, working on such issues as clarity of the project scope and focus to all the partners, knowledge sharing between the participants, and, from another side, combining social impact orientation with technological solutions (van Winden et al. 2016).

Methodology

Combing use of the ARA (activities, resources, actors) framework (Hakansson et al. 1992) with the resource orchestration mechanisms of structuring, bundling and leveraging might provide insights and understanding of relations between different mechanisms of network coordination.

Case studies in purchasing and supply management are especially helpful in understanding dynamics or emerging issues (Dubois et al. 2016). Here two exploratory case studies based on semi-structured interviews on interorganizational smart city networks are performed to examine how smart city innovations are scaled up to city wide supply; one of the cases is of a successful scaling up, the other less successful. The units of analysis are projects for particular innovations. The network boundary is drawn to include key organizations involved at the phase of the projects when the networks attempt to scale up the innovation diffusion to supply more widely across the city. Data are collected on critical resources to enable scaling up and how they are successfully orchestrated. Small number case studies are more parsimonious when examining complex interorganizational settings than multiple case studies chosen to fit and represent various contexts (Eisenhardt et al. 2007). Small number case studies are assumed to be

appropriate for the exploration of complex interorganizational networks (Harland et al. 2017), so called 'whole network' studies (Provan et al. 2007).

The two case studies – project A and project B – that have been investigated are two smart city projects in Milan, Italy, that relate to the area of logistics. The goal of Project A was to set a control and evaluation of last mile urban logistics processes in real time as well as to aggregate the ecosystem of stakeholders to manage the distribution process. Last mile logistics refers to the final stage of the delivery process from a distribution point to the end-user. The project has included a number of various partners from public administration, industry, and research. The main purpose of Project B was to develop a conceptual, governance and business model for last mile logistics by developing a scalable platform for governance, control, and management of city logistics based on optimization techniques and integration of technology and social approaches. Both of the projects arose from the Smart City of Milan call for projects in 2012, although over time some differences evolved in funding sources and particularities of project realization (e.g. mandated involvement of smaller businesses). Both case studies included interviews with involved key partners of the project crucial for the projects' city wide implementation, or scaling up. Data collected so far has included 8 interviews with an average duration of 1 hour, secondary data in the form of project documentation, project presentations, and calls for projects. Content analysis has been applied to data collected. Further interviews are planned since the work is still in progress. Short descriptions of the two projects are presented below.

Project A lasted for 30 months; from very early on in the project a clear vision, shared project goals and clarity of partner contributions to the project were evident. Committed contributions included technologies, skills and competences, or links and connections with other stakeholders. There were project pilots that went very smoothly due, in the main, to good collaboration links between project partners and public administrator stakeholders. The project partners had previously worked together on organizational and project levels and had good, reliable connections with each other that facilitated the piloting and helped to gain extra support where required. The project has since been implemented in two cities and demonstrated feasibility and viability of the solutions beyond the pilot stage. This is interpreted here as successful scaling up.

Project B lasted for 18 months and was initiated by the partners responding to a call for regional funding of smart city projects, specifically last mile logistics. Whilst the project might be viewed as having some success, in that part of the solution has been implemented within another project that is going on a wider scale now in the city, and it has been agreed to continue working with some logistics companies to develop the solution further with them, the actual project B in itself did not scale up in the way Project A was able to. Defined by the call, the project was required to include smaller businesses as partners, and it was particularly specified that one of them should be a project coordinator. Municipalities were not involved as project partners and the only support obtained from them for the pilot was through letters of support. This lack of direct municipality support caused a rather random spread of pilots in quite diverse locations where the partners could persuade local groups to participate (such as areas in a big city and testing in one street of a small city). Different pilots were also focused on different parts of the solution which caused difficulties with their comparison and implementation. The overall solution was not implemented on a city scale, but this was not a goal set by the project partners from the outset. Later in the project the partners lacked motivation to scale up when they were wrapping up the project. However, the overall solution that was developed was viable and innovative and informed further projects within the Smart City of Milan initiative.

Findings

In order to facilitate the analysis and comprehension of the findings, two cases would be analyzed through the ARA framework that allowed to clarify actors, resources, and activities of the two projects (Table 2).

Table 2 – Projects description in terms of ARA framework

ARA dimensions	Project A	Project B
Actors	• Technology partners (big national ICT company) • Logistic operators (big international company) • Consultancy (company with a specialized expertise in the area) • Academic partners (universities with relevant expertise or connections) • Vehicle providers (big and companies) • Public administration • Data provider	• Technology partners (smaller businesses) • Academic partners (universities and consortia with relevant expertise) • Data provider • Subcontracted – academic and consultancy partners
Resources	• Technology • Data • Knowledge (expertise of technological solutions, technological and economic types of analysis) • Physical vehicles • Land and infrastructure	• Technology • Data • Knowledge (expertise of technological solutions, technological and economic types of analysis)
Activities	• Platform development • Pilot testing in two cities • Actual implementation and further plans	• Development of the solution • Pilot testing in several cities of the region

Here we apply Resource Orchestration Theory to analyse the initial findings. Comparative analysis has demonstrated two different approaches in smart city projects development.

In the case of **project A** the management of the project has been performed by the orchestrator who had an existing extensive experience of managing technology-based projects. The orchestrator role has been played by a large national ICT company – by attracting and taking on board those actors that can support and complement resources and activities for the project they were executing *structuring* activities of orchestration. They selected and recruited all the solution-relevant actors, e.g. logistics operators and municipalities that were targeted to be the users of this platform, choosing partners with relative expertise and complementary solutions. Chosen partners had been involved in similar projects or had worked together before. The orchestrator structured expertise, technology and social capital in the form of network connections that were needed for them to test and implement the solution successfully. *Bundling* mechanisms included: coordination, monitoring the results and efficient management of unexpected events. *Bundling* of resources was evident in that partners switched their roles by taking initiative on their own when it was needed, providing flexibility and opportunity to leverage accumulated project resources. *Leveraging* in a form of pilot testing of the smart city project in several sub-areas simultaneously has improved the probability of the project to scale up since some of the lessons learned have been efficiently incorporated and knowledge of them has been efficiently shared. Initially it was agreed to conduct the pilot in three cities while some difficulties arose when implementing it in one city – due to the

reasons of initially agreed partners in charge dropping out and lack of public administration support; leaving two remaining successful implementations. These pilots progressed with a certain level coordination and assistance form public administration side.

Project B had the opposite *structuring* approach from the beginning and included only smaller businesses with relevant technological expertise and academic partners that were able to support the development of the solution. Project *bundling* and *structuring* activities included focusing on developing the solution that is in core competences and is in an the area of expertise of project partners (*bundling* network knowledge and expertise to develop the solution), while at the same time subcontracting on the partners that might help to facilitate the collaboration or provide some complementary resources (e.g. social capital in form of links to another project or public administrators – *structuring*). The project did not include any public administration partners, but was able to organize pilots in several cities with its own previous contacts (*leveraging* and *structuring*). The outcomes of this project have included further development and elaboration of the solution together with organizations that are could be categories as supplier in the field (logistic operators), as well as its implementation in a project of a similar nature. Even though the project did not include main players from the supply side and did not have a specific goal of scaling up, the solution that has been developed, main partners involved in the project have found a way to deliver it to some markets or, at least, to incorporate the idea within another project.

The case studies reveal that successful scaling up is dependent on the ability of network orchestrators to gain from synergies with similar projects by establishing links between them (*structuring/bundling*). Pilot testing of the smart city project in several sub-areas simultaneously improves the probability of the project to scale up since some of the lessons learned have been efficiently incorporated and knowledge of them has been efficiently shared (*leveraging*). Rich exchange of expectations and collaborative network boundary shaping was another trait of successfully scaled up projects (*bundling*).

Apart from similarities, projects have demonstrated some differences mainly in connection with how they actually match the resources that are available to them with the external ones. Project A was quite clear on what resources and partners are required for the solution (*structuring*) and how it will be developed (*bundling*), who will be responsible for which part (*leverage*), with quite clearly organized project coordination and monitoring (*bundling and leveraging*), and very clearly organized pilots for both cities that worked out well (*leveraging*).; while project B could be characterized as a more organic development of the solution and its implementation – from the beginning it has involved a smaller number of partners with a less diversity between them (*structuring*), the development of the project has also implied so events that were considered and fixed during the project (*bundling*), while for the pilots it was also an emergent scheme rather than a deliberate planning (*leverage*).

For project A with an involvement of large national and international organization, public administrators a planning, monitoring and control has been done deliberately. The project has involved suppliers form the initiation and had necessary resources from the beginning. Mainly orchestration activities were around coordination of internal resources in pursuing the expected outcome. Project B was more focused on the solution development and testing and included mainly smaller businesses and academic partners in order to innovate. Not all the resources and expertise needed for the project were included in the initial network, so orchestration activities had to spread both internal and external resources. The involvement of suppliers and users has been assumed only at later stages. So, project A network structuring activities form the beginning assumed

exploration and exploitation of the solution, while for project B initial structuring assumed only exploration, while structuring for exploitation happened at later stages with the help of accumulated social capital and expertise during piloting.

Discussion and Conclusions

This paper has investigated the development of smart city projects for scale up from a resource orchestration perspective. The findings illustrate that project success to scale up can be achieved through a proper orchestration of resources in a network with respect to initial set of actors and resources involved, and activities performed. Firstly, current research reveals that in smart city projects even if some core partners associated with core resources necessary for the project scaling up are missing, an orchestration in a way of attracting those resources through bundling and leveraging activities will be beneficial for the project. Secondly, more extensive and complex projects with key suppliers on board might require more coordination and control as compared to more flexible and adaptable projects of smaller business involved that use softer mechanisms of orchestration. Thirdly, some differences between management of tangible and intangible resources can be highlighted – planned and deliberate orchestration through the project have been found to work well for such critical resources as technology, as well as for intangible ones as social capital. While for more flexible projects planning, coordination and control have been done mostly on tangible resources, while intangible social capital has been developed and acquired organically during the project.

Critical resources to scaling up that have been identified include: financial (opportunity to get additional funding when it is needed); technology ownership (partners that have had a separate ownership on different parts of the project or technologies have more opportunities to scale it up in one or another way – through a key partner network or using public administrators as technology or knowledge transfer setters (from one project to another); social capital as a result of collaboration and for further facilitation of the project; obtaining synergies from collaboration with partners involved in similar projects (expertise, connections). Depending on combinations of initial set of resource various emphasis on orchestration activities might be expected. Projects with a number of big and experienced players including core organizations might be orchestrated in a more deliberate, structured and coordinated way to attain the implementation of the solution. Projects with smaller businesses and less diversified actors and with less experience might require orchestration especially for assessing lacking resources and establishing missing links through the execution stage that will allow the project to be implemented further. Smaller projects in terms of number and diversity of partners project has shown to be more active in finding the ways to implement the solution afterwards and, despite some difficulties that has been caused by improper management, continued to work further and continue implementing the idea.

This research contributes to understanding of the issues of scaling up in complex interorganizational networks at the public private interface. The findings illuminate the relational aspects of networks as important resources at this stage of network development. Findings on structuring, leveraging and bundling in smart city networks are novel.

Further research is needed both to consolidate the present finding by adding more interviews to the two cases and to validate them through additional case studies.

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