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Conceptualizing semi-temporary project networks through actor roles in smart city innovation

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ABSTRACT

Our study examines the under-theorized, yet essential roles adopted by actors in fostering urban innovation, with a focus on the organization of project networks in smart cities, and conceptualizes these as semi-temporary project networks, a new form of organizing innovation. Specifically, it addresses two research questions: (1) How do actors adopt or create roles when organizing project networks for smart city innovation? and (2) How do these roles enable and promote innovation in complex, multi-actor environments such as smart cities? Drawing on two case studies of smart city project networks, the study identifies six distinct actor roles that contribute to innovation: i) the orchestrator, ii) facilitator, iii) integrator, iv) co-creator, v) tester, and vi) knowledge developer. By mapping the actors' roles and linking them to project networks literature, we show empirically that the role of the orchestrator matters in project development, but some supporting roles in the specific innovation tasks become even more relevant than the orchestrator itself. The interplay between temporality at the project level and relative permanence at the relationship level forms the foundation of semi-temporary project networks for sustained innovation and collaboration across projects. This study has implications for project management literature, particularly on managing and organizing projects for societal impact, as well as for practitioners and municipalities interested in knowing which roles lead to effective smart city implementation.

1. Introduction

Smart city innovation – defined as the use of information and communication technology (ICT) to enable public administration to create new and better ways of managing cities (Nam & Pardo, 2011) - has the potential to address societal grand challenges such as climate change and increasing urban population. Although smart city projects typically have smaller budgets than large-scale infrastructure projects (Aaltonen et al., 2017; Harris, 2017; Yu et al., 2017), they tend to be more complex. Complexity arises from integrating advanced ICT, involving multiple actors such as companies, government, civil society organizations, users, and citizens (Leite, 2022; Leite & Ingstrup, 2022), and the challenges inherent in urban environments (Di Maddaloni & Sabini, 2022; Kroh & Schultz, 2023). Smart city projects often operate through multi-actor networks, which refer to a group of stakeholders connected through formal or informal collaborations (Leite, 2022). Within these networks, actors interact in various ways, such as coordinating projects, sharing knowledge, and developing technological solutions, just to name a few. These multi-actor networks, together with multi-technological dependencies, present unique challenges in innovation for smart city development. However, we still do not fully understand how roles enable or constrain innovation (Klessova et al., 2022).

Particularly, there is a lack of understanding about the temporal and relational dynamics of these networks, that is, how actors interact, coordinate activities, share knowledge, adopt roles, and influence innovation over time (Grabher, 2004; Gulati et al., 2012; Roehrich et al., 2023). Understanding these dynamics in a complex innovation setting, such as smart cities, is crucial for practitioners, scholars, and policymakers seeking to improve public services. This study addresses this gap and aims to understand the interplay between roles, governance, and innovation in the context of smart cities. Roles provide insights into how responsibilities, resources, and interactions shape the functioning of a project network (Sydow, 2022). Accordingly, this study raises two research questions: RQ1: How do actors adopt or create roles when organizing project networks for smart city innovation? and RQ2: How do actors' roles enable and promote innovation in complex, multi-actor settings such as smart cities?

This study contributes to the literature on project networks, actors roles, business in networks, ecosystems, and smart city innovation by (1)

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providing an in-depth empirical investigation of actor role adoption in smart city project networks; (2) developing the concept of Semi-Temporary Project Networks (STPNs) that integrates the temporal and relational aspects of collaboration in smart cities; and (3) proposing a conceptual framework that links actor roles, membership, and positions to governance mechanisms in these networks.

To answer the above questions, two case studies of smart city innovation in Brazil are undertaken. In Curitiba, a government-led initiative used ICT to enhance the public transit system, while in Águas, a private-sector-led initiative implemented integrated smart solutions for parking, street lighting, security, e-health, and education via an IoT platform. Cities offer an interesting context for this study due to their openness to collaboration and their capacity for citizens' involvement (Reypens et al., 2021; Lievens & Blažević, 2021).

A project network is defined as the embedded relational structure among project actors, each assuming distinct roles to achieve shared goals (Manning, 2005). Prior research identifies key roles in innovation management, including network brokers (Burt, 2009; Blackburn, 2002), boundary spanners (Stjerne et al. 2019; Iorio & John, 2014), and orchestrators (Roehrich et al., 2023; Sydow, 2022; Dhanaraj & Parkhe, 2006). However, the influence of these roles on innovation within project networks remains under-theorized.

Role theory explains roles as the behaviour expected by organizations or individuals occupying particular positions within a network system (Havila, 1996; Biddle, 1986). Positions can be central or peripheral, and most studies affirm that centrality matters for innovation (Dhanaraj & Parkhe, 2006). However, there is an overemphasis on the innovation orchestration capability of the central actors, which may lead to a limited managerial perspective and understanding of the phenomenon. A more holistic understanding of role dynamics can help us to understand how innovation emerges and evolves in smart cities.

Drawing on project networks and actor role literature, this study identifies six actor roles that contribute to innovation in smart city project networks: i) the orchestrator, ii) facilitator, iii) integrator, iv) co-creator, v) tester, and vi) knowledge developer. While the orchestrator matters in the general project activities, such as coordination and communication among network partners, supporting roles – specialized roles that assist in advancing specific parts of the project - such as integration of the technology, building knowledge in the network, etc., become even more relevant in certain phases of the project than the role of the orchestrator itself. This highlights a dynamic interplay of roles that shift depending on the project's phase and focus. Findings reveal that actors adopt or create roles through strategic positioning and learning-by-doing as an outcome of the evolving project demands. Role adoption is neither static nor formally assigned; it emerges through ongoing network interactions. Actors continuously assess opportunities, leverage expertise, and adjust their involvement based on mutual expectations and network conditions. Some roles are proactively assumed (e.g., orchestrators, integrators), while others emerge through informal negotiation, such as referrals. Furthermore, actors prioritize maintaining their membership within the project networks and promoting long-term collaboration rather than competing for centrality. Empirically, the study shows the semi-temporary nature of such networks, where actors balance immediate project demands with the potential for future business opportunities through continued collaboration. This challenges the dichotomies in project studies between temporary and permanent organizational forms.

Based on these findings, we introduce the concept of Semi-Temporary Project Networks (STPNs): innovation-oriented, time-bound collaborations among legally and organizationally autonomous actors whose relational ties extend beyond individual project lifecycles. Unlike traditional temporary project organizations, STPNs exhibit *semi-temporariness* through recurring collaboration, shared routines, and evolving yet continuous role configurations across projects. Coordination is governed through relational mechanisms - trust, mutual goals, and ongoing knowledge exchange - rather than formal hierarchies. These networks support cumulative learning and shared governance in complex, multi-actor settings like smart cities.

While STPNs share some characteristics with platform projects (Davies et al., 2018), project ecologies (Grabher, 2004), and meta-organizations (Gulati et al., 2012), they differ in how they integrate bounded temporariness with sustained inter-organizational continuity. This hybrid form of governance and actor configurations makes STPNs particularly suited to smart cities innovation ecosystems. Building on these findings, we propose a conceptual framework that consists of three interrelated elements: *project network roles, project network membership, and project network positions,* which together explain how these elements shape innovation in semi-temporary project networks. In doing so, it responds to recent calls for research on innovation in project networks (Di Maddaloni & Sabini, 2022; Kroh & Schultz, 2023; Sydow, 2022), specifically on managing and organizing projects for societal impact, such as smart cities. For practitioners and municipalities, it offers valuable insights into how roles and governance mechanisms can facilitate effective smart city implementation.

The remainder of the paper is organized as follows. First, we present a literature review on project networks in connection with the role theory, followed by research methods, which include a qualitative study of two smart city cases. Next, we present the findings, a discussion, and a summary of contributions to project management in general and project networks specifically, along with implications for practice. The paper concludes with a discussion of the study's limitations and directions for future research.

2. Previous literature on project networks

Numerous innovations and production activities are organized around projects, defined as "a temporary endeavour undertaken to create a unique product or service" (Duncan, 1996, p. 4). These projects often involve multiple independent organizations brought together for limited durations, leading to growing interest in understanding how inter-organizational collaboration is coordinated and governed. The concept of project networks provides a useful lens to capture these dynamics, emphasizing the evolving relationships among legally autonomous but operationally interdependent actors contributing to project execution (DeFillippi & Sydow, 2016).

Definitions and conceptualizations of project networks vary. Terms include *project-based organizations* (PBOs), *inter-organizational project networks* (Maoret et al., 2011), *project coalition networks* (Pryke, 2004), *project ecologies* (Hernes, 2025; Grabher & Thiel, 2014), and *meta-organizations* (Gulati et al., 2012). While these perspectives offer important insights, this study adopts the term project networks for its emphasis on actor interdependencies, role configuration, and relationship governance within the temporal boundaries of projects.

Research progress in project networks has evolved over time. Early studies primarily focused on governance mechanisms and institutional conditions enabling collaboration (Jones et al., 1997). Over time, the focus expanded from understanding network formation and control (Verwaal & Hesselmans, 2004) to exploring more dynamic aspects of network governance in temporary organizations and their continuity beyond individual projects (Pirson & Turnbull, 2011; Steen et al., 2018). Recent studies suggest that effective network management requires a leading actor - i.e., an orchestrator - to coordinate tasks and establish routines (Sydow, 2022).

Jarzabkowski et al. (2007, p.11) define actors as entities "who shape the construction of practice through who they are, how they act, and what resources they draw upon." In the context of smart cities, leadership can be assumed by companies, governments, or nonprofit organizations. These actors differ in authority, resources, network position, and strategic goals. Their roles are shaped by both formal agreements and the relationships they build within the network (Andersen et al., 1998). This highlights how actors engage in what Lawrence and Suddaby (2006) term "institutional work," whereby they purposefully create

or transform the institutional arrangements within networks. Ligthart et al., (2016) emphasize that project managers often engage new partners or reactivate dormant relationships while managing current collaborations with future project opportunities in mind. Similarly, Sydow (2022) highlights the importance of coordinating activities with consideration of both past interactions and future possibilities.

Hellgren and Stjernberg (1995) identify three key characteristics of project networks: (1) no single actor holds authority over the entire network; (2) networks are open, with no clear criteria identifying and controlling their boundaries, and (3) networks operate in a temporarily limited, dynamically evolving environment that is created and recreated for specific purposes. Sydow (2022) extends earlier perspectives by highlighting that governance in project networks relies on coordination and trust-building, which might be supported by a lead organization to establish goal consensus among network actors, though governance can also take more distributed forms. Regarding boundary dynamics, Sydow (2022) acknowledges the notion of fluid project network boundaries, referring to the impact of dynamic membership changes and evolving relationships over time. The main reason is that core actors and recurring collaborations provide a sense of continuity. Through projects, relationships are built, developed, and nurtured (Leite & Bengtsson, 2018), forming a more permanent structure. Sydow (2022) suggests that project networks are semi-temporary systems formed by individuals and organizations that are legally independent but operationally interdependent, nurturing long-term collaboration beyond specific project timelines. Coordination practices are influenced by historical experiences, current dynamics, and future expectations, emphasizing the potential for sustaining or reactivating relationships. Thus, coordination of the "temporary" is enabled but also constrained by the more permanent networks of past relationships with key actors and their resources. The notion of temporariness has gained attention, with Bakker et al., (2016) advocating for a hybrid perspective integrating temporary and more permanent organizing views. Despite the emergence of related constructs such as ecosystems, inter-organizational collaborations, platform projects, and meta-organizations (Sydow & Braun, 2018; Gulati et al., 2012; Gawer, 2021), a clear theoretical distinction regarding temporariness remains underdeveloped.

This study aligns with Sydow's (2022) view of project networks as a semi-temporary structure and responds to Sydow and Braun's (2018) call for further theorizing on multilevel perspectives, process-oriented understanding of relationships, and the roles of actors within these frameworks affecting the governance in project networks. This present study addresses the latter, focusing particularly on how actors' roles, responsibilities, resources, and interactions influence innovation and governance in the context of smart city innovation. The study's mapping and analysis of actor roles in smart city project networks are new, showing how they interact, share resources, and shape governance and innovation. This addresses a gap in previous work, which often treats roles as either static (linked to position) or concentrated on the orchestrator, thereby offering a more nuanced understanding of the dynamic and relational aspects of project networks.

We follow Jarzabkowski et al.'s (2007) definition of roles as actors' identities, actions, and resources. Governance includes formal and informal mechanisms that coordinate and regulate interactions, while innovation refers to developing and applying novel solutions. These three elements are closely linked: actors' roles influence how governance is enacted, governance shapes actors' ability to innovate, and innovation outcomes can change roles and governance structures. By linking roles, governance, and innovation, the study differentiates itself from prior research, which most of the time treats these as separate domains, thereby offering a more integrated framework for analyzing project networks in smart city contexts.

2.1. Smart cities innovation developed through project networks

Smart cities involve a wide array of interdependent project networks, including smart transportation initiatives, smart energy systems, digital education projects, and IoT-enabled waste management programs, just to name a few (Kroh & Schultz, 2023; Leite, 2022). These areas are considered project networks because each consists of interconnected projects where multiple actors – including government, companies, civil society organizations - collaborate, share resources, and coordinate activities where appropriate. Citizens sometimes contribute by providing feedback and local knowledge that informs innovation processes (Valta & Leite, 2025). These projects are not isolated; rather, they form a system of interdependent initiatives aiming to create sustainable urban solutions. Smart city innovation emerges from the collaborative efforts of diverse actors addressing complex urban challenges through integrated technologies and services (Nam & Pardo, 2011; Kroh & Schultz, 2023). Project networks play a crucial role by enabling knowledge sharing and partnerships across public and private actors (Leite, 2022; Sydow, 2022). However, managing smart city initiatives poses governance challenges due to the presence of multiple stakeholders, varied project timelines, and the need for interoperability among diverse ICT systems (Lim et al., 2023).

Within this context, new forms of collaboration have emerged, as ICT creates shared platforms where government, companies, civil society organizations, and citizens come together to co-design innovative responses to urban challenges. For instance, companies contribute technological resources, while governments and society provide contextual knowledge about city-specific challenges and community needs. Citizens' feedback can also shape ICT solutions, reflecting their role as users and stakeholders. This demonstrates how roles and resources are critical to foster innovation within project networks (Leite, 2020). Innovation, thus, depends not only on technology but on the way roles and resources are aligned (Adner, 2017) to address real-world problems. Consequently, the roles that actors perform, the resources they bring, and their positions within the network collectively determine how innovation is fostered and implemented. Thus, we argue that actor roles, resources, and positions are intertwined.

Governance in smart projects demands autonomous collaboration through reciprocal interactions without centralized authority. Coordination, thus, demands consensus-building and mutual decision-making (Shergold, 2008). The roles and responsibilities are decided upon through an open discussion among various actors, with their relationships being horizontal. This type of governance is common in living lab initiatives (Nyström et al., 2014). However, other forms of governance are the traditional market-governance type, which involves public-private-people partnerships (PPP). Although collaboration is like partnerships, in PPP, private and public actors work together, and the deliverables are those agreed in advance rather than achieved on a consensus basis (Lim et al., 2023).

Most studies on actors' roles in project management focus on the leading actor (e.g., Roehrich et al., 2023; Dhanaraj & Parkhe, 2006; Manning, 2005). However, this study argues that all actors are relevant to smart city innovation. The objective is to map each actor's role, including responsibilities, resources, and interactions influencing innovation. Orchestration in a complex multi-actor setting remains less explored compared to traditional business-to-business networks. Consequently, the orchestrator's role in such contexts may differ fundamentally, necessitating further analysis.

2.2. Actor roles enabling and promoting smart city innovation through project networks

Actor roles have been discussed in social science for decades, particularly through the lens of "role theory" (e.g., Biddle, 1986). Role theory examines social behavior by assuming that actors occupy specific social positions, each with associated expectations for their own behavior and the behavior of others. This framework has been applied to analyze roles at both individual and organizational levels (Biddle, 1986). At the individual level, Burt (2009) emphasizes the strategic

advantage of actors occupying central positions in networks, enabling them to leverage opportunities for personal benefits. Boundary spanners exemplify such individuals, facilitating the transfer of information and knowledge between decision-makers and using their positions to exert influence (Gupta & Polonsky, 2014; Möller & Svahn, 2006). These actors have a profile of being trustworthy and possess the ability to put unlikely people in collaboration (Klerkx & Aarts, 2013).

While these studies have centered their analysis on the roles of individual actors aiming to get personal rewards when embedded in a network of partners, there are also many studies analyzing the cooperative aspect of the network and the actor roles to gain collective benefits. For example, the roles of improving communication, support, and commitment among network members have been identified as key to fostering collaboration for innovation (Cantù et al., 2012). Similarly, Dhanaraj and Parkhe (2006) at the organizational level highlight the role of orchestrators who set rules, create stability, distribute knowledge, and combine resources for value creation to the network partners. Building on this view, Adner (2017) introduces the idea of the ecosystem as structure, positioning networks as systems of interdependent actors whose roles are aligned to achieve joint value. He identified leader-follower roles. A leader refers to which actor(s) will take coordination for leading the network towards alignment of innovation activities, and which will follow the guidance of these leaders and accept a follower role. In this study, the term orchestrator is deliberately chosen over leader to emphasize coordination and consensus-building. While leaders typically imply authority and hierarchical control, orchestrators act as enablers, negotiating power and fostering alignment among diverse actors (Dhanaraj & Parkhe, 2006). This perspective enhances role theory by embedding role dynamics within ecosystem-level coordination.

Roles have also been explored in project networks and strategic network performance. Koops et al., (2017) analyze actor roles in project networks, while Bayne, Schepis and Purchase (2017) investigate their influence on strategic performance. Nyström et al., (2014), in their study of 26 living labs, identify several roles in smart city innovations, including coordinators who organize participants and gather user information, messengers who disseminate ideas, facilitators who motivate and guide users, and orchestrators who lead project activities and inspire collaboration. Other roles include informants who test prototypes, testers who evaluate technology from a user perspective, and contributors who collaborate to develop new products, services, and processes. The authors claim that contributors have an active role in the innovation process in addition to coordinators.

In a study of mobile service project networks, Heikkinen et al., (2007) identified managerial action-based roles categorized by whether their actions were expected or emergent and whether they introduced radical or incremental changes. Andersen et al., (1998) associate roles with the positions actors occupy in a network, suggesting that roles are determined by these positions. However, this view suggests positions as relatively stable, while Henders (1992) and Leite et al., (2018) argue that positions are dynamic and can change across projects, depending on the relationships actors build and cultivate. These relationships form the basis through which roles and positions are continuously constructed and adapted. This relational process underlines that roles are not fixed but are context-specific and emerge through interactions. For instance, in smart city project networks, actors may agree on different roles for various phases of development, reflecting the situation's unique demands. Further, Cantù et al. (2012) and Nyström et al., (2014) emphasize the strategic dimension of roles by linking them to access to and control over resources. Resources—whether financial, informational, or technological—are viewed as valuable assets that empower actors to influence decision-making, organize activities, and strategize within the project networks. Access to resources often depends on the quality and extent of relationships, reinforcing the relational aspect of roles. Taken together, these perspectives highlight that actor roles in smart city project networks require integrating the dynamic interplay among roles, positions, and relationships. In this regard, understanding role dynamics can provide insights for the governance of project networks.

2.3. Synthesis

This study assumes that actors in project networks strategically pursue their own interests while collaborating to develop the project (DeFillippi & Sydow, 2016; Heidenreich et al., 2016; Manning, 2005). Actors participate in projects only if they perceive benefits, often taking on roles such as 'orchestrator' or 'non-orchestrator.' Orchestrators manage network activities and hold central positions, while non-orchestrators contribute supportively, sharing knowledge and collaborating on technological development, typically occupying peripheral positions. Despite the orchestrator's centrality, disagreements with their leadership can arise (Havila, 1996). Furthermore, we believe that actor roles and positions are dynamic. Thus, actors may assume more than one role, but this is less expected concerning the orchestrator. Also, an actor may change position from project to project, but this is unlikely within the same project. Moreover, we expect that actors change roles and positions depending on the circumstances; however, the orchestrator is the actor who initiates the project, and therefore, its role and position are predetermined.

In this study, innovation is seen as both a process and an outcome, requiring actors to combine resources, assume responsibilities, and adopt roles that drive the network's goals. Fig. 1 illustrates a project network framework for smart city innovation, characterized by a diversity of actors and heterogeneity of resources. The figure shows four linear stages (membership, roles, positions, and innovation outcomes) supported by two perpendicular elements: resources (shaping membership and roles) and social context (shaping positions and later stages of the process). All arrows in the figure are single-headed and indicate a dynamic flow: actors bring resources that enable membership, adopt roles that influence their network positions, and together these drive the innovation process. The perpendicular arrows from resources and social context highlight their moderating role, linking membership to roles and positions, ultimately shaping how the project networks enable innovation.

In the framework, we assume that project network membership emerges through actors' perceptions and assessments of how their resources—such as skills, knowledge, technical and financial assets, relational competencies, and organizational practices (DeFillippi & Sydow, 2016)—can be combined. This collective pool of resources enables strategies essential for implementing smart city innovations. Once the project network membership is initially formed and members get together based on their resource capabilities and roles, thus positions are shaped by a social network system in which actors become embedded. According to Biddle (1986), a social system refers to a group of assigned positions and shared norms that regulate differentiated behaviors and the conduct of actors.

Actors bring resources to the network. By contributing these resources, they gain membership, which enables collaboration through shared goals, trust, and access to others' capabilities. Their positions then shape the responsibilities they assume within the innovation process. Based on this, the framework suggests that smart city innovation requires actors (project network membership) to take responsibilities (project network position) and combine resources through the roles they play (project network roles) with the intent of innovation.

Given the exploratory nature of the study and the limited prior theorization on the interplay between actor roles and governance in smart city project networks, the process model (see Fig. 1) was inductively derived from the empirical material. The novelty of the topic necessitated a data-driven approach, in which theoretical insights emerged through recursive iterations between data, emerging concepts, and existing literature. This abductive logic (Dubois & Gadde, 2002) allowed for a grounded conceptual framework that reflects the dynamics observed in the field.

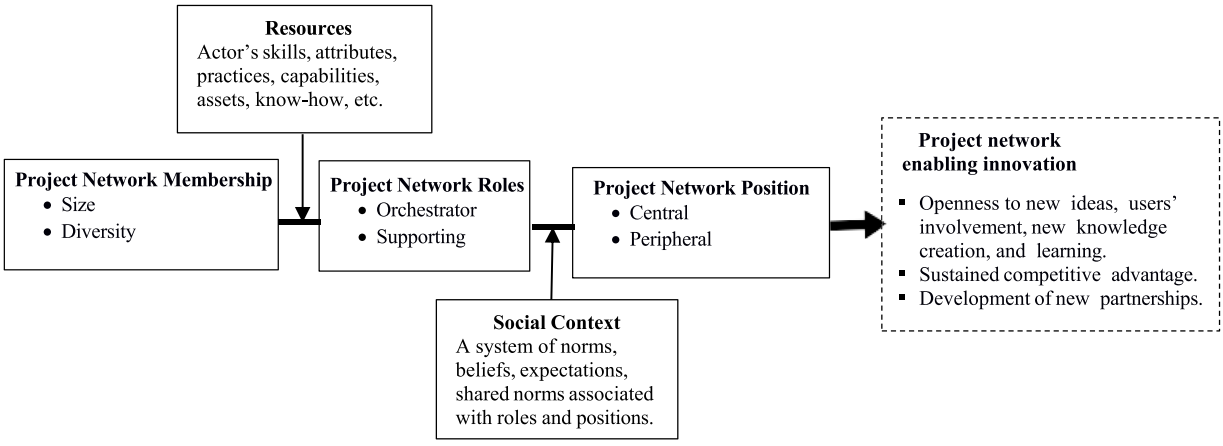


Fig. 1. A framework for project networks enabling and promoting smart city innovation.
Single-headed arrows (→) indicate the direction of influence, showing how actors bring resources that enable membership, adopt roles that influence network positions, and together drive the innovation process.
Perpendicular arrows from resources and social context indicate a moderating role, linking membership to roles and positions ultimately shaping how the project networks enable innovation.

3. Method

We examine two cases of smart city project networks in Brazil. A case study approach is appropriate for our research questions, which seek to understand how actor roles are adopted or created (RQ1) and how those roles promote innovation in complex, multi-actor environments (RQ2). Given that roles are dynamic and context-dependent, case studies allow for in-depth, processual insight into actor interactions in real-world settings (Yin, 2017). To strengthen analytical depth and reduce context-specific bias, we employ cross-case analysis (Eisenhardt & Graebner, 2007) not only to identify role types but also to compare how roles are enacted across different contexts and how these influence innovation dynamics. This comparative dimension enables us to trace patterns and divergences in role formation and innovation outcomes, thereby addressing the full scope of both research questions. Furthermore, cross-case analysis helps us group and contrast diverse perspectives from interviewees (Patton, 1990), revealing not just what roles exist but how they emerge and evolve across different smart city innovation contexts.

3.1. Data selection and gathering

Three criteria guided case selection. First, we prioritized cases involving multi-actor collaboration projects, as these offer diverse perspectives and interactions that are essential for understanding the innovation process. Second, the cases had to be information-rich, particularly in the context of urban innovation applications. Finally, we sought cases characterized by an open innovation process that actively facilitates community involvement. To align with these criteria, we focus on cities with a high level of human development index (HDI) since we expect that this type of city will have better ICT infrastructure which may foster community engagement.

The empirical sources concerning our cases include a total of 73 interviews with relevant key informants collected from 2013 to 2018 and 2022 (see Table 1). We interviewed managers working for public and private organizations involved in the project. The interviews performed in 2022 were collected to understand post-project activities and to know if new roles emerged after the project's implementation. Most of the interview duration ranged from 30 min to 1,5 h. The interview protocol involved first general questions about the process of developing the project, aspects of the collaboration, and then more specific questions about actors' interests in participating, how roles were established, and in which ways roles influenced behavior, actions, and the organizing process of the project activities. We also analyzed secondary data such as national and international news about the project, companies' reports, press releases, and videos related to the project in different media channels. To ensure the trustworthiness of our findings, we applied validation techniques by triangulating data from interviews, field notes, and secondary sources (Eisenhardt & Graebner, 2007).

Table 1
List of respondents.

Organization	Case 1	Case 2	Respondents by professional position	Interviews	Location
Ericsson	✓	✓	Managers, head of marketing, engineers, consultants, and analysts.	19	Sweden, Brazil
Huawei		✓	Engineers, head of innovation department, project managers, and business developers.	5	Brazil
Telefonica/ Vivo	✓	✓		16	Brazil
Telefonica Foundation		✓	Head of CSR initiatives, CSR managers, communication managers, and public relations managers	5	Brazil
ISPM		✓	Head of Innovation	3	Brazil
Dataprom	✓		Engagement management, head of marketing, director of innovation	6	Brazil
URBS	✓		Public officials in the department of finance, project managers, and the president	11	Brazil
ICI	✓		Project managers	4	Brazil
City Hall		✓	Secretary of Tourism	1	Brazil
IPUCC	✓		Head of city urban planning	1	Brazil
Vanzolini Foundation		✓	Project Manager	2	Online

Total number of interviews **73**.

3.2. Data analysis

We coded the data using NVivo, which enabled us to perform a systematic analysis. We applied an abductive approach (Dubois & Gadde, 2002). Hence, data analysis was an iterative process, constantly moving back and forth between our collected data, existing theories (role versus project networks), and our emerging findings. The large dataset was first clustered into a manageable form using a narrative strategy aimed at building a "story" to explain how actors participated in and shaped smart city innovation. This narrative analysis was designed to develop a case-oriented understanding of the phenomenon, considering multiple actors' perspectives on practices, experiences, and learning in smart city development projects.

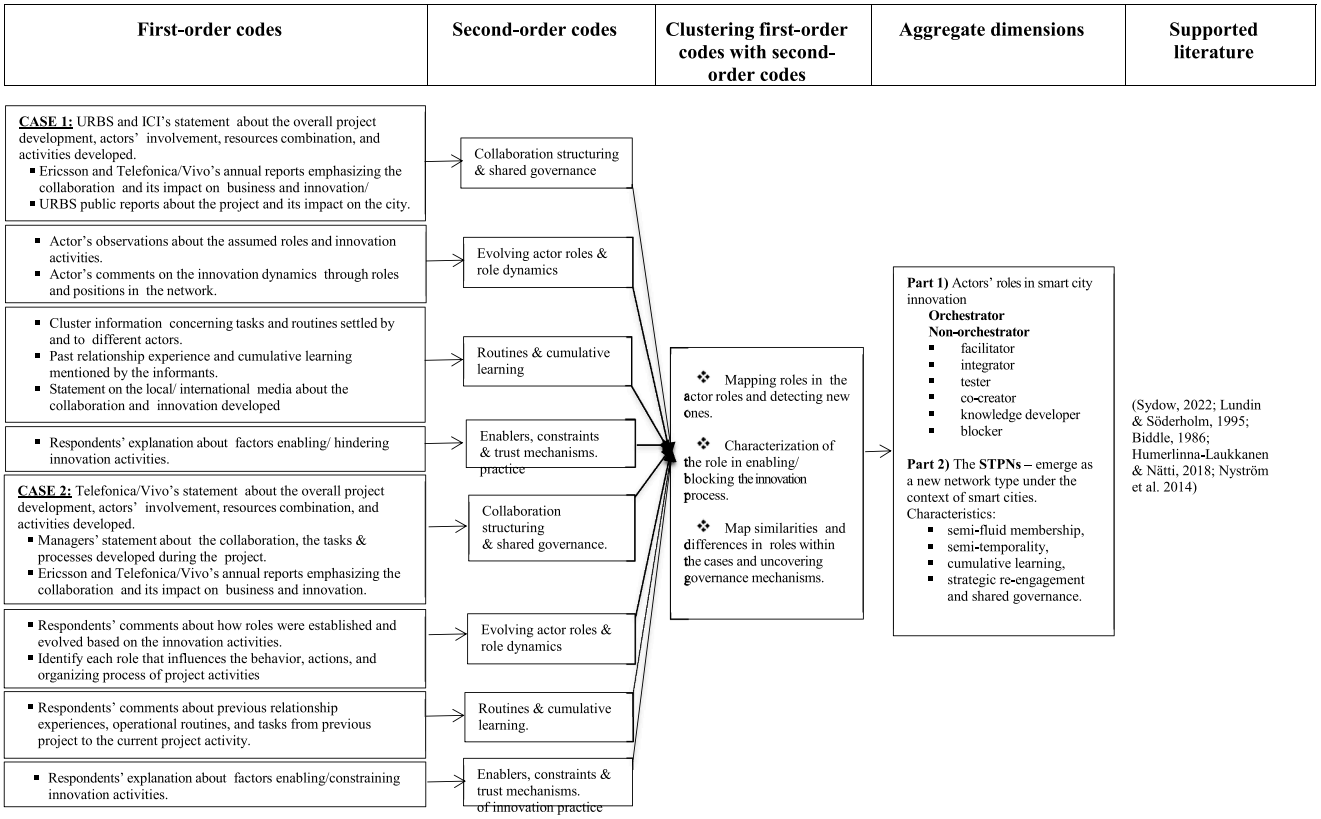
To code our transcripts, we began by clustering relevant information into first-order codes (Gioia et al., 2013), initially focusing on the project initiation and development phases – covering general information about the project, how tasks were organized among actors, how they worked together, and the main challenges they faced. This first round of data analysis was connected to the actor role theory (see, for example, Biddle, 1986), which focuses on mapping patterns and characteristics of the actors' social behaviors. Following Biddle's (1986) view, we considered roles as generating social positions and expectations that influence the conduct of actors within project networks.

The first-order codes reflected respondents' terms and early emerging categories. We aimed to discover patterns and develop a detailed mapping of the codes by engaging in an iterative comparison between empirical material, theoretical perspectives, and relevant literature. After the second round of interviews, we refined the codes by creating subcategories and labeling them according to the project implementation phase (e.g., tasks, routines, responsibilities, and innovation activities). To understand the roles of each actor, we mapped these routines and responsibilities and linked them with the innovation activities performed, as well as with respondents' perceptions about their own roles and those of others within the project, in line with Biddle (1986).

As the analysis progressed, we identified similarities and differences among the categories, which revealed emerging themes that helped describe and explain our phenomenon. In the final interview round, we investigated how roles were combined and evolved over time, identifying which role enabled and/or blocked the project's progress. We then compared our findings with previous research (cf. Heikkinen et al., 2007;Nyström et al., 2014; Manning, 2005; Hellgren & Stjernberg, 1995), which enabled us to understand the interplay between roles, governance, and innovation in the context of smart cities and develop the second-order codes. Furthermore, we turned to the aspects of collaboration from a project network perspective (e.g., Leite, 2022; Sydow, 2022; Hellgren & Stjernberg, 1995) within smart city development. By linking actor roles and innovation within project networks, we became interested in whether certain roles, such as the orchestrator, could generate any conflicts if other actors desired to have a leadership position. We continued to distill emerging second-order themes into aggregated dimensions until reaching theoretical saturation (Glaser et al., 1968).

In doing so, we were inspired by Leong, 2024 in their data representation from raw data to theoretical insights. Throughout, we cycled again between emergent data, concepts, themes, dimensions, and relevant literature to support conceptual development and to understand how practices emerged from actors' interactions. The analysis progressed in two parts: Part 1 (see Table 2) focused on the characterization of actor roles in enabling or blocking innovation across the projects; Part 2 (also in Table 2) uncovered governance mechanisms through which collaboration was enacted, leading to the conceptualization of Smart

Table 2
Data categorization structure and analytical process.



City Temporary Project Networks (STPNs). These aggregate dimensions reflect the conditions for STPNs to emerge, which are linked to actors' behavior, shared practices, task division, routine formation, and trust-based norms. These conditions, combined with the roles assumed by actors, shaped the innovation processes in smart city contexts. This was based on our understanding that institutional arrangements within the network were not fixed but co-constructed through interactions and learning across project phases, shaped by both responsibilities and informal relationship dynamics. By recursively iterating between theory and data, the process model (see Fig. 1) was inductively derived and gradually shaped. Two additional interviews conducted in 2022 provided insights into the post-project phase, revealing shifts in role configurations and continued collaboration patterns beyond the formal conclusion of the projects. Table 2 summarizes the data structure and analytical process, using the actors' roles at the network level as the unit of analysis.

4. Cases

Case 1. Curitiba smart city project

The project network happened in Curitiba, a city located in the Paraná state in the South of Brazil. With an estimated 1.7 million inhabitants and a human development index of 0.82 (IBGE, 2024). Curitiba is known for several of its innovative green projects. Curitiba exemplifies the smart city concept through its strategic use of digital technologies, participatory governance, and integrated urban planning aimed at improving the quality of life for its citizens.

In 2010, it received the prestigious 'Globe Sustainable City Award', and in the subsequent year, it was recognized by C40 Cities as a city that is leading the way toward a more sustainable future (C40.org). Curitiba's international recognition continued in 2023, when it won the "Most Intelligent City in the World" award at the Smart City Expo in Barcelona. This award acknowledged a broad range of initiatives, including the implementation of 5G technologies, free public Wi-Fi at over 310 locations, and civic engagement (Innovate, 2023).

Curitiba is also well known for its Bus Rapid Transport (BRT) idea of 1974, and since then, the municipality has kept improving the city's public transport. In 2012, the municipality envisioned enhancing its public transportation with the implementation of 3G technology that could enable better real-time fleet management. From the public sector, two organizations, URBS (Urbanização de Curitiba) and ICI (Institute of Intelligent Cities), acted as project orchestrators. URBS is a state-owned organization responsible for the supervision of the city's transportation system, while ICI is a not-for-profit organization that develops ICT solutions for public management. From the private sector, three companies were involved in the project. The Swedish Ericsson is one of the leading companies of ICT solutions to service providers, the Brazilian Dataprom, which develops hardware/software for transport, and the Spanish Telefonica/Vivo, a telecom company that provides connectivity among machines.

Since 2009, URBS has encountered numerous communication failures with increased dissatisfaction and citizen complaints. For the time being, all communication happened via radio, and ICI acknowledged that wireless communication could improve the city's transport. Despite being a software developer for URBS, ICI did not have its own technological solution, so they coordinated the project together. The manager at ICI stressed that *URBS was determined to implement the project [Project Manager, ICI, Case 1]*. In Curitiba, it is the URBS's responsibility to regulate public transport, but buses belong to private companies that are affiliated with Setransp, a transport union with the mission of protecting these companies' business. During an interview, the URBS director affirmed that conflicts exist between URBS and Setransp. The manager stressed that *the transport companies dislike our system of control. These companies try to put public opinion against us by affirming that electronic ticketing is fraudulent. Sometimes they manage to put projects on hold by asking for an audit beforehand [Director, URBS, Case 1]*

Despite the existing conflicts, URBS started by asking Dataprom to adjust its electronic ticketing to receive the Telefonica/Vivo SIM card. The objective was to connect buses with the OCC (operational control center). But when the OCC was implemented in 2011, the new system did not work as expected. Communication was lost several times, mainly during rush hours. The main problem was that Telefonica/Vivo's USB modem was embedded in an unusual environment, i.e., in buses, causing data loss and connectivity failure among devices. To solve the problem, several adjustments were made by both companies to co-create a system of embedded ticketing with connectivity. For Telefonica/Vivo, it was the first time that connectivity was provided between public buses and OCC. After several meetings mediated by ICI, partners understood that the system needed new technology that could stabilize the system, and thus Ericsson's technology, originally developed for PCs, came across as being the best equipment. Ericsson's equipment was suggested by Telefonica/Vivo. Subsequently, all actors worked together to integrate the partners' different pieces of technology. When the project was fully implemented in 2012, URBS invested over 10 million USD, and the ICT solution helped to increase efficiency, reduce emissions, and energy use. In addition to national recognition, the UNFCCC (United Nations Framework for Climate Change Convention) also recognized this project as an example of cities' carbon footprint mitigation and brought international visibility to all actors involved.

Case 2. Aguas smart city project

Aguas is a small urban city located 187 km from Sao Paulo, Brazil. The city has a population estimated at 2780 inhabitants (IBGE, 2024) and is characterized by a high human development index of 0.854. In 2016, the municipality of Aguas embraced a digital transformation that expanded the city's ICT infrastructure and made it a smart city. Areas identified included digital services in education, parking, streetlights, and health. The project was proposed by companies to the city administration. Given its high human index, small size, and low level of investment, Aguas was chosen by companies interested in showing their ICT solutions applied to cities. Telefonica/Vivo, Ericsson, Huawei, and ISPM were the companies working to implement the technologies. The companies' objective was to foster the smart city market in Brazil and show how their technology positively impacts society.

Ericsson and Telefónica/Vivo collaborated on the "Curitiba Smart City Project", as previously mentioned. Interviewees also emphasized the longstanding partnership between the two companies (see Appendix, Case 2). This is supported by companies' annual reports indicating several joint initiatives before the Curitiba project, such as the Amazon case and the Connect to Learning in South America.

Huawei is a Chinese global provider of ICT infrastructure and smart devices, while the Brazilian ISPM is a leading vendor of service assurance and integration of IoT (Internet of Things) technologies. Furthermore, to compose the solution, it was also necessary to engage startups that worked as software suppliers for companies. From the societal sphere, the city mayor and public officials partnered with the companies and with two NGOs named Vanzolini Foundation and Telefonica/Vivo Foundation, which specialize in pedagogical projects.

As a first step, Telefonica/Vivo invested over US 560,000 in modernizing the city's network infrastructure. The total investment was estimated at around 5 million US dollars. A manager at Telefonica/Vivo affirmed that: *The improvements in network infrastructure reduced energy consumption by 23 % [Head of Smart Cities, Telefonica, Case 2]*. With over 5000 municipalities in Brazil, Telefonica/Vivo's president stresses that there are great business opportunities, and he affirms that *a pilot project serves as a first step in engaging in future public-private partnerships in Brazil [President, URBS, Case 1]*.

The project included a smart parking and smart street lighting solution implemented by Ericsson, while Huawei developed a smart security solution in which surveillance cameras were installed in the city.

Furthermore, ISPM's main role was to integrate all digital services into its IoT platform. ISPM also contributed to the development of digital solutions in e-health, such as medical records with residents using fingerprints to confirm their identity. Yet, ISPM developed an app that helped to prevent dengue outbreaks. Dengue disease is transmitted by the Aedes mosquito, and severe infection can be life-threatening. Through the app, residents send photos to the city hall and inform potential areas for dengue proliferation. The solution helped to reduce mosquito habitat and consequently the number of cases of dengue. In education, Telefonica/Vivo and Vanzolini Foundation tailored their digital technologies to a public library and classrooms, where students received tablets. Furthermore, the two foundations together trained schoolteachers on how to use the new educational solution connected to the IoT platform. This is not the first time the two foundations have worked together; they developed two educational platform projects in Brazil, "Digital School initiated in 2013 and "Educarede" in 2002.

Aguas' smart city project was launched in 2015 and received national recognition for the project's cost efficiency for public administration and positive societal impact by TM Forum (a global industry association for service providers and their suppliers in the telecommunications industry). Moreover, the project was also presented at the 'Connected Smart Cities in 2015′ – an event that brought together companies and the local government (from several levels) for a panel discussion about the future of smart cities in Brazil. Table 3 presents comparative information on each smart city case with overall objectives, outcomes, and the number of interviews per case, as well as secondary sources.

5. Findings

5.1. Actors' role adoption and creation when organizing smart city project networks

How do actors adopt or create roles when organizing project networks for smart city innovation? **Six** actor roles emerged from our empirical analysis, some of them, for example, the orchestrator, earlier found in the literature on project networks (Sydow, 2022; Nyström et al., 2014; Dhanaraj & Parkhe, 2006), but less discussed in a multi-actor setting. Non-orchestrator roles, for instance, ii) facilitator, iii) integrator, iv) co-creator, v) tester, and vi) knowledge developer. Additionally, co-creator and blocker emerged from the data. A summary of relevant quotes is presented in Appendix.

The **orchestrator** is the central actor in the network. *In case 1*, two network orchestrators were identified, i.e., URBS, a public organization, and ICI, which is a nonprofit organization. The project idea came from them, and they are seen in the project as both designers and users of the technology developed. Their role emerged from the city hall mandate for project development and coordination for urban mobility improvement. It was through their knowledge of the city's needs that it was possible for the companies to customize the solution. URBS and ICI had a kind of dominant orchestrator style by setting the agenda, recruiting partners, and explaining to them how the solution should be aligned with URBS's objective. URBS' manager highlights: *We booked a meeting with Dataprom and Telefonica/Vivo to explain to them what we needed help with [Project manager, URBS, Case 1].* An interesting observation is that both URBS and ICI behaved as strategic coordinators. I.e., in addition to coordinating the project, they facilitated membership access and have relational skills to gain the cooperation of others. URBS and ICI's main strategy was to create a solution for urban mobility while acting to ensure the implementation of the solution would align with their requirements. This top-down orchestration provided the network with strategic clarity and operational focus, essential for innovation in a complex, multi-actor setting. This was observed when the system was not properly functioning, and ICI was intermediating meetings between URBS and the companies while at the same time working together with URBS' technicians to solve the problem. This suggests that the orchestrator acts as a strategist, in contrast to convening and facilitating the network development as mostly argued by network researchers (see, for example, Dhanaraj & Parkhe, 2006; Heikkinen et al., 2007; Nyström et al., 2014; Sydow, 2022). Furthermore, ICI was acting as a facilitator, working together with companies to make the necessary adjustments to connect the OCC and buses, intermediating meetings, helping to solve conflicts, and giving support to URBS. Interviewees indicated that ICI's role emerged from a constant dialogue with URBS, and ICI sometimes

Table 3
Comparative information about each smart city project.

Case	Goals	Initiative	Key actors	Outcome	Network actors' position	Number of interviews per case	Secondary sources
Curitiba Smart City	Increased transport efficiency and better fleet management.	Municipality	Public actor: URBS, ICI, IPUCC Business actors: Dataprom, Telefonica, Ericsson.	ICT solutions increased the efficiency of transportation, communication, reduced emissions, and energy use.	Public actors URBS (Orchestrator) ICI (Orchestrator) IPUCC Business actors Ericsson Telefonica-Vivo Dataprom.	45	The project's homepage, companies' annual reports, the project's press release, national and international news about the project, UNFCCC report = over 412 pages of documents.
Aguas Smart City	Improve public services in the areas of education, health, security, and transport.	Companies	Public actor: Tourism secretary. Business actors: Telefonica, Ericsson, Huawei, ISPM. Civil society actor: Telefonica/Vivo Foundation and Vanzolini Foundation.	IoT solutions helped to reduce costs for public administration while increasing citizens' satisfaction.	Public actor Secretary of Tourism Private actor Ericsson Telefonica-Vivo (Orchestrator) Huawei. ISPM Civil society actor Telefonica-Vivo Foundation. Vanzolini Foundation	28 73	The project's homepage, companies' annual reports, the project's press release, national and international news about the project, and news on social media concerning the project = 220 pages of documents. 632 pages of documents

serves as a consultant for the public administration, indicating solutions to improve public service, to both the city hall and URBS, suggesting they have a trust-based relationship. This exemplifies how facilitators can evolve from embedded relationships and contextual familiarity, challenging the notion of predefined roles.

In addition to facilitators, Case 1 suggests the existence of blockers such as Setransp. According to the URBS managers, the union sometimes acts to block URBS' projects. They try to create tensions by putting public opinion against URBS. Their discourse is that private administration can provide better public service. The public relationship manager stressed that when they used the media to make accusations about fraud at URBS, all projects were put on hold until external auditing was performed. This implies that Setransp is an actor that uses its role as a service provider to strategize and achieve its private goals. When the system was not yet operating properly, Setransp was skeptical about the technology and demanded meetings and information from URBS. This caused delays in the project development. Although we refer to "blocker" as a role, we clarify that it denotes actor behavior that—intentionally or not—creates friction or obstructs progress.

In Case 2, the orchestrator is a company, i.e., Telefonica/Vivo, which coordinated most of the communication with its business partners and the municipality. Roles, however, have been settled in advance, but more on a consensus basis. In this case, the membership was voluntary, with trust governing relationships among actors. All partners have been collaborating with Telefonica/Vivo in previous projects in Brazil. This trust-based orchestration created a stable environment for innovation. CSR's managers highlighted: *We are happy to participate in this exciting project; it is an opportunity to demonstrate our technology while strengthening our ongoing relationship with Telefonica/Vivo. Additionally, we know each other, we have our practices, and we know what to expect from each other [CSR managers, Ericsson, Case 2]*. Data shows that the business partners refer to the project as 'the Telefonica/Vivo's project in Aguas city'. Moreover, Telefonica/Vivo's leadership role and coordination skills can be observed through the words of managers at Telefonica/Vivo. *We had employees responsible for communicating and coordinating with other partners on what to do together, to settle the routines necessary to accomplish the project [Project Manager, Telefonica/Vivo, Case 2]*. Telefonica/Vivo's orchestration style emphasized coordination over control, aiming to balance formal authority with relational trust. This coordination approach by Telefonica/Vivo underscores the importance of establishing routines and clear communication channels, facilitating collaboration among diverse stakeholders. These practices illustrate how historical relationships, built on prior successful collaborations, current project dynamics, and future aspirations, contribute to nurturing long-term partnerships. This implies that the project networks take on a semi-temporary structure, where actors maintain connections beyond the project timeline, aligning with Sydow's (2022) view. Interviewees in 2022 informed that when the project was implemented, companies organized a workshop in the city and invited mayors from several cities to show how the technology could improve cities. During this phase, Telefonica/Vivo left the orchestrator position and let the city hall take the lead. Managers explained that it is not their job to coordinate cities, and therefore, they return to a role of being a service provider of the technology.

Interestingly, the secretary of tourism became an essential partner for the companies. By acting as a facilitator, but at the individual level, the secretary created a communication channel between companies and the city hall, managed conflicts, reduced bureaucracy, and recruited technicians from the public side to help with the project implementation. Secondary sources (e.g., local business newspapers) show that the secretary advocated in favor of the project by participating in smart city workshops organized by the companies, thus legitimizing the initiative within the public sector. This role emerged from his belief that the project could benefit the city while also enhancing his political visibility, aligning with his aspirations to become secretary of tourism in the next election. His personal motivations, thus, intersected with the project's goals, illustrating how individual motivation can play a key role in promoting innovation. Interviewees in 2022 informed that the tourism secretary was granted four more years as secretary of tourism in Aguas, with the mayor being re-elected.

In Case 2, Telefonica/Vivo also acted as a strategic coordinator. Telefonica/Vivo's main strategy was to foster smart city technologies in Brazil. When asked about possible conflicts concerning roles, managers explained that the role was predetermined, but they affirmed that centrality matters for companies. The main point is that the role brings visibility, increases the likelihood of new business opportunities in comparison to a supporting role, and creates more channels to get access to a new network of partners. A manager at Telefonica/Vivo mentioned: *In one meeting for smart city development, a partner may treat me as a rival, but in another meeting, we end it by shaking hands because we became partners [Innovation consultant, Telefonica/Vivo, Case 2]*. When asked about how to solve such tension, the consultant said: *Sometimes it is ok to perform a non-leadership role and still be part of the project [Innovation consultant, Telefonica/Vivo, Case 2]*. A manager at Telefonica/Vivo Foundation shares a similar view concerning the central position. The manager affirmed: *sometimes it is interesting to be the central actor coordinating a project, mainly if the partner is the government or a university, but sometimes it is also relevant to be part of the conversation, for example, with a group of NGO leaders about what comes next [Project Manager, Telefonica/Vivo Foundation, Case 2]*. These statements indicate the importance of navigating between leadership and supporting roles within the dynamic nature of semi-temporary project networks. It reflects how actors strategically choose their roles to optimize both project outcomes and ongoing relationships. Managers at Ericsson highlighted the following: *We are a B2B company, and sometimes we foster business for our B2C partners. This means we're not always in the lead of a project — but that's perfectly fine. For us, relationships matter most. Providing value and opportunity to our direct customers ultimately brings new business back to us [Managers, Ericsson, Case 2]*. Those statements are in line with what Hernes (2025) named as temporary organizing in project ecology studies - a process that actors anticipate connections to other future, ongoing, or past temporary organizations.

Our findings show that the management role of an orchestrator includes the coordination of tasks and interaction with other actors, setting the routines to be followed, establishing deadlines and goals, selecting partners, as well as solving and intermediating conflicts. This role can be occupied by users or producers. Nyström et al., (2014) do not distinguish who can be an orchestrator in living labs and suggest that there is a need to have a separate coordinator role aiming to support a specific community of actors, for example, users and providers. In contrast, our findings indicate that for smart city development, the orchestrator role should support all actors to achieve the common goal, and it can be a company, a government, or even a public organization. Notably, previous research has also discussed the role of a facilitator. Heikkinen et al., (2007) consider a facilitator an actor role that stays outside of the network, while Nyström et al.,(2014) discuss a facilitator as a role expected to direct users in a specific direction. Our findings suggest that the facilitator in smart city development can be a user or a producer, and is not only part of the network but also contributes to the development process by bringing intangible and/or tangible resources.

Our data show that the integrator is another role observed in both cases. They were the only entities in the network capable of combining technical components into interoperable solutions, enabling real-time data exchange and system functionality. The integrator role in this paper and Nyström et al., (2014) resembles each other in integrating technologies into a functional entity. However, this study goes a step further by comparing the integrator role with the orchestrator role and how actors perceive and relate their roles to other roles in the network.

In Case 1, Dataprom's card validator integrated the connectivity from Telefonica/Vivo and the modem from Ericsson. Through Dataprom's system, it was possible to cross information between the card validator, OCCs, and the buses, which allowed URBS to have better fleet

management. It is relevant to emphasize that the integrator role is intertwined with the orchestrator role, since the orchestrator is the actor who recruited those companies and made this project possible. In Case 2, the integrator of the technology was ISPM, whose role was to connect solutions in education, health, parking, and security into its IoT platform. When asked about the role played by the company, the ISPM's manager explained that: *Through our platform, we connected all solutions and helped to create the smart city project in Aguas [IoT Manager, ISPM, Case 2]*. The manager mentioned that in the case of procurement, the city hall does not need to talk to all suppliers, but only to the integrator. For him, the orchestration role was not relevant, but the actor who puts all pieces of technology together - i.e., the integrator -was key. Again, despite the orchestrator being less knowledgeable about how to integrate all these technologies, the need to have an integrator was identified by the orchestrator. When managers from both companies were asked how their roles emerged in the project, they explained that it was about resource complementarity. That is, the integrator assumed its role due to its technology that enabled the connection of various devices within the system. This smart system facilitated real-time data collection and optimized resource allocation. By enabling interoperability across different components, these capabilities enabled the network to implement new service models—thereby fostering innovation in a complex, multi-actor environment.

The co-creator is a collective role played by the network actors. In this collective role, co-creation is a process, for example, in case 1, the network allowed the integration of companies' ideas, feedback from the bus drivers, and suggestions from ICI. This led to a co-creation process that helped to develop the urban mobility solution. According to the ICI project manager, the bus drivers played an important role in the project because they provided URBS with information about when the technology was or was not working, the main challenges faced, etc. The manager said: *Their feedback helped us to detect failures in the broadband coverage implemented by Telefonica/Vivo [Manager, URBS, Case 1]*. Thus, the co-creator role promoted innovation not only by bringing user needs into the solution's design but also by problem-solving.

In Case 2, the co-creation process is well illustrated by the project manager at the Vanzolini Foundation. The project manager explained that the solution in education required several adjustments to improve communication among students, teachers, and parents. The foundation developed a solution named 'school with mobile phones'. By using mobile phones in schools, a platform was established to engage and educate students and parents about recycling and environmental conservation. To achieve that, it was necessary to educate parents and develop activities in collaboration with teachers to show the benefits of using mobile phones in specific school tasks. The Vanzolini Foundation's manager affirmed that: *Demonstrating how to use mobile phones in pedagogical activities to teachers helped us to show the social contribution of the project [Project manager, Vanzolini Foundation, Case 2]*. Interestingly, mobile phones were not allowed in public schools in Brazil (Law 12.730, 2022). The Vanzolini Foundation wrote a report to the public administration showing the impact of using mobile phones for pedagogical purposes. The project manager mentioned the following: *I left the foundation to become a politician, and one of my missions was to modify this regulation. This project was used to support my arguments and convince legislators [Project manager, Vanzolini Foundation, Case 2]*. When asked about the result, the manager said: *I managed. The law was changed in 2017. Now I am back in my position at the foundation [Project manager, Vanzolini Foundation, Case 2]*. When asked about the importance of the orchestrator's role in this specific solution in education, the manager said: *None, we coordinate all things with the teachers and just informed Telefonica/Vivo what was done [Project manager, Vanzolini Foundation, Case 2]*. As can be noticed, the orchestrator did not influence this part of the project, but the co-creator became an essential process, enabling innovation. In other words, the idea did not originate from the orchestrator; the coordination was done between the managers of the two foundations and the teachers. Also, a significant aspect of the co-creator's process in fostering innovation was linked to its ability to remove barriers via "changes in regulation" that opened new opportunities for civil society organizations and companies to use digital tools in education. These examples reflect the purposeful actions that shape, sustain, or disrupt institutions, in line with Lawrence & Suddaby's framework.

Despite not being directly involved in this part of the project, the orchestrator benefited from the solution created. For example, Telefonica/Vivo's reputation concerning its leadership skills and successful project implementation was perceived by the market, media, and public authorities. Based on the data, we observed that some actors played particularly decisive roles in shaping the direction and outcomes of the innovation. These actors engaged in role-making and problem-solving that went beyond general participation. When comparing our findings with previous research, the co-creator process in smart city development is slightly in line with the co-creator discussed in living labs by Nyström et al., (2014). Our findings, thus, complement previous research by demonstrating that the co-creator, mainly in Case 2, acts as a role-maker and/or role-taker, and this process may occur inside and outside of the project network.

Based on our observation, the tester is another role existent in the cases and differs from Nyström et al., (2014)'s findings, in which testers are the users who experience the technology. In our findings, the tester is the company that validate its technologies to be launched in the market by gathering information and feedback from users. In case 1, companies together with URBS/ICI created and tested the solution for urban mobility in a process of learning by doing. In Case 2, Telefonica/Vivo, together with all private actors and the NGOs, were using Aguas city to test their solutions, with customization being done along with the project development. Thus, companies and NGOs were acting as testers. For the Vanzolini Foundation, the motivation to work on this project was branding. The project manager mentioned the following: *Our participation in this project was an opportunity to demonstrate technologies in education while reinforcing Vanzolini's organizational mission [Project manager, Vanzolini Foundation, Case 2]*. Willingness to test, thus, motivated partners' participation.

Another role that emerged from our data is the knowledge developer's role, which aims to ensure knowledge mobility in terms of how easily knowledge is shared, learned, co-developed, and employed within the project network. In Case 1, the knowledge developer actor was Telefonica/Vivo, who suggested Ericsson to URBS and ICI. Telefonica/Vivo had previously worked with Ericsson on some projects in Brazil and therefore knew Ericsson's technological know-how. Neither Telefonica/Vivo nor Ericsson could predict in advance that Ericsson's modem would bring stability to the system, but the suggestion of a partnership from Telefonica/Vivo to URBS helped to create the urban mobility solution. In addition to that, URBS and ICI, as orchestrators, also acted as knowledge developers, trying to leverage knowledge by bringing Telefonica/Vivo and Dataprom to the project networks. Dataprom was already a supplier of the card validator, but the idea of having 3G technology made them mobilize knowledge from other actors, and this created something new. Ericsson's CSR manager stresses the novelty aspect by saying that: *The modem and its applications were deployed for computers. We adjusted it to be used in buses for this specific project. This granted us new business opportunities in transportation [CSR Manager, Ericsson, Case 1]*. In this case, the orchestrator played the role of both orchestrator and knowledge developer. First, by recruiting both Telefonica/Vivo and Dataprom, URBS, and ICI increased the knowledge within the collaboration, while Telefonica/Vivo also played a role as a knowledge developer by suggesting Ericsson. The above statements and situations show how roles played by actors are used for organizing innovation for smart cities. This implies a dual aspect in the network in which the orchestrator influences its partners by combining the resources of partners that can be translated into innovation, but partners can also influence the orchestrator by suggesting new partners that can add new competencies that the orchestrator may not be knowledgeable about. Hence, innovation for

smart city development is a result of actors' roles and their interactions.

In Case 2, Telefonica/Vivo acted as a knowledge developer by leveraging knowledge from different partners. The role of a knowledge developer was not solely linked to combining different pieces of technology but also linked to relational skills. These skills included building an open information flow within the project network. For example, Telefonica/Vivo applied a flexible management style permitting an informal relationship among members and explicating how resources from different partners could be combined while creating an environment for sharing knowledge. Another actor who played the role of a knowledge developer was ISPM through its IoT platform. ISPM's manager explains the following: *Our software, Netvision, could cross information among all ICT solutions and then extract information, make statistics, and generate big data [Project Manager, ISPM, Case 2].* Most of the time, the orchestrator also plays the role of a knowledge developer. However, the knowledge developer is not solely a role for the orchestrator, since other actors can also leverage knowledge to and from the network and therefore contribute to the overall innovation process. Despite the knowledge developer's suggestions of members, it does not have the final decision concerning which actor to include in the network. Noticeably, our findings display that some actors play the role of a knowledge developer by leveraging and transferring knowledge from different points in the network. The knowledge developer, whom Nyström et al., (2014) describe as actors who only promote relationship building, is not supported in our data. However, Nyström's role of informant comes closest, but it is associated with opinions from users. In our data, knowledge developers are organizations that know producers who have the technological know-how to meet users' needs and therefore may suggest them to the orchestrator.

5.2. Actors' role adoption and creation when organizing smart city project networks: A cross-case analysis

When comparing the two cases, the two networks have a similar structure, i.e., they contain a semi-temporary network structure. Some of the business actors have nurtured a long-term collaboration across projects. Furthermore, there are orchestrators coordinating activities, and non-orchestrators pursuing a supporting but still relevant role in the project networks (see Fig. 1, -Cases 1 and 2). Actors assume different roles, with orchestrators acting as strategic coordinators. Major differences noticed between cases are that in Case 1, the network orchestration was done by the nonprofit organizations, i.e., URBS and ICI, while in -Case 2, the orchestrator is a private actor, i.e., Telefonica/Vivo.

These roles help bridge the temporary nature of projects with a semi-permanent structure in which relationships are nurtured and developed from project to project. Interviews and secondary sources (e.g., URBS's public report, companies' CSR reports) indicated that actors such as URBS and ICI (case 1) and Telefonica/Vivo, Ericsson, Telefonica Foundation, and Vanzolini Foundation (Case 2) have been working on previous projects. This pattern of recurrent collaboration creates practices, routines, and trust-based relationships necessary for project development success. Such continuity challenges the dominant project management literature that assumes "temporariness". Instead, this study highlights how the past and the future of these relationships shape the present, leading to the emergence of a semi-permanent structure within the network. While projects themselves remain bound by their initiation and ending phases, a sense of permanence and continuity is evident at both the relationship and network levels. Additionally, established relationships often facilitate partners' referrals, where actors suggest each other for new collaborations, influencing network membership.

5.3. How do actor roles enable and promote innovation in complex multi-actor settings?

The role of the orchestrator matters in the general project activity, such as coordination and communication among network partners, the ability to support the project network members, skills in leveraging knowledge sharing, etc. Findings indicate that some supporting roles for specific innovation activities during the project became more relevant than the orchestrator per se. Examples include knowledge about how to integrate different pieces of technology, build knowledge in the network, and suggest new partners to the project network, etc. This finding differs from most of the studies within the project networks, which concentrate on examining the role of the central actor in coordinating the innovation activities (see, for example, Steen et al., 2018; Hurmelinna-Laukkanen & Nätti, 2018; Dhanaraj & Parkhe, 2006). However, in this study, both the central and peripheral positions are relevant for smart city project networks, with peripheral positions sometimes becoming even more important in various phases of the project. This was clear in the role of integration and the co-creation process, for instance. Another major difference is that in case 1, we noticed the presence of blockers obstructing the innovation process, while in Case 2, we noticed a role-making process outside of the project network when actors influenced the local institutional environment.

In summary, empirical findings reveal that innovation through project networks for smart cities requires actors to play different roles more than once. We conclude that both the orchestrator and the integrator have important roles in enabling the innovation process, while the tester, co-creator, and knowledge developer are relevant in promoting and supporting the innovation outcome. Proposedly, we do not describe a blocker since we do not recognize it as a role but as an actor or a group of actors who may hinder innovation. These actors usually lack understanding of a new process and its benefits; they do not comprehend the reasons for creating new structures or how the new ideas can positively impact the network. This can happen across companies and their various departments, but also in project networks. Thus, to turn a "block" into innovation development and diffusion, orchestrator managers (see Fig. 2) may allow actors with a profile of blockers to engage in a collective co-creation process, and get them involved in the early stages to eliminate "veto, skepticism, bottlenecks," etc. Alternatively, orchestrator managers need to carefully reduce their bargaining power or influence on other network members to avoid pitfalls and then advance the process of innovation.

6. Discussion

6.1. Actor roles in smart city innovation

By investigating the variety of actor roles and the interplay of roles that make innovation in projects for smart city development possible, this study contributes to our theoretical understanding of both actor roles and project management literature in various ways. First, findings suggest six actor role patterns for smart city innovation: i) the orchestrator and the non-orchestrator, which are ii) facilitator, iii) integrator, iv) co-creator, v) tester, and vi) knowledge developer. These roles were important in shaping the innovation process and promoting ICT solutions for cities. However, some actors may act as blockers, impeding innovation development. Moreover, the orchestrator acted by guiding and supporting the overall tasks as well as helping partners to achieve the goal of the collaboration, while the non-orchestrator played a supporting role that benefited both the project innovation outcome and the image of the orchestrator, who is perceived by the market, public administration, and society as the project leader. The reputation and legitimacy of the central actor have also been enhanced through national and international recognition, for example, by the UNFCCC award in Case 1 and the TM Catalyst Award in Case 2.

Furthermore, we show empirically that the orchestrator matters in the general project activity, for example, coordination and communication among network partners. However, supporting roles in the specific project activity, such as integration of the technology, building knowledge in the network, etc., become even more relevant in certain phases of the project than the role of the orchestrator per se. The

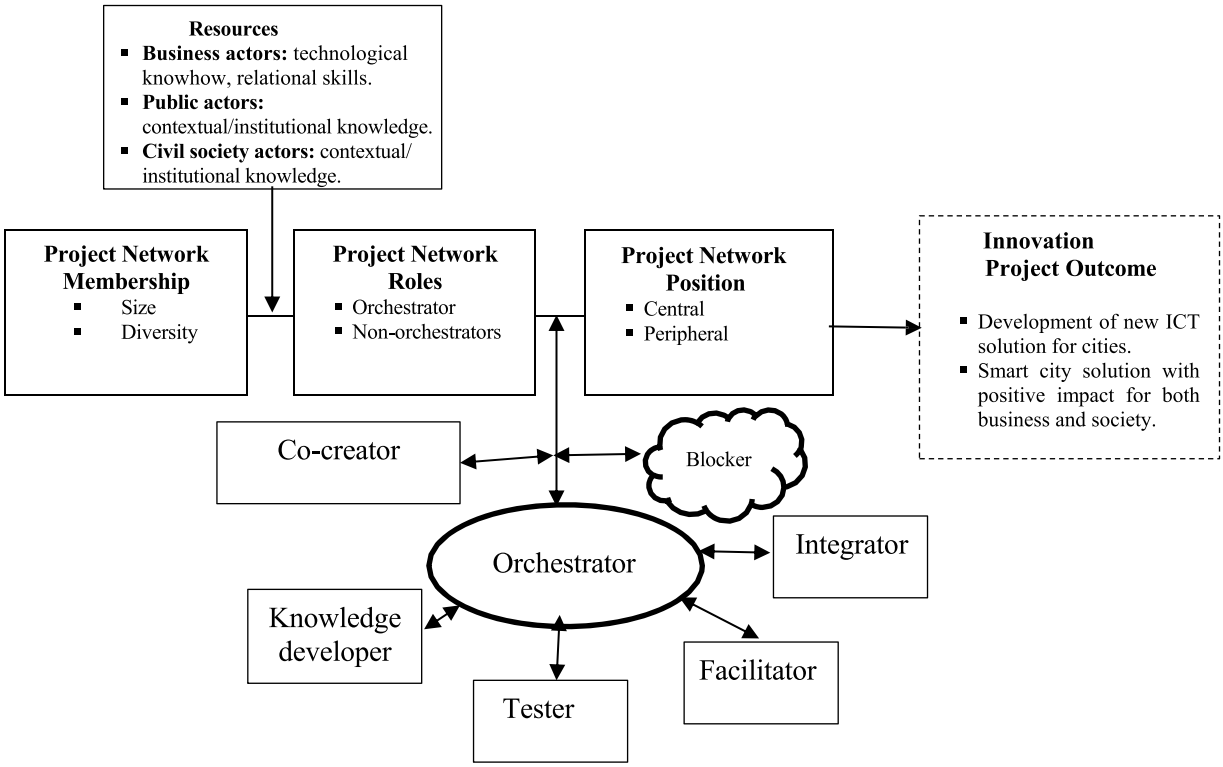


Fig. 2. The role of actors in promoting and enabling smart city innovation.
Single-headed arrows (→): Represent the directional influence of resources on project network roles and positions, as well as the flow from membership → roles → positions → innovation outcome.
Double-headed arrows (↔): Represent reciprocal interactions and collaboration among actors (co-creator, integrator, facilitator, tester, knowledge developer, orchestrator), highlighting knowledge exchange, co-creation, and mutual influence within the network.
Note: The **blocker** is not considered an actor role per se but is represented as a cloud to illustrate potential obstacles that may impede innovation within the project network.

strategic position held by the orchestrator provides visibility and can lead to competition among actors for centrality. However, sometimes it is also strategically relevant to assure project networks' membership and keep the collaboration rather than compete for being the central actor in the project networks (cf. Mäkinen & Dedehayir, 2012). Remarkably, pursuing an orchestrator role may have different strategic choices if the leader is a company, a public organization, or a non-governmental organization. In other words, a successful leadership role in projects for smart cities can be translated into new business opportunities for companies and increases broad-based support if the leader is a governmental organization, since projects can be used by politicians in their electoral campaigns (see Case 1, Appendix), and reinforces NGO's mission while increasing their likelihood of fundraising. This led us to assume that orchestrators are relevant for broad network innovation activities, while non-orchestrator roles are relevant for specific innovation network activities. Hence, the central position brings visibility, but the same firm cannot occupy a leadership role in all projects for a smart city. For that reason, it is sometimes strategically relevant to choose a supporting role while assuring network membership. This highlights a dynamic interplay between different roles depending on the phase and focus of the project. The study further demonstrates that sometimes it can be more advantageous for actors to prioritize sustaining their membership within the project network and promoting long-term collaboration rather than competing for centrality. It also empirically shows the semi-temporary nature of such networks, where actors balance immediate project demands with the potential for future business opportunities through projects.

6.2. *Semi-temporality and relationship continuity*

While projects themselves are temporary, a sense of continuity and permanence is evident at the relationship level. Established relationships often lead to partners' referrals, where actors suggest or inform each other about new collaboration opportunities, such as the repeated involvement of Ericsson and Telefonica in Cases 1 and 2. This suggests that rather than isolated encounters, repeated collaboration creates conditions for developing routines and trust-based relationships necessary for project success.

Our findings from smart city initiatives led us to define a new type of network: Semi-Temporary Project Networks (STPNs), as innovation-oriented, time-bound collaborations among legally and organizationally autonomous actors whose relational ties extend beyond individual project lifecycles. Different from traditional temporary projects and/or permanent organizations (see, for example, Lundin & Söderholm, 1995; Grabher, 2004), STPNs exhibit *semi-temporariness* through recurring collaboration, shared routines, and evolving yet continuous role configurations across projects. Coordination in these networks relies on relational mechanisms— trust, shared objectives, and continuous knowledge exchange— rather than formal hierarchies. These relationships foster cumulative learning and enable adaptive governance within complex, multi-actor settings like smart city innovation initiatives. Although STPNs exhibit similarities to platform projects (Davies et al., 2018), project ecologies (Hernes, 2025; Grabher, 2004), and meta-organizations (Gulati et al., 2012), they differ in how they combine bounded temporarily with sustained inter-organizational continuity and a non-centralized coordination logic. This hybrid form of governance and actor configurations makes STPNs particularly suited to complex multi-actor innovation ecosystems such as those found in smart cities.

This network type, however, does not diminish the value of the theory of temporary organizations (Lundin & Söderholm, 1995) or suggest that they become redundant. Rather, the point is to show that there is a conceptual gap between temporariness and hierarchy (permanent organizations) in the field of project management studies that an STPN lens can help to close. In the following, we discuss the characterization, conditions, and implications of STPNs on project governance.

6.3. Governance in STPNs: characterization, condition, and its implications

STPNs exhibit a unique duality where projects are time-bound, but the relationships and collaborations among actors extend beyond individual projects. This requires governance that can support both the short-term demands of project execution and the long-term maintenance of relational continuity. Thus, STPNs are characterized by evolving actor roles, semi-fluid membership, and shared governance that enable cumulative learning, trust-building, and strategic re-engagement among partners over time. Table 4 summarizes these defining characteristics and their governance implications.

By semi-fluid membership, we refer to a flexible yet stable composition of actors within STPNs. Participants may enter, exit, or re-enter the network across different project phases depending on the project's needs. Empirical findings suggest that this occurs quite often through referrals. This dynamic structure balances adaptability with continuity, maintaining a core group of recurring actors alongside peripheral contributors who shift roles over time. In essence, semi-fluid membership captures the coexistence of stability and change (cf. Feldman & Pentland, 2003), enabling STPNs to respond to evolving innovation challenges. Importantly, governance must facilitate effective onboarding

Table 4
Key characteristics, conditions, and governance implications of semi-temporary project networks (STPNs).

Characteristics of STPNs	Description	What it means	Why it matters (practical relevance)	STPNs Governance implications
Semi-Temporariness	▪ Projects are time-bound, but relationships and collaboration extend across projects.	▪ Project activities are temporary, but the relational structure among actors persists over time. ▪ This duality requires both operational coordination (roles, tasks) and relationship management.	▪ Without trust, actors may hesitate to engage in future collaborations, undermining the long-term value of the network.	▪ Governance must support short-term project execution while cultivating long-term trust.
Semi-Fluid Membership	▪ Core actors return across projects; others join or leave based on needs.	▪ STPNs must accommodate flexible participation, enabling actors to enter or exit at different stages without disrupting project progress. ▪ Some partners may participate in only one phase or cycle, while others may enter or re-enter later.	▪ Unlike fixed project teams, STPNs evolve over time. ▪ When new actors join, there must be a way to quickly share the project context, knowledge, practices, and norms of the network. ▪ Without mechanisms to integrate new actors (onboarding), projects risk delays, inefficiencies, or misalignment.	▪ Governance should enable flexible entry and exit, support role adaptation, and ensure effective onboarding to maintain continuity.
Evolving Actor Roles & Role Dynamics.	▪ Role's shift depending on project phase, actor capacity, and strategic interest.	▪ Actors strategically choose their involvement based on what aligns with their goal, visibility, or future business opportunities. ▪ Actors may step up or back depending on how the project serves their long-term agenda.	▪ This fluidity enhances flexibility but requires clarity and coordination. Without adaptive governance, shifting roles can lead to confusion, gaps in responsibility, or inefficiencies.	▪ Governance structures must support coordination, shared responsibility, and decentralized authority to accommodate changing roles while maintaining project alignment and accountability.
Shared Governance	▪ Not all decisions flow from a single orchestrator; authority is shared.	▪ In STPNs, leadership and decision-making are distributed across actors, allowing contributions based on context, expertise, and project phase.	▪ STPNs are semi-temporary and fluid; rigid hierarchies do not work well. ▪ Shared governance allows flexibility, encourages actor engagement, and reduces reliance on a single decision-making node.	▪ Rigid hierarchies do not suit semi-fluid networks. Shared governance enhances flexibility, promotes engagement.
Trust and Reputation	▪ Ongoing collaboration relies on history, past performance, reputation, and referrals.	▪ Trust and reputation substitute for formal structure, enabling STPNs to function effectively despite their evolving, semi-temporary nature.	▪ In STPNs, where actors re-engage across projects, continuity depends on relational stability. ▪ Trust reduces coordination costs, speeds up collaboration, and encourages cooperative rather than competitive behavior within the network.	▪ Governance must actively support soft elements such as trust-building practices, reputation systems, and relational norms to sustain long-term collaboration. ▪ Soft governance is essential because continuity in collaboration depends on relational stability.
Cumulative Learning across Projects	▪ Knowledge, routines, and relationships carry over to future projects.	▪ Although individual projects are temporary, the network of actors remains connected. Over time, shared practices, mutual understanding, and trust are built.	▪ Learning does not disappear with each project. Instead, it accumulates, enabling foster collaboration and more efficient project execution in future project cycles.	▪ Governance should extend beyond single-project performance to support knowledge retention, shared learning, and practices that strengthen the network over time. ▪ This turns temporary efforts into lasting capabilities.
Strategic Re-engagement	▪ Actors rejoin future projects based on past experience and future project opportunities.	▪ Strategic re-engagement refers to how actors who have worked together in previous projects choose to collaborate in the future.	▪ Long-term collaboration encourages actors to invest in relationships, knowing they may collaborate again. ▪ Familiar partners can reduce time spent on establishing norms, roles, and expectations. ▪ Repeated partnerships facilitate goal alignment. ▪ Encourages actors to behave cooperatively, knowing future collaboration depends on current performance.	▪ Strategic re-engagement is the backbone of the STPNs. Even though the projects are time-bound, the actors' intentional re-engagement turns these temporary efforts into an ongoing strategic ecosystem. Governance must encourage trust, reward reliability, and foster an environment where the best partners want to return.

processes to integrate new actors smoothly, ensuring they quickly acquire the network's shared context, knowledge, and norms to prevent delays or misalignment of goals. As such, STPNs facilitate innovation through diverse actors' contributions and long-term collaboration. This was noticed in the URBS and ICI relationship, in Case 1, and in Ericsson and Telefonica/Vivo, as well as Telefonica Foundation and Vanzolini Foundation in Case 2.

Shared governance in STPNs means that not all decisions flow from a single orchestrator; thus, authority is distributed rather than centralized. This was observed in Case 2 when actors suggested a flexible coordinated approach by Telefonica/Vivo (Case 2) in both the IoT implementation and the solution in education. Shared governance was observed in Case 1 between URBS and ICI. Hence, in STPNs, leadership and decision-making are shared across actors, depending on the context, expertise, and the project cycle. Such shared governance increases flexibility and encourages active engagement by ensuring that responsibilities are not overly dependent on any single actor. Additionally, trust and reputation serve as the essential components holding these semi-temporary networks together, substituting rigid formal hierarchical structures and enabling the network to function effectively despite its evolving and fluid nature. Governance practices, therefore, must actively support trust-building activities, relational norms, and reputation systems, which collectively reduce coordination costs and promote cooperative behavior. This was observed when actors mentioned that they knew each other and their way of working from previous projects (see Cases 1 and 2). Furthermore, STPNs enable cumulative learning across projects, where knowledge, routines, and relationships developed in one project carry over to future collaborations. This was supported when Ericsson mentioned that the project opened doors to opportunities in transportation, something that Ericsson was not known for. This accumulation transforms temporary efforts into long-lasting capabilities.

Lastly, strategic re-engagement becomes the backbone of the STPNs, where previously collaborating actors intentionally reconnect in future project networks. These ongoing partnerships are shaped by prior experience, reputation, performance, and referrals, forming a recursive process (Hernes, 2025) of trust and commitment that encourages actors to behave cooperatively, knowing that current performance influences future collaboration opportunities. This was revealed when actors in Case 2 mentioned the importance of being in this constant dialogue about what project comes next, what they can do together, etc. (see Section 5.1). Governance, therefore, should nurture this environment by valuing reliability and creating conditions that motivate trusted partners to return. Together, these characteristics reflect STPNs as an evolving environment shaped by actors who reinterpret past interactions and anticipate future collaborations. Effective governance balances operational coordination (tasks) with relational management (teams), enabling the network to adapt dynamically while sustaining continuity and trust.

In this study, we propose a conceptual framework (see Fig. 1) to illustrate the roles of actors in enabling and promoting innovation for smart cities. The framework illustrates that innovation through project networks requires project network membership, project network roles, and project network position, supported by both case data and theoretical discussion on actor roles and centrality (Mäkinen & Dedehayir, 2012). This implies that, by being part of a network, actors may assume roles and positions for the development of specific innovation activities (see Fig. 2). Thus, project networks are a distinct organizational form characterized by connections, ties, and relationships that actors maintain beyond the project timeline. Therefore, this complements the research on classical project-based (PSO) and project-based organizations (PBO).

Combining the three above elements of the framework, this paper has unpacked the box of the actor role by showing, from a project network perspective, both how actors pursuing certain roles contribute to the overall project development and how orchestrator and non-orchestrator roles are relevant in different phases of the project. These roles shaped the innovation outcome, which was the creation of a smart city with new ICT solutions. From a theoretical perspective, roles in line with Nyström et al., (2014) suggest a process in which an actor first agrees on or has a pre-established role, then starts to transform the role to perform those activities that, on one hand, are required from the project networks to create the technological solution and then a business and societal value, and on the other hand, align with the actor's own goals and actions. However, these roles are not static, and actors assume roles along with project development. Fig. 2 depicts this dynamic interplay with both directional influence (→) and reciprocal collaboration (↔), showing how innovation results from knowledge exchange, co-creation, and mutual adjustment among actors. A blocker, represented as a cloud, indicates potential obstacles that may impede progress. As a result, the innovation process and outcome become a result of the partners' interactions through the roles they assume in the project networks. Hence, the combination and interplay of these roles enable the innovation process and promote the innovation output.

7. Theoretical contributions

Our contributions are threefold. First, we contribute to the actor roles and innovation literature (Biddle, 1986; Dhanaraj & Parkhe, 2006) by moving beyond static role typologies by emphasizing the interplay of roles, their temporal dynamics, and strategic positioning within project networks. By doing so, this study provides a more dynamic understanding of how actors contribute to innovation over time, especially in complex settings like smart cities. Second, we contribute to project studies by introducing the concept of Semi-Temporary Project Networks (STPNs) as a new theoretical category that explains hybrid forms of organizing. While previous literature on project management (e.g. Sydow, 2022) acknowledges that a relationship continuity often extends beyond the project itself, we explicitly argue that STPNs challenge the traditional dichotomy between temporary and permanent organizations (Lundin & Söderholm, 1995; Grabher, 2004) and respond to recent calls to better understand blurred temporal boundaries in public innovation initiatives (Hernes, 2025) by demonstrating how recurring collaborations, referrals, and shared routines create a semi-permanent structure within time-bounded projects. This notion of temporariness distinguishes STPNs from related constructs, such as meta-organizations, ecosystems, and platform projects. Additionally, we offer a comprehensive framework (*roles, membership, and positions*) to theorize semi-temporariness—a concept previously discussed but not fully developed in project network literature. The study also extends the business-in-networks literature (Havila, 1996; Anderson et al., 1998) by introducing STPNs, which capture the in-between nature of networks – neither fully temporary nor permanent – and showing how interactions, continuity, and interdependence drive innovation. Moreover, this study enriches ecosystem literature by introducing a temporal and adaptive dimension. While Adner (2017) presents ecosystems as relatively stable configurations requiring initial alignment, this study shows that in project-based ecosystems like smart cities, alignment must occur repeatedly over time. Actors may shift from orchestrators to non-orchestrators' roles (or vice versa) depending on the project, strategic priorities, or contextual factors. These findings extend Adner's view by showing that innovation is often driven by cumulative, trust-based collaboration, not by static role tasks.

Much prior research emphasizes the orchestrator role, its characterization, and its centrality to manage project networks (e.g., Sydow, 2022; Hurmelinna-Laukkanen & Nätti, 2018). However, this study emphasizes the importance of examining the interplay of roles (*orchestrators and non-orchestrators*) and how both contribute to project success in different ways and at different stages. A deeper understanding of the roles and their interactions can advance both project management and project network theory. In sum, the study demonstrates how roles, positions, and resources interact dynamically to drive innovation in smart

city projects, providing a strong theoretical foundation for future research in this area.

7.1. Managerial implications

This study also contributes to practitioners by providing managers with a better understanding of the complexity involved in smart city development. There are many roles and different responsibilities expected to be played by actors in smart city projects. Managers acting as orchestrators need a clear view of how the innovation activities (e.g., customization) should be adjusted. This also requires relationship development with a range of partners (e.g., business, government, and society). Based on the notion that firms change roles from project to project, managers also learn about the non-orchestrator roles. This suggests that managers need to recognize in advance when to assume an orchestrator role to increase the firm's performance, and when playing a more supporting role will be significant for relationship development with other actors in the project networks, while granting them future business opportunities. Furthermore, projects developed with the public administration may have actors who use their role to create bottlenecks. Thus, identifying these actors and anticipating their actions is necessary for decision-makers interested in strengthening the means of implementation. Developing, for example, contingency plans can help mitigate such challenges, particularly when dealing with public administration.

7.2. Limitations and future research

Some limitations of this study lead to directions for future research. First, it is based on two cases within the ICT industry; thus, conclusions need to be tested through other cases in different industries, for instance. Second, while we focused on actor roles enabling and promoting smart cities that involve the high-tech industry, a natural question arises as to whether the results will be similar when actors belong to a more traditional industry, for example, mining. Those roles are context-specific and may vary from project to project. Furthermore, we encourage more research on how innovation through project networks is organized and strategized through the actor roles. For example, which other roles matter in multi-actor innovation projects that benefit business and society? Importantly, there is a need to explore how orchestration unfolds in contested or politically complex urban contexts, where control, power, or resources are disputed or unstable.

8. Conclusion

This study investigated the interplay between roles, governance, and innovation within smart city project networks, guided by two research questions:

1. How do actors adopt or create roles when organizing project networks for smart city innovation?
   - Six distinct actor roles were identified, reflecting dynamic role adoption shaped by long-term relationships and historical collaborations that often transcend individual project boundaries.
   - These interactions form a semi-permanent network characterized by trust-based practices, routines, and shared knowledge, consistent with Sydow's (2022) concept of semi-permanent project networks.
   - Actors' past experiences and future aspirations for new business opportunities influence current project dynamics and network membership.
2. How do roles enable and promote innovation in complex, multi-actor settings?
   - Orchestrators play a pivotal role in coordinating and managing project activities, but findings suggest that supporting roles for specific innovation activities (e.g., integrating technologies or building network knowledge) can become more crucial than the orchestrator's role in certain project phases.
   - Different governance approaches exist depending on the actor types (e.g., nonprofit versus private company). A successful leadership role in smart city projects can bring diverse benefits, depending on the choice of who will lead. For companies, it translates into new business opportunities, while for governmental organizations, it enhances public support, as projects can be leveraged by politicians during electoral campaigns. Similarly, for NGOs, such roles reinforce their mission and improve fundraising prospects.
   - Innovation emerges from the dynamic interplay between central (orchestrators) and peripheral (non-orchestrators) roles, with peripheral actors sometimes acting as key contributors and blockers/co-creators influencing the institutional environment.
   - Successful innovation depends on actors repeatedly playing diverse roles, balancing competition for centrality with maintaining collaboration and network membership.

Through a data-driven approach following an abductive logic, we proposed, thus, a conceptual framework (see Fig. 1) integrating project network membership, roles, and positions for enabling and promoting innovation in smart city innovation. This led to the identification of Semi-Temporary Project Networks (STPNs), a novel network form characterized by time-bound yet recurrent collaborations that extend beyond individual project lifecycles. While not part of the framework itself, the STPN builds directly from its analytical insights, offering a theoretical contribution that helps explain how innovation unfolds across interconnected project network constellations in smart city contexts.

While prior research focuses primarily on the orchestrator role and its attributes in managing projects (e.g., Sydow, 2022; Nyström et al., 2014), there is a critical lack of theorizing regarding which other roles, non-orchestrators for instance, and the combination of roles, may promote and/or hinder innovation in smart cities. This paper takes a step towards this. Smart city project networks are, in most cases, organized to address societal grand challenges such as a pandemic, climate change, etc., mostly existing in cities. Therefore, more studies are crucial to facilitating social transformation. We hope our examination of semi-temporary project networks and roles has provided a good basis for subsequent research in this intriguing area.

CRediT authorship contribution statement

Emilene Leite: Writing – review & editing, Writing – original draft, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work

Appendix. From raw data to aggregate dimensions in theorizing, illustrated with supporting quotes

Raw data (Some Quotes) CASE 1 – Curitiba urban mobility	First-order code	Second-order code	Aggregate dimension
We were committed to solving the communication problem while being open to new ideas [URBS Innovation Manager] URBS was very committed to having the project implemented [ICI's Project Manager] We checked all companies' equipment to assure that they met all requirements necessary for a public purchase [URBS' Project Manager]. We at URBS and ICI are in constant dialogue about what and where to improve. We know each other quite well; we are collaborators, we have our ways of doing things together [ICI Managers].	Collaboration structuring & shared governance	Project coordination	**Orchestrator/ facilitator**
After the implementation of the whole technology inside the 1500 buses, we needed to check again and again to identify the problem. It was a stressful time [ICI's Project Manager] URBS's interests were in fleet management in real-time. Thus, we sought partners that could help us [Dataprom's Relationship Manager].	Seeking technical partnership for resource integration	Evolving actor roles & role dynamics	**Integrator/ knowledge developer**
The project allowed us to show how our technology can contribute to people's lives [Ericsson's Communication Manager] Technology was tested as it was developed [Dataprom's Relationship Manager].	Ongoing testing during development/ embedded experimentation	Evolving actor roles & role dynamics	**Tester**
While we were discussing how to bring stability to the system, we also developed training for the personnel at both URBS and Setransp [ICI's Solution Manager] The feedback from bus drivers helped us to detect a failure in the broadband coverage employed by Telefonica/Vivo [URBS' Project Manager]	Feedback-driven technical discovery, training as a tool for cumulative learning.	Co-creation process, shared governance, and enablers of innovation.	**Co-creator/ orchestrator**
We did not know where the project would lead us, but we knew Curitiba's know-how in public transportation, thus we wanted to take part in this project and have our image associated with the city. [Ericsson's Communication Manager]	legitimacy, reputation.	Trust mechanisms.	**Informant/ tester**
We arranged many meetings at the ICI office [ICI Project Manager] Beto Richa is the first mayor in Brazil to give talks at the World Week of Urban Mobility in Seoul [Beto Rita, Political Campaign]	Process facilitation	Evolving actor roles & role dynamics	**Facilitator**
The transport companies do not like our control system. (URBS Technical Director)	Resistance, institutional pushback.	Innovation constraint.	**Blocker**

Raw Data (Some Quotes) CASE 2 – Aguas Smart City	First-Order Code	Second-Order Code (Role/Pattern)	Aggregate Dimension
Every company wants to play a role as an orchestrator, but it is not possible to play such a role in every city we work in. Thus, we change roles from project to project, playing sometimes as orchestrators and sometimes playing a supporting role. It is good for the business [Telefonica/Vivo's Manager]. The network is very dynamic, and it generates conflict all the time. In a meeting for smart city development, a partner will treat me as a rival, but in another meeting, we ended it by shaking hands because we became partners. [Telefonica/Vivo's Manager]. Telefonica/ Vivo had a leadership role; thus, we started by talking to the city hall to understand the city's needs and demands, and then we invited partners that could address the needs, etc. [Head of Innovation at Telefonica/Vivo] When we talk about the project in the media, we mention the names of our partners, for instance, Ericsson, Huawei, etc. We always put the partner together with us. It is a win-win game, and we all benefit from the collaboration [Telefonica/Vivo's Manager]	Collaboration structuring & shared governance	Project coordination	**Orchestrator**
Our role was to enhance the use of mobile phones for pedagogical purposes, increase student-teacher interaction, etc. [Vanzolini Foundation's Sustainable Project Manager]. Our role in this project allowed us to be in business meetings with new partners, for example, Telefonica Group in Spain [ISPM's Innovation Director].	Trust mechanisms, strategic re-engagement	Evolving actor roles & role dynamics Routines & cumulative learning.	**Integrator/co-creator/ tester/integrator**
I was interested in the project's social impact, firstly in terms of cost reduction, and then in helping us to improve the public service to the residents. Therefore, we were open to companies testing their technologies. [Tourism Secretary, at Aguas] We – at Ericsson, are a B2B company, but we foster business to our partners on the B2C side of their business. For example, Telefonica/Vivo is one of our major partners in Brazil. We have developed other projects together, for example, Project Belterra at Amazon and Connect to Learn in public schools. We know each other quite well; we develop our ways of working together [Ericsson Sustainability Managers].	Openness to the pilot project	Evolving actor roles & role dynamics	**Tester/facilitator**
Showing teachers how to use mobile phones in teaching activities while encouraging better engagement among teachers, students, and parents contributed to demonstrating the project's social impact [Vanzolini Foundation's Project Management] The solution in health has motivated residents and helped the public administration to prevent the proliferation of dengue mosquitoes [ISPM's Innovation Manager]	Co-designing solutions with social impact. Enablers of innovation with citizen engagement	Collaboration structure/ shared governance Enablers of innovation.	**Co-creator**
Our software Netvision can cross information from all ICT solutions implemented in this project and then extract information, make statistics, and generate big data [Innovation Director at ISPM] Our software creates and sends reports to the public administration about what	Enabling system-wide data use. Technological infrastructure	Collaboration structure/ shared governance	**Knowledge developer/ integrator**

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(*continued*)

Raw Data (Some Quotes) CASE 2 – Aguas Smart City	First-Order Code	Second-Order Code (Role/Pattern)	Aggregate Dimension
is going on and what needs attention, [ISPM's Director of Innovation] Smart city solution requires a network solution in which several partners bring different expertise [ISPM's Innovation Manager]			
I tried to reduce all the bureaucracy to speed up the project development and implementation [The Secretary of Tourism]	Reducing barriers	Enablers, trust mechanisms.	**Facilitator**

References

Anderson, H., Havila, V., Andersen, P., & Halinen, A. (1998). Position and role-conceptualizing dynamics in business networks. *Scandinavian Journal of Management, 14*(3), 167–186.

Adner, R. (2017). Ecosystem as structure: An actionable construct for strategy. *Journal of Management, 43*(1), 39–58.

Bayne, L., Schepis, D., & Purchase, S. (2017). A framework for understanding strategic network performance: Exploring efficiency and effectiveness at the network level. *Industrial Marketing Management, 67*, 134–147.

Biddle, B. J. (1986). Recent development in role theory. *Annual Review of Sociology*, 67–92.

Blackburn, S. (2002). The project manager and the project-network. *International Journal of Project Management, 20*(3), 199–204.

Burt, R. S. (2009). *Structural holes: The of competition*. Harvard University Press.

Cantù, C., Corsaro, D., & Snehota, I. (2012). Roles of actors in combining resources into complex solutions. *Journal of Business Research, 65*(2), 139–150.

DeFillippi, R., & Sydow, J. (2016). Project networks: Governance choices and paradoxical tensions. *Project Management Journal, 47*(5), 6–17.

Di Maddaloni, F., & Sabini, L. (2022). Very important, yet very neglected: Where do local communities stand when examining social sustainability in major construction projects? *International Journal of Project Management, 40*(7), 778–797.

Dhanaraj, C., & Parkhe, A. (2006). Orchestrating innovation networks. *Academy of Management Review, 31*(3), 659–669.

Dubois, A., & Gadde, L. E. (2002). Systematic combining: An abductive approach to case research. *Journal of Business Research, 55*(7), 553–560.

Eisenhardt, K. M., & Graebner, M. E. (2007). Theory building from cases: Opportunities and challenges. *Academy of Management Journal, 50*(1), 25–32.

Feldman, M. S., & Pentland, B. T. (2003). Reconceptualizing organizational routines as a source of flexibility and change. *Administrative Science Quarterly, 48*(1), 94–118.

Gawer, A. (2021). Digital platforms' boundaries: The interplay of firm scope, platform sides, and digital interfaces. *Long Range Planning, 54*(5), Article 102045.

Grabher, G., & Thiel, J. (2014). Coping with a self-induced shock: The heterarchic organization of the London Olympic games 2012. *Social Sciences, 3*(3), 527–548.

Gioia, D. A., Corley, K. G., & Hamilton, A. L. (2013). Seeking qualitative rigor in inductive research: Notes on the Gioia methodology. *Organizational Research Methods, 16*(1), 15–31.

Glaser, B. G., Strauss, A. L., & Strutzel, E. (1968). The discovery of grounded theory: Strategies for qualitative research. *Nursing Research, 17*(4), 364.

Gulati, R., Puranam, P., & Tushman, M. (2012). Meta-organization design: Rethinking design in interorganizational and community contexts. *Strategic management journal, 33*(6), 571–586.

Gupta, S., & Polonsky, M. (2014). Inter-firm learning and knowledge-sharing in multinational networks: An outsourced organization's perspective. *Journal of Business Research, 67*(4), 615–622.

Havila, V. (1996). International business-relationship triads: A study of the changing role of the intermediating actor (Doctoral dissertation, Företagsekonomiska institutionen, Uppsala University).

Heidenreich, S., Landsperger, J., & Spieth, P. (2016). Are innovation networks in need of a conductor? Examining the contribution of network managers in low and high complexity settings. *Long Range Planning, 49*(1), 55–71.

Heikkinen, M. T., Mainela, T., Still, J., & Tähtinen, J. (2007). Roles for managing in mobile service development nets. *Industrial Marketing Management, 36*(7), 909–925.

Hellgren, B., & Stjernberg, T. (1995). Design and implementation in major investments—a project network approach. *Scandinavian journal of management, 11*(4), 377–394.

Henders, B. (1992). *Positions in industrial networks: Marketing newsprint in the UK*. Doctoral dissertation, Department of Business Studies [Företagsekonomiska institutionen], Univ.[distributör].

Hernes, T. (2025). Ecologies of temporary organizations. *Project Management Journal*, Article 87569728251324097.

Hurmelinna-Laukkanen, P., & Nätti, S. (2018). Orchestrator types, roles and capabilities–A framework for innovation networks. *Industrial Marketing Management, 74*, 65–78.

IBGE (2024) – Instituto Brasileiro de Geografia e Estatística. Last time accessed on January 10, 2025. https://www.ibge.gov.br/en/cities-and-states/pr/curitiba.html.

Innovate (2023). CURITIBA – THE MOST INTELLIGENT CITY IN THE WORLD – Innovations of the World. Last time accessed on April 19, 2025.

Klerkx, L., & Aarts, N. (2013). The interaction of multiple champions in orchestrating innovation networks: Conflicts and complementarities. *Technovation, 33*(6–7), 193–210.

Klessova, S., Engell, S., & Thomas, C. (2022). Dynamics of couplings and their implications in inter-organizational multi-actor research and innovation projects. *International Journal of Project Management, 40*(5), 547–565.

Koops, L., Bosch-Rekveldt, M., Bakker, H., & Hertogh, M. (2017). Exploring the influence of external actors on the cooperation in public–private project organizations for constructing infrastructure. *International Journal of Project Management, 35*(4), 618–632.

Kroh, J., & Schultz, C. (2023). The more the better? The role of stakeholder information processing in complex urban innovation projects for green transformation. *International Journal of Project Management, 41*(3), Article 102466.

Law 12.730 Assembleia Legislativa do Estado de São Paulo. https://www.al.sp.gov.br/norma/?id=74333, Last time accessed on January 14, 2022.

Lawrence, T. B., & Suddaby, R. (2006). *1.6 institutions and institutional work, 2* pp. 215–254). The Sage handbook of organization studies.

Leite, E., & Bengtson, A. (2018). A business network view on value creation and capture in public-private cooperation. *Industrial Marketing Management*.

Leite, E., Pahlberg, C., & Åberg, S. (2018). The cooperation-competition interplay in the ICT industry. *Journal of Business & Industrial Marketing, 33*(4), 495–505.

Leite, E. (2020). *Cross-Sector partnership in smart city development: The case of Brazil*. Efosa.

Leite, E. (2022). Innovation networks for social impact: An empirical study on multi-actor collaboration in projects for smart cities. *Journal of Business Research, 139*, 325–337.

Leong, C., et al. (2024). Coordination in a digital platform organization. *Information Systems Research, 35*(1), 363–393.

Lievens, A., & Blažević, V. (2021). A service design perspective on the stakeholder engagement journey during B2B innovation: Challenges and future research agenda. *Industrial Marketing Management, 95*, 128–141.

Lim, Y., Edelenbos, J., & Gianoli, A. (2023). Dynamics in the governance of smart cities: Insights from South Korean smart cities. *International Journal of Urban Sciences, 27*(sup1), 183–205.

Mäkinen, S. J., & Dedehayir, O. (2012, June). *Business ecosystem evolution and strategic considerations: A literature review* (pp. 1–10). *Technology and Innovation*.

Manning, S. (2005). Managing project networks as dynamic organizational forms: Learning from the TV movie industry. *International Journal of Project Management, 23*(5), 410–414.

Maoret, M., Massa, F. G., & Jones, C. (2011). Toward a project as events perspective. *Project-based organizing and strategic management* (pp. 427–444). Emerald Group Publishing Limited.

Möller, K., & Svahn, S. (2006). Role of knowledge in value creation in business nets. *Journal of Management Studies, 43*(5), 985–1007.

Nam, T., & Pardo, T. A. (2011). Smart city as urban innovation: Focusing on management, policy, and context. In *Proceedings of the 5th international conference on theory and practice of electronic governance* (pp. 185–194).

Nyström, A. G., Leminen, S., Westerlund, M., & Kortelainen, M. (2014). Actor roles and role patterns influencing innovation in living labs. *Industrial Marketing Management, 43*(3), 483–495.

Patton, M. Q. (1990). *Qualitative evaluation and research methods*. SAGE Publications, inc.

Pirson, M., & Turnbull, S. (2011). Toward a more humanistic governance model: Network governance structures. *Journal of Business Ethics, 99*, 101–114.

Reypens, C., Lievens, A., & Blazevic, V. (2021). Hybrid orchestration in multi-stakeholder innovation networks: Practices of mobilizing multiple, diverse stakeholders across organizational boundaries. *Organization Studies, 42*(1), 61–83.

Roehrich, J. K., Kalra, J., Squire, B., & Davies, A. (2023). Network orchestration in a large inter-organizational project. *Journal of Operations Management, 69*(7), 1078–1099.

Shergold, P. (2008). Governing through collaboration. *Collaborative Governance, 13*, 13–22.

Steen, J., DeFillippi, R., Sydow, J., Pryke, S., & Michelfelder, I. (2018). Projects and networks: Understanding resource flows and governance of temporary organizations with quantitative and qualitative research methods. *Project Management Journal, 49*(2), 3–17.

Sydow, J. (2022). Studying the management of project networks: From structures to practices? *Project Management Journal, 53*(1), 3–7.

Valta, J., & Leite, E. (2025). Designing an energy community operator. *Citizen Participation in Sustainable Urban Development, 129*.

Verwaal, E., & Hesselmans, M. (2004). Drivers of supply network governance: An explorative study of the Dutch chemical industry. *European Management Journal, 22*(4), 442–451.

Yin, R. K. (2017). *Case study research and applications: Design and methods*. Sage Publications.