

Creating urban platforms – opportunities and challenges for innovation in commercial real estate development

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Abstract

Current theories of commercial urban development are dominated by a concept of linearity that poorly accommodates the demands of adaptation posed by the pace of change in digital developments, which is in marked contrast to the pace of change in physical developments. In the hi-tech sector, the application of platform ecosystems has been employed to accommodate innovation and change. This paper explores the potential application of platform ecosystem theory to the commercial urban development process, where there is now great uncertainty regarding the future economic implications and societal requirements of physical commercial space. The boundary conditions for value creation in platform ecosystems: modularity, standardization, complementarity, and connectivity, are explored through a survey of key actors in recently completed commercial urban developments. The analysis identifies significant differences in the capacity of public and private sector actors to promote platform ecosystem emergence, particularly in the complementary action of development participants. The application of an approach to urban development based on a platform ecosystem might offer great opportunities but will be held back by the major challenges identified in this paper.

Keywords: urban development, platform ecosystem, value creation, complementarity, modularity, connectivity

Introduction

The pace of change affecting urban built environments has increased remarkably in recent decades. Climate change and carbon reduction commitments are altering the existing systems, such as in energy production and transportation. In addition, the digital revolution is changing the traditional business models of fields such as retail, transportation, and hospitality in a way not previously seen (Rydin, 2010). As a consequence, the socio-technical infrastructures of a city need to be increasingly adaptive to support innovations, socio-technological transitions, and sustainability (Hodson & Marvin, 2010; Säynäjoki, Inkeri, Heinonen, & Junnila, 2014). Yet, the existing urban development regimes are dominated by linearity – a search for the right solution based on the prevailing rationality (Davies, 2004; Healey 1991; Inness & Booher, 1999; Rydin, 2010; Säynäjoki et al., 2014).

Linear and hierarchical models of management are known for their efficiency (Teece, 1986; Williamson, 1979), but are less suitable during highly unpredictable technological and market shifts (Velu, Barrett, Kohli, & Oliver, 2013). Adopting a more systemic view of urban development with an emphasis on partnerships, networks, co-creation of value, and the promotion of innovation and adaptability is required (Doak & Karadimitriou, 2007; Guy & Harris, 1997; Hodson & Marvin, 2010;

E. Klijn & Koppenjan, 2000; Kuronen, 2011; Trevillion, 2002; Weltevreden, Atzema, & Frenken, 2005). However, there is lack of research on how systemic conceptualizations of urban development may be operationalized and utilized in empirical research to be used as a basis for recommendations for policymakers and practitioners.

In the hi-tech sector, a platform ecosystem has been used as a concept to describe a technology based business system that is constructed around a central point of control, the platform (Ceccagnoli, Forman, Huang, & Wu, 2012; Cusumano & Gawer, 2002; Gawer & Cusumano, 2008). Through shared resources of the platform, organisations leverage their own performance and co-create value through specialization and complementary offerings (Gawer & Cusumano, 2002; Llwellyn D. W. Thomas, Autio, & Gann, 2014). Value-creation in a changing environment rests on the platform ecosystem's ability to adapt and evolve (Bresnahan & Greenstein, 1999; Cusumano & Gawer, 2002; Llwellyn D. W. Thomas et al., 2014).

In this paper, we argue that platform ecosystem theory can provide a non-linear approach to analyse the adaptive capacity of urban developments. Our aim is to identify the opportunities and challenges related to shifting current urban development practices towards a more systemic and adaptive approach. Specifically we ask:

- *How does the current process of urban commercial development promote the creation of platform ecosystems to potentially support a more adaptive urban design process?*

In order to consider this research question, we build our study on a comprehensive review of platform ecosystems by Thomas et al (2014), which identified the concepts of modularity, connectivity, standardization and complementarity as the key boundary conditions for the value creation potential of platform ecosystems. Hence, our two research sub-questions:

- *How are the boundary conditions of value creation in platform ecosystems: modularity, standardisation, complementarity and connectivity, currently implemented in urban commercial developments?*
- *How does the implementation of the boundary conditions vary between the key actors of urban commercial development?*

The paper is divided into four parts. First, through a literature review, we set out the evidence that urban development can be conceptualized as a systemic process and analysed through the platform ecosystem lens. Second, we present the methodology of the study. We also present the data collected through a survey targeted at key actors in commercial development. Third, the results of the analysis are introduced identifying significant differences in the capacity of public and private sector actors to promote the creation of platform ecosystems. Fourth, the key findings and conclusions are discussed.

Urban developments as platform ecosystems

Urban areas as ecosystems

Business ecosystems are dynamic and purposive networks whose participants co-create value based on non-linear value creation, non-market governance mechanisms, and co-evolution of participants (Adner & Kapoor, 2010; Iansiti & Levien, 2004; Jacobides, Knudsen, & Augier, 2006; Moore, 1993; Pierce 2009; Ritala, Agouridas, Assimakopoulos, & Gies, 2013; Teece, 2007). The similarities of cities with ecological systems has already been recognized in the 1980s in academic literature concerning city developments and planning (e.g. Harvey, 1989; Mäntysalo 2000; Kuronen, 2011). Concepts such as complex adaptive systems (CAS) and adaptive non-linear networks, discussed by previous writers have direct linkages with a business ecosystem concept (Doak & Karadimitriou, 2007; Inness & Booher,

1999; Peltoniemi & Vuori, 2004). Urban areas specifically are locally bound systems of economic activity, combining a complex network of different actors: developers, residents, service providers, financiers, and public authorities that in a co-evolving way produce value for a number of stakeholders and customers, such as residents, local businesses and communities (Luhmann, 1990 & 1995, Mäntysalo, 2000; Inness & Booher, 1999; Trevillion, 2002, Healey, 1998).

The platform of an ecosystem is made up of the services, tools, technologies, standards, and other assets that other members of the ecosystem can use to enhance their own performance and co-create value through specialization and complementary offerings (Gawer & Cusumano, 2002; Iansiti & Levien, 2004a; Li, 2009; Nambisan & Sawhney, 2011; Thomas, Autio, & Gann, 2014). A platform exhibits a diversity of ownership and control, of both the complementary assets and the components that make up the platform (Cusumano & Gawer, 2002; Gawer & Henderson, 2007).

The success of a platform ecosystem is based on its ability to create value for the actors connected to the platform. The value can be innovation leverage, production leverage (i.e. the (re)use of a collection of assets and the interfaces and standards that enable sharing these to drive economies of both scale and scope), or transaction economies leverage (Llwelllyn D. W. Thomas et al., 2014). These leverages in turn are affected by the technological architecture of the platform. In their recent, comprehensive review on platform ecosystem literature, Thomas et al (2014) identify the concepts of modularity, connectivity, standardization and complementarity as the key boundary conditions for the value creation potential of platform ecosystems' technology architecture (Thomas et al., 2014). In this study, we build on these boundary conditions.

Value creation of the actors in urban areas is connected to the physical infrastructures of the city. The city infrastructure and institutions can be seen as a platform for multiple forms of value creating activities that operate on and utilize a shared technological and institutional basis such as logistic systems, utilities, city planning, construction regulations, and safety.

In addition, existing academic research has identified business ecosystems to be organized around a shared focal point, such as location (Adner & Kapoor, 2010; Teece, 2007), central organization (Moore, 1993), or technology platforms (Thomas, Autio, & Gann, 2014). In the literature, urban development is defined as a spatial process, comprising of the technical infrastructure, services, and contractual and institutional arrangements related to a location (Webster, 2003). Thus, we conclude that urban areas are ecosystems, organized around *both* a shared location and technological platforms.

Urban development as platform creating process

Urban development is as a spatial development activity aiming at organising the interests of network of actors and coordinating of their actions in goal-oriented, purposive ways directed to achieving desired development goals (Gualini & Majoor, 2007).

Institutional models of urban development focus on the roles, behaviour and decision making of different actors, their relationships and related impact on the development outcome (Ball, 1998 in Guy & Hennenberry 2002). D'Arcy & Keogh (2002) present an institutional hierarchy of property markets on three levels: the institutional environment, the property market as an institution, and property market organisations. Organisations involved in urban development include public representatives, consultants, financiers, constructors, and clients directly or indirectly involved in commercial property while institutions comprise of the practices and networks that influence the ways in which organisations and individuals operate and interrelate (Ball et al., 1998).

According to Thomas & Autio (2014), the concept of an ecosystem shares several characteristics with the traditional institutional approach. First, both constructs address the network of actors being

embedded within a network that influences the power of each participant to capture or direct the actions taken (D'Arcy & Keogh, 2002). Second, both ecosystems and organizational fields have governance systems which consist of regulative and normative elements. Third, both address the need for joint logic that constitutes its organizing principles and is available to organizations and individuals to elaborate. The ecosystem construct also adds the aspect of collective value creation to the traditional institutional approach.

Existing literature on platform ecosystem emergence has identified four key phases in a platform's life cycle: birth, expansion, leadership, and self-renewal (Moore, 1993). During these phases, the involvement of different actors and the resources employed vary by their type and intensity.

Event-sequence models unpack the urban development process into its constitutive events (e.g. Miles et al., 2000, Syms, 2002, Goodchild and Munton, 1985). Cadman and Austin-Crowe (1978), in their classic work divide the development process into four events: evaluation, preparation, implementation, and disposal. Säynäjoki, Inkeri, Heinonen, & Junnila (2014) describe a typical commercial urban development process in Finland, which is the context of this study, constituting of two main phases: planning and decision-making; and construction. In turn, the planning and decision making phase consists of four sub-phases: preliminary reporting, preliminary planning, contract negotiations, and ratification of the detailed plan. In addition, the construction phase can be divided into two sub-phases: municipal engineering work; and design and construction.

Models used in describing property development focus on the initiation and construction, assuming that the urban development process ends at the disposal of the produced property to customers – firms or residents. A platform ecosystem approach sees the process of platform creation as a starting point, but that the majority of value is created after the set-up of the platform, during the use phase of the new development. This highlights the major departure point between traditional urban development models and platform ecosystems. This is also the key discontinuity in the traditional linear approach to urban development; traditional models do not allow for an analysis of the factors promoting continuous modular renewal and adaptability of the urban areas produced through the process. Existing studies on large-scale urban infrastructure projects (Chou & Huang, 2012) have noted that this discontinuity between development actions and the use phase creates situations where added value of the development throughout its life cycle diminishes. Actors' efforts focus on the disposal of the new development and any future issues arising, such as social and environmental sustainability, and the long term viability of the development are not well supported (Ben Letaifa, 2014; Chou & Huang, 2012; Gualini & Majoor, 2007; Säynäjoki et al., 2014).

Even though the need for a systemic approach in urban development has been clearly identified in the literature, the platform ecosystem concept has currently received limited attention. While we see that there are perspectives in the literature on city and market analysis, urban planning, as well as construction economics and building technology that touch upon the principles of a platform ecosystem, the literature streams remain unconnected.

The current literature on cities as complex adaptive systems focuses on property markets and economic analysis (e.g. Trevillion 2002). In the urban planning and development literature, the existing studies on actor networks have limited connections to technological systems, their boundaries and the role of technological systems or platforms in value creation (e.g. Crawford & French, 2008). Construction management research has touched upon platform ideas through analysing the construction production process, and the possibilities to improve production systems (e.g. Voordijk 2011, Kendall, 1999). However, the perspective has focused on product platforms, and at the building component level, with limited linkages to actor networks or network management.

Table 1 presents the key contributors within the built environment literature with identified linkages to the platform ecosystem theory.

Table 1. Key references within built environment literature with linkages to platform ecosystem theory

Platform ecosystems, urban interpretations	Key contributors	Level of analysis		
		City & property markets	Urban planning process	Construction economics & building tech.
Urban development process				
Urban development process as a complex adaptive system: complexity theory and networks in urban redevelopment processes	Doak & Karadimitriou, 2007; Innes & Booher, 2010; Trevillion 2002; Guy & Henneberry, 2002; (Savini, Majoor, & Salet, 2015)	x	x	
Urban planning process: Cities as leverage planners, entrepreneurialism, strategic urban planning	Mäntysalo, 1999; Harvey, 1989; de Graaf & Dewulf, 2010, Webster, 2003	x		
Urban planning process: resilience and adaptation	Albers & Deppisch, 2013		x	
Urban planning process: Creation of technological platforms	Crawford & French, 2008	x	x	
Platform ecosystem design				
Building system design; innovation, connectivity	Winch, 1998; Brady, Davies, & Gann, 2005b; Brady, Davies, & Gann, 2005a; (Edum-Fotwe, Gibb, & Benford-Miller, 2004); Koskela 2003			x
Building component & production design; modularity	Kendall, 1999; Gil, 2007; Vimpri & Junnila 2015; Voordijk 2011			x
Building component & production design; standardization	Edum-Fotwe et al., 2004; Gibb, 2001; Voordijk 2011			x
Complementarity in supply chain networks	Dubois & Gadde, 2000			x

In our study, we look to analysing the adaptive capacity and potential for continuous value creation of existing, completed urban development projects in Finland.

The success of a platform ecosystem is based on its ability to create value for the actors connected to the platform. The value can be innovation leverage, production leverage, (i.e. the (re)use of a collection of assets and the interfaces and standards that enable sharing these to drive economies of both scale and scope) or transaction economies leverage (Llwelllyn D. W. Thomas et al., 2014). These leverages in turn are affected by the technological architecture of the platform. In their recent, comprehensive review on platform ecosystem literature, Thomas et al (2014) identify the concepts of modularity, connectivity, standardization and complementarity as the key boundary conditions for the value creation potential of platform ecosystems technology architecture (Thomas et al., 2014). In this study we build on these boundary conditions.

Methodology

In this chapter, we present the overarching research process of the study, the target population, and the data collection process. We also describe the process of developing the survey, the operationalisation

of the key concepts of modularity, connectivity, standardization and complementarity, and the subsequent development of scales.

Research process

The research was conducted in five main phases, as depicted in Figure 1. First, the literature on platform ecosystems was combined with the nascent ecosystem literature in urban development to create a theoretical basis for the operationalisation of the boundary conditions of platform ecosystem value creation in an urban context. Second, the survey constructs were explored through interviews regarding three commercial developments. Third, the survey constructs and scales were developed based on the enhanced theoretical framework. Fourth, the opportunities and challenges of the current process of urban commercial development promoting the creation of platform ecosystems were explored through a cross-sectional survey. Fifth, the results of the survey were considered alongside the qualitative data to form conclusions.

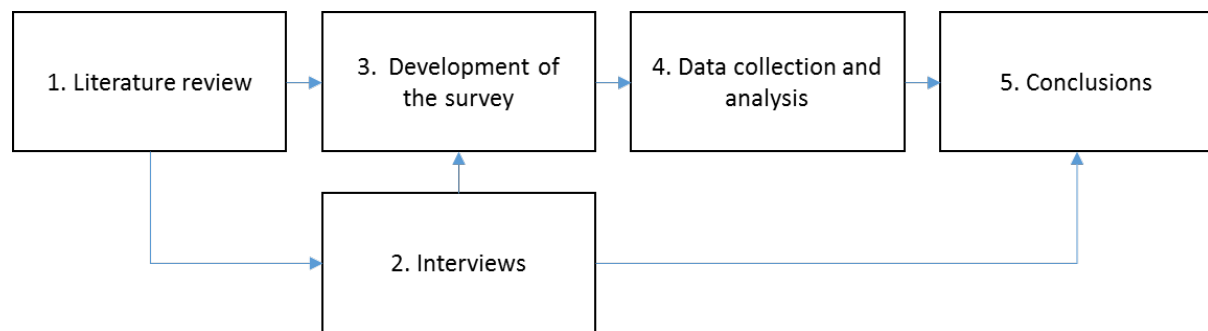


Figure 1. The research process

The descriptive survey method as used in this study is recommended in situations where achieving the research objectives demands observing a population too large to observe directly, i.e. via questionnaires as the principal means of collecting the research data (Leedy, 1997).

We selected commercial developments as the focus of the study for several reasons. First, shopping centres as development projects are clearly identifiable entities with a relatively uniform set of goals and actors enabling comparable data. In comparison, mixed-use CBD development initiatives are often geographically less framed, stretching over a long period, involving several developers and stakeholders and multiple goals. Second, a comprehensive data about the key actors in shopping centre development was available through data from the Finnish Council of Shopping Centres. Through these records, we were able to identify the total population of Finnish shopping centers and match it with relevant actors in municipalities and developer organisations. Third, the value creation process of shopping center development was considered to be more clearly identifiable than in other types of urban development. Thus, a shopping center development provides a simpler model of an urban development project.

Key actors and data collection

The initial interviews covered three on-going commercial development projects. The cases and related interviewees are listed in Table 2 below:

Table 2: Interview case studies

Project description	Interviewees	Supplementary material
1. A greenfield mixed use development (retail, housing, public services), with focus on creating physical solutions for internet-based commercial services, such as e-retailing and local health care services	2 interviews (Project manager of the city, developer)	Participant observation, planning strategy workshop Public documents and website
2. A brownfield mixed use development (retail, housing, public services), with focus on testing flexible zoning approach	2 interviews (planning architect, developer)	Public documents and website
3. A greenfield town centre development project (retail, office, public service and residential space)	(13 interviews (mitä nämä olivat?))	Public documents; Case study report

We defined the target set of survey respondents through identifying the key actors of commercial urban development projects that have an inter-dependent relationship with one another in developing and implementing a project. Urban development projects can be considered to involve multiple actors, stakeholders, and interest groups with varying degrees of involvement (Ball & Maginn, 2005; Kuronen, 2011). We focused on the key actors: 1) developers, responsible for the integration of technical, financial, and commercial aspects of the development; 2) users, typically represented by the shopping centre management or large anchor retailers; and 3) municipalities, through coordinating planning activities and construction regulation, issuing building permits, and implementing public infrastructure. As the focus of our study are clearly defined commercial entities with a very limited amount of housing, we purposefully did not include sub-contractors, designers, and consultants for the survey, nor did we include residents, workers, shoppers, and others, even though these may all play a vital part in any development. We limited our target group of survey participants in order to focus the analysis on their representatives and to make the survey more manageable in practice. For example, sub-contractors, designers, and consultants are in practice acting under the supervision and management of the planners and developers included in the survey. Similarly, residents, workers, and shoppers are represented by the planners (municipalities) and shopping centre managers (users).

The survey was conducted utilizing an internet-based survey tool in June-August 2015. An invitation to participate in the survey was sent out to all managers of Finnish shopping centres that were members of The Finnish Council of Shopping Centers, totalling 80 persons in 96 shopping centres. In addition, an invitation to participate in the survey was sent to 35 project managers of private commercial developers as well as retail premises managers of the largest retail corporations in Finland employed by 12 different organisations. These actors and individuals were identified through The Finnish Association of Building Owners and Construction Clients.

The survey was also sent to all municipalities where the surveyed shopping centres are located or that have had commercial development activities during recent years. The focus group totalled 238 persons in 33 municipalities that represent 58% of Finland's total population¹ comprising all municipalities in Finland with an identified shopping centre or on-going commercial developments. We sent the questionnaire to several persons and positions in municipalities, such as planning officers, land-use officers, commercial officers, and urban project managers, since the roles and responsibilities related to commercial development are divided differently depending on the organizational structure and amount

¹ Finnish Population Register Centre Jan 31, 2014

of resources in different municipalities. In Finland, as in other countries where the planning is institutional-led, such as in Scandinavia and the Netherlands (Newman & Thornley, 2002; van Meerkerk & Edelenbos, 2014), urban commercial developments are initially led by planning authorities in the majority of municipalities. Therefore, the majority of the public sector respondents were employed by the municipal planning departments. These respondents were identified through public records.

Each respondent was asked to fill in the questionnaire with their most recently completed commercial development in mind, to which they were advised to refer to when responding to all questions. The request to fill in the questionnaire was sent to the responders by e-mail containing a link to the survey. We also sent them two reminder mails concerning the survey, and in addition, called a random sample of initial non-respondents by phone to remind them about the survey and to identify any reasons for non-response. Table 3 describes the targeted population of the Finnish shopping centre managers, private urban development actors, and corresponding representatives in municipalities. Table 3 also shows the response rate, which is 22% overall (N = 353). The responses were analysed using SPSS statistical software.

Table 3. Targeted population and response rate of the survey

	Population	Responses (absolute)	Responses (%)
Employees of municipalities	238	36	15,13 %
Employees of private developers	35	17	48,57 %
Private Shopping Centre managers	80	23	28,75 %
Total	353	76	21,53 %

For the survey, Likert-type measurement scales were developed to measure the implementation of modularity, connectivity, standardization, and complementarity in urban development projects. The scales were developed through combining key contributions to the generic platform ecosystem literature in the fields of engineering and management with existing urban development and construction management specific research. In addition, the survey constructs were complemented by the interviews and analysis of case reports and other material in three commercial developments. The interviews were focused on creating an understanding of the objectives of the development, key actors and their roles in the development, as well as the organization and visibility of the boundary conditions: modularity, standardization, complementarity, and connectivity in the development. For example, the operationalization of modularity was explored with questions related to the flexibility of administrative regulations and zoning decrees, and separate questions were asked focusing on building construction and use phases. The measurement scales were constructed as summary variables of the individual questions based on their arithmetic mean. The actual survey questions are presented in Table 5.

A key priority was to keep the total questionnaire relatively short in order to increase the response rate (cf. Dillman, 1978). The survey was tested by commercial property development actors and researchers and developed according to the feedback received in order to improve its clarity and user experience. Based on the feedback from test respondents, the survey was condensed and divided into separate questionnaires for private and public sector respondents, and some of the questions were re-phrased to be more readily understandable by commercial development professionals.

Development of the scales: Boundary conditions for platform ecosystems

Modularity

Modularity refers to the functional partitioning of a product or service into discrete, scalable, and reusable component consisting of isolated, self-contained functional elements, i.e. “modules” (Baldwin & Clark, 2000, LDW Thomas et al., 2014; Ulrich, 1995). A modular architecture enables innovation within modules, through increasing the adaptability the system, product variety, and upgradability (Brusoni & Prencipe, 2001) and reduces the costs of splitting design and production across multiple firms (Langlois & Robertson, 1992; Sanchez & Mahoney, 1996). Benefits of modularity arise also when there are high uncertainties related to the future use of the product due to either the product’s long life cycle, such as real estate or other urban structures, or due to rapid changes in the business environment, such as digitalization (Brusoni & Prencipe, 2001). Then, modularity allows for the effective use of real options in the design and operations of these systems (Gil, 2007; Vimpri & Junnila, 2016).

Two of the three constructs of modularity, independence and technical flexibility, are widely identified in both the generic platform and product design literature (e.g. Baldwin & Clark, 2002; Schilling, 2000; Ulrich, 1995) and to some extent also in the construction management literature:

- **Independence** of infrastructure and building parts, i.e. enabling separation of different building parts based on their functional and technical life cycle (Kendall, 1999).
- **Technical flexibility** of the designs, i.e. designing the infrastructure components in a matter that enables a change in the purpose of the use of the buildings and infrastructure without significant technical re-arrangements, i.e. building in real options for future changes (Baldwin & Clark, 2002; Pellegrino, Vajdic, & Carbonara, 2013; Vimpri & Junnila, 2016).

In the urban development context, we added a third component, administrative flexibility.

- **Administrative flexibility** is a specifically public management related construct, in this study aimed at measuring how strongly the publicly led planning process and zoning decrees moderate the ability of actors to change the purpose of use of existing infrastructures and buildings (Knill, 1998).

Standardisation

Modularity as a design strategy aims at defining a standardized set of interfaces among system components (Schilling, 2000; Ulrich, 1995). In turn, the standardization of component features and sub-system interfaces enables the creation of new product features and services through the development of new components and sub-systems without the need to interfere with the other functions of the system (Baldwin & Clark, 2002; Gawer & Cusumano, 2002; Schilling, 2000). Publicly available industry standards can ease both the decision to participate by reducing the investment required, as well as the ongoing burden of participation (Baldwin & Clark, 2000), thus affecting the number of potential ecosystem participants, affecting in turn the platform’s innovation potential.

Standardisation in platform ecosystems is explored through two main perspectives:

- the use of **common standards** in design and construction of the project (Baldwin & Clark, 2002; Cusumano & Gawer, 2002; Schilling, 2000),
- and the **availability of these standards** to willing participants of the ecosystem (Kendall, 1999).

Complementarity

Synergistic interaction between sub-systems and capabilities of the ecosystem participants enable the generation of an impact that is significantly more valuable than the cost of the required inputs (Llwelllyn D. W. Thomas et al., 2014). Because sub-systems are heterogeneous, the creation of synergies is not achievable without complementarity (Iansiti & Levien, 2004).

In urban development, complementarity of infrastructure and buildings is crucial for the value creation within the area, both in terms of technical subsystems and functional levels. The provision of public services and technology is needed to complement private developments. In addition, complementarity of the activities and services within the area impacts the viability of the urban areas (Weltevreden et al., 2005). In the construction industry, a lack of co-evolution has been identified, which hampers the innovativeness of the industry (Dubois & Gadde, 2000).

We examine complementarity through two separate measurement scales: complementarity of actions and complementarity of technical systems.

1. **Complementarity of actions** is measured through the level of the synergistic and cumulative interaction between actors (Adner & Kapoor, 2010); additivity, the capacity of actors to add value to the joint offering instead of duplicating the effort of other participants (Boudreau, 2012); and co-evolution, the actors develop together over time so that they are able to provide complementary inputs during the design, construction, and use phases of the project (Afuah, 2004).
2. **Complementarity of technical systems** refers to the ability of technical components to work together in a way that adds functionality to the ecosystem offering (Thomas et al., 2014). In turn, the intention to achieve technical complementarity of the platform in the design and construction phase by measuring the level at which the common technical systems have been identified (e.g. Cusumano & Gawer, 2002; Tiwana, Konsynski, & Bush, 2010).

Connectivity

Connectivity refers to the ease with which the components of the platform can be integrated together (Thomas et al., 2014) and is a necessary precondition for the functionality of systems built of modules (Baldwin & Clark, 2000). When the production and development of components is shared across different firms, inter-firm coordination is not achieved through arm's-length relationships, but through conscious coordination performed by specific systems integrators (Brusoni & Prencipe, 2001).

In construction projects, the system integrator is typically a principal architect or a contractor (Winch, 2010; Hellström, 2014). However, their role typically ceases once the development has been completed. In temporally modular systems, e.g. in urban developments with a long lifecycle but shorter-lived components and functional needs, the system integrator is needed to optimise the functionality of the system (Ristimäki & Junnila, 2015). In the integrated solutions literature (e.g. Brady et al., 2005a, 2005b; Davies, 2004; Windahl, 2007), system integrators have typically been given the role of ensuring the performance and connectivity of components at different stages of the development's lifecycle, such as optimizing the lifecycle costs of the assets (Brady et al., 2005a, 2005b; Davies, 2004; Windahl, 2007).

Connectivity is examined through two separate constructs: task coordination and technical connectivity.

1. **Task coordination** is measured through the level of management systems and communication (Pulkka, Ristimäki, Rajakallio, & Junnila, 2016). As the consistent sharing of inputs and outputs is identified to be a key issue in building trust and co-operation in networks and alliances (Das & Teng, 2001; van Meerkerk & Edelenbos, 2014) and to build up ecosystem momentum (Jacobides, Knudsen, & Augier, 2006; Teece, 1986), an aspect of cost and profit sharing was also included in the task coordination measurement scale.
2. **Technical connectivity** refers to how easily the technical components can be integrated together (Baldwin & Clark, 2000). This integration is measured through the level of co-creation in the design process and the achieved level of integration of the systems.

Background variables

We selected three background variables to test whether the measured effects on our dependent variables are caused by other specific characteristics of the project or the survey respondents.

Size of the project is seen as a proxy for the complexity of the development (e.g. Klijn, Edelenbos, & Steijn, 2010). Even though the performance of spatial and physical solutions becomes more visible in the later stages of urban development projects, we did not include project phase as our control variable because the respondents were asked to respond based on their latest completed project. We asked about the project size using categories of 0-4999 m², 5000-19999 m², 20 000 - 49 999 m², 50 000 – 100 000 and over 100 000 m². The average size of the surveyed projects is between 20 000 - 49 900 m² (*mean*= 3,274, *median*=3,00) which is in line with the average size of shopping centres in Finland, app. 22 000 m² (Finnish Council of Shopping Centres, 2016).

City size is expected to affect the available resources of public administrators and also the development size and type. The size of the city where the developments are located is measured through the population of the city. The mean population of the city is 167 859 (*median*=103364). However, the standard deviation of the population is high (165 076), with the population ranging from 7300 to extreme cases of 613 000. This strengthens the case to include city size as a control variable.

Respondents' experience, i.e. the number of years the respondent has been involved in commercial development. This is a general check on whether the respondent has participated for a sufficiently substantial amount of time to actually be able to make experience-based judgments (Juenke, 2005). We asked the experience using categories of 'less than 5 years', '6-10 years', '11-15 years' and 'over 15 years'. The respondents on average are relatively experienced, having more than 11-15 years of experience in urban commercial development (*mean*= 3,74, *median*=4).

Results

Descriptive statistics and correlations

The specific items of the scales and the related background variables, their descriptive statistics, and the correlation matrices can be found in Table 4.

From Table 4, we can see that the platform ecosystem boundary conditions are generally identified in urban commercial development, with means generally above 3 (min 1, max 5). Table 4 also shows that the perceived presence of platform ecosystem boundary conditions have several significant (*Pearson correlation*, $p < 0,05$) and strong ($r > 0,3$) positive correlations. This is in line with the propositions set out in literature (Thomas et al., 2014; Thomas et al., 2014) and confirms that platform boundary conditions are strongly interdependent.

Table 4 Descriptive statistics and correlations between variables in analysis

	N	Min.	Max.	Mean	Std. Dev.	Modularity	Standardization	Complementarity of activities	Technical complementarity	Task coordination	Technical connectivity	Experience	Project size	Population
Modularity	54	1,00	5,00	3,14	0,96	1	,339*	-,202	,230	-,236	,294*	,264	,151	-,118
Standardization	54	2,00	5,00	3,89	0,93	,339*	1	,187	,579**	-,005	,320*	,170	-,204	,256
Complementarity of activities	49	2,20	5,00	4,12	0,68	-,202	,187	1	,598**	,651**	,251	-,280	,216	,317*
Technical complementarity	53	2,00	5,00	3,85	0,91	,230	,579**	,598**	1	,327*	,439**	,042	-,003	,280*
Task coordination	44	1,83	5,00	4,02	0,74	-,236	-,005	,651**	,327*	1	,163	-,327*	-,134	-,001
Technical connectivity	73	1,50	5,00	3,69	0,88	,294*	,320*	,251	,439**	,163	1	,195	,254*	,201
Experience	76	2,00	5,00	3,70	1,14	,264	,170	-,280	,042	-,327*	,195	1	,036	,023
Project size	76	1,00	5,00	3,24	1,12	,151	-,204	,216	-,003	-,134	,254*	,036	1	,338**
Population	73	7303	612664	167859	165076	-,118	,256	,317*	,280*	-,001	,201	,023	,338**	1

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

* $p < 0,05$, ** $p < 0,01$

To assess the reliability of the scales, we computed corrected item-total correlations and Cronbach's alphas for them. All items of the scales except one had corrected item-total correlations that were greater than .40, which represents a general threshold (Field 2005). All alphas exceeded the widely accepted cut-off value of .70. A confirmatory factor analysis could not be conducted because three of the six scales contained less than three items.

Analysis by respondent types

In order to understand, how the process of urban development currently promotes the creation of platform ecosystems, we need to analyse in more detail the responses given by the different actors. The following section presents the most significant findings across constructs of modularity, standardization, complementarity, and connectivity.

Analysis of variance (ANOVA) tests were performed to assess if organisation type (municipality, developer or shopping centre manager) and background variables (project size, city size and personal experience) influence the perceived implementation of boundary conditions in urban commercial developments. The results of the ANOVA confirms that the difference of responses across respondent type, i.e. whether the respondent is employed by a municipality, a developer or by a shopping centre, is significant ($p < .05$) in the majority of summary variables. No significant differences were found in the analysis across other control variables. This is surprising, as we expected the project complexity ('*project size*') or the organizational resources ('*city size*') to have an effect on implementation practices. Figure 3 and Table 5 present the descriptive statistics of how the boundary conditions of value creation in platform ecosystems are currently implemented in urban commercial developments and how the results vary between the key actors of urban commercial development. In the remaining sections of the paper, we focus on the results from the perspectives of these three respondent types.

Although the means of responses within the boundary conditions are relatively close to one another, the differences between actor types in implementing platform ecosystem boundary conditions are statistically significant ($p < .05$) for modularity, complementarity of activities, and technical complementarity. Also the significance level of the task coordination construct ($p = .053$) is very close to the general significance level. Developers are overall more active in implementing the boundary conditions of platform ecosystem value creation in urban commercial development than shopping centre managers or municipalities. Shopping centre managers perceive the implementation status of modularity, standardization, and technical connectivity most critically, whereas municipalities are least active in implementing the boundary conditions of complementarity of activities, technical complementarity, and task coordination.

We see also an interesting trend in the responses given by shopping centre managers. They have appraised the existence of boundary conditions of modularity, technical complementarity, and technical connectivity at a lower level than standardization, complementarity of activities, and task coordination. The former measures the results of the development process, i.e. the functionality of the technical platform, as opposed to the latter, which measures the active development process of the platform. The combined responses of the shopping centre managers, i.e. the users of the urban development, indicate that the focus in retail development is more on the design process and there is less emphasis on ensuring that the end product of the development actually works in the use phase.

Table 5 descriptive statistics and analysis of variance

¹ Welch ANOVA because the assumption of homogeneity of variances was violated

	All			Developer		Municipality		Shopping Ctr Mngr		ANOVA Sig.
	N	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	
<i>Modularity</i>	54	3,139	0,962	3,469	0,889	3,412	0,892	2,667	0,916	0,013**
The purpose of use of buildings and infra can be changed without significant administrative process	72	3,194	1,318	3,412	1,326	3,333	1,384	2,818	1,181	0,273
The purpose of use of buildings and infra can be changed without significant technical arrangements	67	3,403	1,244	3,824	1,131	3,536	1,290	2,909	1,151	0,055
The technical parts of buildings can be changed or expanded without sign. technical arrangements	57	3,228	1,102	3,353	1,222	3,647	0,862	2,826	1,072	0,054
The technical parts of infra can be changed or expanded without sign. technical arrangements	67	3,030	1,193	3,000	1,317	3,517	1,056	2,409	1,008	0,003**
<i>Standardisation</i>	54	3,889	0,930	4,088	0,690	3,974	1,060	3,611	0,963	0,285
Participants use commonly agreed upon standards	59	4,000	0,983	4,176	0,728	3,913	1,083	3,947	1,079	0,683
Applied standards are open	56	3,804	1,069	4,000	0,935	4,095	1,044	3,278	1,074	0,036*
<i>Complementarity of activities</i>	49	4,118	0,684	4,477	0,487	3,507	0,728	4,333	0,444	0,000**
The value appropriated by each of the project actors is dependent on the complementary offerings of other actors	75	4,227	1,021	4,706	0,772	3,800	1,132	4,522	0,730	0,002**
New participants to our project bring new business ideas and service concepts	71	4,070	0,946	4,471	0,874	3,719	1,023	4,273	0,703	0,012**
Diversity of actors is promoted in our project	69	3,971	0,891	4,412	0,618	3,667	0,884	4,045	0,950	0,018**
Actors develop new offerings together in design and construction phase of the project	63	4,127	0,992	4,529	0,624	3,760	1,091	4,238	0,995	0,036*
Actors develop new offerings together in the use phase of the project	51	4,176	1,014	4,385	0,768	3,500	1,265	4,545	0,671	0,0221**
<i>Technical complementarity</i>	53	3,849	0,912	4,265	0,731	3,400	0,890	3,833	0,940	0,025*
The technical systems of the project complement each other in a way that adds value more than utilizing the systems separately	55	3,836	1,032	4,118	0,928	3,588	1,064	3,810	1,078	0,329
Technical systems benefiting many actors of the project have been identified	57	3,860	1,025	4,412	0,712	3,368	1,116	3,857	0,964	0,007**
<i>Task coordination</i>	44	4,015	0,740	4,097	0,474	3,526	1,043	4,298	0,429	0,053 ¹
There is a management system in place in design phase	68	4,397	0,849	4,765	0,437	4,100	1,062	4,524	0,602	0,0151**
There is a management system in place in use phase	57	4,404	1,015	4,733	0,458	3,750	1,410	4,773	0,429	0,0151**
The decisions are communicated systematically in design phase	68	4,074	0,798	4,125	0,719	4,031	0,897	4,100	0,718	0,917
The decisions are communicated systematically in use phase	52	4,250	1,027	4,308	0,480	3,588	1,460	4,727	0,456	0,0041**
The costs and profits of development are shared consistently in design phase	62	3,581	1,222	3,412	1,326	3,750	1,294	3,524	1,078	0,667
The costs and profits of development are shared consistently in use phase	48	3,604	1,333	3,462	1,506	3,154	1,463	3,955	1,090	0,210
<i>Technical connectivity</i>	73	3,692	0,880	3,618	1,039	3,814	0,738	3,548	0,973	0,513
Technical systems benefiting many actors are designed together	73	3,671	1,081	3,647	1,222	3,857	0,912	3,381	1,203	0,282
The technical systems of our project work well together	75	3,680	0,903	3,588	0,939	3,771	0,770	3,609	1,076	0,718

* Significant at the 0.05 probability level

** Significant at the 0.02 probability level

The different perceptions on the implementation status of the boundary conditions of platform ecosystem value creation between the key actors of urban commercial development are particularly evident between private actors (developers, shopping centre managers) and public actors (municipalities).

Developers consistently perceive all the ecosystem boundary conditions to be more strongly present than other respondent groups, especially in relation to municipal respondents. By looking at Table 5 and Figure 3, we see that the shopping centre managers have a similar response pattern to the developers, though at a somewhat lower level. The representatives of municipalities consistently have statistically significant lower means than other respondent groups, most evidently in constructs related to complementarity (complementarity of actors, technical complementarity), which have the largest differences of means between municipalities and private sector respondent groups. Moreover, complementarity scores of different respondent groups lie at opposing ends of the spectrum; the private sector evaluating it as the most present boundary condition and municipalities as the least present. This indicates that there are contradictory views on the implementation status of complementarity.

The difference between private and public becomes even more evident when we study the “I do not know” answers in the survey. The difference between developers, shopping centre managers, and municipalities in the share of respondents that answered “I do not know” to questions that make up the constructs reflecting the boundary conditions is presented in Figure 4. The differences between actor types were found to be significant (*Chi square –test, Pearson correlation, two sided sig. $p < .002$*) when cross tabulating “I do not know” with the other responses given across respondent groups.

In all respondent groups, there are respondents that have answered ‘I do not know’ to questions on the scales. However, we see that the proportion of “I do not know” answers from public sector respondents is significantly higher. In addition they have given these answers to a higher number of scales. For example, 40% of respondents employed by municipalities answered “I do not know” in four or more scales. The share of “I do not know” answers among municipalities is particularly high in variables that measure the implementation of ecosystem boundary conditions in the use phase of the commercial development.

Users have a relatively low percentage of “I do not know” answers related to the design and construction phases of the developments, despite their position at the other end of the linear commercial development value chain – and in contrast to the situation of municipalities at the beginning of the chain. It is plausible to assume that the functional solutions created in the design and construction phases of a development do have a pertinent role in the value creation of the development in the use phase and thus are of key interest to users. Indeed, the involvement of users and the key role of customers in creating sustainable and innovative built environment solutions has been widely discussed in the literature (e.g. Majamaa, Junnila, Doloi, & Niemistö, 2008; Nam & Tatum, 1988).

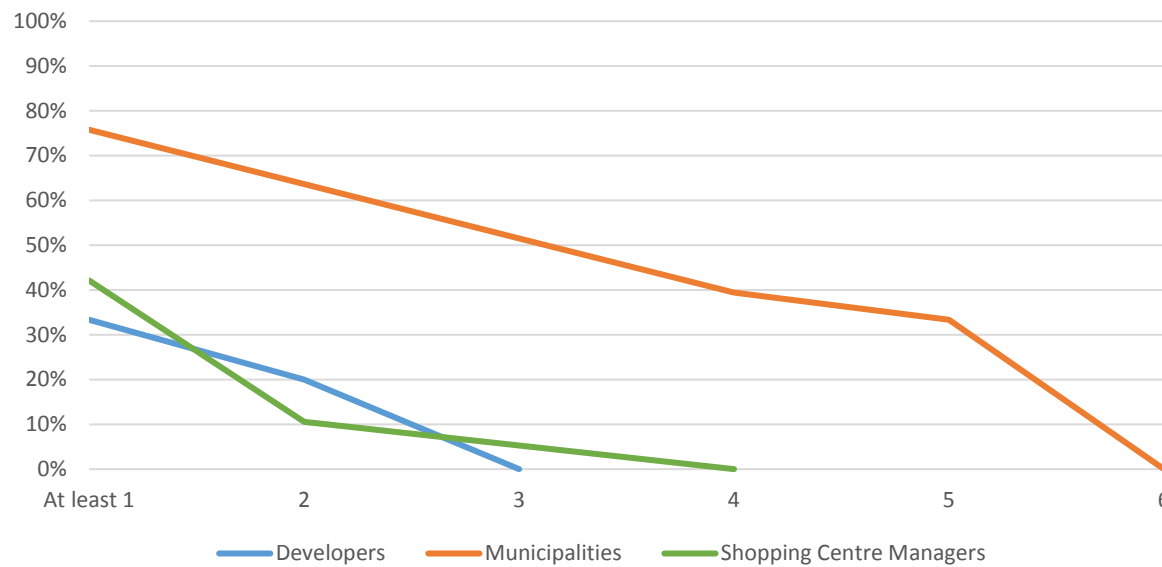


Figure 4. "Do not know" answers to the boundary conditions

Figure 4 illustrates clearly this difference between public and private actors. Because respondents that answered “I do not know” to any of the questions that comprised the scale were excluded from the statistical analysis, and therefore are not included in calculating the mean, the relative number of valid answers of municipal respondents was significantly lower than other respondent groups.

Discussion

The aim of this study is to identify the opportunities and challenges related to shifting current urban development practices towards a more systemic and adaptive approach. In particular, we ask how the current process of urban commercial development promotes the creation of platform ecosystems to support a more adaptive urban design process. In contrast to a linear approach, value creation in a platform ecosystems approach is based on the platform’s ability to promote relationships and create network externalities. Platform ecosystems are capable of innovating and maintaining their value creation due to their ability to adapt and evolve in changing environments (Bresnahan & Greenstein, 1999; Cusumano & Gawer, 2002; Thomas et al., 2014). Hence, there appears to be potential opportunities in taking a platform ecosystems approach to urban commercial development.

The literature review conducted confirms that a platform ecosystem approach is a suitable systemic framework for analysing urban development. The subsequent analysis focuses on modularity, standardisation, complementarity, and connectivity, which are identified as the boundary conditions for value creation within a platform ecosystem approach (Thomas et al., 2014).

Answers to research questions

In response to our first research sub-question as to how the boundary conditions for value creation in platform ecosystems are currently implemented in urban commercial developments, the empirical results of our survey confirm that all four boundary conditions are identifiable in the urban developments under

investigation. However, both the literature and empirical results suggest that the boundary conditions are unconnected and that the current urban development process appears to be dominated by a traditional event-sequenced linear approach.

This is made more visible by contrasting the responses of planners (municipalities), developers, and users (shopping centre managers). The results indicate that the focus of urban commercial development is on the design process and that there is less emphasis on ensuring that the subsequent development functions well in the use phase. In particular, the relatively high percentage of “I do not know” answers from planners (municipal respondents) and developers concerning questions related to the use phase indicates a lack of focus on the subsequent use of the development.

The limited connection to the use phase is also clearly reflected in the users’ perceptions of the low modularity of developments. The need for flexible technical systems and modular design is identified by the municipalities and developers. This was also highlighted in the interviews, for example, in demands for legislation that would allow more flexible zoning regulations and the use of temporary structures during the construction of an urban commercial area. However, in practice modularity is often not given enough prominence from the user’s perspective. For example, town centre developments may span over a decade, leading to a situation where the best commercial solution may change over time as the area evolves as residents, workers, and shoppers gradually move into and out of the area. However, the development plans and technical solutions tend to focus solely on the immediate stage of use following the completion of construction, and so do not adequately allow for gradual development and add-ons.

Hence, our first research sub-question highlights a major challenge for implementing a platform ecosystems approach in urban commercial development as the current focus is on a limited term project of design and build for immediate use, with any future use receiving little or no consideration during implementation.

Our second research sub-question asked how the implementation of the boundary conditions for value creation varies between the key actors of urban commercial development. The significant differences in perceptions towards platform ecosystem principles in urban commercial development highlight the *differing roles* of the actors in the developments under investigation. This was particularly evident in constructs related to complementarity, a precondition to capturing synergies and achieving co-evolution.

This finding may appear startling, given the fundamental role of complementarity in creating and sustaining ecosystems (Iansiti & Levien, 2004b). Typically, in construction projects, complementarity is pursued through the use of a centralized coordinator i.e. the system integrator (Davies, 2004; Winch, 1998). The contrasting results, low scores for municipalities and high scores among private sector actors, indicate that the municipality’s role as a system integrator is low and that the main responsibility for ensuring complementarity in developments lies within the private sector actors, predominantly the developer.

Furthermore, the significant difference between public and private sector respondent’s share of “I do not know” answers to the boundary conditions appears to highlight the *different current capabilities* of the respondent groups to apply the ecosystem approach in urban development. The results indicate that municipal respondents currently have less knowledge, time, visibility, resource, or interest in these issues as they relate to commercial urban development.

Hence, our second research sub-question highlights a further challenge for implementing a platform ecosystems approach in urban commercial development as current practice relies on the developer, rather than the municipality or user, to lead integration, which naturally tends towards the previous conclusion of

a focus on design and build (the developer's main interest) rather than future use (the municipality's and user's main interest).

Thus, our results point to two major challenges in shifting current urban development practices towards a more systemic and adaptive approach, one challenge apparently dependent upon the other. While developments are largely developer led, then any platform development will continue to focus on a linear approach to design and build, rather than supporting a sustainable ecosystem for use both today and in the future. Most notably, municipalities currently appear to be ill-equipped to adopt to a new model of development due to their limited knowledge ("I do not know" answers) on the value creation processes of the urban ecosystem, alongside their low scores on issues of complementarity. As a consequence, the linear approach currently adopted prevents the public sector from actively influencing value co-creation during the lifecycle of the urban commercial development and so limits their share of the value created (Ben Letaifa, 2014; Chou & Huang, 2012; Thomas et al., 2014). Indeed, the dominant integration role of the developer tends to focus on the value co-creation process of the design and build phases, rather than the full lifecycle of the urban commercial development and so also potentially limits the share of the value created for the user.

Further implications from the results

Based on previous studies, the traditional institutional framework may be one factor explaining the limited understanding of complementarity and co-creation by public sector actors, as it effectively limits major networking activities and experiences of successful partnership approaches (Klijn & Koppenjan, 2000). In addition, the institutional fragmentation of the public sector may enhance the complexity of decision-making, and increase the need for managerial effort (Klijn & Teisman, 2003). The initial interviews conducted at the beginning of the research, though not statistically generalizable, confirm this result. The governance structures of the municipality were seen to limit a more systemic approach to the urban planning process. The benefits of a more holistic approach was seen as useful but would require the creation of a new administrative layer that was not perceived to be in the sphere of influence of individual planners.

In addition, a lack of connection with the business logic of users may result in plans for development that do not support long term value creation potential. In our study, the questions focusing on sharing inputs and outputs among participants have notably lower importance than questions related to management or communication. The fair division of costs and profits related to co-operation seems to be a potential bottleneck for effective co-development and task-coordination. This finding is in line with previous general research on alliances (Das & Teng, 2001) and some built environment specific research, for example, on the successful implementation of life-cycle management (Ristimäki & Junnila, 2015) and business models in construction networks (Rajakallio, Ristimäki & Junnila, 2014).

Developers appear to take a central role in developing an embryonic platform that could support an ecosystem. The current role of the system integrator by developers is a natural consequence of them considering the immediate needs of their clients (e.g. shopping centre managers) and thus recognizing the need to integrate the interests of multiple actors in the short term. As such it cannot be stated that developers purposefully act towards creating a resilient platform ecosystems or encouraging co-creation and adaptation across the lifecycle of platforms. On the contrary, the short-sighted perspective of developers has been confirmed in previous studies (Aho, 2013; Fernie, Leiringer, & Thorpe, 2006; Lind & Borg, 2010). The lack of involvement of municipalities in the latter stages of the development does not incentivize developers to take into account longer term value creation from the citizens' perspective, issues with less immediate

economic value, such as social and environmental sustainability (Säynäjoki et al., 2014), nor does it incentivize developers to fully consider the long term viability of any ecosystem supporting (re)development. As a consequence, the heterogeneous objectives of the parties involved in commercial urban development may lead to tensions and claims ex post and diminishing end-user value (Kivleniece & Quelin, 2012; Majamaa et al., 2008).

While the results do not suggest that developments are better off managed by private or public sector actors, it is rightfully questioned as to whether the public sector possesses enough capacity for change to revolutionise the current paradigm within urban development (Savini et al., 2015). However, moving towards a more adaptive planning process does not necessarily require the radical adoption of new planning systems, institutions and norm. Planning is always likely to focus on aspects of certainty. Traditionally planners have endeavoured to manage increased uncertainty of the environment by stricter regulations and envisioning the desired future. Instead of managing uncertainty through stricter norms or their more effective implementation, municipalities should focus on norms that allow for more creativity and change. The operationalisation of the boundary conditions of modularity, standardisation, complementarity, and connectivity can be used as a measurement scale and joint framework through which relevant partners may assess the adaptive potential of any new urban development.

Conclusion

This paper has examined how the current process of urban commercial development may potentially promote the creation of platform ecosystems to support a more adaptive urban development process. It has highlighted the systemic issues that arise from the current practices and relationships between public and private organisations in today's commercial real estate development, and suggested a radical, but practical, way forward by adopting a platform ecosystems approach. The literature review conducted and the empirical results both confirm that the approach has a good potential fit with the urban development context, and the operationalisation of the necessary boundary conditions for platform ecosystem success enables the identification of key areas for improvement within the current process. For practitioners, both from commercial organizations and public bodies, the study provides insight as to how to promote the co-creation of value and new innovations in commercial urban development. However, much will depend upon the resources and abilities of municipalities to better understand and be more involved in the long term use phase of any development, alongside the willingness of developers to take a longer term view of the co-creation of value, and for users to provide well-informed and timely input on the changing demands of the urban environment.

The study also makes two theoretical contributions. First, it expands the discussion of the role of public keystone organizations in creating and sustaining business ecosystems. Second, it applies platform ecosystem theories to a new field of the built environment and extends current urban development theories to incorporate more systemic and interconnected aspects through the ecosystem lens. This study also presents evidence of the institutional barriers to moving from a linear, project based approach to a systemic process in commercial real estate development, thus providing some of the answers to Hodson & Marvin's (2010) questions concerning "whose interests and priorities shape interventions and how?" in the current socio-technical transition taking place.

Limitations

Our research has some limitations. The study examines the particular case of current commercial urban development ecosystems, and its perspective is therefore biased towards the immediate economic value created through key ecosystem participants. The study has thus excluded potentially important aspects of boosting urban ecosystems through education, social programs etc. (e.g. Harvey, 1989) or indirect factors affecting the demand for housing and retail in the case areas.

The study was conducted in Finland, and the developments are all Finnish. The results may differ in other countries with different decision-making cultures (e.g., Skelcher, 2011). In Finland, as in some other countries e.g. the Netherlands and Denmark, the zoning authority resides solely in municipalities, which may create an additional contest between public and private sector actors and drive parties to focus on their respective primary roles. In countries with a more strategic planning approach, this pattern may be less visible, though the same conceptual model could still be applied.

We have not measured the performance of the surveyed developments. However, there are studies that suggest an ecosystem approach is beneficial over the linear approach in urban development (Pulkka et al., 2016). It would therefore be interesting to conduct a study measuring the performance of the developments with an ecosystem approach in different markets using the conceptual model outlined.

As explained in the methodology section, the survey was sent to a limited group of potential actors in urban commercial development and thus the analysis is based on the perceptions of the leading actors within these networks. Although our approach is not unusual (e.g. E.-H. Klijn et al., 2010), we have to be careful in making generalizations. For example, the personality of the respondent could influence the respondents' perception of ecosystem boundary conditions and his/her perception of the success of certain tasks. However, we believe that within these constraints we can draw meaningful conclusions from the results of the study.

In conclusion, despite these limitations, our study suggests that there appear to be many opportunities for a more adaptive urban design process in commercial real estate development in an increasingly digital world by employing a platform ecosystem approach. However, our research has identified some of the potential challenges to such innovation.

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