Orchestration and governance in digital platform ecosystems a literature review and trends

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Orchestration and governance in digital platform ecosystems: a literature review and trends

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Abstract

Purpose – *Because of the attention increasingly being focused on digital transformation, interest in business models of platform-enabled ecosystems is rising rapidly. Although there are different theoretical views on the role of ecosystems, a synthesis of research, with a focus on governance and orchestration in dynamic, multi-industry eco-systems, is lacking.*

Design/methodology/approach – *A systematic literature review was conducted by following a rigorous search protocol in the scholarly databases covering both journal articles and conference papers These papers were subsequently filtered, and finally, 48 relevant papers were selected for analysis.*

Findings – *The review identifies five key aspects of platform governance design that need close consideration: the meta-organisation or ecosystem design, coordination mechanisms, mechanisms for value co-creation, value appropriation mechanisms and architectural principles. To achieve balance among a set of competing demands, platform leaders need to devote adequate attention to these aspects.*

Practical implications – *Based on a literature review, the authors provide an overview of underlying theoretical views, research methods and key trends to develop a sound theoretical grounding for research on platform governance design. The paper also suggests research gaps in the existing literature and sets directions for researchers to strengthen the understanding of effective platform governance design. The paper also provides valuable information to managers in developing or leading a successful platform ecosystem.*

Originality/value – *The paper uses existing literature published in this topic and original in nature.*

Keywords *Control, Governance, Ecosystems, Literature review, Business models, Digital platforms*

Paper type *Literature review*

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1. Introduction

With the rapid progress of digital technology and new business models to support those, platforms and related eco-systems have received attention from scholars from such diverse disciplines as industrial economics, strategic management, information systems (IS), product management and innovation management (Gawer, 2014; McIntyre and Srinivasan, 2017; Nambisan and Sawhney, 2011). The increased interest in this phenomenon can be attributed to a number of factors:

- Instead of analysing competition between stand-alone firms, market leadership can be explained more adequately by studying platform-mediated networks of competing and collaborating firms (McIntyre and Srinivasan, 2017; Mukhopadhyay *et al.*, 2016b). Organisations with a balanced ecosystem (for example, Apple and Google) are more likely to dominate the industry and to capture most of the values.
- Platform-mediated ecosystems have emerged as a preferred method of collaboration for innovation and value co-creation (Eaton *et al.*, 2015; Valkokari *et al.*, 2017). This is corroborated by the fact that Apple Store offers more than 2 million mobile applications for consumers (Statista, 2018), provided primarily by independent developers.

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- From being a niche phenomenon in technology-intensive industries, digital platforms and their associated ecosystems are now transforming and impacting all important industries like health-care, education, banking, energy, public transport and government services.

While researchers with a background in industrial economics view the concept of a platform as intermediating between two or more market segments (Evans and Schmalensee, 2008; Gawer, 2010; McIntyre and Srinivasan, 2017), IS and technology-focused researchers view a platform primarily as a technical infrastructure designed for the facilitation of collaboration and innovation between multiple entities (Gawer, 2014). It is evident that the platform concept is closely related to ecosystem concepts (de Reuver *et al.*, 2018). The ecosystem concept allows to study how platform leaders collaborate with a larger community of complementors, instead of limiting their partnerships only to their supply chain partners (Rong *et al.*, 2013) and that, too, without having a formal authority over these partners (Gulati *et al.*, 2012).

In existing IS research with a focus on governance and control, there is limited research on the governance aspects of large ecosystems. More frequently, existing governance studies are focused on single firms and projects (Tiwana *et al.*, 2013), mainly in a software development context. Results from a software development context are biased because of their focus on the principal–agent relationship and have limited applicability to platform ecosystems (Tiwana *et al.*, 2010; Jansen and Cusumano, 2013). These types of relations cannot be found in many innovative multi-industry platform ecosystems. In these ecosystems, complementors are not contracted by the platform owner (Goldbach and Kemper, 2014). Accordingly, it is difficult for ecosystem leaders to exert control over other organisations, because of the absence of a contractual or hierarchical relationship (Goldbach *et al.*, 2017). Besides, the number of complementors in an ecosystem can be very large, which calls for a more cost-effective governance mechanism (Huber *et al.*, 2017). As a result, the large body of IS research on governance cannot be directly applied in the context of platform ecosystems.

A few studies have also examined the aspects of governance in the context of platform ecosystems, which are consolidated in the next section. But we have found that researchers in platform governance possess varied backgrounds and they have used different theoretical prisms to explain the governance of digital platforms.

Given the high diversity of studies, theories and foci, it is imperative to consolidate the fragmented studies. The objective of our literature survey is to establish a robust foundation for future research on the dynamics of governance and orchestration in platform setting by summarising present state of research as well as identifying important research gaps. To be more specific, we address the following research questions in our literature survey:

RQ1. What is the research output per year in the 'digital platform ecosystem' governance field?

RQ2. What are the type of research methodologies that platform ecosystem governance research reports?

RQ3. What are the key management theories used by researchers in this domain?

RQ4. What are the key thematic areas or topics those can be derived from the existing platform governance research?

For doing the same, we cover 48 articles published between 2010 and 2017, primarily dealing with governance and control aspects of digital platform ecosystem. The reason for selecting this time frame is that the topic is relatively new and it has caught the researcher's interest during this period. To have a clear focus, we have concentrated primarily on the perspectives of platform leaders. Complementors in a platform ecosystem can also influence platform governance (Eaton *et al.*, 2015), but have limited capability for driving the

vision and evolution of any platform. To summarise, we have structured the paper as follows. Section 2 provides the theoretical framing, while Section 3 provides the systematic literature review process. Section 4 provides the results, including descriptive statistics as well as a conceptual model as derived from the meta-analysis. Section 5 discusses the result and provides proposals for future research. Section 6 concludes the paper.

2. Theoretical framing: a multifaceted definition of platform

In industrial economics, platforms are seen as an intermediary between two or more groups of customers. Because of the existence of an indirect or cross-side network effect, a platform creates value between two distinct sets of customers (Evans, 2003; Evans and Schmalensee, 2008; Gawer, 2010, 2014; Rysman, 2009; McIntyre and Srinivasan, 2017). The network effect emphasises the importance of large platform ecosystems (Lee *et al.*, 2015), leading to a winner-take-all syndrome. Researchers with a background in engineering see a platform as a specific type of modular artefact designed for collaboration and innovation between multiple entities to leverage the economics of scope (Gawer, 2014). In this world view, the platform can also be decomposed into three core components, that is, a stable, low-variety core, a set of high variety, continuously evolving peripheral modules and interfaces linking the core and peripheries (Baldwin and Woodard, 2009). Gawer (2014) classified platforms in three distinct categories, that is, internal platforms for usage within firms, supply chain platforms to be used in the extended supply chain of a firm and industry platforms that cater to multiple heterogeneous, independent actors from multiple industries. As our focus is on inter-organisational governance across a single platform, we exclude internal and supply chain platforms from our analyses. The reason being that we wanted to focus on platforms that allow diverse ecosystem partners primarily from independent organisations, while internal and supply chain platforms are used for value creation by involving different subunits or suppliers of a firm (Gawer, 2014). Governance of industry platform is more challenging and needs urgent attention. Partners in this type of platform ecosystem can come from different industries having different life cycles, that is, infrastructure providers have lifecycles of 15-20 years, while service providers have very short lifecycles as well as different cultures and practices (Mukhopadhyay and Bouwman, 2018). The increasing cost and complexity of coordination can overshadow the gain coming out of collaboration.

More specifically, we are interested in software-driven digital platforms (Yoo *et al.*, 2010; Spagnoletti *et al.*, 2015). These digital platforms are expected to dominate our economy (Boudreau, 2012) and to affect every industry. Therefore, we focus on multi-sided, digital industry platforms in our literature review and we identify them as digital platforms henceforth.

Integrating the perspectives from economics, technology management and IS, we take the definition of Tiwana *et al.* (2010, p. 675) a step further by defining a digital platform as "the extensible codebase of a software-based system that includes a core module, add-on modules using core functionality and interfaces through which the core and multiple add-on modules interoperate" and that intermediates between two or more groups of users. The core module provides important, but restricted and limited functionalities, when left alone, but complementors' add-on modules increase the platform value manyfold (Gawer and Cusumano 2008; Wareham *et al.*, 2014).

Digital platform ecosystems can be thought of as the meta-organisation (collective of firms and individuals) around a digital multi-sided platform with a shared vision on the prosperity of the platform (Spagnoletti *et al.*, 2015; de Reuver *et al.*, 2018). A digital platform ecosystem consists of one or multiple platform leaders and a large number of complementors. The concept of an ecosystem highlights the informal nature of an inter-organisational network, the collaborating and competing nature of the participants and their high level of interdependence as well as their ability to evolve with the changes in the

external environment (Moore, 1993; Iansiti and Levien, 2004a, 2004b). The definition of a "digital platform ecosystem" combines the meta-organisation described by the ecosystem concept with a digital, multi-sided, industry platform.

3. Research method

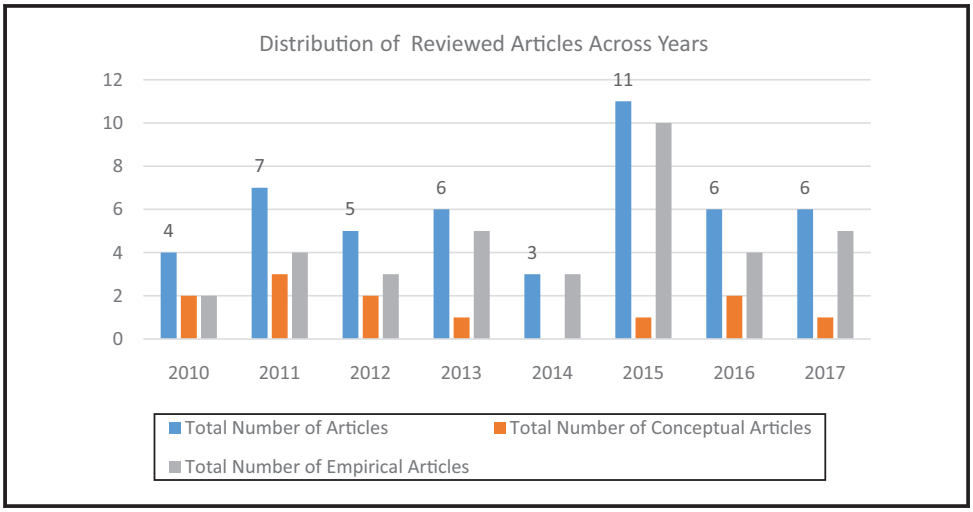
For determining the source content for this review, we drew principles from structured literature review approaches (Rowley and Slack, 2004; Webster and Watson, 2002; Zhang *et al.*, 2014). The design of this literature survey ensured that we did not limit ourselves to only a few journals, a particular methodology or a particular discipline (Webster and Watson, 2002); instead, we focus on the well-known scholarly databases with a number of key words involving a number of steps:

- ***Step 1:*** We consulted the following databases: ABI/Inform (ProQuest), Academic Search Elite (EBSCO), Elsevier Science Direct, JSTOR, Informs, Google Scholar and Emerald Full Text. In terms of decision related to the time frame, we selected papers published between 2010 and October of 2017, because research interest in digital platform governance is a recent phenomenon.
- ***Step 2:*** For extracting the relevant research papers from the databases and in the above timeframe mentioned, key search terms were decided based on the approach proposed by vom Brocke *et al.* (2009). The key word combination contains at least one standard phrase and one extension phrase. For our scenario, the standard phrases were: 'platform' and 'ecosystem', while the extension phrases were 'control', 'governance' and 'business model'. The above combination allows us to identify papers those study governance in the context of platform ecosystems. Once the set of papers were found, we assessed the relevance of the articles for our review through an iterative approach as mentioned in Steps 3 to 5.
- ***Step 3***: First, we reviewed the title and keywords of the papers for relevance and excluded inappropriate papers such as book chapters, editorials, working paper, duplicate papers and news-related articles. We also excluded all articles written in any language other than English.
- ***Step 4***: Next, for the remaining papers, we reviewed their abstract and conclusion, which helped us to reject a few additional irrelevant papers.
- ***Step 5:*** After all the above mentioned steps, a total of 76 articles are left for our consideration. The final selection of paper for our review was based on reading the full text of the papers and identifying their relevance for our study. Based on this rigorous process involving multiple levels of exclusion, we are left with a total of 48 peer-reviewed papers, for our study (Appendix). To enhance the reliability of the article selection process, the first researcher reviewed and verified 28 excluded papers again to confirm the motivation for exclusion. Based on this second level of review by the first author, no change was made in the corpus. The paper by de Reuver *et al.* (2018) considered part of 2017 publication based on its online availability.

Figure 1 shows the distribution of the papers by year of publication (2010-2017) . Other than large number of articles in 2015, the trends in terms of number of articles in each year is almost uniform. In terms of publication outlet, most of the articles are from journals; only three are from conferences. The result highlights journals as the primary source of knowledge dissemination for researchers.

Once the corpus identification is completed, the literature review focuses on both content (key concepts in this topic and their relationships) and methodologies (how has the research been conducted). To address the research questions, during data analysis and synthesis, we performed the following activities:

Figure 1 Distribution of papers over time



- We counted the number of valid publications per year. We classified each of the empirical papers based on research methodologies (Qualitative/Quantitative/Mixed method), data collection and analysis method (case study/Survey/Others; primary or secondary data source; longitudinal or cross-sectional data collection).
- To get an overview of the theoretical foundation in platform ecosystem researches, we identified the underlying theories of each of the relevant papers.
- Most importantly, we identified one or multiple key themes for each of the papers with respect to platform governance. This allowed us to identify key research topics in the platform governance domain and create a structure for organising the research finding. We did this exercise of identifying the key governance topic discussed in a paper multiple times to avoid wrongly classifying a paper. The themes of governance are consolidated by merging similar concepts or removing the concept, which are not directly related to platform governance.

4. Literature review findings

We will discuss the empirical basis of the papers analysed, theories used and key themes in governance research from the extant literature.

4.1 Empirical grounding

To identify the methodological plurality present in the literature, we focused on data collection and analysis techniques for 36 empirical articles. The remaining 12 papers were found to be conceptual in nature. Empirical research articles can be classified in three broad categories, that is, qualitative, quantitative or mixed method research (Creswell *et al.*, 2003; Mukhopadhyay and Gupta, 2014). The quantitative researches are mainly based on surveys to collect data. One of the quantitative researches used experimentation, two quantitative researches have used more than one method of data collection combining survey and secondary data or survey and experiments. Qualitative researches primarily used case study approaches for data collection and analysis. We also identified one mixed method research paper that combined qualitative interviews with a survey to collect qualitative and quantitative data (Tables I and II).

Table I Methodological plurality

Methodology	*Method*	*Count*	*(%)*	*References*
Qualitative	Case study – Primary data collection	12	33.33	de Reuver (2011), Nambisan and Sawhney (2011), Zhang and Liang (2011), Nikayin *et al.* (2013), Wareham *et al.* (2014), de Reuver *et al.* (2015), Mukhopadhyay *et al.* (2015), Schreieck *et al.* (2016), Huber *et al.* (2017), Mohagheghzadeh and Rudmark (2017), Mattila and Seppälä (2017) and Qiu *et al.* (2017)
	Case studies – Secondary sata collection	8	22.22	Ghazawneh and Henfridsson (2010, 2013), Campbell and Ahmed (2011), Selander *et al.* (2013), Pon *et al.* (2014), Eaton *et al.* (2015), Spagnoletti *et al.* (2015) and Ondrus *et al.* (2015)
Quantitative	Secondary data	7	19.44	Boudreau (2010 (2012), Ceccagnoli *et al.* (2012), Huang *et al.* (2013), Cennamo and Santalo (2013), Oh *et al.* (2015) and Boudreau and Jeppesen (2015)
	Survey	5	13.89	de Reuver and Bouwman (2012), Lee *et al.* (2015), Kim *et al.* (2016) and Mukhopadhyay *et al.* (2016a, 2016b)
	Survey and secondary data	1	2.78	Tiwana (2015)
	Experiment	1	2.78	Goldbach and Kemper (2014)
Mixed method	Experiment and survey	1	2.78	Goldbach *et al.* (2017
	Interview and survey	1	2.78	Benlian *et al.* (2015)

Table II Theories and concepts used to study governance in eco-systems

Theory	*References*
Types of governance (Hierarchical, market and trust derived from transaction costs and network governance concepts)	de Reuver and Bouwman (2012), de Reuver (2011)
Organisational control [(Formal control (Outcome, behavioural and Input)), Informal (Self)]	Scholten and Scholten (2012), Goldbach and Kemper (2014), Tiwana (2015), Goldbach *et al.* (2017), Mukhopadhyay *et al.* (2015 (2016a, 2016b)
Resource dependency theory (RDT)	Mukhopadhyay *et al.* (2015)
Gatekeeper roles (Rooted in RDT)	Pon *et al.* (2014)
Collective action theory	Nikayin *et al.* (2013), de Reuver *et al.* (2015)
Boundary resource theory	Ghazawneh and Henfridsson (2010, 2013), Eaton *et al.* (2015), Mohagheghzadeh and Rudmark (2017)
Roles in ecosystem (Keystone)	Zhang and Liang (201)1
Indirect network effect	Cennamo and Santalo (2013), Boudreau and Jeppesen (2015)

4.2 Theoretical grounding

Secondary to the empirical grounding, it is important to establish the theoretical grounding of the research papers. Theories as used are derived from multiple disciplines including innovation management, economics, organisation design, technology management, IS and sociology. A few of the articles use platform or ecosystem attributes like modularity and openness to expand their work, but we have not considered these attributes as core theory. Next, we have focused on the key theoretical themes used in control and governance research.

Governance in the context of platform ecosystems refers to the structure, process and methods to make decisions related to collective activities concerning the platform (Tiwana *et al.*, 2010; de Reuver and Bouwman, 2012). The common decisions that platform governance needs to handle are:

- design guidelines for the architecture and the interfaces;
- guidelines for new partner on-boarding;
- revenue sharing mechanisms;
- managing platform vision and integrity; and
- conflict resolution.

The extant literature in economics and strategic management talks about three types of governance mechanisms. In a market or contract based governance mechanisms, contracts, commitments, intellectual properties and other legally binding agreements are used as basis for collective action and decision-making. A power or authority based governance mechanism allows one organisation to enforce decisions over multiple other organisations. Trust-based governance mechanisms depend on mutual trust, agreed code of conduct, faith in shared vision and adherence to similar culture.

de Reuver (2011), in a case study on mobile operator-led value-net, found that networks are practicing all three types (power, market and trust) of governance but are moving towards a model of arm's length transactions that entail less governance. de Reuver and Bouwman (2012) connect a phasing model of service innovation to the three types of inter-organisational governance mechanisms.

Organisational control theories are used by multiple studies. Controls primarily deals with operational aspect of governance. The dominant model of organisational control was developed by Ouchi (1977, 1979) and later expanded by other researchers (Eisenhardt, 1985; Snell, 1992; Govindarajan and Fisher, 1990). In the context of platform ecosystems, control mechanisms are utilised by platform ecosystem leaders to create conditions that motivate and influence other participating organisations to achieve a desirable outcome and, in the process, reduce the risks, uncertainties and costs in multi-organisation collaboration (Mukhopadhyay *et al.*, 2015). Both formal (behavioural and outcome) and informal (self) modes of control are investigated to identify their impact on developers' intention to stay in an ecosystem and to assess the quality of deliverables (Goldbach and Kemper, 2014; Goldbach *et al.*, 2017). The differential impact of formal controls (behaviour, outcome and Input) are investigated with respect to their impact on achieving the platform leader's multiple objectives (Mukhopadhyay *et al.*, 2016a). There are few researches focusing on input control in a platform ecosystem context. The role of input control was investigated with respect to the management of intraplatform competition (Tiwana, 2015).

In the absence of a principal–agent relationship and the negative impact of control on innovation, researchers investigated the roles of control mechanisms in a platform ecosystem setting (Mukhopadhyay *et al.*, 2015, 2016b). Traditionally, agency theory is used to explain why an organisation can control other organisations. In the absence of a principal–agent relationship in an ecosystem, researchers have used alternative theoretical prisms, like Resource Dependency theory (RDT) to explain the control phenomenon. RDT treats organisations as open systems whose performance depends on resources as controlled by other organisations. By controlling vital resources, organisations can achieve power (Ulrich and Barney, 1984). In the context of platform ecosystems, researchers have found that, in the case of asymmetric resource exchange, organisations with access to critical and rare resources can exert control over dependent organisations (Mukhopadhyay *et al.*, 2015).

Collective action theory is used to identify the factors that impact interorganisational collaboration (Nikayin *et al.*, 2013) and how the collaboration and competition between ecosystem partners with different industry backgrounds impact the success of the platform (de Reuver *et al.*, 2015). One of the primary challenges in platform ecosystem governance

is to balance control of the platform and generativity of the complementor. Because of the indirect network effect, heterogenous and large quantities of outputs from complementors can bring more consumers to the platform, but at the same time, it is important to manage the integrity and vision of the platform.

Boundary resources are used to balance the objectives of controlling the platform and transferring the design capabilities to the complementors at the same time (Ghazawneh and Henfridsson, 2010, 2013). These researchers also provided a process model of the working and emergence of boundary resources. Eaton *et al.* (2015) introduced the tuning concept to investigate the emergence of boundary resources through accommodation and resistance between multiple stakeholders.

In the context of the mobile ecosystem, the leader of the ecosystem tries to control critical resources by occupying gatekeeper roles, as discussed by Ballon and Walravens (2008). The concept of the gatekeeper role is rooted in resource dependence theory (Pfeffer and Salancik, 1978). The gatekeeper roles are value-adding and strategically important roles, and an ecosystem around a platform can be thought of as consisting of many actors trying to occupy gatekeeper roles. Each wants to control the access to critical resources that are owned and managed by different organisations (Ballon and Van Heesvelde, 2011). In the context of a Google-managed Android platform, Pon *et al.* (2014) investigated the roles used to defend the central position in a successful platform.

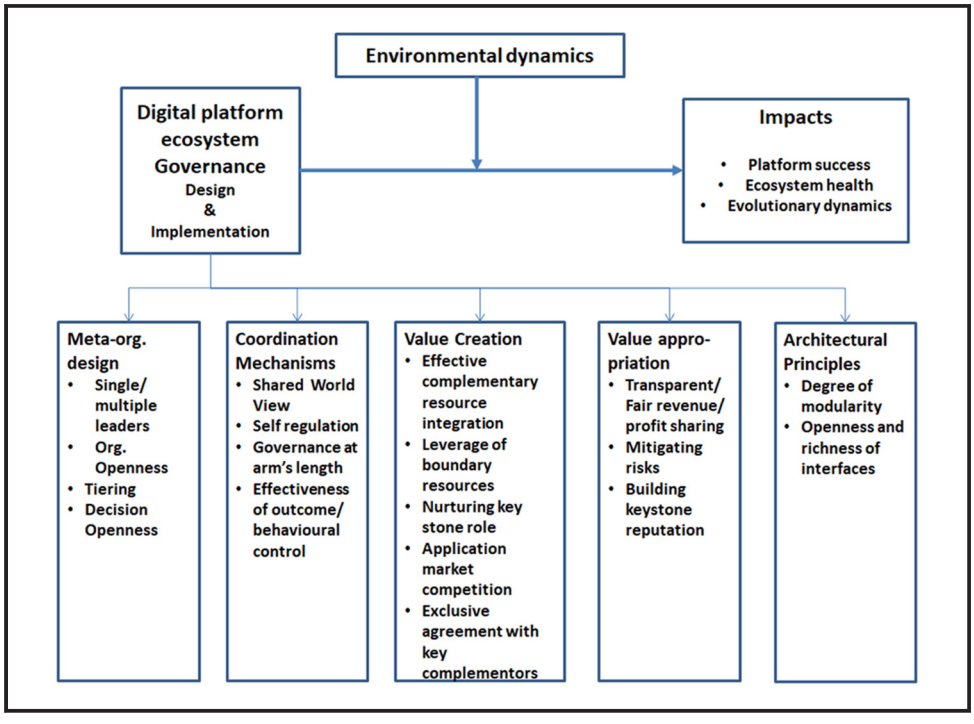
As addressed in the ecosystem literature (Iansiti and Levien, 2004a, 2004b), platform ecosystem leaders have the option of behaving like a keystone, dominator or landlord, each of which would have a different impact on ecosystem health. Based on a case study on a mobile ecosystem, the leader's behaviour was explained from the perspective of the keystone role and its positive impact on the ecosystems, including complementors (Zhang and Liang, 2011).

While innovation competition between complementors and acquiring exclusive rights from complementors were found to have a positive indirect network effect, executing them in parallel led to a marginal negative effect (Cennamo and Santalo, 2013). While investigating the impact of network effect related to unpaid complementors, Boudreau and Jeppesen (2015) encountered an absence of network effect. When a greater number of unpaid complementors is added, the negative direct network effect generated due to competition for the fixed amount of attention rules out the indirect network effect created by interaction between complementors and users.

4.3 Main research topics in design of platform governance

Tiwana *et al.* (2010) viewed governance primarily from the perspective of power and control and focused on three aspects of governance: decision rights, control and ownership. This definition completely overlooks the important role governance plays in ecosystem-centric value co-creation as well as value appropriation among ecosystem participants. Furthermore, Tiwana *et al.* (2013) later asserted that architectural design principles could be used as long-term and non-overt governance mechanisms in a distributed and less hierarchical organisational setting. Based on the above discussion and review of the extant literature, we propose to study digital platform ecosystem governance in a more comprehensive manner by focusing on five key themes as shown in Figure 2. Researchers have also conceptually or empirically identified the differential impact of different types of governance design (Tiwana *et al.*, 2010; Mukhopadhyay *et al.*, 2016a, 2016b; Goldbach *et al.*, 2017). Therefore, governance design needs to be studied together with governance outcome. Based on insights into how the two core concepts are interrelated, the governance mechanisms can be fine-tuned. We have used this model to consolidate and interpret the existing literature on platform governance.

Figure 2 Derived model linking five aspects of governance design and its impact



4.3.1 Meta-organisation design. The design of the meta-organisation or ecosystem around a platform has gained significant research interest for two reasons:

1. the importance of complementors to leverage innovation is central to the success of platform ecosystems (Hoehle and Venkatesh, 2015; Benlian *et al.*, 2015); and
2. the informal nature of the relationships between platform leaders and complementors, as well as between complementors themselves (Gulati *et al.*, 2012; Goldbach and Kemper, 2014), which are legally autonomous actors (Gulati *et al.*, 2012).

As a result, traditional organisational design variables like 'control, hierarchy, formal roles and pecuniary incentives have less traction' (Gulati *et al.*, 2012, *p* 572). A number of included papers investigate this phenomenon of purposefully designing an ecosystem of complementors for generativity (Eaton *et al.*, 2015). We specifically focused on literature detailing the organisational design aspect of platform ecosystems. We found that the existing researches are focused on understanding:

- What is the optimal network configuration in terms of numbers as well as profiles of platform leaders and complementors?
- What are the possible options to share the privileges and responsibilities among multiple network participants?

Based on the above two broad design questions, four dimensions, that is, leadership structure, membership openness, tiering structure and decision rights, as well as a number of possible configurations for designing the meta-organisation structure can be identified from the literature (Table III).

4.3.1.1 Single/multiple leaders. Most of the platforms have a single platform leader, which reduces the chances for conflict in developing a vision for the ecosystem as well as managing the ecosystem. But there are examples of a community (for example, Eclipse),

Table III Four design dimensions for platform meta-organisation/ecosystem

Meta-organisation dimensions	*References*	*Design options*		
Single/Multi-leaders in a platform ecosystem	Ondrus *et al.* (2015), Benlian *et al.* (2015)	Single firm	Community (Multi-firms same industry)	Community (Multi-firms different industries)
Membership openness	Gulati *et al.* (2012), Boudreau (2012), Ondrus *et al.* (2015), Benlian *et al.* (2015), Boudreau (2010), Nambisan and Sawhney (2011), Campbell and Ahmed (2011), Tiwana (2015)	Open	Controlled (Screened)	Closed
Tiering	Gulati *et al.* (2012), Nambisan and Sawhney (2011), Campbell and Ahmed (2011), Huber *et al.* (2017)	Flat	Two tiers	Multi tiers
Decision rights	Gulati *et al.* (2012), Tiwana *et al.* (2012), Nambisan and Sawhney (2011)	Centralised	Distributed	Community based

made up of firms or organisations from the same or different industries, jointly creating a platform (de Reuver *et al.*, 2015; Nikayin *et al.*, 2013; Ondrus *et al.*, 2015). A platform managed by a single leader can also be opened horizontally by licensing the platform to rivals or integrating with competing platforms (Benlian *et al.*, 2015; Ondrus *et al.*, 2015).

4.3.1.2 Membership openness. Technically, a digital platform ecosystem can allow many types of individuals and firms to join, but accessibility or access criteria are important design decisions (Gulati *et al.*, 2012), particularly in relation to the "quality versus quantity" paradox (cost-benefit analysis of unrestricted entry versus cherry picking among aspirants). The arguments for opening the ecosystems to multiple partners are well established. Boudreau (2010, 2012) observed that with an increasing number of participants, interest diversity increases; as a result, coordination becomes difficult. The same researches also indicate that too much dependence on complementors would cause the platform leader to lose control over the integrity of and roadmap for further development of the platform. Existing researchers have found three distinct types of new member admission methods to an ecosystem: closed, open and controlled.

In a *closed* ecosystem, granting access to new members is not automatic. The requests are evaluated, and some amount of approval is required (Gulati *et al.*, 2017). The boundaries of *open* membership ecosystems are less stringent and make use of self-selection and self-certification mechanisms to induct new members (Gulati *et al.*, 2012) as well as for creating and publishing new components in the platform store (Jansen and Cussamano, 2012). As a result, the ecosystem might end up with higher coordination cost, redundant capabilities, competence gaps and a large number of participants with little or no productive contribution (Gulati *et al.*, 2012). Between closed and open ecosystems, platform leaders can deploy a range of ***controlled*** access mechanisms as part of ecosystem design (Boudreau, 2010).

4.3.1.3 Tiering. An ecosystem designer can decide to develop a more egalitarian membership structure, in which all complementors are considered to be equal, and no differentiation in privileges is associated with any of the members. Alternately, two or more tiers or levels of membership benefits can be introduced (Gulati *et al.*, 2012). Different levels of membership in an ecosystem reduce coordination complexity by assigning some of the coordination responsibilities of lower tiers to higher tiers (Gulati *et al.*, 2012). It also motivates complementors by offering the opportunity to move to a more central level and allowing the platform leader to award complementors who are dominant or make a higher contribution (McIntyre and Srinivasan, 2017). However, platform leaders also need to evaluate the cost-benefit of the introduction of stratification. Stratification introduces some

additional management cost and hierarchy, which might have a negative impact on innovation and community feeling (Gulati *et al.*, 2012).

In a case study on an enterprise resource planning (ERP) software major, there are five different tiers for the complementors (Wareham *et al.*, 2014). Complementors always join the ecosystem at the base level. Each higher level provides additional benefits to complementors as well, while expecting an additional performance requirement will be met. Complementors, on their own, may decide to move to upper tiers or remain forever in the base tier, based on their cost-benefit analysis (Wareham *et al.*, 2014).

4.3.1.4 Decision right sharing. Tiwana *et al.* (2010) argued that *decision right sharing* between the platform leader and complementors is one of the main components of platform governance. The decision rights are related to the role of the modules, architectural and design guidelines and interface specification. Other studies have also identified decisions related to the launch of the product and their variants as important decision points (Mukhopadhyay *et al.*, 2016b; Tiwana *et al.*, 2015). For example, in the context of Salesforce.com, important complementors were involved in defining design libraries and setting parameters (Nambisan and Sawhney, 2011), leading to decision decentralisation. There are multiple arguments in favour of decentralising decision rights. If it is important to involve important complementors in decision-making, then a tiered decision-making process allows them to have such a role (Nambisan and Sawhney, 2011). A decentralised decision-making process enhances the perceived fairness and credibility of the decision process, increases trust among partners and leverages complementors' knowledge of a specific domain (Nambisan and Sawhney, 2011).

Architectural attributes like modularity and ecosystem design parameters like making distinctions between different tiers (Nambisan and Sawhney, 2011, Gulati *et al.*, 2012) have been found to have a positive influence on the decentralisation or openness of decision-making. Allowing easy entry for new members or membership openness has an inverse relationship with the decentralisation of decisions (Nambisan and Sawhney, 2011). Conversely, increased membership openness reduces cohesiveness and leads to concentration of decision-making among a few core members. A relatively closed network allows for decision-making to be distributed.

4.3.2 Coordination mechanisms. In a platform ecosystem, platform leaders and a multitude of complementors have their own motivations, business objectives and industry logic. In such a scenario, for ongoing coordination and conflict resolution between complementors, as well to reduce the scope of opportunistic behaviour and to motivate participants to achieve desirable outcomes, the platform leaders make use of shared world-views or values, as well as implicit and explicit rules or protocols for exchange (Lusch and Nambisan, 2015; Mukhopadhyay *et al.*, 2016b). We will discuss this next in greater detail.

4.3.2.1 Values. Ecosystems need to continuously evolve in response to changes in the market, in competitor behaviour, in technology and regulation (Lusch and Nambisan, 2015). As ecosystem participants are varied in size, industry background, technological capabilities and so on, they need to share an ecosystem-wide institutional logic or shared worldviews to effectively compete in the market (Lusch and Nambisan, 2015). A shared worldview also helps to identify the possibilities for innovation and to act upon it, by recombining existing sets of (diverse) capabilities. A shared vision, continuous information exchange and working collaboratively helps to reduce cognitive distance and develop a shared worldview among participants (Lusch and Nambisan, 2015).

When shared value systems become entrenched among ecosystem partners, self-control or clan control can be more effective instead of enforcing formal behavioural and outcome controls (Goldbach *et al.*, 2017; Goldbach and Kemper, 2014). Self-control is more effective than formal controls, as it promotes a sense of higher perceived autonomy and, in turn,

improves application quality and reinforces complementors' intention to adhere to the ecosystem (Goldbach *et al*., 2017; Goldbach and Kemper, 2014).

4.3.2.2 Rules. In addition to shared values and worldviews, platforms need to have agreed protocols, rules for exchange of resources, mechanisms of coordination and conflict resolution (Nambisan and Sawhney, 2011; Tiwana *et al*., 2010; Mukhopadhyay *et al*., 2016b). Lusch and Nambisan (2015) defined this as the architecture of participation. Such an architecture brings clarity and transparency in collaborative value-creation. From the prism of organisational control, rules can be defined and implemented though two types of already mentioned formal controls, i.e. behavioural and outcome (Mukhopadhyay *et al*., 2015, 2016a, b; Tiwana *et al*., 2010). Empirical studies have confirmed that both behavioural and outcome control are equally effective for ecosystem-wise coordination management (Mukhopadhyay *et al*., 2016a). Behavioural control mechanisms are, however, less used as they are found to be more expensive. Overall, control mechanisms can have negative effects on innovation, so platform governance needs to address the paradox of control and autonomy to have the right kind of control and autonomy in the ecosystems. The controls should be transparent and codified to increase trust among network partners (Lusch and Nambisan, 2015).

By designing ecosystem-wide rules and emphasising the values, ecosystem coordination can be standardised. A standardised ecosystem coordination approach provides the platform owner a cost-effective way to manage a large ecosystem of partners effectively, that is, governance at arm's length (Huber *et al*., 2017; de Reuver, 2011). But for collaborating with important complementors, when large gains or higher co-created values are at stake, platform leaders need to be willing to go beyond mere cost-effective ecosystem governance and opt for dyadic governance (Huber *et al*., 2017). Dyadic governances are associated with higher costs and the possibility for higher co-created value (Huber *et al*., 2017).

4.3.3 Ecosystem value Co-creation mechanisms. Platform leaders invest significant resources to attract the best complementors to their ecosystem. To recover the investment, platforms need to facilitate and provide incentives for rapid innovation by these complementors (McIntyre and Srinivasan, 2017; Kim *et al*., 2016) and retention of complementors as well. The cost of retaining existing complementors in ecosystems is less compared to acquiring new ones (Goldbach and Kemper, 2014). Stickiness of the platform refers to its ability to retain complementors (Goldbach and Kemper, 2014). From a platform leadership perspective, when a company's complementors switch to another platform, they are able to provide benefit to the rival platform, as they are likely to transfer experience and knowledge of the earlier platform to the new platform (Selander *et al*., 2013). While retaining complementors is important, effective resource integration is imperative for value co-creation with complementors in platform ecosystems. For this, transparency, increased interaction among partners and proper definitions of the roles to fulfil are critical (Lusch and Nambisan, 2015).

Other methods of higher value-creation are promoting competition among partners and securing exclusive arrangements with important complementors (Cennamo and Santalo, 2013). Platform leaders promote competition among complementors (*apps market competition*) to increase the variety of output. To restrict multi-homing, platform leaders secure exclusivity arrangements with complementors. The products developed by complementors can only be sold via their platform and denied to other competing platforms (Cennamo and Santalo, 2013, Gulati *et al*., 2012). An exclusivity arrangement leads to closer coordination with those complementors, allowing platform leaders to influence the roadmap and quality of the complementor's product (Cennamo and Santalo, 2013). While enhancing competition among complementors and exclusive arrangements for output have been independently found to have a positive impact on the competitive positioning of a

platform leader, pursuing them in parallel could lead to a marginal negative effect on platform performance (Cennamo and Santalo, 2013) (Table IV).

In the reviewed papers, ecosystem roles and health concepts (Iansiti and Levien, 2004a, 2004b) are used to investigate successful nurturing of the ecosystem by platform leaders (Zhang and Liang, 2011). In the case study of Chinese mobile manufacturers, ecosystem leaders or the keystone player's success can be attributed to the sharing of high-value assets with the complementors, actively managing innovation processes and sharing fair value with partners (Zhang and Liang, 2011).

Multiple studies have used the concept of *boundary resources* to investigate a platform leader's dual objective of increasing generativity in the platform as well as maintaining control over the complementors. Typical boundary resources in the context of a platform are application programming interfaces (API) and software development kits (SDK), guidelines for application development and technical documentation. Ghazawneh and Henfridsson (2013) found that boundary resources are used to transfer design capabilities to complementors. In this way, the heterogeneity of the platform resources are increased, but at the same time, it secures the platform by preventing application development that is not in synch with the vision of the platform leader (Ghazawneh and Henfridsson, 2013).

4.3.4 Fair value appropriation mechanisms. For sustainable ecosystem health, platform ecosystem leaders need to effectively facilitate value appropriation once the value is created (Nambisan and Sawhney, 2011). Without appropriate monetary and non-monetary incentives, platform ecosystem leaders find it difficult to attract complementors (Benlian *et al.*, 2015). The literature shows that excessive value appropriation by platform leaders reduces the interest of the complementors and negatively impacts the health of the ecosystem (Mukhopadhyay *et al.*, 2016b). Accordingly, it is important for platform leaders to share platform success with complementors (West and Wood, 2014). In the case study related to China Telecom, by encouraging diversity in resources and fairness in value sharing, the ecosystem leader improved the health of the ecosystem. In doing so, the survival of the ecosystem is ensured, with a higher payoff for the leader as well as for the complementors of the ecosystem (Zhang and Liang, 2011).

At the same time, researchers have also identified various methods being deployed by platform leaders to extract higher value share for themselves. Platform leaders occupy important gatekeeper roles, particularly the access to customers. As a result, they receive a much higher share of value in a platform ecosystem (Mukhopadhyay *et al.*, 2016a). There is also a conceptual correlation between redundancy in complementors' capabilities and the higher bargaining power of the platform leader (Gulati *et al.*, 2012). When multiple complementors possess similar skills, they can be treated as commodity players, instead of niche players; as a result, their ability to negotiate a higher pay out is reduced (Zhang and Liang, 2011; Gulati *et al.*, 2012).

The practice of sharing a certain percentage of revenue with partners is one of the most important business practices enabling value appropriation between platform leader and complementors (Oh *et al.*, 2015). Kim *et al.* (2016) found that revenue share attractiveness

Table IV Key themes in value co-creation research

Key concepts related to value creation in literature	*References*
Keystone role Effective resource integration Boundary resources – resourcing and securing Increasing platform stickiness Apps market competition Exclusive agreement with complementor	Cennamo and Santalo (2013), Boudelau (2012), McIntyre and Srinivasan (2017), Eaton *et al.* (2015), Ghazawneh and Henfridsson (2010, 2013), Ceccagnoli *et al.* (2012), Zhang and Liang (2011), Lee *et al.* (2015), Mohagheghzadeh and Rudmark (2017)

positively impacts complementors' continued intention to stay with the same platform ecosystem. Though many innovative revenue sharing arrangements are in place, there are frequent complaints from complementors related to not receiving their fair share of the returns (Oh *et al.*, 2015). Mukhopadhyay *et al.* (2015), in multiple case studies, found that in a mobile platform ecosystem led by a mobile operator, the ecosystem leader received a higher proportion of the revenue share. The same study also highlights that the revenue share process is completely managed by the platform leader and lacks transparency. To shed light on an appropriate revenue share between multiple partners, Oh *et al.* (2015) developed a new bargaining model to split revenue between platform leaders and complementors in a mobile platform ecosystem.

Other than the revenue share itself, complementors also face other risks related to value-appropriation. Because of unintended knowledge transfer, the platform leader and other complementors may be able to offer a similar and competing product. In case the market served by the complementor is lucrative, the platform leader might decide to enter it (Nambisan and Sawhney, 2011; Ceccagnoli *et al.*, 2012). The appropriability concern increases when there are significant differences between the size and power of the platform leader and other complementors (Nambisan and Sawhney, 2011). To address these value appropriation concerns of complementors, ecosystem leaders have the option of putting in place additional measures. The key among them are a) the platform leader's decision not to compete with complementors; b) sharing some amount of platform control and decision rights with complementors; c) transparency and clarity of the value share process and rules; and d) building one's reputation as a keystone leader (Huang *et al.*, 2013; Berline *et al.*, 2015; Nambisan and Sawhney, 2011, Tiwana *et al.*, 2010, Gulati *et al.*, 2012; Zhang and Liang, 2011).

4.3.5 Architectural principles. Because of its distributed and modular structure, a platform leader can effectively use architecture as a form of non-overt control (Tiwana *et al.*, 2013), both for managing coordination challenges and for pursuing the long-term goal of retaining a central position in the platform ecosystem. Once implemented, the architectural choices are mostly irreversible and always have a long-term impact; therefore, they should be in synch with the long-term vision and strategy (Tiwana *et al.*, 2010). From the literature, we have identified degrees of modularity, interface openness and richness as key components of architectural control (Tiwana *et al.*; 2010; Benlian *et al.*, 2015; Pon *et al.*, 2014).

4.3.5.1 Degrees of modularity. Platform architecture can vary among a range of options, from completely modular to completely integrated (Tiwana *et al.*, 2010). A completely modular architecture decouples the modules by hiding the intra-module decision and changes from other parts of the ecosystem (Tiwana *et al.*, 2010). A modular architecture, because of its effective portioning of the complexity, reduces the coordination and governance cost and increases resource specialisation (Tiwana, 2015; Tiwana *et al.*, 2010; Nambisan and Sawhney, 2011). But researchers have also found that too much modularity can erode the distinctness of the modules and platform and reduce both the scope for cross-learning and network embeddedness between ecosystem members (Tiwana *et al.*, 2010; Nambisan and Sawhney, 2011).

4.3.5.2 Interface openness and richness. The modularity is closely related to the technical or interface openness of a platform. Technical or interface openness indicates mechanisms that allow data and information to flow between components within a platform as well as to and from the external environment. While a modular architecture can allow sharing of innovation responsibilities among multiple complementors, technical openness along with organisational openness can be used to regulate the entry of complementors to the platform ecosystem. The capabilities of a platform are exposed to the partners through interfaces, so control of interfaces is essential to control the platform and the profit that accrues to it (Gulati *et al.*, 2012; Tiwana *et al.*,

2010). In the context of the Android OS-based platform, researchers found that because of the free licensing of the Android OS, multiple possible competitors of Google (Amazon, Xiaomi, others) have created their own versions of the Android OS and application store. To address this competition and safeguard its position in the ecosystem, Google has used a proprietary Android API to accommodate the latest innovations, while keeping the open source Android-Base version as a less-capable version (Pon *et al.*, 2014).

4.4 Outcome and impact of governance mechanisms: Governance outcomes

Different governance mechanisms including architectural principles impact the evolution of the platform, which leads to the differential value propositions of platforms (Tiwana *et al.*, 2010). Because of the indirect network effect, higher varieties and numbers of applications attract a higher number of users in response to the enhanced value-exchange opportunities (Cennamo and Santalo, 2013; Boudreau, 2010). Therefore, platform governance plays a significant role in determining platform success. The concept of ecosystem health as operationalised by Iansiti and Levien (2004a, 2004b) and implemented in a case study by Zhang and Liang (2011) establishes important metrics for the long-term sustainability of any platform ecosystem. The existence of transparent and innovation-stimulating appropriation mechanisms, codified rules and shared values positively impact ecosystem health (Zhang and Liang, 2011). In addition, governance and orchestration in an ecosystem are not static. Ecosystems also change as they make their way through development, via the implementation to operational phases, with the consequence that the governance framework evolves requiring the use of changing coordination mechanisms over time (Darking *et al.*; 2008, Tiwana *et al.*, 2010; de Reuver *et al.*, 2018) for achieving the expected outcome.

Based on the above discussion, we have summarised the core concepts and their relationships derived from the literature review in the below model (Figure 2). The relationships between governance design and implementation choices and governance outcome are moderated by external environmental dynamics, for instance, the specific industry sector the platform is functioning within (Tiwana *et al.*, 2010; Ribbers *et al.*, 2002).

5. Discussion and future research opportunity

Our research paper provides an overview of the state of the art with regard to platform ecosystem governance knowledge and research. We identified a number of research gaps, which can act as a potential agenda for future studies on digital platform ecosystems governance.

Our study uncovers possible design choices to balance a number of competing tensions or paradoxes in platform governance so all involved eco-system partners can benefit and long-term sustainability is achieved. We identified at least four competing requirements: that is,

1. stability versus evolvability of the core and periphery of a platform;
2. control versus autonomy/self-regulation of complementors;
3. quality versus quantity of on-boarded complementors; and
4. aggressive value capture by platform leaders versus a focus on overall ecosystem health.

Effective platform governance should be able to leverage these paradoxes in a sustainable way to optimise long-term value creation. Improper design and implementation of solutions can lead to degeneration of the platform and loss of its competitive position (Wareham *et al.*, 2014). Further research on correlating these competing factors with the industry life

cycle can provide interesting insights. Platform leaders can choose to allot more importance on a set of factors while developing a successful platform ecosystems, as the main goal would be to attract a large set of complementors and end users. But once a platform is established, the platform leader can decide to focus more on monetising the platform, as well retaining the market leadership position.

Platform ecosystems, and platform governance specifically, have attracted a great deal of interest from researchers from different backgrounds. The resulting research field can be termed multi-disciplinary based on the researchers' choice of theories borrowed from diverse streams such as economics, organisational science, strategic management, information science and innovation management. We noticed, as the field is maturing, that the number of empirical research papers has been increasing in number, compared to the growth of conceptual articles.

Most of the studies are focused on the specific aspect of platform governance. Though Tiwana *et al.* (2010) have provided a framework to define platform governance and its key components, researchers have deviated from that definition and added new components or motivations of platform governance based on the research objectives. The literature, therefore, provides no unique but multiple definitions of platform governance, which go beyond the traditional concept of governance in the IT context. Governance in the traditional IT context primarily deals with managing the opportunistic behaviour of the partners and coordination among them. In addition to the above two challenges, platform governance is also expected to address additional challenges, including:

- defending the platform owner's central position and, related to it, ensuring higher pay-off for platform leaders;
- defending the integrity and vision of the platform;
- onboarding the right set of partners;
- enabling partners through multiple boundary resources; and
- managing the overall health of the ecosystem.

As a consequence, there is an opportunity to define platform–ecosystem governance more tightly and appropriately. This scenario becomes even more interesting when the platform ecosystems does not have a clearly defined leader or multiple players exert equal influence over the platform. As platform development is becoming more investment intensive and risky in nature, it would be common to find multiple players joining hand to establish a platform ecosystem. Researchers also need to understand the governance challenges and possible approaches a platform leader can have, while defending its central position in an open platform (i.e. Google android).

The current delineation of the boundary of the platform and ecosystems is research specific. The degree of interconnectedness as a proxy is rather arbitrary (Halinen and Törnroos, 2005). In technology-focused platform studies, the delineation is based on the technology at stake. For mobile platforms, this for instance equals with the mobile OS, such as Android and iOS and the associated app store. However, a technology-based delineation of platforms comes with problems as well. Many of the ecosystem partners may not be software developers. These types of partners basically "consume" the API provided by the platform and take care of a specific business process required for end-to-end service delivery. The typical example would be logistic providers, banks and channel partners. With a technical definition of digital platform ecosystems, it would be difficult to see them as providers of complementary services. But as platform ecosystems are increasingly being used in complex business configurations where the digital meets the physical, these types of

complementary providers play an important role; hence, the definition of a platform ecosystem needs to reflect this reality.

A number of researchers, who have a strategic management background, have done important studies on interplatform competition, while very limited research effort has been done with regard to intra-platform competition (Tiwana, 2015). Intraplatform competition has two components, competition and conflict between platform leaders and complementors (Ceccagnoli *et al.*, 2012; Huang *et al.*, 2013) and competition between multiple complementors offering similar applications or capabilities (Tiwana, 2015). While value co-creation mechanisms involving platform leaders and complementors have been researched extensively, more research is required to understand the nature of value sharing between platform leaders and complementors (Oh *et al.*, 2015). While a fair value-share mechanism:

- increases the generativity and stickiness of any platform;
- reduces the scope of conflict; and
- contributes to the overall aim of the platform leadership, platform leader and complementors might differ on the definition of a fair value-sharing arrangement.

In the same grain, there is space for additional researches on the dynamics of competition between complementors. While regulated competition between complementors increases variety, quality and customer attraction (Cennamo and Santalo, 2013), unmanaged competition may lead to a slow pace of innovation, reduced trust and collaboration and the departure of crucial complementors from the platform. Additional researchers will be required to identify possible methods of quality assurance in a large platform ecosystems. Because of the large volume of innovation produced by the platform partners, it is often difficult and very expensive to implement direct quality control mechanisms, in line with the practices followed in the software industry. However, at the same time, unregulated output through negative indirect effect might severely impact platform reputation and customer satisfaction.

In our research model, architecture has been incorporated as an important component of governance. There is a conceptual understanding on the importance of architecture in effective platform governance (Tiwana *et al.*, 2010), and other researchers have linked one of the architectural attributes, that is, openness to platform leadership (Benlian *et al.*, 2015; Lee *et al.*, 2015; Ondrus *et al.*, 2015). However, additional research is required to conceptually determine how architectural attributes can be used to exert non-overt control over partners and complementors and to validate this relation empirically. Comparing different types of OS platform architecture, as can be found in specific industries and how they affect governance, is important. As many of the platforms store different types of demographic and transaction data of users, platform architecture governance need to adhere to emerging concerns of different regulators and of individuals, while allowing complementors to benefit from the richness of aggregated big data, its volume and variety.

Most of the empirical studies have used a single-case study or survey method for data collection. As a result, there is significant space for experimentation with diverse, preferably mixed method-based research strategies. Quantitative researchers would also benefit from longitudinal research to gain more insight into the evolution of governance mechanisms, as well as the effectiveness of a governance portfolio by linking it with performance metrics. Multiple case studies, action research and even designing science-based researches would lead to methodological diversity and be likely to contribute to new insights. Particularly, researchers using multiple case studies have the option of within and cross-case analysis. As a result, the problems of generalisation can be addressed (Mukhopadhyay *et al.*, 2014), and hence, the

research findings would be more compelling. The problem of external validity is significant in platform research, as platform ecosystems are embedded in specific contexts. It is difficult to compare multiple platform ecosystems because of their differences in size, industries served and partner profiles. To provide an example, Netflix and Amazon Prime are both considered as digital streaming platform. But Amazon Prime membership allows its subscriber to enjoy preferential treatment in Amazon's e-commerce marketplace, in addition to digital content, which makes it difficult to compare value propositions of Netflix and Amazon Prime.

Focusing on mobile payment, mobile payment ecosystems can be seen as a specific configuration of a platform ecosystem. In terms of research outcome, research on mobile payment platforms has grown in stature and has become one of the most researched examples of platform ecosystems. Unlike other software developer ecosystems, mobile payment platform ecosystems contain more large players with diverse, but also overlapping, capabilities. Because of its uniqueness on providing financial services and the existence of diverse players (banks, telcos, technology players and others) from multiple industries, lessons from mobile payment platform ecosystems cannot be generalised. Mobile payment industry also provides examples of how platform leaders can monetise their ecosystems and platform capabilities to enter a new domain. While PayTM (the largest mobile payment platform in India) added digital shopping, travel and hotel booking to its portfolio, technology platforms like Alibaba, Google and Whatsapp started offering payment solutions in multiple geographies.

As governance mechanisms are an important part of platform ecosystem business models, uncovering the business model of failed ecosystems can provide important lessons from a governance perspective. Even large organisations like Blackberry and Nokia, despite their dominant position in the pre-platform era, could not maintain their position in the battle for platform leadership. Their failures are, among other reasons, generally attributed to their inability to create and foster a vibrant ecosystem, leading to a range of interesting discussions on sustainable platform governance and the role of platform governance in ensuring platform leadership.

There is also limited research on the unique challenges associated with governance of platform ecosystems led by government and non-profit organisations. Governments are focusing increasingly on participative government, collaborative technology and citizens' involvement in service design and innovation by using digital platform (Janssen and Estevez, 2013). Research on governance of these types of platforms need to manage unpredictable behaviour of a larger set of stakeholders in the society. In addition, government platforms are not driven primarily by a desire to maximise financial returns of the platform leader, but safeguarding other societal values, which requires a different approach to platform governance. The case of Aadhaar identity platform in India, developed and managed by the government while being used by the multitude of government and commercial providers to provide citizen services is an interesting example.

As platform ecosystems centric online businesses have started to dominate the economy by rapidly displacing incumbents, their business models face intense scrutiny. The governments as well as different super-national regulators, like the European Union, are finding ways to regulate their unrestricted growth as well as privacy invasion. Large platforms, like Facebook and Amazon, primarily because of the massive network effect and interactions have acquired a massive volume of data on their consumers, markets and products. Platforms in the initial phase of establishing dominance, often use this massive set of interaction data to help their sellers and buyers, while at the same time establish their value propositions. A dominant platform may not remain benevolent, and in many cases, data are used against new entrants. From its partners, dominant platforms might demand exclusive arrangements, restricting multi-homing coercively. There are cases when platform

leaders use the behavioural and transaction data to identify more lucrative segments of the market, to launches private and premium label products (assuming the role of complementors and displacing earlier partners).

Recently, many governments have actively taken actions to restrain the misuse of dominant positions by the platform leaders. Recently, the government of India notification on platform based online retailers (The Economic Times, Dec 27, 2018) a) limits any subsidiary or any other connected entities of the platform leaders from selling on that platform and b) disallows preferential treatment of any partner. In the case of online food aggregators in India (Swiggy, Zomato, Uber Eats), smaller partners are asking for regulator's intervention. As successful platforms continue to capture more share of businesses as well as focus on capturing larger share of value, impacted partners and competitors would retaliate and call for government intervention. Effective platform governance, by avoiding or limiting competition with partners, managing partners with transparent rules, and sharing fair value with partners can make the regulators more supportive in the emergence of a platform-centric economy.

6. Conclusion

Our study consolidates and provides a multi-faceted definition of digital platform ecosystems. We systematically reviewed the theoretical foundation, methodologies and key research topics in the platform governance literature. Based on the literature study, we consolidated our findings in a model, which can be used by researchers for further research as well as by practicing managers to have a more structured conceptualisation of the different aspects of platform governance. This model can be tested empirically, making use of mixed method approaches, for single platform leaders, as well as in ecosystems in which no clearly defined platform leader, or more than one platform leader, can be distinguished.

This study also has some limitations. Of course, our platform eco-systems' governance could have been more extensive if we would have used a few other and/or more related concepts from organisational studies or technology or innovation management to complement our findings. Also, our material is limited to those studies that have been accepted and reviewed. Therefore, these studies might be subject to prevailing norms and personal preferences. Moreover, in some domains, specific industry-related causes might be more critical for the success of platform governance. Nevertheless, we think that with this review we reflect the present state of knowledge and draw attention to some interesting research avenues, as discussed before.

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Appendix. List of 48 papers reviewed as part of literature review

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