Editorial: Workshop on the Role of Platforms for Enterprise Ecosystems (3EP)

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1 Motivation and Introduction

Since their introduction, information systems have substantially changed the way business is conducted. This is particularly true for cooperation between firms that leads to an integration of value chains across multiple entities. The emerging networks span not only the various business units of a single company, but also include multiple units from different firms. As a consequence, companies do not only need to consider their internal organization in order to ensure sustainable and superior business performance, but also need to take the entire ecosystem of entities surrounding them into account. In order to allow these different units to cooperate successfully, the existence of a common platform is crucial. Such platforms enable the transformation of monolithic, closed system infrastructure into an open infrastructural backbone for business networks. An example is the increasing adoption of service-oriented architecture (SOA). Through its higher degree of modularity, SOA allows companies to integrate external services much more easily. Moreover, the process and service chains of various entities along a value chain can be integrated much more seamlessly. Another case in point is the growing importance of Platform-as-a-Service (PaaS) concepts and corresponding offerings.

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The workshop on Emerging Enterprise Ecosystem Platforms (3EP) provides a forum for the scientific discourse dealing with the role of platforms in business networks. It aims at taking a both diverse and balanced look at the impact and effects of platforms on enterprise ecosystems. During the workshop we want to discuss technological, economic, and organizational issues and want to encourage an exchange concerning design and usage of platforms in enterprise ecosystems among software developers, platform providers, and users.

In the following, we will give a short introduction to the workshop topic by providing basic definitions, giving an overview of current research activities, introducing appropriate theoretical lenses, and highlighting promising directions for future research on the role of platforms for organizational ecosystems.

2 Foundations

Many industries use platforms to build derivative products tailored to customer needs. With his well-known Model T, Henry Ford successfully introduced the platform concept into the automotive industry about a century ago [ASS09]. Based on Ford's seminal work, the platform approach has been further developed in the automotive industry, for example, the VW Group uses its platform PQ 34 as the foundation for building different models for different customer target groups; such as the Golf IV, Audi A3, or Skoda Octavia.

Platforms are defined by Tiwana et al. [TKB10] as an "extensible codebase of a software-based system that provides core functionality shared by the modules that interoperate with it and the interfaces through which they interoperate" (p. 676). Schilling [Sc00] defines the concept of modularity, embedded in the above definition, as a "a continuum describing the degree to which a system's components can be separated and recombined, and it refers both to the tightness of coupling between components and the degree to which the 'rules' of the system architecture enable (or prohibit) the mixing and matching of components" (p. 312). In the platform context, modules can be considered as components, services, or applications that run on the platform.

Platforms can be described using different dimensions: first, the question is which layer(s) are served by the platform. Platforms often consist of multiple layers, such as the hardware layer, the system software layer, the middleware layer, or the application software layer. Moreover, one may also include a functional or business layer to a platform. Second, the level of deployment needs to be considered. Platforms can be established within companies (e.g., SOA) or as a market which offers shared services to multiple firms. Third, different role models on platforms need to be distinguished, such as the platform operator, module provider, and module consumer. Fourth, platforms can follow different module provider participation concepts complemented with specific governance approaches, such as the open model, the proprietary model, or the exclusive model [EK06]. Recently, the term Platform-as-a-Service (PaaS) was coined in the context of cloud computing. PaaS bundles hardware and software as a service enabling the creation and operation of Software-as-a-Service (SaaS) solutions [Gr09]. This

platform approach supports the entire lifecycle from development to introduction and use of SaaS solutions [Mi08]. Recently, many different PaaS product offerings have appeared on the market. Examples are the Google App Engine, Microsoft Azure, or Salesforce's Force.com.

Ecosystems can be considered from a platform-independent or a platform-dependent perspective. Generically, business ecosystems can be defined as an economic community supported by a foundation of interacting organizations and individuals [Mo93]. Companies participating in business ecosystems typically co-evolve their capabilities and roles and tend to align themselves with the directions set by one or more central (focal) companies. Platforms and ecosystems are tightly interrelated. Cusumano and Gawer [CG02] define the platform and the modules specific to that platform as the platform's ecosystem. Following this notion, The concept of platform-based ecosystems is becoming the dominant model for software development and software-based services [TKB10]. Well-known examples are the Firefox add-ons or Apple's iPhone apps. Beside this delivery perspective on platform ecosystems, one can also consider a consumption-oriented perspective. B2B marketplaces, such as, for example, SupplyOn in the supply chain management domain, provide platforms enabling intercompany collaboration within ecosystems.

3 Recent Research Activities

Probably due to the many disciplines involved in platform-oriented studies – spanning a diverse field from organization and management research to computer science and information system – we feel that a unified body of research on platforms and the resulting ecosystems has not yet evolved. Despite some recent and substantial progress in that direction [for example the seminal review of TKB10], three main perspectives need to be considered when characterizing recent research activities: (1) technical, (2) economic, and (3) organizational. As research in all these domains is more diverse than we can capture in this brief overview, we focus on important and perhaps representative research from the various domains without claiming representativeness or comprehensiveness. Towards the end, this chapter will also briefly introduce the contributions to the 3EP workshop.

Technical Perspective: in platform-based ecosystems, interoperability challenges appear in many forms. A lot of work has been done in the context of service interoperability. McIlraith et al. [MSH01] introduce the concept of Semantic Web services. By adding a semantic markup to Web services, automated Web service composition and interoperability can be achieved. Following this concept, the extension of the W3C Web Service Description Language (WSDL) standard with further semantics has been introduced by the WSDL-S proposal [AFM05]. The different approaches for Web Service composition have been compared by Milanovic and Malek [MM04] along the four key requirements of connectivity, non-functional properties, correctness, and scalability.

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Platform interoperability is another key challenge. Specifically in the context of cloud computing, PaaS interoperability has recently received more attention. PaaS solutions come with different functions and associated interfaces resulting in interoperability issues. Accordingly, the need for reference architectures and associated interoperability standards has been recognized. For example, Loutas et al. [LPB10] provide a first proposal of a cloud reference architecture and a model for a common cloud API.

Economic perspective: The economic particularities of platform-based ecosystems, such as multi-sided markets, network effects, and path dependencies have already found some attention in recent research. Several works address the interdependencies of the decision behavior of platform providers, module providers, and module consumers in favor of or against certain platforms, the resulting market dynamics, and the resulting success of one platform vs. another. For example, Dobusch [Do10] highlights how platform-based markets are multi-sided, and that customer behavior can be as decisive for the economic fate of a platform as provider choices. Market models developed by Rochet and Tirole [RT03] and Economides and Katsamakas [EK06] explain decision behavior of the various participants and can be used to analyze the resulting competition dynamics. In this context, researchers have also addressed the question under which circumstances a platform provider should decide whether to open a platform to developers or to keep it exclusively for own development [EK06, EPV09]. Reversely, the question for the module provider is to develop exclusively for a single platform or to follow a multi-homing approach offering a module on several platforms [AW07, MSV10]. Formal or empirical analyses of the platform-induced market particularities have led to normative works which make suggestions about how to design pricing structures and platform governance [Ha06], and on how to deal with antitrust issues [ES08]. Orthogonally to those questions, the role of standards is important for driving platform strategies and explaining market dynamics.

Standards are necessary on multiple levels (technology, data, interfaces, business logic, etc.) to enable both development of modules for one or more platforms and for the interplay of different modules which are jointly operated to provide a composite outcome. Exemplary research in this field [e.g., BBG04] discusses the role of industry standards for platform design, or evaluates the interplay between standards on multiple layers in SOA [WB09].

Organizational Perspective: Closely connected to the economic perspective on the role of platforms in enterprise ecosystems, the emergence of platforms as backbones for inter-organizational cooperation and collaboration also impacts the way economic activity is organized. This perspective equally impacts all of the partners participating in such an ecosystem, that is, platform providers, module providers, potential entities for coordination and certification, and module users. As these entities create markets, they form ecosystems. Sanchez et al. [SM96] have shown that the evolution of such markets built on modular platforms is likely to differ from the classical lifecycle for integrated products. Hence approaches to organize and coordinate the economic activities on these markets need to match differing characteristics; an insight particularly interesting for focal players in such networks. Accordingly, governing platform-based ecosystems is likely to go beyond some of the classical success factors for strategic networks [e.g.,

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Mö06]. As these modular rather than integrated networks arise, some authors [SBW10, Ti08a] have investigated the questions whether modularity changes the need for information and knowledge exchange among participating entities and how incentive structures need to be adapted accordingly.

Many of these issues highlight the challenges for governing platform ecosystems. Here, a broad range of issues have already been investigated, ranging from the allocation of decision rights [La02, Ti08b] to pricing models [SBW10] and the impact of modularity on control [Ho07, HS07, Ti08b]. A better understanding of these issues should enable platform providers to attract new and innovative modules (by either new or existing providers), ensure new modules' compatibility with the platform, and attract and retain new customers using the platform and its modules.

Looking at the contributions to our workshop, all of them provide interesting additions to platform research. Through their longitudinal study of the vendor-sided characteristics of online marketplaces for modules, Burkard et al. [BDW11] provide an interesting empirical look at how the platforms they investigated changed over time and how different governance approaches might impact platform development. In studying the openness of platforms for third-party providers, Hilkert et al. [HBH11] also extend our knowledge on platform management by highlighting the different facets that constitute openness as perceived by the developers and how they impact their acceptance of a platform. Finally, the paper by Kunkel et al. [KKL11] provides a specific example of organizational integration in a supply-chain management context by introducing the prototype for a platform for integrating fourth-party logistics providers.

4 Theoretical Foundation

As the previous section has shown, platforms and resulting ecosystems are complex phenomena and corresponding research is very diverse. Accordingly, several theoretical perspectives can be applied to investigate the related phenomena. In a recent review, Tiwana et al. [TKB10] suggested a set of theoretical lenses that can inform platform-oriented research and theorizing.

For example, evolutionary economics, along with game theoretical approaches, can be used to better understand the emergence, competition, and prevalence of multi-sided markets such as platforms. A case in point is the work by Mantena et al. [MSV10] who build a model to understand the competition of two platform-based markets. Such approaches might be extended by using propositions from network effect theory, established paradigms of adoption and diffusion, or cooperation theory to better understand emergent structures, pricing models, and restrictions. This field links well to the economic perspective introduced above.

For the organizational perspective, modular systems theory and its extensions probably offer some of the most fundamental propositions enabling explanation and prediction of platform evolution [Ho06, Sc00]. In this context, modular systems theory proposes that modular systems are more amendable to change since their constituent subsystems have

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the ability to evolve independently and can thus increase a platform's fit to its relevant environment. Especially the decentralized nature of knowledge transfer, collaboration, and coordination will increase the autonomy of the participating entities and, thus, decrease coordination cost [SM96, Ti08b]. It would be interesting to see how different governance models for platforms compete and whether there are any dominant models for certain environments. Especially understanding the demand-pull and technological push on modules and platforms can help respective providers to better adapt their offering.

Beyond modular systems theory, a wide set of theories from economic, management, and organizational studies have the potential to inform the organizational facets of platform-based research. An interesting candidate is structuration theory [DP94, Gi84, Or92]. Especially the related notion of path dependence, that is, the question of how choices today impact the number of options available tomorrow [SSK09], is a promising venue to better understand platform evolution and survival. Here, research can shed light on how today's decisions (e.g., platform design, governance mechanisms, technological choices) will create a path for the platform and might lead to inertia. Presumably, avoiding such inertia or breaking it once it has occurred, especially in competitive environments, could be instrumental to ensure a platform's innovativeness and, thus, its prevalence. In the workshop, the invited talk by Dobusch and Sydow[1] will introduce and discuss the notion of path dependence and illustrate some of the potentials this theoretical lens has for platform-oriented research.

Further potentials of this wide field are transaction cost economics, agency theory, real options theory, and bounded rationality [e.g., GF09, TKB10], to better understand interactions between platform providers and module developers and to structure and design governance mechanisms accordingly.

5 Promising Directions for Future Research

The aim of the 3EP workshop on platform ecosystems is to discuss current developments of platform research – including the works submitted to and presented at the workshop – and to identify the most important and promising avenues for future research in this field. In preparation for the workshop, we provide an initial step and group promising research directions into four clusters. However, researchers should be aware that those are strongly interconnected and that multi-disciplinary approaches will be required to address them in a comprehensive manner.

1) Focusing on **effective platform designs**, Tiwana et al. [TKB10] and Lerner et al. [LPT06] have argued that the interplay between platform architecture and platform governance has been completely neglected by previous research. The question about which decisions regarding module design can and should be made by the platform providers vs. the module developers is of an essential nature and affects

[1] The underlying working paper will be available from the workshop's homepage or the members of the organizing committee on request.

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the economic dynamics and the eventual market success of a platform. Works on IT governance have discussed the fit between types of IT architecture and corresponding types of IT governance, which could be adaptable to the platform context. Another important question in this context is the question of optimal module granularity, which has extensively been discussed (e.g., in the service and SOA context). In a platform context, the question becomes even more complex since the granularity of a module might be in scope of the platform governance. Therefore, the question is whether and how the platform provider can and should take influence on the granularity of the modules being deployed on the platform. Currently, research has not even answered the question whether there is a link between module granularity and sustainable market advantage of the platform [PC06, TKB10].

2) This leads to the economic perspective that – as already outlined above – primarily has to handle the **dynamics of multi-sided markets and the interdependencies between different platforms**. The design of the platform architecture and of the corresponding governance has a substantial influence on the decisions of the different market participants and will thus influence the market dynamics. Since the "market" consists of at least platform provider, module providers, and module consumers – but also increasingly of added-value providers, certification authorities, etc. – these interdependencies represent a highly complex and important research topic.
Multi-sided platform-based markets offer rich opportunities for researching the impact of different types of network effects (direct vs. indirect, positive vs. negative, same-sided vs. mutual) [EPV06]. The platform paradigm represents a standardization problem [WBK06] which not only consists of competing standards (e.g., battle of platforms such as Android and iOS) but also consists of multiple levels of interdependent standards (e.g., standards on different layers in the SOA context) [WB09]. Moreover, platforms are highly dynamic, they enter new markets and often converge [TKB10] (e.g., cooperation of Intuit and Azure). The underlying technologies are very volatile as well, which makes "platform standards" quite fuzzy or "morphing" as Tiwana et al. [TKB10] call it.
Another issue gaining importance in this context is the phenomenon of value co-creation [KG08, VMA08]. It describes the fact that value is not just created by an entity for that entity (e.g., by a module provider through developing and selling a module), but that the entire ecosystem profits from the value-creating act of any participant (e.g., platform providers through an increased attractiveness of their platform through additional modules and users through an increased choice in modules offered). Often, such co-creation is not just a zero-sum game, but can actually provide additional potential as, for example, customers make their unique knowledge a competitive resource of the network [OP08, PSF08, SK10]. In the platform context, developers and users of modules do not only decide for a certain platform because of the benefits delivered (including those induced by network effects), but also because of the opportunities of getting involved in shaping the services deployed on the platform. Therefore, the artifact itself becomes a function of the involved entities' decision behavior. An investigation of how value is constituted (i.e., not just through sales/purchase of a module but also through the

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differing opportunities to involve oneself or to gather information from customers to better design a platform's offerings) could help to better understand the success of different platforms and might help platform and module providers to design better offerings and attract and retain more customers.
These and other questions need to be addressed to design effective platform ecosystems. However, due to the particularities of platform ecosystems, this kind of research will also offer the opportunity to re-inform theories on multi-sided market economics in general. Investigating the interdependencies on two-sided markets by combining multi-sided adoption and diffusion models will improve our understanding about these dynamics and thus can help to explain certain market outcomes, such as the success of a certain platform or of the modules offered.

3) Platforms redefine the way in which software is produced and distributed, thus fundamentally **changing the business paradigms of the software industry**. From an industry design perspective, emerging production and distribution models have to be evaluated regarding efficiency and effectiveness, and the creation of complementary service models (e.g., marketplaces, certification and recommendation systems, billing and collection services, e-contracting, and metering) needs to be supported. From a welfare economic perspective, the influence of platforms on software market efficiency and innovativeness of the overall software industry needs to be evaluated. For example, will platforms sustainably lead to more and smaller software development firms and will this increase overall innovativeness of the software industry? Conversely, it has to be examined which impact consumerization, standardization, and industrialization will have on platform ecosystems, and whether those will finally allow for transferring the mass-customizing concept known from other industries to software production in order to sufficiently serve the "long tail" of software demand (e.g., ERP add-ons for very specific needs required just by few, very specialized firms).

4) The final research direction we would like to emphasize is reflected by this workshop's title: What is the **role of platforms for enterprise ecosystems**? How does a platform-based economy of embedded services, which leads to granular business functions being provided via external services, reshape firms' boundaries? While the software industry as provider will fundamentally be transformed by the platform paradigm (cf. previous paragraph), those firms which *consume* platform-based services will also experience substantial organizational change. As with any major IT innovation, such as ERP, client/server, or the advent of the Internet, platform ecosystems bear the potential to change the way how firms are functioning. For instance, new IT outsourcing and BPO strategies will appear, inducing more comprehensive and more granular, selective outsourcing. This might change the characteristics of inter-firm relationships but also affect the internal structure and the outer boundaries of organizations. For example, modularity of business functionality embedded in software services bears potentials to both extend BPO (leading to more comprehensive outsourcing strategies) but also to reduce the size of the outsourced function (leading to more selective outsourcing) [BJW11, TKG07]. Firms will tap into different platform ecosystems and demand modules as services from different platforms. Consequently, fundamental questions

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to be answered are: How do platforms change the way outsourcing (BPO in particular) is done? What are the benefits and risks from partial overlaps of the different platforms' scopes and a firm's boundaries? Beside various technical and organizational problems which require new sets of interrelated standards, there will be conflicts of interest and accountability problems resulting from the fact that interdependent services are received from different, independent providers (e.g., cloud provider (IaaS), platform provider (PaaS), and module providers (SaaS or BPaaS)) which, in turn, will require new modes of governance.

Overall, we expect a wide variety of important research work to appear in the future, both contributing to the design of platform architectures and governance as well as refining theory for understanding the behavior of the different actors involved in platform ecosystems and the resulting market dynamics. We would like to take this opportunity to thank all members of our program committee and the reviewers who have substantially contributed to evaluating and developing the submissions we received. Along with the authors of the workshop papers, they helped in making the works presented at the 3EP Workshop an important step along the path to future insights into the role of platforms for enterprise ecosystems.

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