The Architectural Enablement of a Digital Platform Strategy

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WWW.CBS.DK

ISSN 0906-6934

Print ISBN: 978-87-93956-22-3
Online ISBN: 978-87-93956-23-0

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PhD Series 6.2020

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HANDELSHØJSKOLEN

The Architectural Enablement of a Digital Platform Strategy

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The Doctoral School of Business and Management is an active national and international research environment at CBS for research degree students who deal with economics and management at business, industry and country level in a theoretical and empirical manner.

Acknowledgements

First and foremost, I would like to thank my academic supervisor Stefan Henningsson and my professional supervisor Anders Lerbech Borregaard, whose last name was still Vinther when my PhD project started in 2017. Time flies when you spend it well.

Both supervisors have acted as true role models, professional leaders and admirable characters that any individual would be blessed to work with. Both have trusted me with a great amount of freedom from early on; have inspired me with their own, more mature intellectual views of the world; have invested time as well as effort into my professional development; have placed me into the suitable environment to execute; and have pushed me to supreme effort when required. I could not have imagined better supervisors and am deeply grateful to both of them.

Next, I would like to thank the entire Enterprise Architecture team in the LEGO Group for adopting me like a family member from day one and for sharing their extensive professional knowledge with me. I have been very fortunate to become part of a team that understands and appreciates academic perspectives on practical issues. Special appreciation goes to Edwin van Kouwen, who has invested a great amount of time into the alignment between academic and practical perspectives, and Bo Kaastrup, my Brickmate in the LEGO Group. Naturally, the same gratefulness is extended to the entire LEGO Group where every individual has been open, interested and caring to contribute to the project.

On the academic side, I would like to recognize the effort of my secondary supervisor Phillip Yetton and Ben Eaton, who have both spent substantial time on my personal development. Naturally, all other academics and lecturers, who I have learned from or interacted with at Copenhagen Business School (CBS), the University of Mannheim, Germany, or other universities, are highly appreciated.

Furthermore, I would like to thank Henrik Amsinck, Chief Information Officer of the LEGO Group, and Niels Bjørn-Andersen, Professor Emeritus at CBS, for their effort in making this exceptional PhD setup come to life and placing me into an environment that allows for strong professional as well as academic development.

Eventually, within my circle of family and friends there are too many individuals to thank on paper. Every person that steps into someone else's life will leave an impact of smaller or greater magnitude. I have been blessed with a lot of individuals making very positive impacts on my life. And those that have done so tend to know.

Abstract

Facing the opportunities and threats arising from digitalization, traditional brick-and-mortar companies are increasingly following the lead of digital natives and seeking speed in the development of digital value propositions. This ability hinges on the flexibility and evolvability of each company's existing information systems landscape. As a result, the underlying architecture has turned into a crucial determinant of a company's proficiency to leverage the business potential induced by new inventions in digital technologies.

This PhD thesis elaborates on the digitalization journey of the LEGO Group to investigate how companies create innovation-enabling platform architectures to overcome previous limitations to digital innovation as well as international expansion. Based on the theoretical findings from four individual research papers, the pervasive analysis presented in this thesis explains the phenomenon of architecting from a configurational perspective. The research results provide a contingent conceptual understanding of the mechanisms through which architecture decision-making produces innovation-enabling or -constraining outcomes for the overall platform architecture.

Portraying Enterprise Architecture (EA) as a central mechanism to guide the transformational journey, the four individual research papers explain (1) how the dynamic capability of EA can be built, (2) how EA as a function drives a company's platformization journey, and (3) how this transformation removes previous barriers to digital innovation as well as internationalization into digitized markets.

Resume (Dansk)

I mødet med de muligheder og trusler, som digitaliseringen bringer med sig, er traditionelle virksomheder i stigende grad begyndt at følge de digitalt indfødtes eksempel og søger at skabe hurtighed i udviklingen af digitale værditilbud. Muligheden herfor afhænger af den enkelte virksomheds aktuelle informationssystem-landskabs grad af fleksibilitet og udviklingsevne. Som resultat heraf er den underliggende arkitektur blevet en afgørende faktor for en virksomheds evner i forhold til at kunne udnytte det virksomhedspotentiale, som nye opfindelser inden for digital teknologi har medbragt.

Denne ph.d.-afhandling gennemgår LEGO Gruppen digitaliseringsproces for at undersøge, hvordan virksomheder skaber innovationsmuliggørende arkitektur for at kunne afhjælpe tidligere begrænsninger for digital innovation så vel som international ekspansion. Med afsæt i teoretiske resultater fra fire forskellige forskningsartikler redegør afhandlingens gennemgående analyse for det fænomen, det er at udforme arkitektur ud fra et konfigurationsperspektiv. Forskningsresultaterne giver en konceptuel forståelse af mekanismerne, hvorigennem beslutningstagning i forhold til arkitektur skaber innovationsmuliggørende eller -begrænsende udfald for den overordnede platformsarkitektur.

Ved at fremstille Enterprise Architechture (EA) som en central mekanisme i styringen af forandringsprocessen illustrerer de fire forskellige forskningsartikler, (1) hvordan EA's dynamiske kapabiliteter kan skabes, (2) hvordan EA som funktion driver en virksomheds platformsskabende proces, og (3) hvordan denne forandring fjerner tidligere barrierer for digital innovation så vel som internationalisering.

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Chapter 1: Introduction

Digitalization has become a ubiquitous phenomenon shaping global industries as well as societies and offering tremendous opportunities for smarter ways of doing things - conducting business, providing health-care, offering public services, designing cities, or constructing currencies. Digitalization has become embedded at the core of society and the exploitation of associated opportunities has therefore become an important agenda not only for practitioners in the private sector, but equally for researchers in a diverse range of fields, including politicians, medical practitioners, as well as private investors.

The cross-sectorial strategic importance has subsequently lead to a broad public articulation of the phenomenon characterized by very diverse perspectives regarding its true meaning (El Sawy et al. 2015). In the private sector, the increasing digitalization of economies and industries is in essence characterized by a changing part played by information technology (IT) from an originally supporting role in foremost physical value propositions towards an increasingly essential role in business models that have digital components inscribed into their value proposition (El Sawy 2003; El Sawy et al. 2016). This shift bears promising opportunities for companies that are able to seize the moment, while simultaneously posing enormous threats on incumbent firms that may see well-established business models being disrupted by digitally-enabled products or services from the network economy. Responding to these competitive dynamics, traditional brick-and-mortar companies are following the lead of digital natives through strategic digital transformations (Sebastian et al. 2017). Often associated with digitization – i.e. the injection of digital technology into physical products –, these transformations seek to create digitally-enabled platform-based business models, the ability to quickly develop new products as well as services, and a business ecosystems of partners to co-create digital innovation (Eaton et al. 2015; Gawer and Cusumano 2014; Tiwana 2013).

The LEGO Group has made digitalization a fundamental pillar of the overall business strategy already in 2012 and has in the meantime earned recognition as a digital leader in the toy industry (El Sawy et al. 2015). Emerging from a small carpenter business over 85 years ago, the LEGO Group is nowadays globally known for the production of the iconic plastic LEGO brick that offers a platform of play upon which creative builds ranging from spaceships to ninja castles are equally constructed by design experts within the company and end-consumers after purchase. During the late 20th century and particularly in the beginning of the 21st century, the LEGO Group has realized more than a decade of exceptional growth (beyond 10% p.a.) and has become one of the most powerful brands in the world.

While this growth has been enabled by highly efficient enterprise IT, the company simultaneously embraced product digitization as well as digital customer engagement (c.f. Sebastian et al. 2017). Early instances involve, but are not limited to, the LEGO Mindstorms project and LEGO universe. The company's overall digitalization agenda has, however, not come without challenges. Particularly, the continuous digitalization of physical play and the upsurge of online retail have created competitive pressures that have recently forced the company to revisit value propositions and operating models that had until now been highly successful.

For instance, if you come across children playing with smartphones or tablets in public spaces nowadays, you may see that they are building models or creating entire universes using digital bricks. But if you observe more closely, they are most probably not using LEGO bricks, but rather the digital solutions offered by Minecraft or Roblox that allow for digital play in conjunction with social interaction with their friends. Accordingly, the strong dominance by the LEGO Group in the physical construction toy industry does not guarantee equal success in the digital space, where time-to-market is even more relevant and distinct phenomena, such as network effects, shape the rules of the game.

Under these market conditions, the company's existing Information Systems (IS) landscape has increasingly turned out to become a liability as it had been continuously built with the primary goal of sustaining supply chain efficiency by establishing global business process standardization alongside integration. Within the context of this thesis, the term *IS landscape* describes the holistic collection of all technology infrastructure (hardware and software), business logic, and data that serves internal employees and external business partners. The LEGO Group's IS landscape became extremely successful at enabling efficient business operations through highly standardized as well as integrated business processes. This quality, however, was established by gluing individual components together, co-producing tight coupling. As this global architecture limited the replaceability of systems and the re-use of data or functionality in the development of digital experiences, the need for a new global IS landscape architecture soon became evident. Accordingly, the LEGO Group established a new global Enterprise Architecture (EA) function in early 2017 with the purpose of guiding the architectural transformation of the IS landscape with an end-to-end, long-term perspective.

The challenge portrayed is not specific to the unique context of the LEGO Group. According to McKinsey Digital (Bossert and Desmet 2019), IT-platform-enabled business flexibility is a key objective for companies across industries to keep up with digital natives. The existing academic IS literature outlines a similar challenge for companies on the digitalization journey predicting that along the way "the role of corporate IT infrastructures is likely to transform" (Yoo et al. 2010, p.732) in order to support distributed innovation by providing generativity for the integration of dispersed digital capabilities. As the function of IS landscapes shifts from an efficiency-focused support of business operations to flexibility-enabled value creation, Agarwal and Tiwana (2015) proclaim the evolvability of IS as a strategic capability that long-term organizational survival depends on.

In academic research related to IS evolvability, the critical role of architecture as a "mass-coordination device" (Agarwal and Tiwana 2015, p.474) has been emphasized from early contributions onward (Duncan 1995). In this context, the concepts of modularity, connectivity, compatibility, and loose coupling have been advanced by various contributions from distinct research streams in order to characterize flexible or evolvable IS architectures. Equally, the platform concept, which has gained particular prominence in terms of describing and explaining the technology-enabled innovation capacity of products or organizations, is at its heart based on the premise of an innovation-ready architecture (Baldwin and Woodard 2009; Thomas et al. 2015).

Nevertheless, very little conceptual knowledge exists in the IS literature about the processes by which companies purposefully construct and evolve innovation-enabling architectures. The literature on EA portrays the architecture design process as a top-down endeavor that consists of several high-level sequential steps and is shaped by a company's strategy as well as its operating model (Ross et al. 2006). While architecture is a global concept that is commonly applied on the holistic level of a platform or company, architecture decision-making usually occurs at the local level where individual solutions are designed as well as implemented. For this local level, Baldwin and Clark (2000) provide six modular operators that characterize the basic patterns of architecture decision-making in pursuit of modularity. Further contributions are, however, scarce and specifically provide little insights into how the holistic macro-level process can be bridged with situated architectural decision-making on the micro level. As a consequence, this thesis addresses the following overarching research question: *How do companies create innovation-ready IS landscape architectures?*

Leveraging the rare opportunity to study the phenomena of interest from the inside of an organization making substantial investments into the transformational journey, the research is based on a rich amount of data that has been collected in an engaged scholarship in the LEGO Group. As an industrial PhD Fellow, the author has spent 36 months as an integrated member of the LEGO Group's EA team and witnessed the establishment and continuous improvement of the EA capability. Based on these observations, complementary interviews, and the analysis of internal documents, four individual peer-reviewed research publications focus on more specific research questions that have been derived from the overarching phenomenon of interest. Figure 1 places these publications into a meaningful relationship to each other. Finally, this manuscript provides a fifth contribution, which specifically addresses the overarching research question by taking a theoretical perspective that traverses the four previous contributions.

The first research contribution, as presented in Paper #1 (Chapter 5), conceptualizes EA as a dynamic capability that orchestrates the adaptability of a company's technology-enabled business processes and digital value propositions to changing market environments. The findings emphasize that, in addition to learning from previous experience, a dynamic capability can be built through deliberate prospective activities in preparation for future use.

The second research contribution, presented in Paper #2, takes a path-constitution perspective on the platformization of an IS landscape. Based on the conceptualization of the LEGO Group's IS landscape as a drifting corporate Information Infrastructure (II), the study develops a mid-range process model that explains how mindful deviations by innovative individuals triggers the constitution of a new platformization path through delegated action. The findings reveal that this process of *architecting* is similar to installed-base cultivation and equally shaped by deliberate, top-down management, as well as emergent forces from within an organization.

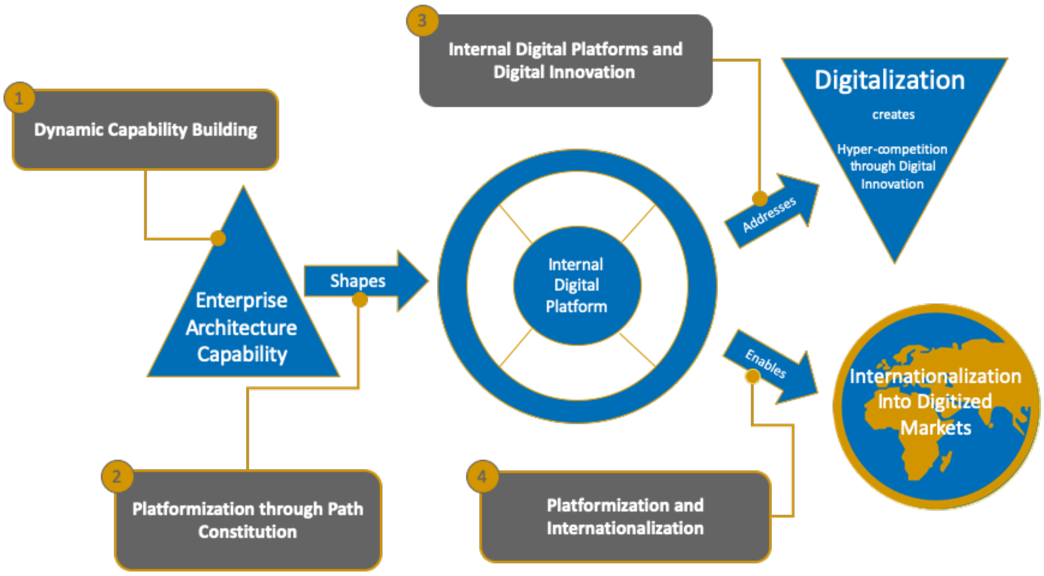

Figure 1: High-Level Coherence among Existing Research Contributions

The third research contribution, presented in Paper #3, draws on Systems Theory in order to conceptualize a company's IS landscape as an internal digital platform. Inducting from evidence regarding how the platformized parts of the LEGO Group's IS landscape have enabled digital innovation in the past, the study develops three generative mechanisms of how an internal digital platform enables digital innovation within a company. These mechanisms reveal the critical characteristics of platform architecture, which enable the innovation potential of a platformized IS landscape. The findings additionally identify a tension between these generative mechanisms that reveals the strategic choice of modularity that companies face when architecting a digital platform.

The fourth research contribution, presented in Paper #4, explains the role of IS landscape platformization during a company's internationalization process. The study is based on an analysis of the LEGO Group's past and present journey in the Chinese market and of the LEGO Group's current investments into IS landscape platformization that are deliberately aiming to facilitate the future entry of fundamentally different new markets. The main findings consist of mechanisms through which IS landscape platformization removes internationalization barriers imposed by psychic distance between market regions. Targeting primarily a practitioner audience, the contribution is rounded off by lessons learned.

Finally, this thesis provides an integrative analysis, which is partly based on previous findings from existing research contributions and equally scrutinizes pre-existing as well as additional case evidence. For this purpose, the final contribution focuses on the concept of *architecting* to describe and explain the socio-technical process by which companies deliberately shape their IS landscape architectures. Theoretically, this analysis is framed within a configuration perspective (Meyer et al. 1993) and the quest for a set of context-mechanism-outcome configurations (Pawson et al. 1997) that jointly explains the process of architecting. By investigating individual points of architecting within the LEGO Group, the theoretical analysis reveals how contextual factors contingently shape individual architecture decision outcomes and thereby uncover the mechanisms at play during this process. This analysis furthermore reveals how a company's overall architecture practice can be deliberately shaped by EA interventions in order to introduce contingencies into situated points of architecting. In pursuit of an overall innovation-ready platform architecture, these contextual variables frame decision-making on the micro-level and thereby steer collective outcomes into a desired trajectory. Figure 15 illustrates how this pervasive analysis relates to the four individual published research papers.

This manuscript presents an overarching synthesis of the PhD project's theoretical foundations, research methodology, research process, as well as theoretical findings along with a pervasive analysis that traverses the units of analysis investigated by all four published research papers. Chapter 2 reveals the relevant academic literatures on IS evolvability and architecture (incl. EA) that has provided the conceptual basis for this research. Also, the segment unveils the state of existing knowledge before the engagement in this research project to set the baseline for theoretical contributions. Moreover, the subsection on configuration theories introduces the theoretical perspective taken in the overarching pervasive analysis. The unification of this lens with existing knowledge on architecting yields the generic conceptual research framework for this thesis.

Chapter 3 reveals the adopted research methodology of the overall research project as well as the specific method for the analysis presented in this manuscript. Starting with a broad overview of engaged scholarship as a research methodology, the section derives relevant sampling, data collection, as well as data analysis techniques that have been applied during the research. The individual research methods used within the published research papers are described within their summaries in Chapter 5. Nevertheless, Chapter 3 describes the common components in terms of sampling, data collection and overarching analysis. Additionally, the method adopted in the analysis presented in this document is unveiled in detail.

Chapter 4, recounts the holistic case narrative underlying the four published research papers. This provides rich and detailed insights into the LEGO Group's digitalization journey and particularly the foundation as well as continuous evolution of the company's EA capability. Based on the case evidence, chapter 5 introduces the summaries of each individual published research paper. The recaps include an outline of relevant literatures, the research questions, adopted research methods as well as eventual findings.

Chapter 6 presents the overarching pervasive analysis that unifies pre-existing theory with findings from the four research publications as well as novel case evidence to create a configuration theory that explains architecture decision-making in distinct contextual settings. The section substantiates the generic theoretical model introduced in the theory chapter and develops six context-mechanism-outcome configurations (Pawson et al. 1997) that build the core of this thesis' research contribution.

In chapter 7, this theoretical contribution is discussed in relation to the four existing research publications. Along these lines, the discussion also reveals implications for academia in terms of existing as well as future research and implications for practice. Furthermore, the generalizability and limitations of the research are evaluated. Finally, chapter 8 closes the thesis with a conclusion.

Chapter 2: Theoretical Foundations

This thesis draws on several distinct bodies of literatures that are related with the overarching goal of sustaining flexibility, agility, or evolvability of a company's IS landscape architecture in preparation for digital innovation. From an overarching conceptual perspective, this phenomenon is best described by Agarwal and Tiwana's (2015) editorial, which established a dedicated research stream on IS evolvability. The relevant theoretical phenomena underlying IS evolvability have, however, been subject to IS research for decades and have been primarily described in the literatures on strategic management of IS, II, and digital platforms. Therefore, the following section provides a synthesis of existing findings, which originate from distinct streams of the IS literature, but all provide theoretical insights relevant for the outlined research question.

IS Evolvability

The strategic role of an agile or flexible corporate IS infrastructure in terms of enabling business benefits related to organizational flexibility has been investigated by scholars in the field of strategic IT asset management since the early 1990s (Allen and Boynton 1991; Avison et al. 1995; Boynton 1993; Broadbent et al. 1999; Duncan 1995; Monteiro and Macdonald 1996). These studies are primarily quantitative or conceptual in nature and explain that a flexible corporate IS infrastructure enables business value from IT assets (Sambamurthy and Zmud 1994), long-term competitiveness (Boynton 1993; Duncan 1995; Ross et al. 1996), or business process redesign (Broadbent et al. 1999). Based on the socio-technical nature of IS, an IS infrastructure is not limited to the basic technology components of which it consists, but also comprises core data-processing applications, resource planning, as well as management factors (Duncan 1995). Also, early studies already acknowledge the role of architecture for IS flexibility by establishing that connectivity, compatibility, and modularity are essential architectural characteristics that constitute a flexible IS infrastructure (Duncan 1995; Monteiro and Macdonald 1996). Due to the distributed nature of large-scale IS infrastructures, as well as the subsequent challenge for organizations to manage their architecture across departmental boundaries, several contributions are also directly related to the early IT governance discussion around centralization versus de-centralization (Allen and Boynton 1991; Duncan 1995).

After the turn of the millennium, research on strategic IT asset management continued to investigate the effects of enterprise-level IS infrastructure flexibility on firm agility (Sambamurthy et al. 2003; Tallon 2007; Tallon and Pinsonneault 2011), strategic flexibility (Chen et al. 2017), business process agility (Tallon 2008), and, finally, sustained competitive advantage (Byrd 2002). In this context, the vital part of complementary organizational capabilities, such as IT personnel capabilities, has been increasingly emphasized (Neumann and Fink 2007), while some scholars have argued that it is specifically the support of a company's core competencies that generates business value from a high-quality IS infrastructure (Byrd 2002; Chen et al. 2017).

Simultaneously, other research streams within IS equally praise the strategic role of IS infrastructure flexibility. Within the field of mergers & acquisitions (M&A), for instance, Benitez et al. (2018) reveal that IS infrastructure flexibility facilitates the development of business flexibility and post-M&A IT integration capability.[1] Most fruitfully, however, the IS literature on IIs (or Digital Infrastructures) has produced significant findings on the role and evolvability of large-scale IS within and across organizations. At the origin of this literature rests the assumption that an II's future evolution is limited by its existing socio-technical components (i.e. its installed base) that strengths and limitations are inherited from (Ciborra 2000; Grisot et al. 2014; Star and Ruhleder 1996). To this end, the deliberate progression of an II is additionally complicated by its distributed nature and heterogeneous set of stakeholders who each shape the installed base in pursuit of individual goals and interests (Ciborra 2000; Star 1999).

Against these barriers to evolvability, several individual research contributions examine how IIs do progress dynamically in order to serve novel purposes. Henfridsson and Bygstad (2013) develop three socio-technical mechanisms – adoption, innovation, and scaling – and explore patterns of mutual interactions that lead to the successful progression of a corporate Digital Infrastructure. In a similar vein,

[1] While Benitez et al. (2018) use the term IT infrastructure flexibility, their definition of the term refers to this thesis' understanding of an IS infrastructure flexibility.

but in a cross-organizational context, Grisot et al. (2014) elaborate on the socio-technical process of successful II development. Eventually, Rolland et al.'s (2018) research on the management of an externally-provided digital platform from a client perspective exposes how the interaction with the client company's existing Digital Infrastructure generates opportunities (i.e. digital options) and technical restrictions (i.e. digital debt). All of these contributions point out the critical role of architecture and specifically the enabling part of loose coupling between individual components. Similar findings emerge from the IT governance literature, where Gregory et al. (2018) reveal that IT consumerization transforms governance patterns away from formal processes to governance through standards and platform architecture.

In summary, research on IS infrastructure flexibility has been progressing for several decades and has continued to re-emphasize the criticality of technical architecture. The current state of IS literature limits the understanding of a flexible architecture to the few characteristics of modularity, connectivity, compatibility, and loose coupling. Architecture is, however, a much more sophisticated phenomenon that does not only determine interface specifications for how individual modules come together as a whole, but also an entire set of functions to be performed as well as a mapping of functions to modules. As a result, architecting involves delicate, critical trade-offs with long-lasting impact that the current literatures on IS and organizational science do not provide guidance on (Pil and Cohen 2006). Several studies, for instance, question the value of full modularity and subsequently justify the question of "how much modularity is good for innovation?" (Pil and Cohen 2006, p.1008). Additionally, research on the mechanisms through which a high-quality or loosely-coupled architecture enables flexibility-related business benefits is still in its infancy.

In the meantime, the technological and managerial realities surrounding the management of IS have also changed which is only catered for by more recent research contributions. For a start, as digitalization accelerates, companies' quest for competitive advantage is increasingly dependent on the ability to tap into new value propositions in the digital space in addition to efficiency gains in physical value propositions through business process improvements (Ross et al. 2019). Simultaneously, the increasing availability, quality and malleability of cloud-based digital platforms catering for enterprise software purposes (e.g. for customer relationship management (CRM) or human resources; c.f. Hedman and Xiao 2016; Rolland et al. 2018) allow companies to compose major parts of their IS landscapes based on externally-hosted services and thereby leverage vendor-provided, incremental innovation. As the firm subsequently owns only a fraction of its large-scale IS infrastructure consisting of multiple moving parts, their coordination becomes increasingly complex (Agarwal and Tiwana 2015) – particularly as "the type of knowledge resources needed for innovation cannot be fully known a priory" (Yoo et al. 2010, p.732). In this context, Agarwal and Tiwana (2015) point to the critical challenge of "designing systems for disassembly, not just integration" (Agarwal and Tiwana 2015, p.476) to ensure infrastructure robustness in case individual sub-systems are removed or exchanged.

Additionally, the sharp increase in data-producing devices connected to the internet and the subsequent distributedness as well as the scale of IS further exacerbate the complexity of this challenge (Agarwal and Tiwana 2015). Originating from the equipment of physical products with digital technologies, the layered modular architecture has harmonized data transfer among physical devices and become the dominant design hierarchy for digital products across industries (Yoo et al. 2010). As this design hierarchy becomes equally prevalent in the world of enterprise systems and "firms start competing with layered modular products, the role of corporate IT infrastructures is likely to transform again" (Yoo et al. 2010, p.732).

In this context, the platform concept is increasingly utilized to conceptualize how individual companies can holistically structure their landscapes of IS to effectively enable business in the digital age (El Sawy et al. 2016; Sebastian et al. 2017). Specifically "the proliferation of digital tools or digital components allows firms to build a platform not just of products but of digital capabilities used throughout the organization to support its different functions" (Yoo et al. 2012, p.1400). Recent evidence suggests that internal enterprise platforms, including enterprise resource planning (ERP) systems, play a key enabling role in leveraging digital technologies for innovation (Henfridsson and Bygstad 2013; Lokuge and Sedera 2016; Sedera et al. 2016) and enabling two-way interactions with customers (Sebastian et al. 2017). Particularly large-scale IS "are increasingly serving as a platform to which other tools can be added in order to take advantage of shared data and resources" (Yoo et al. 2012, p.1400).

This perspective follows the technological, engineering strand of the academic platform literature. In contrast to the economic theoretical perspective, which conceptualizes platforms as multi-sided markets, the engineering perspective studies platforms as technological architectures that drive platform innovation (Gawer 2014). For this purpose, they are classified into stable core and variable peripheral components that interact via standardized interfaces (Baldwin and Woodard 2009). This conceptualization explains how modular architectures spur product variety by providing a technological architecture to innovate upon in production and design (Eaton et al. 2015; Gawer 2014; Ghazawneh and Henfridsson 2013; Selander et al. 2013). This architecture may be used only within the boundaries of a single company or across several organizations.

Capturing the increasing orientation towards platform strategies in practice, the term “platformization” has emerged in the IS literature to describe the commercial transformation from products to (multi-sided) platforms (Constantinides et al. 2018) or the establishment of large-scale platform architectures to spur innovation within and across organizations (Bygstad and Hanseth 2018).

From Architecture to Architecting

The holistic management of a company’s IS landscape architecture in conjunction with business processes as well as strategy has in academia and practice commonly been subsumed under the discipline of EA management. EA refers to the definition and the representation of a company‘s organizing logic for structures, roles, incentive systems, business processes, and IT systems (Ross et al. 2014). The purposeful (re-)design of these elements is a crucial strategic task that aims for coherence between organizational capabilities and broader business goals to yield a foundation for execution of the overall business strategy (Ross et al. 2006).

Focusing pre-eminently on technological components, EA has traditionally been conceived as interconnected layers of IT infrastructure, data, and applications (i.e. IT architecture) that enable appropriate degrees of business process integration and standardization (Ross et al. 2006). In this definition, IT infrastructure refers to the “centrally coordinated, shared IT services providing part of the foundation for execution" (Ross et al. 2006, p.121) and excludes data, applications, and business processes. Therefore, Ross et al.'s (2006) notion of IT infrastructure describes the basic technology components enabling applications and business processes and only captures a subset of what Duncan (1995) describes as an IS infrastructure.

Following this perception, the EA discipline seeks to align systems as well as processes with a company's IT and business strategy to drive business value from IT (Ross et al. 2006). More recently, however, practitioners and researchers from the IS community have begun to recognize the fact that EA management is not a pure IT systems challenge and to follow a more holistic view, which accounts for the dedicated business architecture (Mocker et al. 2015; Ross et al. 2014).

The design, implementation, and refinement of a consistent - as well as effective - EA enables companies to realize superior organizational performance (Ross et al. 2006). Despite difficulties quantifying business value from EA initiatives, consensus exists in the IS community that a high-quality EA improves organizational performance through several mediating organizational benefits, such as increased operational efficiency or strategic agility (Mocker et al. 2015). Therefore, EA management, commonly abbreviated as simply EA, is often used as a vehicle for strategic digital transformations.

The term EA has ambiguous meanings as it may either refer to a company's EA capability (i.e. a firm's capacity to deploy EA resources for a desired end result; Grant (2016), the process and practice of EA management, or the collection of systems and processes that have actually been implemented in a company. For the remainder of this thesis, EA thus refers to the EA capability, if not stated otherwise.

In order to describe the process of EA management, the term *enterprise architecting* has emerged in the IS literature (Kaisler et al. 2005; Rolland et al. 2015). This process has traditionally been portrayed as a top-down strategic endeavor aligning a company's IS landscape architecture with business strategy and processes (Ross et al. 2006, 2014). Kaisler et al. (2005, p.1), for instance, define enterprise architecting as "the set of processes, tools, and structures necessary to implement an enterprise-wide coherent and consistent IT architecture for supporting the enterprise's IT resources." On a high level, Tamm et al. (2011) describe the inherent activities as (1) the definition of a desirable future state architecture and (2) the elaboration of a roadmap for reaching this target departing from the current state. Simon et al. (2013) argue that the former part has so far been the main focus of academic research on EA, while the implementation aspect of the latter transition part has received only minor attention. Addressing this gap, Rolland et al. (2015) introduce the notion of *ambidextrous enterprise architecting* to explain architecture evolution as an emergent phenomenon, which is path-dependent on a company's pre-existing IS setup. Architecting is accordingly characterized by "intentional acts to circumvent path-dependencies and evolve towards an envisioned architecture" (Rolland et al. 2015, p.1).

Similar to architecting, the concept of *infrastructuring* captures the evolution of large-scale IIs through appropriation in local points of infrastructure where in-situ design activities create new infrastructure usages that may or may not involve infrastructural changes (Pipek and Wulf 2009). Generically, IIs denote large-scale IS, which evolve dynamically to serve initially unanticipated user needs (Hanseth and Lyytinen 2010). Since the concept has also been used to investigate corporate IS landscapes (Ciborra 2000), selected findings, such as the role of architecture for II evolvability (Grisot et al. 2014), are equally relevant for the purpose of the EA discipline.

As IIs are heterogeneous in nature and serve the connectivity of dispersed communities, they are commonly shaped by a large set of stakeholders who add on the installed base "in modular increments, not all at once globally" (Star, 1999, p.382). As a consequence, lack of control is a fundamental characteristic of II development, which has been described as *installed base cultivation* to denote the II's incremental modification until it comes as close as possible to a desirable scenario (Ciborra 2000; Grisot et al. 2014; Hanseth 1999). Accordingly, the II literature recognizes a fundamental tension between local architectural decision-making and global II evolution (Hanseth and Lyytinen 2010).

Equally, the studies within the realm of the EA discipline acknowledge a distinction between the enterprise level of architecture and solution architecture on a local level (Bruls et al. 2010). In order to bridge the two worlds, Bruls et al. (2010) suggest domain architectures as intermediary artefacts. Rolland et al. (2015) draw on the II literature to advance a cultivation perspective that portraits architecting in small incremental steps over time, but lacks conceptual detail on the concrete process through which this phenomenon unfolds.

In their work on generic modular architectures, Baldwin and Clark (2000) describe and explain design tasks as the search activities that result in the choice of design parameters. On the level of a holistic architecture, they define the formalization of interface specifications as well as the granularity of individual modules as the two most central design parameters. The definition of a holistic architecture subsequently enables de-centralized design decision-making for individual modules. Similarly, Ulrich (1995, p.3) defines product architecture as the "scheme by which the function of the product is mapped onto physical components". This is achieved by arranging functional elements, mapping functional elements to physical components, and specifying the interfaces between interacting components.

This view is consistent with Henderson and Clark's (1990, p.10) understanding of architectural innovation, which they define as change in "the way components of a product are linked together, while leaving the core design concepts (and thus the basic knowledge underlying the components) untouched". On the level of individual modules, Baldwin and Clark (2000) additionally introduce six modular operators that conceptualize generic in-situ design choices during the process of an existing architecture's evolution. In the context of a modular architecture, these operators enable future options that enable the superior evolution of the overall architecture in comparison to non-modular ones.

In sum, the findings on the process of architecting are scattered across different streams of the IS literature. Particularly on the level of individual design decisions, the IS literature lacks conceptual insights into which activities, parameters, influencing factors, or trade-offs are involved in the process. Simultaneously, the paradox between local design decision-making and the global nature of the architecture phenomenon – which is evident from the II literature – remains under-addressed. Most academic research on EA is based on the assumption of top-down architecture planning and governance, such that the impact of EA interventions on concrete points of architecture design has not been theorized. As digitalization accelerates, however, "the locus of innovation activities is increasingly moving toward the periphery of organizations" (Yoo et al. 2012, p.1401). The IS landscapes of organizations are increasingly penetrated by more specialized point solutions replacing large-scale enterprise suites, which have traditionally been implemented through thoroughly planned and top-down driven projects. At the same time, IT organizations progressively transform to agile ways of working and subsequently rely on autonomous teams to make smaller-scale architectural decision. These trends imply increasing de-centralization of in-situ architecture decision-making, giving rise to emergent solution architectures and creating socially complex dynamics in the process of architecting. The explanation of how innovation-ready architectures come about therefore requires a deeper understanding of these dynamics to theorize architecting as a socio-technical process on distinct layers of abstraction.

To define the *architecting* concept for the context of IS, this thesis follows the understanding of Henderson and Clark (1990), Ulrich (1995), as well as Baldwin and Clark (2000). Accordingly, architecting refers to the process of design decision-making that divides functional requirements into individual elements of expedient size, assigns these elements to individual software modules, and establishes required interactions among modules based on the definition of corresponding interfaces. Within IS, architecting is concerned with the design of complex hierarchical systems (c.f. Baldwin and Clark 1997), which recursively consist of modules that are complex hierarchical systems in themselves. This means that individual points of architecting can occur on distinct levels of the design hierarchy. Yet, on any level, architecture decision-making evolves around the definition of subsystems (i.e. modules) and the design of their interactions via interfaces. On the lowest levels, the modules refer to software classes or components, while on a higher level they may entail entire large-scale enterprise systems. Also, on the higher layers, decision-making may be focused on interactions among large scale systems and therefore become highly conceptual in nature. Nevertheless, even on this level, smaller-scale components, such as an individual micro-service, may become relevant.

Even though this delimitation of the phenomenon entails a strong focus on the technical design parameters, architecting should be understood as a social process that is shaped by interactions with a broad array of stakeholders from diverse functional areas. At the same time, the design of IS within the context of private organizations or public institutions has significant implications on the effectiveness, efficiency as well as flexibility of corresponding business processes and capabilities. Therefore, architecting requires a cross-functional understanding of technology as well as business capabilities to choose technical design parameters in harmony with current and future business ambitions. This cross-functional challenge to manage IS and business architecture from an end-to-end, long-term perspective lies at the core of EA management (Ross et al. 2014).

Delimitation of the IS Landscape Concept

To explain how companies design and change the architecture of their existing IT setup, this thesis relies on a rigorous conceptualization of the central phenomenon of interest. For that purpose, the term IS landscape is used to refer to "the holistic collection of all technology infrastructure, business logic, and data that serves internal employees and external business partners" (Törmer 2018, p.11).

In general terms, IS are defined as socio-technical systems consisting of people, technology and tasks. People use the technology to fulfill certain tasks and are thereby provided information by the technology (Heinrich et al. 2008). In this definition, a task is a generic, goal-oriented activity that could more concretely refer to a step in a business process. Accordingly, the conceptualization of an IS landscape is not limited only to the technological aspects, but includes social interactions among users as well.

Hence, the concept is largely congruent with Ross et al.'s (2006) understanding of an EA on the implementation level, where the concept is often divided into four layers from the bottom to the top: technology architecture (i.e. architecture of the IT infrastructure), application architecture, data or information architecture, and business process architecture. The term IT architecture has been used to subsume the lower three layers in isolation. On a more abstract and representational level, Ross et al. (2006) define a company's EA as "the organizing logic for business processes and IT infrastructure reflecting the integration and standardization requirements of the company's operating model" (Ross et al. 2006, p.47). This conceptualization may refer to both (1) the representation of systems as well as processes in documentation and (2) their actual implementation. As a result, Ross et al.'s (2006) definition takes, at least in the author's understanding, a more logical perspective on the complex interplay between technology, tasks and people. Within the context of this thesis, the term IS landscape is intended to cover the actual implementation of a company's EA in terms of systems and processes, and therefore describes a similar concept from a slightly different perspective.

A company's IS landscape has, on the other hand, equally been conceptualized as a corporate II (Ciborra 2000) to emphasize its distributed nature and the lack of overarching architecture control. In Hanseth and Lyytinen's (2010) conceptualization, an II is particularly characterized by unboundedness, openness, and autonomy of relevant actors (Star and Ruhleder 1996). Equally, the platform concept has been used to describe and explain the evolution of large-scale, emergent IS consisting of a multitude of IT capabilities. In contrast to II, however, platforms are subject to a central design framework that controls the architecture through principles (Hanseth and Lyytinen 2010). Accordingly, this thesis specifically describes and explains how companies introduce architectural control over their IS landscape. In the second research contribution (Törmer and Henningsson 2018), this intervention is depicted as the platformization process of an existing II. Furthermore, the third research contribution (Törmer 2018) provides a rigorous conceptualization of an internal digital platform as a company's IS landscape that lives up to the qualities of a modular architecture.

An enterprise system is a "single system that is central to the organization and ensures that information can be shared across all functional areas" (Xu 2011, p.631). Most traditional enterprise systems, such as ERP or CRM, are vendor-provided, commercial-off-the-shelf (COTS) systems that are built around business processes and allow integrated operations among multiple users across the organization. As such, an enterprise system is an individual component or module of a company's holistic IS landscape and integrates with other systems via interfaces.

Summing up, existing research approaches in IS have regarded the holistic collection of IT infrastructure, applications, data and business processes in distinct concepts, such as EA, IS infrastructure, corporate II, and platform. These concepts are each based on different characteristics and serve a distinct purpose. This thesis adopts the generic and broad term IS landscape to describe "the holistic collection of all technology infrastructure, business logic, and data that serves internal employees and external business partners"

(Törmer 2018, p.11). This denotation does not imply any architectural characteristics per se. Accordingly, the term could equally refer to a more mature and de-coupled IS landscape or a 'spaghetti-architecture' of randomly connected enterprise system serving a specific purpose. Taking this neutral conceptualization as a starting point allows for the identification of interventions that can be applied to any form of IS landscape in order to seek the innovation-readiness of its architecture.

Configuration Theories

To describe and explain the architecting phenomenon in a company, this thesis adopts a configurational perspective, which has been found to be a suitable lens for explaining complex socio-technical phenomena, such as the strategic role of IT in turbulent environments (Pavlou and El Sawy 2010) or the governance of open-source projects (Di Tullio and Staples 2013). Highly popular in the management literature, configuration-based theory has equally gained increasing recognition in IS research over the past decades (Park et al. 2017).

Configuration theories allow researchers to capture complex environments holistically and to grasp causal structures or patterns shaping the interplay between multiple interdependent variables (Meyer et al. 1993). This enables a shift from explanations based on stable patterns between independent and dependent variables towards causation relying on multiple contingencies as well as mechanisms (Ragin 2009). Variance theories consist of hypotheses formulated based on the identification of correlational relationships. Process theories describe unfolding pathways in terms of relevant and sufficient conditions. Configuration theories, on the other hand, "express hypotheses as causal recipes that specify the contextually relevant elements that in combination produce particular outcomes" (El Sawy et al. 2010, p.839). Therefore, configuration theories are particularly suited to explain phenomena characterized by complex interconnectedness among variables, nonlinearities or discontinuity (Meyer et al. 1993).

A configuration is formed in a specific combination of condition variables that jointly produce an outcome of interest (Ragin and Rihoux 2009). By focusing on the underlying causal structures producing different outcomes, configurational analysis allows researchers to explain how interventions bring about change in a social system. For this purpose, Pawson et al. (1997) advance four central elements: mechanism, context, outcome, and context-mechanism-outcome (CMO) configurations.

A mechanism is “one of the processes in a concrete system that makes it what it is - for example, metabolism in cells, intraneuronal connections in brains, work in factories and offices, research in laboratories, and litigation in courts of law” (Bunge 2004, p.182). Generative mechanisms in terms of causal structures or laws form the centerpiece of explanatory theory in the stance of critical realism (Archer et al. 2013). This perspective is rooted in the philosophy’s combination of a realist ontology with an interpretive epistemology (Mingers et al. 2013), which implies a conceptual separation between “a domain of causally operative structures or systems; the events that they generate; and those events that are empirically observed” (Mingers 2004, p.8). Generative mechanisms originate from enduring physical, social, or conceptual entities that have powers or tendencies to act in specific ways (Archer et al. 2013; Mingers 2004). These causal laws continue to exist even if they may not always be observable in the form of empirical regularities (Bhaskar 2013; Mingers et al. 2013).

The concept of explanatory mechanism is the most characteristic tool of configurational analysis and allows researchers to go ‘beneath the surface’ of a phenomenon of interest to explain the underlying ways of functioning (Pawson et al. 1997). For instance, the focus on mechanisms enables the opening of theoretical black boxes and elaboration of explanations for why certain high-performing configurations are the ones that do so. This theoretical deep-dive commonly investigates mechanisms or processes on a micro-level, which contrasts the corresponding macro-level on which the phenomenon of interest to be explained becomes evident (Pawson et al. 1997). The distinction between these two levels is equally picked up by Hedström et al. (1998) who draw on Coleman's (1986) macro-micro-macro model of collective social action to provide a typology of social mechanisms (see Figure 2). The model postulates that in order to explain change or variation on the macro level, researchers shall investigate and account for how individual actors on the micro level are influenced by states on the macro level and subsequently engage in actions that originate new states. Within social sciences, mechanisms are accordingly “hypothetical causal models, which make sense of individual behavior” based on contextual conditions (Hedström et al. 1998, p.22).

The unit of analysis is therefore action by individuals that is oriented to the behavior of others and subsequently generates macro-level outcomes through external or social mechanisms.

Since "the relationship between causal mechanisms and their effects is not fixed, but contingent" (Sayer 1992, p. 107), context subsumes the condition variables or contingencies that turn "causal potential into causal outcome" (Pawson et al. 1997, p.69). Corbin and Strauss (2008, p.230) define context as "the sets of conditions that give rise to problems or circumstances to which individuals respond by means of action/interaction/emotions." For illustration purposes, Pawson (2006, p. 24) advances the example of gunpowder, which "has the chemical composition to create exothermic reactions under an initial application of heat, but whether it does so depends on other conditions such as the absence of damp and the presence of oxygen."

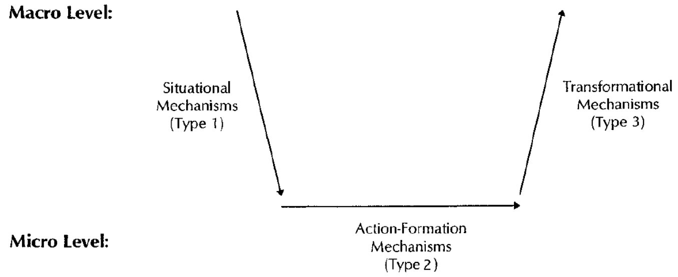

Figure 2: Typology of social mechanisms (Hedström et al. 1998)

Configuration theories allow for situations of causal asymmetry and equifinality. The former refers to the idea that the causes of an outcome's presence may be very different from the causes of an outcome's absence (Fiss 2011; Rihoux and Ragin 2008). This reasoning implies that distinct sets of context variables may be relevant for different substantiations of outcome variables. Equifinality, on the other hand, denotes the completion of an equivalent outcome from different contextual conditions or through different paths. This quality makes theories more adaptable to the messy realities of varying contextual settings in distinct organizations (El Sawy et al. 2010). Simultaneously, as underlying mechanisms gain their explanatory power from an intermediate degree of generality (Hedström et al. 1998), configuration theories are most appropriate for *modest generalization* (Ragin 2009) and allow for intuitive simplicity of typologies – which makes them even more attractive to practitioners.

For Pawson et al. (1997), the identification, articulation, testing, and refinement of CMO configurations are core activities of realist research. One CMO configuration captures a specific combination of causal variables generating an outcome of interest. The simultaneous investigation of all three elements allows researchers to investigate causal relationships in terms of sets of equally effective patterns (Fiss 2011) and answer the master question of realist research: 'What works?' (Pawson 2006). Accordingly, CMO configurations explain outcomes under variations of mechanisms and contextual conditions. In addition, CMOs form the basis for explaining how interventions bring about change in social systems (Pawson 2006). "Interventions are always inserted into existing social systems […] in the hope of changing or re-balancing it" (Pawson 2006, p. 26). In the spirit of critical realism, configuration models are to be understood as propositions subject to further refinement – instead of as universal laws (Elder-Vass 2010).

According to Park et al. (2017), a configurational approach is particularly well-suited to address research topics involving fragmented as well as inconsistent knowledge. Simultaneously, El Sawy et al. (2010, p.838) argue that configuration theories "have the potential to render the next quantum leap in advancing IS strategy research". However, existing configurational research approaches within the context of IS have largely focused on the identification of high-performing configurations and de-emphasized the identification of corresponding mechanisms to explain corresponding outcomes (Pavlou and El Sawy 2010; El Sawy et al. 2010). Having originally focused foremost on entire organizations, a configuration perspective can be applied at diverse levels of analysis, such as the group, individual or ecosystem level (Meyer et al. 1993; El Sawy et al. 2010).

A Configurational Perspective on Architecting

The presented literatures on IS evolvability and architecting reveal that, within the context of a single company, IS landscape architecture is a global phenomenon that is shaped through local, in-situ decision-making. The term IS landscape refers to the collection of all technology infrastructure (software and hardware), business logic, and data that serves internal employees and external business partners. The theoretical focus, however, lies on the application layer consisting primarily of business logic and data.

The architecture of a company's IS landscape is constructed and continuously shaped through individual design decisions, which is an approach similar to 'installed base cultivation' described by (Hanseth 1999). While individual components designed during local architectural decisions are re-using and are heavily dependent on the pre-existing global architecture, their construction adds a component of variable size to the installed base, thereby producing the origin for subsequent design decisions (Grisot et al. 2014). Within the realm of corporate IIs, installed base cultivation occurs in an uncoordinated and decentralized fashion through individual stakeholders bolting technology components onto the II to satisfy specific requirements (Hanseth 1999).

The individuals or groups of individuals making situational design decisions commonly approach a concrete problem within a limited context relevant for the decision at hand. Their formal role is usually Solution Architect (SA) or Application Architect, but in the following, they will simply be referred to as Situational Architects. Within the scope of an individual point of architecting, their decision-context represents the situational design space and only covers a fraction of the context that would be necessary to grasp the company's global architecture. Nevertheless, their decision-making is influenced by a context consisting of numerous relevant contingencies that frame potential solutions as well as their implications (Bruls et al. 2010).

An Application Architect who is developing a mobile application may, for instance, consider the availability of open source software repositories to look for existing solutions to her problem in order to speed up development time. The choice to do so may be discouraged by a colleague who has made bad experiences with open source software, but the Application Architect may overrule this opinion so that she can speed up her project and subsequently benefit from continuous improvement from the open source community. Equally, the architect could also be encouraged by other contingencies in the organization, such as existing standards or guidelines, in the organization that encourage the use of open source software.

Because organizations' IS landscapes are nowadays complex webs consisting of hundreds or even thousands of interconnected applications, most companies employ Enterprise Architects (EAs) that steer the IS landscape architecture from a global and long-term perspective, while focusing not only on IS, but equally on business architecture and strategy (Ross et al. 2014). Depending on the organization's definition, these architects could hold distinct formal titles, such as Strategic Architect or Platform Architect.

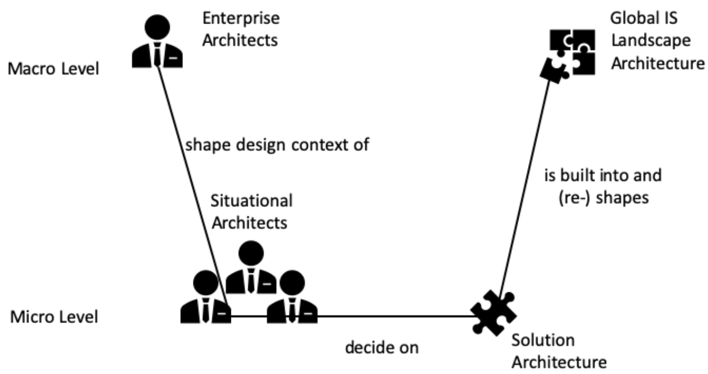

Figure 3: Coleman's (1986) Macro-Micro-Macro Model adapted to Architecting

Coleman's (1986) macro-micro-macro model of collective social action is borrowed to frame the theoretical understanding regarding how companies create innovation-ready IS landscape architectures through the interaction between these EAs and Situational architects (see Figure 2).

As explained previously, the concept of an innovation-ready architecture is a global one spanning a company's entire IS landscape. Therefore, the phenomenon occurs on the macro-level of the analytical model. On the same macro-level, EAs operate to keep track of the architecture and steer its evolution into a desired direction – in the context of this thesis towards innovation-readiness. This evolution is, however, seldomly directly shaped by EAs themselves, but instead by Situational Architects operating on the micro-level of the model. The EA capability "is used to plan, govern and control the detailed architecting and engineering of individual solutions by solution architects and engineers" (Bruls et al. 2010, p.518). Those architects design and guide the implementation of specific technology solutions – often in close collaboration with Application Developers, Technical Consultants, and business stakeholders, whose requirements they are trying to solve.

Since most of the Situational Architects' daily activities evolve around the design of very specific solutions, the design context of their tasks is limited to a smaller fraction of the entire architecture. As elaborated upon above, however, the output of their decisions on the micro-level impacts the global architecture on the macro-level (Grisot et al. 2014). EAs on the other hand, can only impact the global architecture by (a) either moving to the micro-level themselves and becoming part of situational design decisions or by (b) influencing design decisions made by Situational Architects through changes to the social structure surrounding them during this process (Bruls et al. 2010). While the former is practically possible, the behavior – if applied exceedingly - exposes EAs to the risk of becoming deeply engrained in individual design decisions and due to lack of time or resources losing track of the big picture. Simultaneously, EAs, who do not engage in individual design decision-making at all, run the risk of becoming detached from the architectural reality in the company and turning into an 'ivory-tower'. Hence, EAs need to leave an appropriate amount of design decisions to Situational Architects and simultaneously ensure that decision outcomes will steer the global architecture in the desired direction. This challenge is closely related to the centralization-vs.-decentralization discourse in the IS governance literature and particularly the findings of Gregory et al. (2018) that IT consumerization introduces platform governance mechanisms into incumbent organizations. The underlying argument is that architecture is by nature emergent and can only be guided through collective action.

To investigate how this dynamic interaction between EAs on the macro-level and Situational Architects on the micro-level shapes global IS landscape architecture in a company, this thesis focuses on the action-formation mechanisms (c.f. Figure 2) at play during situational architecture decision-making. For that purpose, individual points of architecting are framed by a *design context* surrounding Situational Architects involved in design decisions, which produce a final *architecture outcome*. This logic is depicted in Figure 4. The decision-making process by Situational Architects within individual points of architecting follows particular logical patterns, which are conceptualized as *mechanisms of architecting*. Depending on the prevalent contextual conditions, distinct mechanisms may be actualized or remain unactualized and thereby lead to a corresponding architecture outcome. Since the actualization of mechanisms is contingent on specific configurations in the design context, EAs may impact or transform prevalent situational decision-making practice through active interventions that modify contextual variables. For instance, the introduction of architecture principles by EAs may introduce a new variable into the general design context of Situational Architects, who subsequently change their decision-making logic and create distinct architecture outcomes within individual points of architecting.

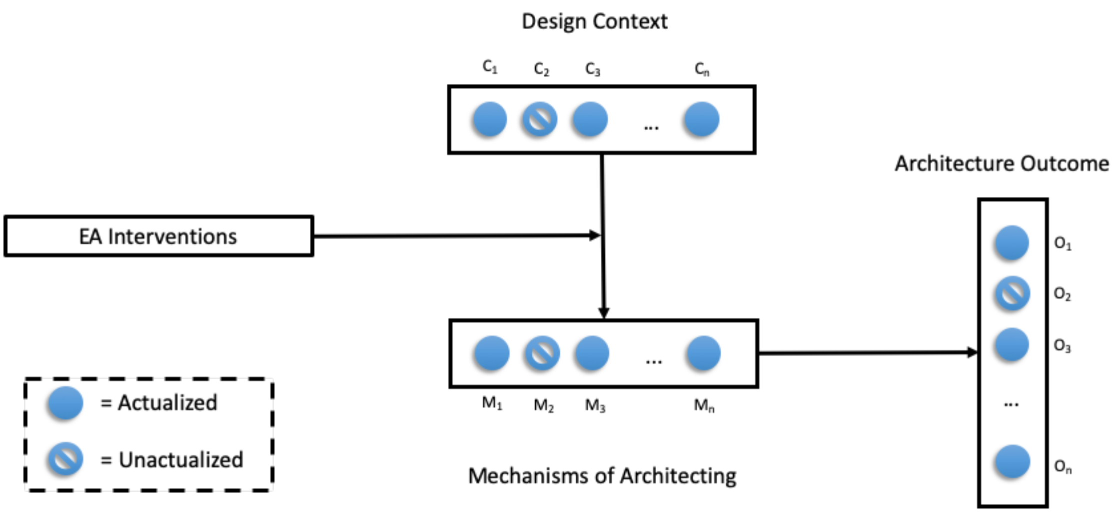

Figure 4: A Configuration Research Framework for Architecting

Figure 4 captures this perspective in a generic configurational research framework, which forms the basis for the theoretical analysis presented in the remainder of this thesis. The analysis substantiates the model with relevant contextual as well as outcome variables and zooms in on individual design decisions to identify relevant mechanisms of architecting. In conjunction, these elements form CMO configurations (Pawson et al. 1997), which provide the explanatory theoretical contribution of this thesis. Additionally, the configurations allow for inferences regarding how interventions by EAs bring about change in existing decision-making behavior to steer the global architecture into an intended direction.

The theoretical framework makes the analytical delimitation that each CMO configuration is based on one dominant decision-making mechanism, which is actualized in the prevalent contextual conditions and creates the associated outcome. While this is a simplifying assumption, it subsequently allows for the rigorous analysis of a highly complex phenomenon and the identification of the most dominant causal structures responsible for the outcome of interest.

Chapter 3: Research Methodology

The overall research project is based on an engaged scholarship in cooperation with the LEGO Group. As an industrial PhD Fellow, the author acted as an integrated member of the LEGO Group's EA team for three years, commonly spending three days of each week at the company's headquarters in Billund, Denmark, and the rest of the week at Copenhagen Business School, Denmark. Complementing the two supervisors from the academic world, the LEGO Group's Head of EA took the formal role of supervisor within the company. This section provides an overview of the overall research project's methodology as well as a description of the research method adopted in this overarching research contribution.

Engaged Scholarship

Engaged scholarship is "a participative form of research for obtaining the different perspectives of key stakeholders (researchers, users, clients, sponsors, and practitioners) in studying complex problems" (Van de Ven 2007, p.9). At its heart, the discipline proclaims and seeks to address a knowledge gap between theory and practice in professional disciplines which is caused by problems in the production or transfer of knowledge. The existence of this gap is explained by the basic assumption that academic and professional knowledge are part of very distinct but related domains. Practical knowledge is not simply seen as a derivative of scientific knowledge, but as a different form that together with scientific knowledge makes up the rudiment of a professional discipline (Kondrat 1992). Consequently, many professionals remain unaware of relevant research findings in academia, while a large proportion of academic research "is not contributing in intended ways to either science or practice" (Van de Ven 2007, p. 2).

Particularly in the IS discipline, the knowledge gap has been referred to in the public debate about balancing rigor with relevance (c.f. Benbasat and Zmud 1999). As a result, "engaged scholarship offers a grand opportunity to address key challenges within the IS discipline in a novel and constructive way" (Mathiassen and Nielsen 2008, p.1). In the interactional view advanced by Van de Ven (2007), professional and research practices complement each other and contribute to each other's advancement through distinct types of activities. The early contribution by Boyer (1996, p.19) describes scholarship of engagement as "connecting the rich resources of the university to our most pressing social, civic, and ethical problems". Beyond the perception of organizations as research clients or sources for data collection as well as funding, Van de Ven (2007) postulates a learning community relationship between researchers and practitioners in order to foster negotiation, collaboration, and knowledge production that advances both scientific and practitioner knowledge.

In IS research, engaging methods have traditionally foremost taken the form of action research or design science research with the goal of developing prescriptive knowledge (Conboy et al. 2012). In addition to these normative and problem-specific modes of practice, Van de Ven (2007) furthermore advances the notions of "informed basic research" and "collaborative basic research." These practices capture the description, explanation, or prediction of social phenomena based on a more detached (i.e. informed) or deeper engrained (i.e. collaborative) research engagement in the field.

Engaged scholarship embraces qualitative as well as quantitative methods, supports process as well as variance studies and encourages the active engagement of perspectives from diverse sets of actors to foster the understanding of complex phenomena, independently from ontology or epistemology (Van de Ven 2007). Consequently, "appreciating these diverse perspectives often requires communicating across different philosophical perspectives" (Van de Ven 2007, p.37), along with a profound understanding of different philosophies of science. The selection of an appropriate underlying philosophy of science should therefore be a conscious choice.

According to Van de Ven (2007), engaged scholarship itself inherits several key assumptions from the critical realist philosophy of science (Archer et al. 2013; Bhaskar 2014) – most importantly the existence of a real world independently from human perception, but a limited individual understanding of this world by human beings. This reality is depicted as a complex, open system consisting of underlying contingent structures or mechanisms that define how things come to behave. Therefore, multiple perspectives are required to capture this complexity and empirical findings cannot be conclusively generalized.

Instead, “all facts, observations and data are theory-laden implicitly or explicitly” (Van de Ven 2007, p.70), such that scientific inquiry is commonly value-full. Accordingly, all knowledge is assumed to be socially constructed and its creation is a process that builds upon existing theories and research results in order to generate new insights (Mingers 2004). Empirical data serves for discrimination between plausible alternative models addressing a phenomenon under consideration, thus giving rise to a selectionist evolutionary epistemology (Campbell 1990). Consequently, “science is an error-correction process that is based on evidence from the world rather than merely reflecting the scientist’s opinions about the world” (Van de Ven 2007, p.65).

In this context, Van de Ven (2007) emphasizes the semantic function of models as a mediating form of knowledge standing between data and theory. “Models are partial representations or maps of theories” (Van de Ven 2007, p.143). Drawing on Azevedo (1997), Van de Ven defines model development as a key step in the engaged scholarship process and praises evidence-based model comparison as a practical exercise that discriminates between competing models while serving as a map to guide action.

Summing up, by drawing on a critical realist ontology and a Campbellian relativist evolutionary epistemology, engaged scholarship is an inclusive research philosophy integrating some of the differences between the opposing poles positivism and relativism. While the discipline itself “also benefited from other philosophical and metaphysical perspectives” (Van de Ven 2007, p.64), the appreciation of miscellaneous research philosophies as well as the triangulation of divergent or inconsistent data are encouraged to support the development of more robust knowledge.

The research process for engaged scholarship involves four main activities, which can be conducted in arbitrary sequence depending on the specific research problem and benefit from engaging actors with relevant perspectives (Van de Ven 2007): (1) *Problem Formulation* seeks to define the research problem, review relevant literature, and ensure relevance by engaging people who experience and know the problem. (2) *Theory Building* leverages abductive, deductive, or inductive reasoning in order to develop a theory based on interactions with knowledge experts that have addressed the problem, review of relevant literature, and comparison of plausible alternative theories. (3) *Research Design* outlines the empirical examination of alternative theories based on an appropriate research model. Finally, (4) *Problem Solving* occurs in the empirical domain, provides answers to the formulated research questions, and also includes the closely engaged communication of research findings to intended communities in order to assess their impact.

The Project's Overall Methodology

Already ahead of this PhD project's formal start date, the research process started with Problem Formulation – or, more precisely, problem delimitation. Based on a broad review of the relevant platform literature, the platform concept was adopted as a main research subject of interest as well as the guiding conceptual idea to apply platform thinking to the design and management of a company's internal IS landscape. Recognizing the lack of previous research on how incumbent companies in traditional industries can develop digital platforms, the author and his academic supervisor searched for a case that could enable in-depth exploration of the process that this transformation entails (e.g. Patton 1990). Early dialogues with the LEGO Group revealed that the company was in the process of establishing a global EA team to seek technology-enabled business flexibility by managing the internal IS landscape from a long-term, end-to-end perspective. During these conversations, a slight shift of the theoretical research problem occurred from a focus on internal and multi-sided platforms towards the idea of an innovation-enabling internal platform architecture. Accordingly, the overall research problem and the high-level research question were co-shaped by stakeholders within the company. This engagement also sought to ensure research relevance to practitioners.

At the same time, the LEGO Group's platformization journey includes several of the typical characteristics associated with how the challenge is commonly portrayed in academia: an IS landscape that was originally crafted to have a supporting role enabling the company's core business activities; a rapidly transforming environment where existing and new competition can embrace digital technologies to reinvent offerings, customer interactions, and processes, as well as complete business models; and a spurring awareness of the transformational need that had created financial resources and managerial attention to potentially progress the company towards the objective of a business enabled by a digital platform. Importantly, the

LEGO Group is known as an industry leader in digitalization (El Sawy et al. 2015) and generally considered a healthy as well as well-functioning company. As such, there was an initial prospect to explore a well-run company that made substantial investments to achieve a particular target state as well as to reflect on the experiences of this journey.

Accordingly, Problem Solving mainly occurred within the company, where the author actively contributed to individual tasks and collected empirical data around the problem-solving process as well as outcome. At the same time, the author and both academic supervisors actively introduced relevant theoretical knowledge from academia (e.g. real options theory, systems theory, and academic perspectives on EA as well as platforms) to corresponding stakeholders within the company in order to support and inspire the problem-solving process. These presentations along with regular supervisor meetings often turned into sessions of knowledge cross-fertilization, where participants exchanged academic and practice-oriented perspectives around IS management. Eventually, also the research findings were communicated to relevant stakeholders within the LEGO Group to assess their congruence with perceptions regarding past activities, enable reflection on previous decisions as well as actions, and guide future problem solving.

According to Van de Ven (2007, p.12), "the design and conduct of the research should apply the standards and methods that a scientific community believes will produce a truthful solution". Correspondingly, the Research Design and Theory Building of this PhD project adopt the case study method, which has "commanded respect in the IS discipline" (Dubé and Paré 2003, p.597) for multiple decades. The goal is not to develop testable hypotheses about the future, but rather to elaborate on how and why phenomena occurred and to provide "an altered understanding of how things are or why they are as they are" (c.f. Type II, Gregor, 2006, p.624). Such explanatory findings may be suitable to inform normative theories in the future. Since the inquiry investigates a rare phenomenon in a particularly fine-grained level of detail, a single-case design is suitable to produce significant research results (c.f. Dubé and Paré, 2003).

For this purpose, the study was designed to initially cover a broad scope and was based on the collection of empirical data to allow for a partially inductive understanding of the transformational process. Data was collected from three sources of evidence: observations, documents and interviews. Direct participant observation data (c.f. Yin, 2013) was collected by the author that for 36 months acted as an integrated member of the LEGO Group's EA management team on site at the group's headquarters in Billund, Denmark. Observations focused on the actions, decisions, and events through which the transformational process unfolded. Observation data and information about relevant supporting material (documents), were captured in a structured diary (c.f. Naur, 1983; Baskerville and Wood-Harper, 2016). The diary entries were collected in a case database and each grouped by direct observations, reflections on observations, plans for future research, and supporting diagrams, drawings, or mind-maps. As Baskerville and Wood-Harper (2016) point out, "data validity is a problem in these techniques, partially because of the interpretive nature of the data, but also because of the intersubjectivity of data capture." The research subjects are not only observed, but actively influenced by the researcher. On the one hand, the research diary enabled the researcher to address this threat to validity by allowing for a more detached reflection on events by revisiting the entries at a later point in time. This reflection was also supported by concurrent reviews of academic literature and participation in academic conferences to step back from daily activities and process events or developments in comparison to academic perspectives or other companies.

On the other hand, 30 semi-structured interviews with key informants are used as a secondary source of evidence to additionally address threats to validity (c.f. Ritchie et al., 2013; Yin, 2013). Each interview lasted approximately one hour. Furthermore, 35 additional interviews of 30 minutes duration each were conducted on individual points of architecting for the specific purpose of the overarching research contribution submitted in this thesis. In some instances, two interviews on two distinct points of architecting were combined in one conversation lasting approximately 60 minutes. The interviews were conducted on the company's premises and supported by an interview guide containing open-ended questions. The informants include EAs, SAs, Application Architects and senior stakeholders, such as the Chief Information Officer (CIO) or Vice Presidents of the technology organization. Except for six instances, all interviews were recorded, transcribed and added to the case database (Yin 2013). In the four exceptional cases, the interviewees did not feel comfortable with being recorded as the content included topics of high confidentiality. In these instances, recordings were replaced with extensive note-taking. The Appendix contains a table listing all interviews including the discussed theme, the position title of the interviewee as well as the length. For the purpose of further triangulation, internal documents from the company, such as reports, presentations, emails, and architecture documentation, are used as a third source of evidence (c.f. Yin, 2013).

Even though all four of the project's individual research contributions are based on a rough core of identical empirical data and develop explanatory models or theory, only one of them inherits the critical realist philosophy of science from engaged scholarship. This choice is driven by the theoretical goal to develop generative mechanisms, which are at the heart of the critical realist stance (Archer et al. 2013). The remaining three contributions aim for the development of explanatory theory as generalizable and falsifiable propositions that can be applied and tested in other case settings. Therefore, these studies adopt a positivist ontology (Dubé and Paré 2003; Eisenhardt 1989; Sarker et al. 2018). Eventually, this overarching research contribution equally follows a critical realist approach.

While each individual contribution's philosophical assumptions and data analysis procedures are elaborated in the paper summaries below, the overall research project relied on two broad phases of coding with distinct objectives. The first phase of coding aimed to capture the event time series of the transformational initiative. Coding categories were generic process codes (Van de Ven and Poole 1995), including events, actions, decisions, outcomes, and states. To determine concepts (such as invention, capacity and frustration, and network) and their properties (e.g. efficient/inefficient, success/failure) in events, actions, decisions, outcomes, and states, we applied an open coding procedure. The author and the primary supervisor jointly coded the data, identifying initial concepts and higher-level categories using a constant comparative method (Corbin and Strauss 1990) and resolving any disagreements through discussion (Saldana 2009). The outcome of this coding phase was an event sequence outlining the unfolding of the initiative with an unstructured list of concepts that seemed to be relevant in the process.

For each individual research contribution, the initial findings, triggered a second phase of more coding as well as additional data collection targeted at the emergent concepts of importance. In the second phase, the initiative was approached as a theoretical issue extending and challenging the initial findings. Stimulated by the emerging event sequences, the author turned to the relevant literatures for focal categories of coding.

These categories allowed for the systematic relation of various concepts of the initiative produced in the open coding phase. The emerging themes spurred a new literature search for theoretical arguments, explaining the findings in relation to the relevant literature.

Finally, the author used empirically induced findings and supportive theoretical arguments to create initial case narratives for each individual publication and a timeline for the development process by tracing the order of events and underlying mechanisms. The narratives are supported with interview quotes for the corresponding concepts of interest to increase its vividness and transparency. Finally, members of the initiative assessed the representativeness of the findings in the narratives (c.f. Yin, 2013). Largely, the perception concurred with our emergent explanation, revealing the need for only marginal adjustments to the narrative.

Method for Pervasive Analysis

Adopting a configuration perspective on architecting, the analysis presented in this document focuses on individual architecture design decisions as a unit of analysis. Accordingly, a multiple case study is adopted that scrutinizes the cases of points of architecting within the single case of the LEGO Group. Over the three-year period of engaged scholarship, the author kept track of individual solution architecture decisions in the company that came to the attention of the EA team – either through formal or informal engagement, such as the architecture forum, the strategy execution process or personal contact. Additionally, the wider organization was consulted by applying snowball sampling (Biernacki and Waldorf 1981) to identify additional cases, which had stayed below the radar of the EA team.

This procedure identified a list of 41 individual design decisions of varying scope and at distinct points in time over the three-year engagement. Out of these 41 individual design decisions identified, 12 were excluded from analysis due to several reasons. Some initiatives had been discontinued due to functional misfit of the solution to business requirements. Others only entailed adjustments to the LEGO Group's technology infrastructure and did modify business logic at all. While these decisions are considered vital parts of architecting, they are out of the scope of this thesis, since the analysis explicitly focuses on the application and data layers of the implemented EA. Eventually, others evolved around the simple reuse of an external micro-service within the development of another broader point of architecting.

Again, three sources of evidence were used for the collection of data on each point of architecting. On the one hand, the research diary written by the author was used, primarily for identification and high-level information on each case. Additionally, at least one semi-structured interview lasting approximately 30 minutes on average was conducted with Engineers, Managers, SAs, Application Architects or EAs involved into the decision-making. The interviews were supported by a high-level interview guide and zoomed in on (1) which circumstances created the need for each new solution architecture, (2) which contextual factors influenced decision-making as well as trade-offs during the process, and (3) which outcome was created in terms of the pre-elaborated theoretical outcome variables (see theory development section below). As a third source of evidence, internal documents from the LEGO Group were used which contained architecture diagrams, architecture scorecards, decision trade-offs or further information. For confidentiality reasons, each point of architecting was anonymized and is in this document referred to by the name of the corresponding business capability it is serving. Also, vendor names have been replaced by generic names, such as Vendor1.

Following Van de Ven's (2007) recommendation for analysis tools in engaged scholarship studies, the coding procedure followed constant comparative method (Corbin and Strauss 1990). Accordingly, the procedure started with a substantiation of the outcome variables that had been derived from existing research as well as the third research contribution. These outcome variables will be presented in the analysis section. Particularly the interview procedures had already focused on the elicitation of data that would substantiate these output variables. Coding was conducted on a paragraph level taking a wider view on the idea or concept expressed in over a number of sentences, instead of focusing on individual words or lines. While each code emerged based on its specific meaning, incident-to-incident comparisons allowed for a clear demarcation of individual categories (Corbin and Strauss 2008). The result of this step was a list of all points of architecting that assigned them to a concrete outcome.

After the substantiation of the outcome variables for each case, the subsequent procedure of coding context variables was slightly more complex, as these variables had not been pre-defined but were instead elaborated in an open coding procedure. For this purpose, coding focused on contextual factors or structures that impacted architects' decision-making behavior in terms of actions or interactions (Corbin and Strauss 2008). In this context, actions mainly refer to decisions relating to the outcome variables. The emerging codes were grouped into various categories. Again, incident-to-incident comparison was applied continuously to distinguish and refine these categories, which increasingly stabilized to form the context variables of the eventual model (Corbin and Strauss 2008). For instance, the following two data points were both grouped in the category *Desired Future Flexibility*, since they with different words referred to the same fundamental influence:

> Data point 1: "*[Custom development] was not considered at all. The HR capability area is at least at this time….it was very clear that this is something we should look for on the market and not build ourselves. […] Because this is a very standard capability. Something that all enterprises need and we should basically buy the industry best practice solutions and implement them in a very standardized way."*

> Data point 2: "*That is where they say, we want to jump on the innovation that our dear software vendor is doing. Because for them, for the software vendor innovation and making new features available is part of the core business, instead of thinking about what kind of improvements and innovations can we at the LEGO Group think of ourselves that we want. So they also want to be inspired by the vendor in this case.*"

Similarly, the following two data points were both categorized as the *Existence of Architecture Principles*:

> Data point 1: *"How could we work with the existing vendors? How could we make agreements with them to change solutions to something that was more in line with our principles?"*

> Data point 2: *"There was a clear direction also formulated in the design principles that we should go for de-coupling that we should leverage cloud. So all the right things."*

Based on this constant comparison, the number of categories never grew larger than ten. With few exceptions, each of the emergent context variables was assigned a specific code for each point of architecting. The result of this second step of coding was a list of outcome configurations brought about by a number of contextual configurations.

In the subsequent step, the sorting of points of architecting according to their created outcome allowed for the identification of context configurations producing equivalent outcomes. For some outcomes, these context configurations were equal or at least very similar. For instance, the creation of a highly granular micro-service architecture was brought about by two very homogenous sets contextual variables. For others, especially those involving customization and tight coupling, context variables were substantiated more heterogeneously. This heterogeneity in context variables indicated equifinality – i.e. equal outcomes that can be brought about by distinct context configurations – and triggered the revisiting of qualitative case evidence to search for structural similarities among cases with equal outcomes.

Focusing the coding on reasoning that explains how outcomes had been brought about by reaction to contextual conditions and constantly applying cross-case comparisons (Corbin and Strauss 1990), common patterns across cases as well as salient contextual variables became evident. This step took a similar form as pattern match described by Yin (2013). The author mainly looked for reasons or explanations regarding why a certain contextual variable was prioritized in similar instances and subsequently justified the particular outcome. Naturally, these patterns were substantially more evident in cases of homogenous contextual conditions causing the same outcome than in heterogeneous instances. In instances as the following one, these patterns were even described by interviewees, who were reflecting upon the past:

> *"And that's interesting looking at this example. That is probably a clear case of what we should definitely not do going forward. First of all, we should not have unclarity into the decision-RAID until such a late state and the technology team clearly sitting with a feeling that they had a recommender role, which they actually did not."*

Stimulated by these observations, the third step applied backward as well as forward chaining (Henfridsson and Bygstad 2013; Pettigrew 1985) and built upon identified patterns as well as salient variables in order to establish generic mechanisms, which explain how homogeneous as well as heterogeneous contextual conditions bring about specific outcomes. By focusing on the salient contextual variables that are central to the invocation of a specific mechanism to produce a certain outcome, CMO configurations were established. This step also identified four contextual variables that did not have a significant impact on the created outcomes. These variables were either dropped or merged with other ones, reducing the number of context variables to six. For instance, the existence of an architecture scorecard was relevant for the decision process, but never found to change a decision outcome. Therefore, the corresponding context variable was merged with one describing the existence of architecture principles. Functional requirements, on the other hand, were present as well as relevant in all cases, but equally never impacted decision outcomes. Instead, other context variables determined if functional requirements were in a given situation prioritized over competing factors. Therefore, functional requirements were also dropped from the list of contextual variables. Appendix 2 contains the complete analysis table containing substantiations of all relevant context and outcome variables for each point of architecting analyzed. Since the identification of these variables is partly based on the four published research paper as well as case evidence, they are presented in the analysis chapter in detail. Finally, the CMO configurations identified during analysis form the cornerstones of the theoretical model advanced in this thesis.

Chapter 4: Case Evidence

As one of the first brick-and-mortar companies in the world, the LEGO Group made digitalization a fundamental pillar of the overall business strategy already in 2012. To meet present and upcoming challenges, the long-term vision for the toy manufacturer from Denmark is to create a highly adaptive organization, which collaborates closely with external partners to co-create innovation. Since the implementation of this agenda placed heavy demands for novel functionality on the company's enterprise systems, the need for a new platform architecture in order to create the foundation for the company's future digitalization journey became apparent. A Principal EA explains: "*We have global processes, global solutions. That brings in a lot of advantages that things are integrated and tied together, but […] because of this huge, tightly integrated, tightly coupled solution, we have difficulties with reacting fast*" (Principal EA, LEGO Group). Business processes have been standardized and integrated to a large extent on non-redundant, global enterprise platforms that enable efficient operational transactions. The tight coupling between systems, however, undermined IT flexibility as change requests and upgrades implied ripple effects on other landscape components.

This platform architecture resulted from the fact that architectural decision-making in the LEGO Group had not previously been managed from a global perspective to focus on the long-term flexibility and evolvability of the system landscape. Over the years, the existing IT principles had largely grown obsolete and other influencing constraints, such as cost or functional requirements, had often been prioritized over architectural considerations. Therefore, design decisions had often not followed a coherent architectural framework and had largely been shaped by choices of autonomous departments prioritizing local demands. "*We are moving forward very quickly in the more digital space and there were really no principles or no overlying roadmap […]. [This] meant that the decisions were potentially going to be fragmented and the wrong decisions [were] taken for the long term*" (Head of Engagement Technologies & Analytics (ET&A), LEGO Group).

At the same time, some design decisions had involved "*less optimal solutions, because [the architects] wanted to stay within [the] platform. […] I think we got too many solutions that are a little bit artificially* *engineered, so they fit into what we had and thereby we stuck also to stuff that we know*" (Principal EA, LEGO Group). According to the Head of EA, "*there has been wild freedom to operate from an architectural point of view. […] Because we had a distributed EA landscape before, […] nobody took the end-to-end responsibility of those priorities that go across the platform. […] We did have a capability within the organization […] BRMs and what were called EAs, but […] they weren't actually doing EA. They were people doing solution architecture for each of the different vertical areas*" (Head of EA, LEGO Group).

The LEGO Group's Pre-Existing IS Landscape

The LEGO Group's physical value proposition relies on a mature operating model that is implemented in a core of largely non-redundant enterprise systems to enable efficient operational transactions through globally standardized and integrated business processes (c.f. Figure 5). "*The centerpiece of our architecture is built around our [ERP] capabilities [, which] support almost, if not all, business processes within the LEGO Group. So they are the heart of our landscape. Around that, we have more specialist or specific capability features provided by different kinds of systems […] A lot of the systems that we use are to some extent relying on information coming from our core [ERP] systems*" (Principal EA, LEGO Group).

The reliance on off-the-shelf enterprise systems has been a strategic choice in the company to leverage externally-created systems or modules and tailor them towards specific needs through configuration and customization. Thereby, system support for core enterprise processes is established faster and cheaper than would be possible through in-house development. "*What makes us believe that we as the LEGO Group are better able to build an ERP system than the likes of SAP, Oracle, Microsoft, Safe, whoever you can find in the ERP market. […] Sometimes we believe that we are also a software-developing house. But that should not be for the core functionalities that you can buy in the market*" (Principal EA, LEGO Group).

The establishment of technical and business process integration among distinct landscape components relies on several different mechanisms. "*From a transactional mindset, we have been able to utilize the [ERP] platform to a very high degree, meaning that it is the built-in ways of integrating modules that has* *been utilized*" (EA, LEGO Group). While integrations among core [ERP] systems are established through proprietary point-to-point (P2P) connections, the reuse of data and functionality by other systems relies to a large extent on a custom-developed, batch-based integration system. "*We developed that before Enterprise Service Buses (ESBs) really came into the marketplace. So there we worked with a data provider and a subscriber concept. And a lot of systems around our landscape, they subscribe to some sort of data coming out of [… the ERP system], where all data is born and raised […] But when [the integration system] stops for whatever reason, it does not take long before the other systems cannot work*" (Principal EA, LEGO Group). Accordingly, the integration system "*can be used in many cases, but for API-(application programming interface) or service-based architecture, it is not that well-suited*" (EA, LEGO Group).

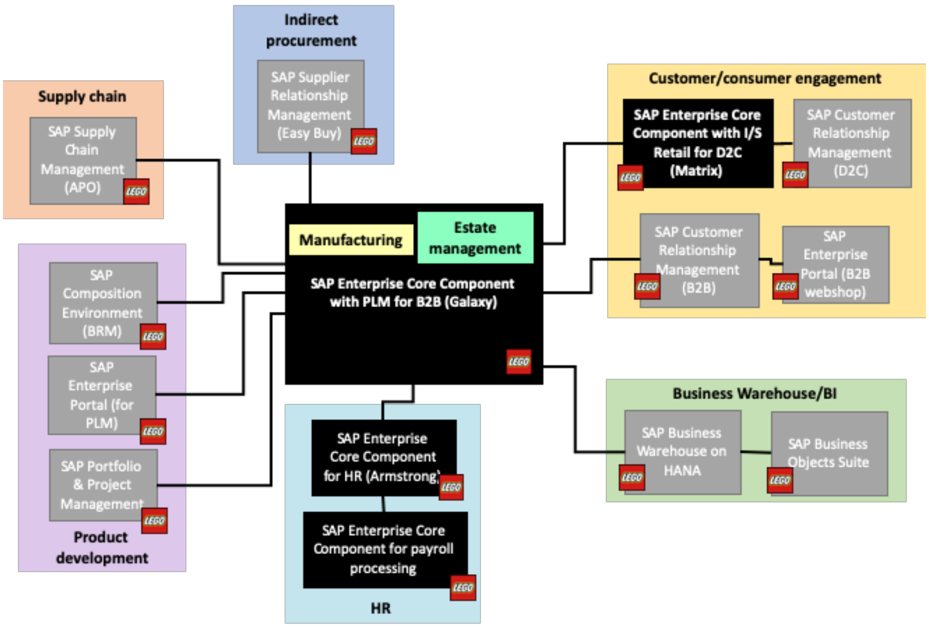

Figure 5: The LEGO Group's core enterprise systems in 2018 excluding surrounding components

Therefore, very few siloed parts of the landscape have begun to rely on decoupled API-based integration – either peer-to-peer (P2P) or via a central ESB. In addition to a very few core enterprise components, such as manufacturing, engineering, and supply chain management, API-based integration is mainly applied in consumer- and customer-facing experiences in the periphery of the landscape.

While this IS landscape has been the foundation for an extremely successful operating model that enabled the company's double-digit growth for more than a decade after 2004, technical complexity is increasingly limiting its upgradability and evolvability. For one, the abundance of tight coupling among enterprise systems limits the speed of implementing changes or system upgrades due to ripple effects, as well as the subsequent need to modify other landscape components. "*We have global processes, global solutions. That brings in a lot of advantages that things are integrated and tied together, but […] because of this huge, tightly integrated, tightly coupled solution, we have difficulties with reacting fast. Our change request process takes forever. An upgrade takes a long time*" (Principal EA, LEGO Group).

In addition to tight coupling among landscape components, the customization and extension of existing off-the-shelf enterprise systems additively hinders the implementation of changes or upgrades. "*We buy a lot of software, but we also abuse the same amount of software […] So we modified the code. […] But it provides a nightmare every time we need to do an upgrade. That are long periods of time*" (Principal EA, LEGO Group).

Furthermore, the LEGO Group's IS landscape is currently challenged by increasing needs to integrate purpose-specific and potentially cloud-based applications and services into the IS landscape quickly. "*Most companies that are in the retail or consumer-facing sector are very much moving away from that monolith concept and towards the whole idea of micro-services and contact solutions*" (Head of ET&A, LEGO Group). "*I have seen a major shift from best-of-suite to best-of-breed. And this means that you are looking at other third-party software vendors and their ways of handling certain business processes. And this is also shifting the need of how to integrate. […] This is very much driven by the whole paradigm of using services and APIs*" (EA, LEGO Group).

Platformization in Silos

In some instances, however, a consistent architecture within isolated parts of the overall landscape did result in locally-optimized platforms that enable flexibility and evolvability. In the context of core enterprise systems , very few systems, such as a 3D model repository system, rely on decoupled integration via APIs to allow for the implementation of upgrades, or changes without implying ripple effects on other landscape components.

Particularly in the periphery of the landscape, the so-called consumer engagement platform emerged which allows for the rapid development of content-based digital experiences and a two-way interaction with customers as well as consumers. The Director for Consumer Marketing Platforms (CMP) explains: "*Our department's platform […] was actually made to support the LEGO.com strategy that was coined four years ago. And that had a COPE – create once, publish everywhere – focus. We created a stack where we had, what we call, content catalogues […] at the bottom that were created with text, images, videos, and relations to other content objects. Then we indexed that in a search engine aggregated with other sources and make that available through APIs. And on top of that, we have some experience-related microservices that the different experiences then can get data from*" (c.f. Figure 6; Director for CMP, LEGO Group). The platform does not only feed digital experiences with content, but it also allows for the collection of user-generated content (UGC), which then feeds the company's big data engine in order to derive insights.

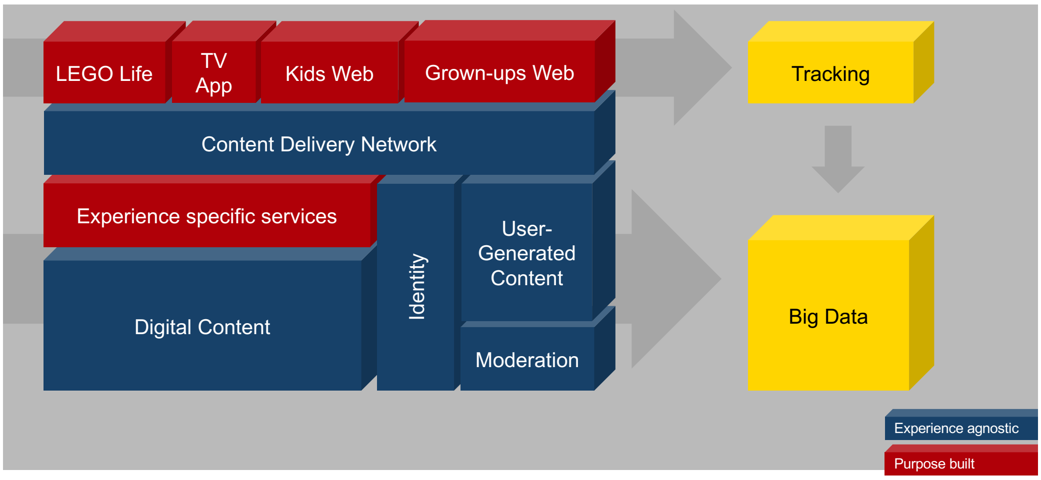

Figure 6: The LEGO Group's consumer engagement platform in 2018

Over the years, the platform has produced distinct digital experiences, including the LEGO Group's websites for children and adults, distinct games, and various TV apps. Most prominently, the LEGO Life app was launched in early 2017 as a fun, creative, engaging, and not least safe social network for children. In April 2018, the app had been downloaded six million times and every month upwards to a million children are sharing their LEGO creations, playing online, and engaging with other users around the world. As icing on the cake, LEGO Life has been rewarded with two Webby Awards – a leading award program honoring excellence on the internet. The social network has also contributed to the LEGO Group's nomination as one of the top ten most innovative companies in consumer electronics by *Fast Company* in 2018.

The initial development and continuous improvement of these digital experiences is enabled by the platform's architectural design, as well as by the corresponding organizational structure. "*As a technician, we see a lot of buzz-words come and go. And yes, we articulated that our platform is a micro-service platform. […] We try to minimize dependencies between products and communicate through APIs and that is what drives the agility within the platform. But yes, that somehow correlates with the term micro-service architecture […] Our whole setup as an organization is towards providing as much decision-power to individual teams as possible, so they can execute. And that is both, on technology decisions, but also on technical dependencies*" (Director for CMP, LEGO Group).

On the one hand, this architecture allows product teams to introduce changes to individual experiences or services in isolation from other platform components. "*We run continuous delivery. […] If you did not have an API-based infrastructure, then I do not think that is possible, because it would mean too many versions of testing […] If you look at this picture [c.f.* Figure 6*], if all of these components were hard-coded against each other, so if you even change a little bit in moderation, you would have to change something in the app, even though it has nothing to do with each other in daily life. So that's going to be very tough. […] So all the backend services, […] we deploy whenever it makes sense for us to redeploy something. And because it is API-based, as long as you do not do a breaking change in the API, it should continue fine*" (Head of Big Data Engineering, LEGO Group).

On the other hand, the elimination of dependencies furthermore allows for service-reuse across experiences. "*When LEGO Life came along, we just created a new experience-specific microservice to cater for that specific need and then we reused the whole stack underneath. And obviously, LEGO Life also had other requirements towards functionality and then we built that as micro-services on the side*"

(Director for CMP, LEGO Group). The reuse of services saves valuable development time and thereby also reduces the cost of introducing novel experiences. "*It allows you to not only do things faster, but also saves you quite a lot of development time, but also cost. […] You just pay for the scaling, you do not pay for the redevelopment and the redeployment of a tool*" (Head of Big Data Engineering, LEGO Group). As a consequence, the Kids Web – a content-based and mobile-optimized web experience – was for instance implemented within one month based on the reuse of underlying services. "*We only did a specific slice of the content services already made available for LEGO Life, we just tweaked it a little bit, published a new endpoint specifically for this experience. And then it was only a front-end task. […] It is only an experiment. But we are going to iterate on this and they are going to release multiple times a week to make this a better experience*" (Director for CMP, LEGO Group).

Despite the tremendous benefits that arise from service reuse, the architecture design entails an inherent trade-off between reusability and the ability to introduce changes to individual services or experiences in isolation. "*If multiple experiences are pulling on the same service and you need to change the interface out towards those experiences, then it gets really ugly, because then you need to update all of those experiences or versions or whatever you do. […] You need to find the right place to actually have reusability where you get the benefit. It is a trade-off*" (Director for CMP, LEGO Group). Therefore, some of the platform's components and services are designed for specific use by an individual experience, while the vast majority is experience-agnostic.

Simultaneously, the department purchases as many parts of the technical stack as possible from external cloud providers, ranging from Infrastructure-as-a-Service (IaaS) to Function-as-a-Service (FaaS). Some of the platform's components are moreover based on externally-developed systems that are adopted in standard form and tailored towards specific needs through reuse. This strategy enables product teams to develop experiences quickly, since they only need to design those services that cannot be bought from providers. "*When we are in the cloud, we are standing upon the shoulders of giants. […] We are reusing a lot of managed services and just purpose-fitting it on the top. […] Some of the service is bought, some of it is built, and the content is ours*" (Director for CMP, LEGO Group).

The LEGO Group’s Journey in China

Common Technology-Related Challenges for Foreign Companies Entering China

The Chinese market exhibits several specific characteristics, which commonly pose very challenging demands on foreign companies optimized for western market conditions. For one, China generally imposes peculiar legal requirements that are cumbersome to fulfill from an IT perspective. For instance, special tax receipts need to be printed on the tax bureau’s dedicated printing machines, which are specially designed and integrated into the tax system.

Secondly, the law that foreigners are not allowed to publish content on the internet in China specifically complicates marketing operations. Consequently, a Chinese middle party is required in order to publish marketing materials on behalf of foreign companies. Thirdly, data protection laws require that personal identifiable information remains stored on servers within the country. This regulation mainly complicates the use of CRM systems or consumer engagement solutions.

Eventually, the “Great Firewall of China” makes data import and export eminently challenging, since systems have to leverage VPN (Virtual Private Network) or MPLS (Multiprotocol Label Switching) connections to integrate with systems hosted outside of China. These connections are very strictly governed by authorities and require special approvals that can only be obtained through long-lasting application processes. Moreover, the connections are subject to legal requirements that each introduce additional complexity from a technical perspective. For instance, VPN connections should not allow users within China to access the internet in the outside world.

The LEGO Group’s Market Entry and Penetration in China

The LEGO Group’s relations with the Chinese market date back to the 1980s and have for a long time relied on a single retail customer to sell LEGO products in China out of production in Europe. It was not until 2012 that the LEGO Group established a sales company in China to target additional wholesale customers under the holistic Asian market group. Due to the market’s increasing commercial importance and in aspiration of market proximity, the decision to build a factory in Jiaxing was announced in 2013.

Almost simultaneously, a Hub office in Shanghai as well as a dedicated market group were established around 2014 which underlined the market's strategic importance for the organization and implied dedicated operations in the country. The Jiaxing factory eventually ramped up production in 2015. Over the years, the LEGO Group has continuously realized very strong growth in the Chinese market. Through the 2014-16 period, Gross Revenue has tripled and Market Contribution has more than quadrupled. In 2018, the LEGO Group was reaching approximately 2 million children in China, with an ambition to reach more than 9 million in 2025.

However, the company's increasing operations in China have been accompanied by a complex technology roll-out, which started out by reusing as much of the existing enterprise systems as possible without introducing new redundancies (incl. the single instance ERP). This roll-out has posed specific demands on the operating model and IS landscape.

China's reporting legislation requirements have been addressed by implementing deviations from the LEGO Group's globally standardized business processes. The LEGO Group is very committed to legal compliance with these requirements and they imply exceptions to global standards that subsequently undermine operational efficiency for business and IT. "*The tax regulation and the tax thinking was something we had to understand and adapt our global template to. [The ERP system] probably provided some [of that functionality] but a lot of the models are LEGO models in our global template of optimizing manufacturing efficiency in Western Europe*" (Principal EA, LEGO Group).

Due to content publishing regulations, own-developed LEGO apps had not been provided to the Chinese market for several years. Particularly for the publication of digital experiences, the LEGO Group has partnered with Chinese internet company Tencent to provide safe and imaginative digital LEGO content that supports children's needs of learning, development and entertainment. "*There is a technical gap to the consumer in that the consumer does not have access to our traditional way of engaging with consumers – being Facebook, Google, Twitter – these traditional platforms. It is very difficult to put up a web-shop in China because of the legal restraints. […] The consumers are on different platforms [… and] consumer engagement is a pre-requisite for success in any space*" (EA, LEGO Group).

The requirement to store personal identifiable information on local servers mainly impacted the operation of CRM and digital consumer engagement solutions (e.g. LEGO Life) within the country. Based on the LEGO Group's one-instance philosophy, these systems would conventionally host functionality and data in centralized data centers in Europe that are merely accessed via a client user interface. Establishing a second instance for these systems within China would challenge global business process standardization, complicate data integrity as well as analysis, and subsequently also reduce IT efficiency.

Also, the connectivity of local solutions through the Great Firewall of China is currently realized through MPLS connections allowing for access to enterprise systems, but preventing access to the public internet. Again, since the LEGO Group is particularly committed to legal compliance, the implementation of these requirements is of the highest strategic priority. "*So far, we have had a network connection directly through the Great Firewall that we have been able to utilize for our own corporate data. [… We are not] allowed to use this gateway or tunnel through to the Chinese consumer, because there are requirements to network providers in China*" (EA, LEGO Group).

The Year 2017 - Establishing the EA Capability

In order to address restrictions on digital innovation posed by a highly efficient but tightly coupled IS landscape and trigger the transition towards a centrally guided platform architecture, the LEGO Group established a centralized EA capability in early 2017. "*When we started to talk in more details about what was needed for the future in terms of direction-setting and governance, it became clear in the leadership team that there was a need [for a centralized EA function]*" (Head of EA, LEGO Group). Subsequently, the function was created out of former SAs that were re-skilled for the new positions. The EA team is a small organizational unit consisting of six EAs, guiding the evolvement of the IS landscape with an integrated long-term perspective. Equipped with a charter of pre-defined responsibilities and deliverables, the team spent the first months after its establishment refining its own playing field and future directions. This process started with defining the winning aspiration to "*allow the LEGO Group to identify and realize real options by providing long-term sustainable, scalable and adaptable IT platforms that ensure that the business agenda is not limited by EA choices*" (Source: the LEGO Group). Subsequently, the overarching focus areas and concrete deliverables for the first year were defined (c.f. Figure 7). "*We did not start from blank paper, but [regarding] the IT direction for cloud, data and integration, it was not clear at the time I took over that we were that bad settled on these in our organisation at that point in time. So that […] influenced the prioritization within our team*" (Head of EA, LEGO Group).

Against a pull from outside the team to allocate EAs primarily to advisory tasks in specific projects, the Head of EA prioritized the establishment of several fundamental artefacts and strategic directions to create a conceptual foundation of knowledge as well as target architectures to draw upon in future communication, as well as in decision-making. "*I did it to protect the team, to have time for the forward-looking activities. But I think it is very unlikely that a special project will never end up in an EA team. But you really have to keep a healthy balance. And I also think you should consider where you are in your maturity journey with your EA capability*" (Head of EA, LEGO Group).

Consequently, the EA team decided to not only manage and govern the platform architecture in the future, but also to lead the platform direction by elaborating long-term strategies for internal as well as external integration, data management, and the adoption of cloud computing. In addition to the definition of a high-level, generic target architecture, the strategic directions should also determine which technical platform components the LEGO Group should invest in and which complementary capabilities should be built within the organization in order to leverage these components.

Strategic Directions for Integration, Cloud, and Data

More concretely, the integration strategy aimed for a consistent high-level direction for the establishment of a decoupled, service-based architecture that should integrate more traditional enterprise systems , enable IT flexibility, and spur the reuse of functionality internally as well as externally. In order to enable automation and self-service in the provisioning of infrastructure, platform services and specific software solutions, the cloud strategy produced guidance on the selection, integration, and migration to cloud services on all layers of the stack. Eventually, the data strategy created a consistent picture of how to retrieve data from sources for analytical purposes and how to convert them into meaningful information to gain business insights. Even though these directions have been implemented in all new solutions, the transformation of existing landscape components has so far been limited. "*The architectural community is […] taking our principles very seriously. Therefore, they implement solutions that are in line with that. But when we modify existing solutions […] then we are not effectively transforming them into how we want to do things in the future*" (Head of EA, LEGO Group).

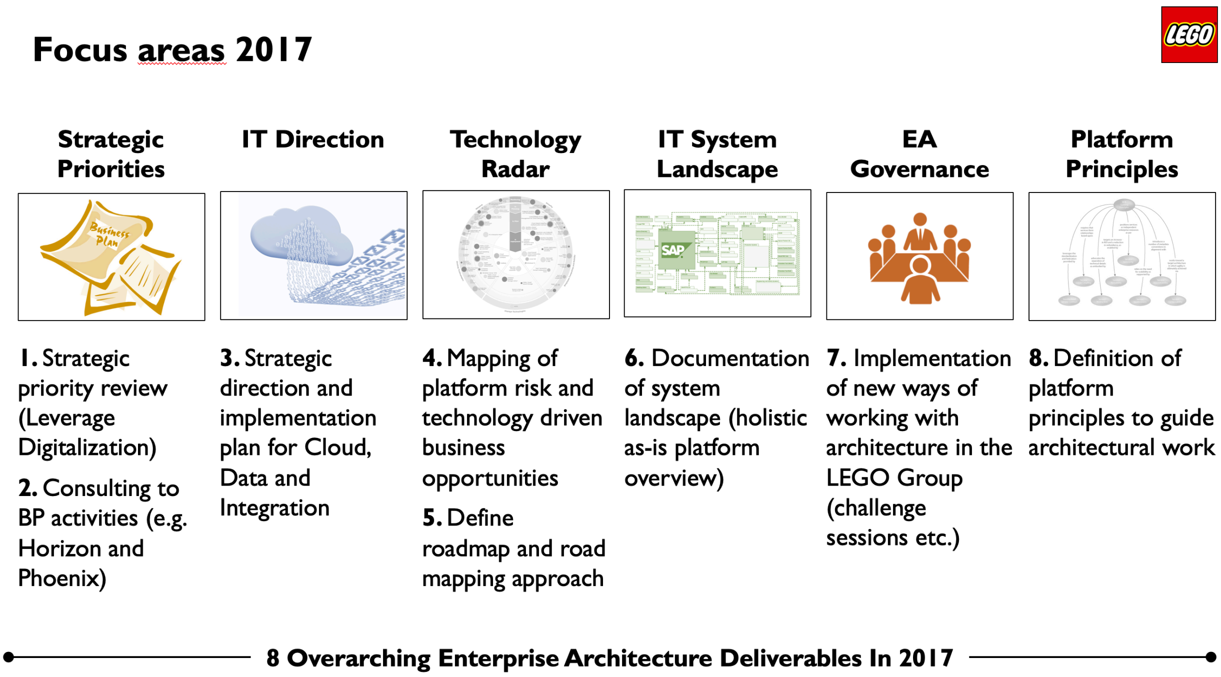

Figure 7: Enterprise Architecture Focus Areas 2017 (Source: The LEGO Group)

EA Design Principles and System Landscape Documentation

In addition to the development of strategic IT directions for the platform and their governance, the EA team immediately embarked on the elaboration of two specific artefacts: (1) new EA design principles and (2) the documentation of the entire system landscape. The EA design principles describe the ideal future state of the platform architecture that individual design decisions should strive towards. A corresponding success scorecard safeguards their implementation by evaluating individual solution designs in terms of their impact on the overall platform architecture.

The documentation of the LEGO Group's entire system landscape, on the other hand, provides a clear picture of the as-is situation, demonstrates the complexity of the system landscape, and was initially leveraged to communicate the criticality of following a global EA direction to senior stakeholders. The

Head of Technology explains: "*Sometimes we all live in our small silos and we forget how much stuff we have actually put together [...] In order to get anywhere, you need to know where you are*" (Head of Technology, LEGO Group). In the sequel, this landscape documentation primarily provided a basis to track the platform's state and clarify the transition path towards the target platform architecture.

Engagement with the Architecture Community and Technology Radar

Even though the three strategic directions are crucial prerequisites for shaping the platform landscape in the LEGO Group, they would remain fruitless, if not taken to life in the organization. For that purpose, the EA function's design has been rooted in an architecture community of Solution and Application Architects who implement strategic directions in concrete architectural designs and thereby expose the EAs to some of the actual decision-making. This exposure occurred in bi-weekly architecture forums, in which individual solution designs were discussed and evaluated, as well as during special projects that involved exceptional risk, high cost, fragile technology, or a strong need for change management. This has allowed the team to steadily keep strategic directions updated based on exposure to actual architectural decision-making. "*We created this kind of hybrid organization with clear deliverables, some of which were actually connected into actual delivery of technology, which meant that the architects were still rooted in that and could not become too ivory tower*" (Head of ET&A, LEGO Group).

Finally, a technology radar has been created in order to harmonize ideas and opinions around platform risks and technology-driven business opportunities. This tool collects technology trends and risks in a central repository that enables the architecture community to create internal alignment around the maturity and applicability of specific technology innovations.

The Year 2018 – Using and Continuously Building the EA Capability

Starting in late 2017, the Corporate IT organization within the LEGO Group embarked on an agile transformation journey, which also required the EA team to re-evaluate their value-add in the organization and articulate the responsibilities and deliverables in the form of products. While the outcome was shaped by previous focus areas, the process also entailed a realignment with the changing environment in the company (c.f. Figure 8). Defining a "Strategic Advisory" product to cater to strategic consulting activities in special circumstances, projects or assignments, the EAs did not know at this point that they would be spending most of their time in 2018 on this product. Even though the team has also been driving other initiatives, such as the company's cloud journey and community-building, these activities are not of relevance for this study and therefore not elaborated upon in this narrative.

ERP Suite End-of-Life Recommendation

A large proportion of the LEGO Group's system landscape consists of a wall-to-wall installation of a large European software vendor's enterprise suite – including ERP. Vendor-provided maintenance of these components has been announced to expire in 2025. In the meantime, the vendor had introduced a new ERP solution and a corresponding suite of enterprise software components that client companies are recommended to migrate to. Even though a multitude of companies across industries were facing this 'end-of-life' challenge in early 2018, few of them had embarked on the journey. In the LEGO Group, the enormous challenge ahead had been known for several years but had not been prioritized until the Head of EA initiated concrete investigations.

Subsequently, the EA team was dedicated for two months to investigating whether the company should migrate to a new ERP solution at all, if the same vendor should be maintained for ERP, and what potential migration scenarios, if necessary, may look like. Based on a thorough analysis that contemplated all potential options, the team delivered a recommendation that was immediately approved by the Chief Information Officer (CIO). "*That was sort of a determining moment for EA, that the EA team with high pace delivered this recommendation back to the CIO and even CEO. And the direction was accepted*" (Head of EA, LEGO Group). During this process, the EAs did not only rely on the system landscape documentation elaborated during the previous year, but also on strategic IT directions and EA design principles that embody consensus on the architectural road ahead. "*In the ERP replacement strategy as well as the technology strategy, the principles have been applied*" (Principal EA, LEGO Group).

Future Platform Architecture Recommendation

In May 2018, the LEGO Group's CIO, Chief Business Transformation Officer (CBTO), and Head of EA were invited by the Chief Executive Officer (CEO) to present a strategic plan for the future platform landscape. The CEO had been newly assigned in October 2017 and had previously been the CEO of a large Danish manufacturing company where he had driven the digitalization agenda and the transformation of the platform landscape.

Specifically based on the system landscape documentation, the EA design principles, and the strategic directions elaborated in 2017, the EA team had an overarching picture of the as-is and to-be state of the platform architecture in place. "*It was the first thing he asked for: 'How does your current landscape look like? Where is it that you are taking off from on this transformational journey and what principles [do] you leverage to steer […] that transformation?'. And that was when we sort of handed over the principles, that we had developed, to him […] After showing these artefacts, there was no more questions basically and I do not know what we would have responded, if we could not have delivered*" (Head of EA, LEGO Group).

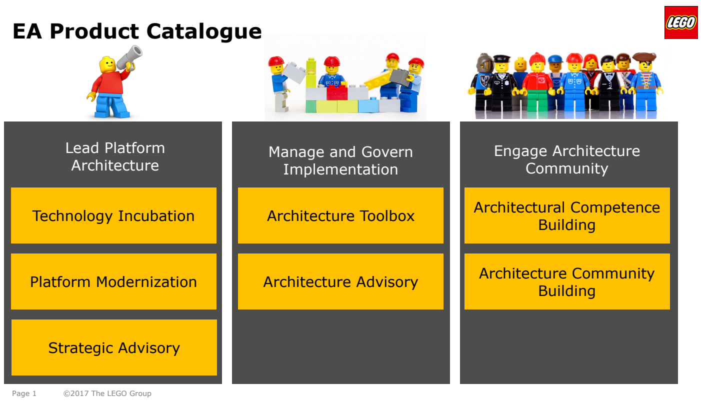

Figure 8: EA Products 2018 (Source: The LEGO Group)

In addition, the vision for the future-state architecture had been advanced further during the ERP end-of-life investigation in 2018. For the specific purpose of the meeting with the CEO, the EA team used existing artefacts and knowledge to paint a picture of the envisioned future platform architecture. "*We came up with both, a recommendation on what to do with the [ERP] but also with actually quite a good storyline* *about where our platform has brought us but also what are the pain points that we have today. [...] That has been used as a good step up after some discussions with the CEO and the CBTO, on how can we drive this further into a […] technology strategy*" (Principal EA, LEGO Group).

Highly satisfied with the presented ideas, the CEO afterwards initiated a program for the development of a new technology strategy that should confirm and extend the content presented in this meeting. "*The CEO also quite quickly afterwards came back and said that he wanted a new technology strategy that should embark on some of the ideas that we had, and of course we could use an external company to build this new IT or technology strategy, but he really believed that we were on the right track with our own ideas*" (Head of EA, LEGO Group).

Technology Strategy Development Process

Initiated in June 2018, the program set out to deliver a technology strategy and a four-year investment roadmap that would enable the company's commercial agenda, address critical technology pain points, drive IT-enabled business flexibility, and afford future digital innovation. Knowing about the criticality of managing technology layers and business processes from a holistic, interconnected perspective, the CEO emphasized the role of EA during the process as well as for the outcome. Subsequently, an overarching technology vision, key technology principles, and a future-state platform architecture model, which all emerged from a refinement of previously developed EA artefacts, form the corner stones of the outcome strategy. "*Some of the principles that we have developed back in '17 are very much in line with what we have come up with from a strategic point of view now. We were probably a little bit ahead of curve when developing these principles*" (Head of EA, LEGO Group). The strategy will also implement the EA team's recommendations addressing the ERP solution's end-of-life.

Additionally, numerous individual workstreams assessed the current maturity-state of applications and corresponding business capabilities in individual functions to create an in-depth as-is picture of the existing architecture. Co-developing desired future ambition levels with business stakeholders, concrete initiatives were developed that would upgrade technology-enabled business capabilities over the four years following 2018. These initiatives are not limited to the replacement or upgrade of existing systems, but also include the active elimination of technical debt in order to enable the flexibility of the overall platform landscape in the future. Simultaneously, new landscape components will only be added in accordance with the overall platform architecture model and principles.

During this process, the EAs were heavily involved within individual workstreams, but foremost in the consolidation of initiatives on the global level. A Principal EA recalls: "*We helped the stream leads quite a bit in their work on the strategy […] We worked quite intense together in those periods which […] has been highly appreciated - the contribution that we gave them*" (Principal EA, LEGO Group). Additionally, the Head of EA points out that "*the EAs have educated themselves throughout the development of the new principles in '17 and that made it much easier to co-create the direction for the future strategy [because the team was] not on a sort of learning journey*" (Head of EA, LEGO Group).

The individual workstreams were not only facilitated by pre-existing EA artefacts but furthermore produced new artefacts with subsequent usefulness. On the one hand, the application maturity assessment relied on the pre-existence of the system landscape documentation developed by the EA team. "*The system landscape mapping […] was a good stepping stone for starting the strategy work. First thing that consultants asked for when they came in is 'How does your landscape look like?'. [This was a] similar question asked by the CEO when he entered*" (Head of EA, LEGO Group). "*That has helped in both our ERP strategy as a well as our technology strategy work. Because that gave us the overview on what is it that we are touching*" (Principal EA, LEGO Group). On the other hand, the application maturity assessment will also make a valuable contribution to the EA's toolbox for future use. "*As part of the strategy [, we] had to make […] a capability maturity assessment as well as an application maturity assessment. […] We only could get that happening due to the technology strategy in kind of a pressure cooker way*" (Principal EA, LEGO Group).

The new technology strategy was approved along with a significant dedicated investment budget by the LEGO Group's executive leadership team as well as the board of directors in October 2018 and subsequently entered execution. Accordingly, the company's EA team also shifted its focus from conceptual strategy-making towards an orchestration role during implementation. Even though the strategy would be subject to continuous refinements as the execution progresses, the EA team would spend significantly more time on advisory and implementation tasks than strategy-making. "*With respect to the principles, scorecard but also the landscape work and this ERP replacement strategy work, […] we showed that we know what we are doing and that we have a certain experience, knowledge, maturity in the organization […] and also that to some extent we deserve a seat at the table. They reached out more than ever before for us now*" (Principal EA, LEGO Group).

Towards a Holistic Internal Digital Platform

Due to the architectural differences between core enterprise systems and the consumer-facing engagement platform, the two landscape components have previously been regarded as separate platforms within the LEGO Group as well as in case study research (c.f. El Sawy et al. 2016; Sebastian et al. 2017). The architectural disparity of the two worlds makes the global reuse of data and functionality particularly challenging. Product data is, for instance, hand-carried from the enterprise product lifecycle management system into the product catalogue of the consumer engagement platform, since the establishment of appropriate APIs on the enterprise side would be too cumbersome to justify the effort in the short run. "*That is error-prone. […] We see some pains here and it is tedious work and you need to do it every half year, because we have new products and so forth. […] As you can see, some of this is designed around the core, because the core is a problem – or was a problem*" (Director for CMP, LEGO Group). At the same time, some functionality, such as the emission of LEGO VIP loyalty points, does integrate from engagement experiences into the core ERP system. These integrations rely on tight coupling, such that the implementation of change is, again, slowed down by subsequent ripple effects. "*[The ERP system] was never meant to do what the LEGO Group made it do – which means, because of the tight coupling, it becomes very hard to do anything without changes in both systems*" (Head of Big Data Engineering, LEGO Group).

While the conceptual distinction between enterprise and engagement platform still has a purpose in the company, a more integrated platform view is currently on the rise (c.f. Figure 9). "*I see [the distinction] to some extent applied in our organizational structure. […] From a system perspective, we do not necessarily* *make that hard of a differentiation anymore […], because they are more and more learning that they rely on each other. We need to collaborate, we need to make the systems interchangeable, make the systems work together, talk together, share information*" (Principal EA, LEGO Group).

At the same time, core enterprise systems are slowly adopting similar architectural characteristics that were previously exclusively applied in the engagement world. "*On the enterprise part, we like to apply more of the principles and the ideas of what you would do more in an engagement world. On the engagement part, we see that in order for them to work properly, they need a lot of data and integration with the enterprise platform*" (Principal EA, LEGO Group). Currently, this is primarily evident in the LEGO Group in terms of a new integration strategy for core enterprise systems focusing on decoupling and interaction via APIs to enable more flexibility in the core, but also to provide agility towards the periphery of the IS landscape. "*I have a strong feeling that a big paradigm shift is coming to us. […] Things are kind of shifting now and the technology stack is moving in a way that we can use it for whatever purpose. So it is more your ability to orchestrate and to use your components that can create an integration-scenario that fits various purposes – both, experience-based as [well as] your enterprise*" (EA, LEGO Group).

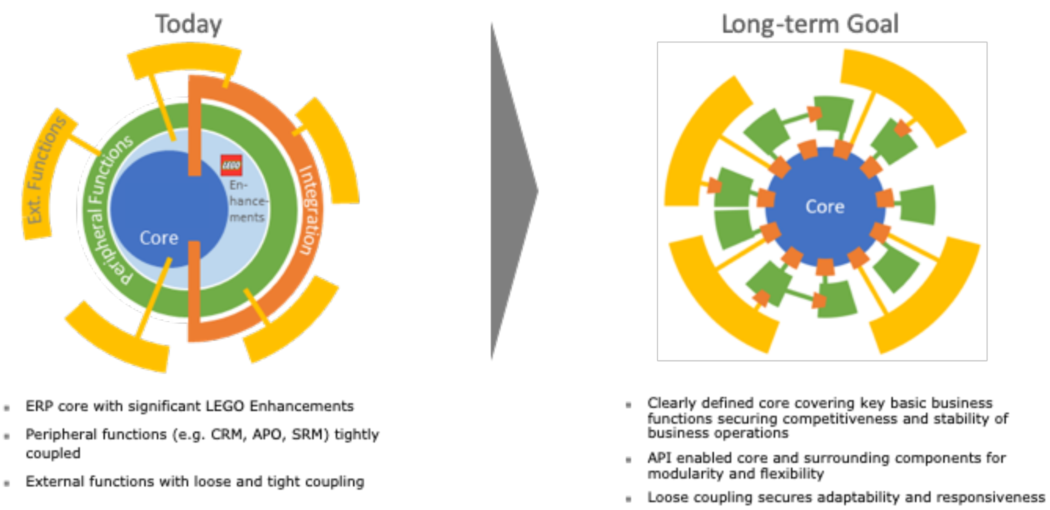

Figure 9: Long-term Platform Vision in the LEGO Group

Additionally, digital SMACIT (social, mobile, analytics, cloud, and Internet of Things - IoT) components are slowly becoming evident in and around the company's core enterprise systems. The collection of sensor data in operations, for instance, is based on a cloud-based micro-service architecture that combines data from distinct enterprise systems to provide insights into the operation of production machinery as well as quality control. Other examples include mobile business applications or social components in enterprise systems. "*We see that nowadays in the way we use Yammer and we started to use Microsoft Teams internally to collaborate, you see these kinds of capabilities coming more and more also from larger software components that we are looking at. […] The way we will collaborate three to five years from now will be different than today*" (Principal EA, LEGO Group). Particularly the upcoming end-of-maintenance of the LEGO Group's ERP suite in 2025 and a corresponding replacement strategy are expected to provide a big step forward in this journey.

An integrated platform architecture designed from a long-term, end-to-end perspective will enable the LEGO Group to realize the benefits on a global scale that have until now only been witnessed within silos. However, the current IS landscape imposes some barriers to the speed of digital innovation in core enterprise systems and towards the periphery of the landscape.

The company's new Technology Strategy and Roadmap therefore puts the goal of an agile platform architecture at the core of a dedicated significant investment into technology for the future. In addition to addressing critical technology pain points, driving IT-enabled business flexibility, and affording future digital innovation, the strategy also seeks foremost to enable the company's commercial agenda in terms of geographical expansion. "*If implemented correctly, […] that would enable us to choose more local components whereas the core components can remain unchanged. […] However, that requires a conscious integration effort in defining what is global, what is local, what is core, and what is periphery – also on the process layer*" (EA, LEGO Group).

While the LEGO Group has adapted to the Chinese market through ad-hoc solutions to the operating model and IS landscape so far, China is only the first of multiple countries that will imply such adaptations. In order to fulfill the strategic ambition to expand global presence and reach 200 million children by 2025, the LEGO Group will continuously focus on new emerging markets that may bear similar challenges. This will not only depend on the successful transition towards a more flexible platform architecture, but will also require an overarching architecture game plan of how specific (legal) requirements of new market regions can be addressed. "*China is a very different market to what a market entry in traditional LEGO terms had meant previously. We had been used to entering markets in the western hemisphere – mainly Europe and North America. And they have been not entirely alike, but culturally and legally widely aligned. However, as the LEGO Group is expanding its geographical reach, we are experiencing more and more diverse cultures, frameworks, and also now the impact of very diverse technology platforms in countries we are entering*" (EA, LEGO Group).

Chapter 5: Research Publications

Based on the previous section's description of the case evidence, this section provides an overview of the project's four published research papers. Figure 1 reveals how these contributions stand in relationship to each other in terms of investigating the individual parts in the overarching phenomenon of architecting. Table 1 provides an overview of each paper's most relevant elements.

Paper	Research Question	Method	Contribution
Paper #1: Dynamic Capability Building in the LEGO Group for a Turbulent Digital Future – Prospective and Reflective Activities	*How can companies intentionally build a dynamic capability?*	Positivist Case Study	Mid-range variance theory on dynamic capability building
Paper #2: From Drift to Central Guidance: A Path Constitution Perspective on the Platformization of an Information Infrastructure	*How can a company trigger the transformation of its drifting II into a digital platform?*	Positivist Case Study	Mid-range process theory on II transformation through architecture path constitution
Paper #3: Internal Digital Platforms and Generative Mechanisms of Digital Innovation	*How does an internal digital platform enable digital innovation?*	Critical Realist Case Study	System theoretic model consisting of three generative mechanisms of digital platform innovation
Paper #4: Platformization and Internationalization in the LEGO Group	*How does the platformization of a company's IS landscape enable its internationalization capability?*	Critical Realist Case Study	Three mechanisms through which IS landscape platformization enables internationalization

Table 1: Summary of Four Published Research Papers

The first two contributions reveal how companies can build the foundational capabilities and embark on the journey of IS landscape platformization. Subsequently, contributions three and four elaborate in detail on how an internal digital platform – i.e. a platformized IS landscape – enables speed as well as efficiency of digital innovation within a company and the ability to expand business into digitized foreign international market regions.

Paper #1: Dynamic Capability Building in the LEGO Group for a Turbulent Digital Future – Prospective and Reflective Activities (Törmer and Henningsson 2019)

The first research contribution is based on the argument that the opportunities and threats arising from digitalization will lead to "next-generation competition" (Teece 2012) in the digital space and will subsequently favor companies in possession of dynamic capabilities. The dynamic capabilities framework claims that, as lifecycles shorten and technology transfer increasingly occurs across enterprise boundaries (Teece 2014), the long-term profitability of companies hinges on their ability to adapt internal resources and capabilities to changing customer demands and technological opportunities (Teece 2007). Consequently, the capacity for continuous adaptation of technology-enabled business capabilities to a company's external environment will determine success or failure for enterprises in the long run (Karimi and Walter 2015; Teece 2012). Despite the framework's prominence in strategic management, relatively little is known about how companies build dynamic capabilities. Specifically, existing research is based on theories of organizational learning, conceives their creation based on learning from experience, and ultimately falls short of explaining the intentional creation of a dynamic capability in preparation for its future application. By conceptualizing EA as a dynamic capability with specific relevance for orchestration in the digital age, the research contribution therefore sheds light on the following research question: *How can companies intentionally build a dynamic capability?*

The study adopts a positivist case study approach (Dubé and Paré 2003; Yin 2013) in order to develop an explanatory, mid-range variance theory of dynamic capability building in companies. Accordingly, the case data is regarded as a shared reality between the author and key informants from within the company to triangulate specific facts (Sarker et al. 2018).

Based on a subset of the case evidence presented in the previous section, the analysis first conceptualizes the LEGO Group's EA capability as a dynamic capability by arguing for the support of sensing as well as seizing of technological and market opportunities and particularly the continuous transformation of existing IT-enabled business capabilities. Whereas the technology radar and engagement with selected technology-driven business initiatives primarily focus on the identification and realization of opportunities, the strategic IT directions, the EA design principles and their implementation in individual initiatives enable the continuous transformation of technology-enabled business capabilities.

Subsequently, the analysis synthesizes what is already known from existing research on dynamic capability building with novel theoretical insights gained by the case evidence. Adopting technical fitness and evolutionary fitness (Helfat et al. 2009) as dependent variables, proposition one rephrases what is already known from previous research contributions, but also evident in the LEGO Group: *(P1) The technical fitness of a dynamic capability increases through capability use, resultant experience accumulation, and reflective learning activities.*

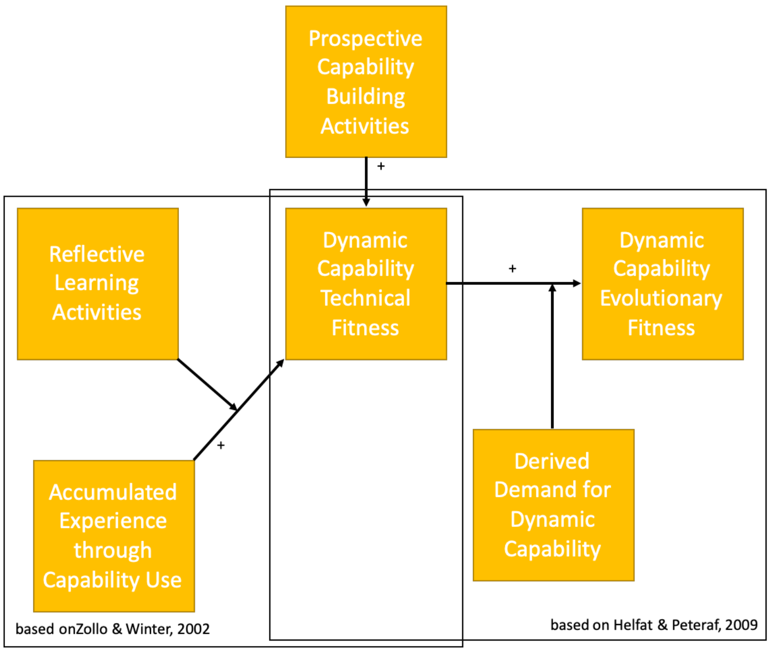

Figure 10: Theoretical Model for Dynamic Capability Building in the Context of Previous Research

Additionally, and in contrast to these backward-looking activities, the study identifies prospective capability building activities as a significant mean in the LEGO Group to improve the EA capability for future use. These activities included the development of strategic IT directions for cloud, data, and integration, the EA design principles, as well as the system landscape documentation. Also, the initial elaboration of the EA winning aspiration, focus areas and deliverables are evidence of prospective activities for an unknown future. The engagement did not deliver the value associated with the EA capability to the rest of the organization, but served the unique purpose of increasing its technical fitness for future use. This evidence justifies proposition 2: (P2) *The technical fitness of a dynamic capability increases through prospective capability building activities that do not contribute to the immediate delivery of its value.*

Combining propositions one and two reveals a strategic choice that organizational units face when deliberately investing into the creation or improvement of a dynamic capability: the allocation of time and resources between (a) prospective activities, on the one hand, which will increase its technical fitness for future application; and (b) will also increase its immediate capability use, on the other hand, to deliver its value while also collecting experience to feed reflective learning. In the LEGO Group, this tension materialized particularly in the year of the EA capability's establishment as the team has continuously been pulled into special projects by senior stakeholders for advisory purposes to deliver immediate value. This reasoning justifies proposition three: (*P3) The strategic creation of a dynamic capability comprises an inherent tension between prospective capability building activities and delivery of value through capability use.*

The case evidence and theoretical analysis reveal how a dynamic capability can be built in a company. Propositions one and two accordingly form a mid-range variance theory, which explains that the technical fitness of a dynamic capability increases not only through reflective learning from capability use and resultant experience accumulation, but also through prospective capability building activities. Methodological overlap between reflective and prospective activities may offer potential for synergistic integration. Nevertheless, this study explicitly emphasizes the split between the two opposing poles. Figure 10 harmonizes these findings in a consistent picture with the findings of previous research. Since reflective learning activities rely on – and amplify the effect of - previous experience accumulation, the concept is depicted as a moderating variable. Finally, by conceptualizing EA as a dynamic capability, this study places the discipline into the theoretical context of strategic management and emphasizes its orchestrating role during a continuous process of digital transformation.

Paper #2: From Drift to Central Guidance: A Path Constitution Perspective on the Platformization of an Information Infrastructure (Törmer and Henningsson 2018)

The second research contribution investigates the process of platformization by applying the II and platform concepts to a company's internal IS landscape. Based on the premise that digital transformation entails an increased orientation towards digitally-enabled, platform-based business models (Cusumano and Gawer 2002; Eaton et al. 2015; Eisenmann et al. 2011; Gawer 2014; Tiwana 2013), the study assumes that platformization is a desirable process that continuously prepares a company's IS landscape for future digital innovation. Pointing out a gap in the academic IS literature around how digital platforms are constructed (de Reuver et al. 2016), the LEGO Group's internal IS landscape is conceptualized as a drifting II characterized by lack of global architectural guidance. Subsequently, the specific research question is addressed: *How can a company trigger the transformation of its drifting II into a digital platform?*

Similar to the first research contribution, a positivist, explanatory case study approach is adopted (Dubé and Paré 2003; Yin 2013). Following an equally data-centric approach, the method differs from the previous work by applying a much more inductive analysis (c.f. Sarker et al. 2018). Since the platformization concept was still emerging in the IS literature during the progress of this PhD project, the analysis could not draw on extensive existing theory, but was led by coding of case evidence.

In general terms, path-dependent processes are non-ergodic, beyond the influence by human actors, and shaped by contingencies as well as history (Sydow et al. 2009). The concept of path creation, by contrast, involves an active involvement through human agency (Garud et al. 2010). Actors deliberately shape the evolutionary path of processes through mindful deviations "from existing artifacts and relevance structures fully aware that they may be creating inefficiencies in the present, but also aware that such steps are required to create new futures" (Garud and Karnoe 2001, p.6). Path constitution unifies these two perspectives by defining a path as a non-ergodic process of interrelated events that may be actively influenced by knowledgeable human actors (Singh et al. 2015; Sydow et al. 2012).

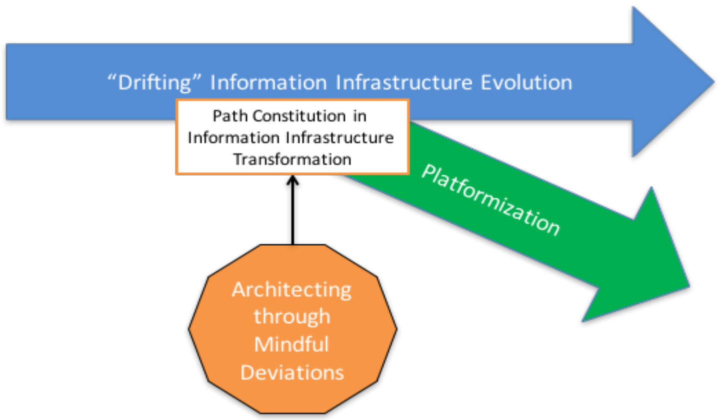

Figure 11: Conceptual Process Model: Creating a New Platformization Path in the Transformation of an Information Infrastructure

Prior to the establishment of a centralized architecture unit, the LEGO Group's II was drifting in a path-dependent, socio-technical evolution process. In the absence of cross-functional, long-term architectural guidance, the IS landscape was shaped by functionally-distributed actors that satisfied individual business requirements by bolting new IT components onto the infrastructure's installed base. This process increased architectural debt and limited the II's flexibility for the future, while also leading to individual lock-in situations. To break away from the path-dependent process of II drifting, architects engage in mindful deviations from existing relevance structures through publication and communication of various artefacts (e.g. architecture principles and scorecard) that should feed the centralized, long-term architectural vision into the organization. These deviations may create inefficiencies in the present and are met with resistance in the organization. Nevertheless, they impose a central design framework over the IS landscape and trigger the constitution of a new platformization path. This gradual transformation will enable the company's progressing digitalization journey.

The theoretical insights spell out the balance between constraining path dependencies and intentional path creation that actors need to manage when engaging in deliberate II transformation. In addition, the evidence discloses in detail how concrete deviations by architects guide collective action in order to cultivate the installed base of an II into an intended development trajectory. These findings stress the importance of human agency and boundary-spanning communication in platform development.

Paper #3: Internal Digital Platforms and Generative Mechanisms of Digital Innovation (Törmer 2018)

The third research contribution applies the platform concept to a company's IS landscape and reveals how an internal digital platform enables future digital innovation. While the enabling role of multi-sided digital platforms for innovation in digital ecosystems is a well-researched phenomenon (Baldwin and Woodard 2008; Eaton et al. 2015; Selander et al. 2013), internal digital platforms have received only minor research attention, the platform concept has often been used in vague terms, and research results have not been conclusive (Sedera et al. 2016). Based on a rigorous conceptualization of an internal digital platform, the study develops three generative mechanisms through which an internal digital platform enables digital innovation within a company. Thereby, the study sheds light on the following research question: *How does an internal digital platform enable digital innovation?*

Generative mechanisms in terms of causal structures or laws are at the heart of explanatory theory in the stance of critical realism (Archer et al. 2013). To account for the view of knowledge as socially-constructed based on existing theory, this study follows a research process similar to analytic induction (Patton 2002), which exhibits close resemblance to what Archer et al. (2013) describe as retroduction (Mingers 2004). Based on the existing platform literature, the starting point of the study is a general proposition that - similar to multi-sided digital platforms - internal digital platforms enable digital innovation within companies. Subsequently, a case study (Yin 2013) is conducted to substantiate the claim with empirical data and describe the process through which the effect unfolds. The inductive analysis of the case data furthermore allows for the discovery of more fine-grained concepts as well as relationships that form the generative mechanisms, which ultimately explain the phenomenon in the real world. Finally, these mechanisms are formulated in the form of three propositions that together build a system-theoretic model.

Based on the observation that all software systems and digital components in the IS landscape of a company can be conceived as larger or smaller clusters of functionality, Systems Theory (Simon 1962) is borrowed as a theoretical lens with which to develop a holistic concept of an internal digital platform. This perception underlines the claim that digital innovation does not only occur in the periphery but also in the core of a digital platform. Specifically decoupled interactions via standardized interfaces among individual platform components is an inherent architectural characteristic that is essential to this conceptualization.

Inspired by the emergence of complex hierarchical systems, the subsequent analysis of the LEGO Group's IS landscape focuses on the granularity of individual components and how they evolve to address specific business problems in the real world. Even though the current state of the company's global IS landscape does not live up to the internal platform concept that was advanced, the evidence reveals how individual 'platformized' subsets enable digital innovation, while others take a constraining effect. The findings entail three generative mechanisms – modular upgradability, economies of substitution, and reproduction – through which an internal digital platform enables digital innovation. Modular upgradability refers to the ability to evolve the overall platform by implementing changes in individual components without creating ripple effects on other components. In the LEGO Group, the lack of modular upgradability due to tight coupling in core enterprise systems impedes digital innovation in the company by slowing down the implementation of changes or upgrades in individual subsystems. On the other hand, the isolated section of the consumer engagement platform does conform to the internal digital platform concept. In this area, it is particularly the ability to implement and deploy changes to individual micro-services in isolation from other platform components that enables speed and efficiency in the development of digital experiences.

Economies of substitution, on the other hand, emerge when the cost of creating a new subsystem by reusing existing components is lower than building a system from scratch. This mechanism is particularly evident in the customer engagement platform of the LEGO Group. By relying on a foundation of existing subsystems (i.e. micro-services) that each provide a solution to a real-world problem, product teams are able to approach new problems by comparing them to those that have been previously-solved. At the same time, the lack of modularity in the LEGO Group's core enterprise systems impedes economies of substitution when relying on their functionality or data.

Finally, reproduction describes the imitation or adoption of externally-created solutions that address known business problems. In the LEGO Group, this mechanism is mainly apparent from the reproduction of external software systems into the consumer engagement platform, where the adoption of stable solutions for known problems allows product teams to focus their efforts on approaching new business problems with purpose-specific components. Also in the context of enterprise systems, the LEGO Group has made the deliberate strategic choice to leverage externally-developed subsystems for efficient digital innovation. However, legacy integration technology and tight coupling creates the need for extensive refactoring when changing individual landscape components, which increases the time and cost of onboarding innovative solutions. In very few instances, however, enterprise systems do rely on decoupled integration to other components and elucidate that this facilitates the implementation of upgrades or changes.

The case evidence furthermore reveals a countervailing interaction between economies of substitution (P2) and modular upgradability (P1). If the development or modification of a subsystem creates requirements for changes to interface specifications, high degrees of reuse imply ripple effects on reusing subsystems that slow down the implementation of change. Consequently, the architectural platform design comprises an inherent tension between the mechanisms of modular upgradability (P1) and economies of substitution (P2). In the LEGO Group's consumer engagement platform, this tension creates the necessity for several experience-specific services (c.f. Figure 6) that undermine economies of substitution, but allow for the more rapid adjustment of interface specifications.

The third mechanism acknowledges the continuous prevalence of COTS software and the increasing ubiquity of cloud-provided solutions. By adopting a holistic conception of an internal digital platform - including enterprise systems and more modern digital components -, the impact of their interactions on platform evolvability and on digital innovation within the company becomes apparent. Furthermore, the findings reveal the strategic choice of granularity that architects face during subsystem design, which should either strive for efficiency through reproduction or flexibility as well as speed through economies of substitution.

Paper #4: Platformization and Internationalization in the LEGO Group (Törmer 2019; Törmer and Henningsson 2020)

The fourth research contribution investigates the role of IS landscape platformization for a company's capability to expand into new geographical regions. Drawing on International Business (IB) theory, the concept of interregional *psychic distance* is borrowed as a key phenomenon of interest. According to Rugman et al. (2011), distance poses a key scholarly and managerial challenge in terms of understanding the transferability of knowledge across market regions. Scrutinizing the architectural aspects of LEGO Group's market penetration journey in China in the light of the future internationalization agenda, the analysis reveals how IS landscape platformization addresses key challenges imposed by psychic distance.

For more than five decades, the field of International Business (IB) has produced research contributions designed to describe, explain, or predict how companies internationalize (Rugman et al. 2011) and has stressed the role of firm-specific as well as country-specific advantages during this process. In this vein, the Uppsala model – one of the most prominent contributions in this area - suggests that distinct forms of distance - i.e. cultural, economic, institutional, and geographic distance - produce cost of employing firm-specific advantages abroad and thereby potentially outweigh the benefits of doing so. Johanson and Vahlne (1977) subsume these forms of detachment under the concept of psychic distance. Other research advances the notions of *liability of foreignness* (Hymer 1976) or the *liability of outsidership* (Johanson and Vahlne 2009) in order to explain how distance or lack of powerful relationships create dispositions that prevent companies from realizing country-specific advantages.

The study follows a very similar research process as the third contribution, even though the method remains theoretically less elaborated upon. Specifically targeting a practitioner audience, the primary goal is the development of relevant mechanisms through which IS landscape platformization enables companies to overcome psychic distance to a specific market region. Accordingly, the method follows a critical realist world view and the analysis departs from a high-level, theory-based hypothesis that is subsequently substantiated with more fine-grained mechanisms. Focusing on how the LEGO Group's market entry and penetration in China have been enabled and constrained by the pre-existing technical architecture, the analysis also conceives how the company's current investments into the IS landscape's platformization seek to address existing pain points. By operationalizing the sub-dimensions of psychic distance, the theoretical model (c.f. Figure 12) reveals how IS landscape platformization addresses distinct challenges related to psychic distance during the internationalization process.

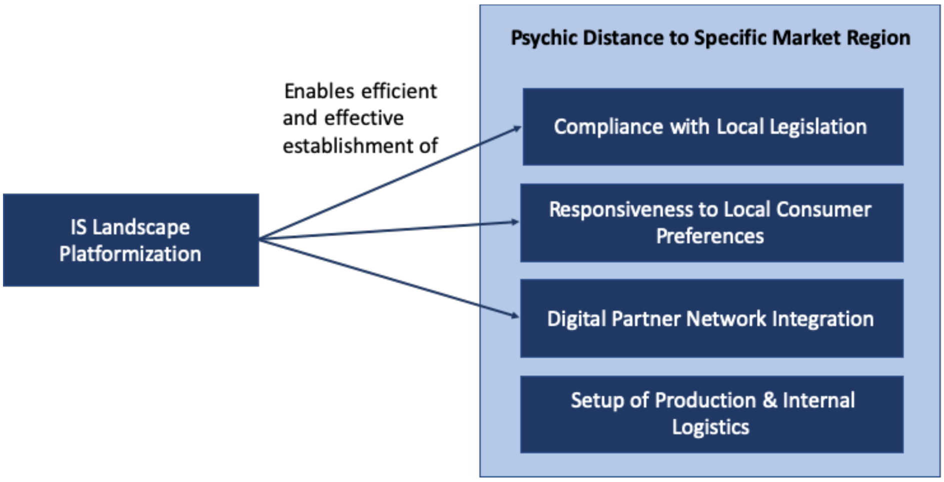

Figure 12: Mechanisms through which IS Landscape Platformization enables Internationalization

For one, compliance to Chinese legislation in terms of reporting and data protection has been established in the LEGO Group through cumbersome customizations within the global ERP template. Since this procedure complicated market entry and limited future system flexibility, the deliberate investment into IS landscape platformization is seeking to enable future adaptation to local legislation through (1) more seamless adoption of software upgrades, (2) smoother connectivity to third-party solutions and (3) architecturally sound implementations of local exceptions to the global template. This ability lowers the impeding effect of institutional distance on the internationalization process.

Operating in the consumer-goods industry, the LEGO Group is following a customer engagement strategy. By offering digital experiences to consumers, generated data is leveraged to develop new value propositions and improve existing ones. Specifically in foreign market regions, this strategy can enable a company to overcome the cultural and economic dimensions of psychic distance more effectively and efficiently by leveraging data-driven insights to learn about purchasing behaviors and country-specific customer preferences. On the one hand, the technical ability for digital two-way interactions has been identified as a generic affordance offered by platforms in the IS literature. Additionally, the case evidence reveals that the ability to develop digital experiences and tailor them to country-specific legislation relies on the platformization and subsequent flexibility of a company's IS landscape.

Moreover, the LEGO Group's continuous internationalization journey reveals a need to connect to a large quantity of heterogeneous technology platforms in distinct countries – not only for external customer engagement solutions, but also for business capabilities from the traditional enterprise world, such as local payroll solutions. Since most of these platforms are loosely affiliated actors that perform business transactions through standardized, public APIs, the IS landscape's affordance to support such connectivity is a vital capability for enabling the internationalization process. By facilitating connectivity to digital partner networks, a platformized IS landscape therefore allows companies to overcome institutional and geographic distance more efficiently, as well as more effectively.

In addition to the overall theoretical model explaining how IS landscape platformization enables companies to overcome the psychic distance to a specific market region (c.f. Figure 12), the paper closes with lessons learned for practitioners who want to embark on the journey. These recommendations point out that (1) platformization is not a silver bullet, but requires complementary organizational setups; (2) platformization is a continuous journey during which companies might never reach a conclusive destination; and (3) this journey should focus on the most pressing pain points of the IS landscape first to eventually move into breadth.

Chapter 6: Pervasive Analysis

In this section, the generic configuration perspective on architecting derived in the literature section is substantiated with outcome variables, which are developed based on the theoretical pre-understanding of the architecting concept as well as the third research paper's findings (Törmer 2018). Based on the definition of the outcome, the analysis of individual points of architecting identifies relevant contextual variables and subsequently develops an explanation how mechanisms bring about architecture outcomes in specific contextual configurations.

Outcome Variables

In order to investigate Situational Architects' design decisions on the micro-level, outcome variables are selected based on a pre-existing theoretical understanding of innovation-ready architectures and particularly the findings from the third research contribution of this PhD project (Törmer 2018). The subsequent empirical analysis then allows for the identification of the context variables and mechanisms relevant for distinct substantiations of the pre-defined outcome variables.

Specifically, the results of Törmer (2018) reveal a dual purpose of innovation-ready architectures that allows architects in specific domains or solution areas to either (a) target primarily speed of innovation in strategically differentiating business capabilities, or (b) focus on efficiency of innovation at the cost of speed in more common business areas. The former is commonly achieved by designing a highly granular architecture consisting of COTS, as well as own-built modules that can be rapidly exchanged to upgrade the functionality of the entire solution. In the most granular form, this architecture would consist of micro-services. The latter outcome, on the other hand, comprises the adoption of a coarse-grained and potentially Software-as-a-Service (SaaS)-based COTS software product. This option is commonly associated with a lower price than highly granular, own-built solutions and allows for the continuous exploitation of vendor-provided upgrades. Similarly, Baldwin and Clark (2000) recognize the number and roles of individual modules as a critical design decision that also determines which parts of an overall solution can be designed and continuously improved by individuals outside the organization. Accordingly, the *granularity* of a module is defined as an outcome variable for the configuration model.

According to Baldwin and Clark (2000), the definition of interface specifications among modules is one of an architecture's most central design parameters. As elaborated in the theory section on IS evolvability, the IS literature identifies modularity, connectivity, and loose coupling as key characteristics of a flexible or evolvable II. In the generic context of complex hierarchical systems, perfectly modular architecture has been proclaimed as an enabler of continuous mutation of individual subsystems. This leads to the overall system's superior ability for adaptation to changing environments and for survival in the forces of natural selection (Baldwin and Clark 1997). In IS, modularity is established through a bijective mapping between functionality and corresponding modules as well as decoupled communication between components through "specific thin crossing points" (Baldwin and Woodard 2008, p. 23; Ulrich 1995). This reasoning implies that connectivity and loose coupling are two separate second-order constituents of modularity (Pil and Cohen 2006).

Loosely coupled integration between a newly designed module and existing architecture components is therefore a crucial enabler of overall IS landscape evolvability. For the purpose of this thesis, loose coupling will not be linked to the use of any specific technology, standards, or protocols. Instead, the phenomenon is simply a logical implementation choice constituted by information hiding and few interdependencies between modules that ensure failover-safety and the elimination of ripple-effects. This means that the failure of one module does not impact the functioning of any related component and that changes in one module's implementation logic do not imply the need for adjustments in related components. The latter can never be achieved in entirety, since changes to interface specifications will always imply a ripple effect on reusing modules. However, the goal is to minimize this need by hiding implementation logic within modules and reducing the need for cross-module communication.

Connectivity, on the other hand, is closely related to compatibility and refers to a solution's ability to interface with other components either within or outside of the company's IS landscape in order to reuse data as well as functionality (Duncan 1995). This quality depends on the exposure of business logic as well as data via interfaces and the adoption of common communication standards as well as protocols in both the reused and the reusing solution. Specifically due to their large-scale adoption by the entire internet, open source standards and protocols, such as the Hypertext Transfer Protocol (HTTP), are increasingly serving integration purposes among solutions within and across companies. In the IS community, APIs have often been associated with the flexibility of IT and business. While these endpoints can be implemented based on a multitude of distinct technologies, standards and protocols, it is the support for the most adopted ones that facilitates connectivity. By enabling the reuse of data and functionality, connectivity is a necessary pre-condition for having a single source of functionality or data within a single enterprise. Hence, connectivity between functional modules also enables modularity. Accordingly, *loose coupling* and *connectivity* are adopted as outcome variables for the configuration model.

Outcome Variable	Definition	Possible Substantiations
Granularity	Granularity describes the number and size of a module's individual subsystems, which can be re-used enterprise-wide. High granularity refers to an architecture built out of a large quantity of individual subsystems, which can be easily replaced. The extreme case represents a micro-service architecture. Low granularity describes an in itself monolithic software module, which exposes relevant data and functionality via interfaces.	High vs. Low
Coupling	Coupling refers to the degree of logical interdependencies brought about by integration solutions between the module under consideration and other modules.	Tight vs. Loose
Connectivity	Connectivity describes the reach of a module's consumed as well as provided integration interfaces and is determined by their degree of open standard adoption as well as their subsequent potential for reuse within and outside the organization's boundaries.	Proprietary vs. Open
Customization of COTS Components	Customization describes the modification of internal source code in a purchased COTS module, which subsequently becomes a part of the company's IS landscape.	Yes vs. No

Table 2: Outcome Variables of Configuration Theory

Finally, the findings of the third published research paper (Törmer 2018) reveal that an IS landscape's evolvability is critically limited by the implementation of customizations to COTS software components. For Baldwin and Clark (2000), the value of a modular architecture lies in the option to replace individual modules selectively, if higher-performing ones come about. However, in the context of an IS landscape, individual components cannot not be replaced one by one on a regular basis, since data transfer from an existing to a new solution is a necessary and time-consuming endeavor. Accordingly, the replacement of existing COTS software with higher-performing releases is commonly achieved through vendor-provided upgrades that need to be installed on the existing system. If a client-company has, however, implemented customizations to the purchased component that interfere with existing functionality being replaced by a new release, the upgrade requires tedious inspections and oftentimes error-correction. This limits modular upgradability of individual subsystems (Baldwin and Clark 1997). Due to the extra efforts and in instances associated omission of upgrades by a client company, customizations of standard COTS software modules lead to slower evolution of a company's IS landscape. Hence, customization of COTS modules is adopted as an outcome variable for architecture decision-making.

Table 2 summarizes the outcome variables that are subsequently adopted in the analysis. On the one hand, a highly granular architecture is in the IS context associated with the utility of a solution's flexibility to accommodate frequent changes in the future through the replacement of individual subsystems. On the other hand, the findings from the third published research paper (Törmer 2018) reveal that, in an enterprise context, granularity is a rather neutral, context-specific design choice. High granularity may not always be desirable since cost of modularity could imply overinvestment, if a highly granular solution is designed for a business capability that does not require frequent changes. A similar point is made by Pil and Cohen (2006). On the other hand, loose coupling, open connectivity and the absence of customization constitute positively connotated outcome variables, since these qualities are desired in all situations to ensure an architecture's evolvability (Törmer 2018). Accordingly, this thesis will adopt loose coupling, open connectivity, and absence of customization as outcome substantiations of an innovation-ready architecture. On the contrary, an architecture outcome characterized by at least one of the opposite substantiations (i.e. tight coupling, proprietary connectivity, or customization) constitutes an innovation-constraining architecture. Granularity, in contrast, is a design choices implying a focus on either efficiency (low granularity) or speed (high granularity) of digital innovation (Törmer 2018).

Relevant Context Variables

The coding procedure described in the method section resulted in six context variables of equal relevance that impacted Situational Architects' decision-making during individual points of architecting in the LEGO Group: *Availability of COTS Solutions or Services on Market*, *Desired Future Flexibility*, *Existence of Architecture Principles and Scorecard*, *Urgent Budget or Schedule Constraints*, *Architect Mandate Endorsed by Senior Management*, and *Presence of Relevant Technical Competences in Organization*. Table 3 provides a holistic overview of these context variables along with descriptions, possible substantiations and example codes for each of them from the case evidence. In the following, each variable is explained in detail.

To begin, *Availability of COTS Solutions or Services on Market* addresses the relevant option to buy and integrate a standard software product or potentially cloud-based service for a specific business need from an external vendor in the market. Usually, software vendors offer products that address a common business problem experienced by a multitude of companies and are therefore able to realize economies of scale in sales by constructing a product that addresses the problem in a generic way. Client companies, in turn, can buy or license the product at a price, which is often (but not always) lower than their corresponding in-house development cost. Additionally, client companies commonly leverage vendor-provided innovation through periodic upgrades of relevant functionality. The 'make-or-buy' decision is one of the most classic phenomena in IS management. At the same time, the decision seems more relevant than ever before, since enterprise software products increasingly embody industry best practices for their respective functional areas. Additionally, seamless, cloud-computing-based delivery models, such as SaaS, render the buy option eminently more viable, while equally implying more complex architectural implications in terms of integration or governance.

Even the in-house development of custom software components is in most companies nowadays based on maximum reuse of existing software components, for instance by incorporating open source software components, having individual calculations executed by use of an external API or by developing entirely on an external cloud vendor's platform, such as Amazon Web Services (AWS) or Microsoft Azure.

Accordingly, the boundaries between build and buy are continuously blurring. Within the context of this analysis, *Availability of COTS Solutions or Services on Market* therefore refers to the supply of a dedicated, potentially cloud-based solution application that addresses the specific business need under consideration.

Closely related to the 'make-or-buy' decision, *Desired Future Flexibility* refers to the anticipated frequency of future changes in a specific solution and the source of innovation for the corresponding technology-enabled business capability. Accordingly, this variable's substantiation commonly results from the strategic importance of the corresponding business capability. Low *Desired Future Flexibility* characterizes solutions that will serve stable business processes or value propositions and which do not change very frequently over time. The associated capability is in most cases a common one in the industry, such that corresponding solution designs can prioritize efficiency over changeability. High *Desired Future Flexibility*, on the other hand, denotes solutions that will be modified very often in order to improve the corresponding business capability on a regular basis. These functional areas are more often associated with strategic differentiation, such that improvements in the capability are the source of, or directly contribute to, the company's competitive advantage. Accordingly, the solution needs to support business practices that are ahead of best practices in the industry. Since *Desired Future Flexibility* is not a choice made during solution design, but rather a requirement resulting from the corresponding business capability or functional area, the variable is adopted as a second contingency in this study.

To describe two central formal artifacts that are relevant in the LEGO Group for guiding the architecture trajectory into an intended direction, the third context variable, *Existence of Architecture Principles and Scorecard*, simply captures whether at least the former artifact is officially present in the company under consideration. The principles embody an organization-wide and top-management approved definition of architecture quality that should feed strategic directions into the organization by guiding individual design decisions in response to contextual considerations. Instead of imposing strict rules or providing a clear recipe for any situation, however, the principles in the LEGO Group follow the lighthouse metaphor (Haki and Legner 2013) to depict an ideal future state that every architecture decision should strive towards. Situational Architects are still empowered – as well as required – to make autonomous design decisions and individual outcomes may still deviate from the principles. Nevertheless, the existence of architecture principles and the corresponding scorecard did make an outcome-changing impact on most design decisions. Additionally, as both artefacts were introduced to the organization during the time period covered by this thesis, the case evidence allows for the comparison of architecture practices before and after their introduction.

While the principles capture the company-specific understanding of architecture quality, a solution's eventual design is often impacted by two opposing factors: cost and schedule. The trade-off between cost, time, and quality is a well-known phenomenon in IS project management and has been captured in the *Iron Triangle*, implying that one element needs to be undermined in case one of the others should be prioritized (Atkinson 1999). As described by a former SA, budget and schedule have in the LEGO Group often impacted a solution's architecture design before architecture quality was prioritized by top management: "*It was always the functional requirements valued higher and the timely delivery. If compromises had to be done in those days, they have been on the quality*" (former SA, LEGO Group). Therefore, *Urgent Budget or Schedule Constraints* are defined as a context variable to describe situations in which these limitations impacted the architecture outcome. Naturally, any software-design endeavor is to some extent subject to certain time and budget constraints. This fourth context variable is accordingly only actualized if they had at least a slight impact on the outcome architecture.

The cases in the LEGO Group equally reveal that the prioritization of architecture quality benefits from an *Architect Mandate Endorsed by Senior Management*. Whereas architecture principles solely define architecture quality for the specific context of an organization on paper, their public appraisal by senior stakeholders, such as the CIO or the CEO, stimulate their meaningfulness to architects and business stakeholders in the organization. Accordingly, an SA explains that "basically, the word of the EA is not that strong. So it needs to come from a senior management level" (SA, LEGO Group). At the same time, formal decision mandates and reporting structures may ensure the prioritization of architecture quality. Accordingly, *Architect Mandate Endorsed by Senior Management* is adopted as the fifth contextual variable.

Variable Name	Description	Substantiations	Example Codes
Availability of COTS Solutions or Services on Market	Supply of dedicated, potentially cloud-based applications that address a specific business need or capability under consideration.	**Yes**: The software market offers at least one solution that is perceived to be functionally and architecturally suitable. **No**: The software market does not offer a solution or the solution offers are perceived functionally or architecturally inappropriate.	"Very quickly it was narrowed down to these two candidate solutions. I think that was also the input from our advisors [...] that these two candidates were really the ones we should focus on." (former SA, LEGO Group) "Still, we also went to see other tools on the market for competition, because the price of [ITSM Product] is something different than the other service management tools." (Product Owner, LEGO Group)
Desired Future Flexibility	Anticipated frequency of change in a specific software solution or the corresponding technology-enabled business capability.	**High**: The solution will be modified very often and needs to accommodate frequent change. **Low**: The solution will not be modified very frequently.	"The ambitions here are way above what the market is innovating for. […] We took it all the way up to [COO] and it is now agreed that this is a differentiating business area" (former SA, LEGO Group) "We wanted to have the flexibility because we could see that, for instance in the future talking about digital shop floor, this would have to eventually be integrated […] with very high-paced event-driven solutions" (former SA, LEGO Group).
Existence of Architecture Principles and Scorecard	Existence of officially approved architecture principles and potentially a corresponding scorecard that are known to Situational Architects and guide decision-making when designing individual solutions.	**Yes**: Officially approved architecture principles exist and are potentially supported by a scorecard. **No**: Architecture principles do not exist.	"How could we work with the existing vendors? How could we make agreements with them to change solutions to something that was more in line with our principles?" (former SA, LEGO Group) "From a principle point of view, they both lived up to our technology principles – cloud-based, decoupled API, kind of a modern architecture" (EA, LEGO Group)
Urgent Budget or Schedule Constraints	The prevalence of scarcity in budget or schedule resulting in an impact on the decision outcome undermining architecture quality.	**Yes**: Budget or schedule prioritized over architecture quality. **No**: Architecture quality prioritized over budget and schedule.	"Urgency […] trumped that way of thinking. […] It would have, of course, been much nicer […]. But at the time it was de-prioritized to do it like that" (SA, LEGO Group) "The preference from the business was that they wanted to start fast and they wanted to have all their features from day one" (EA, LEGO Group)
Architect Mandate Endorsed by Senior Management	The formal and informal prioritization of architecture quality in the organization or a specific initiative through public appraisal by senior management, allocation of decision rights, and design of reporting structures as well as incentive schema.	**Yes**: Architects have the formal and informal mandate to prioritize architecture over competing constraints. **No**: Architects do not have the required mandate.	There has been perfect buy-in into that even though this is not officially a Technology Strategy initiative, we are following the same decision mandate. So that means that it is the different solution architects being the recommenders and then the EAs and Strategy function is having the approval role and the workstream lead is having the final decision call. (EA, LEGO Group) "[The LT member] was closely involved into the decision-process. […] The problem is that in the steering committee meetings you are as well then getting into discussions like 'Yeah, but we want a one-to-one replacement'. And then there is not much they can do. " (former SA, LEGO Group)
Presence of Relevant Technical Competences in Organization	The availability of required technology-related skills and expertise within a specific organizational unit under consideration.	**Yes**: The individual skills to build solutions in accordance with architecture principles are present in the corresponding functional area. **No**: Required skills are absent in the organization and may need to be onboarded, purchased or developed.	"And now we are waiting for the onboarding of the developers that can help us on this journey, because the resources in this area are all consultants. And they are not developers and we need developer skills" (EA, LEGO Group) "We had to hire just for this" (former SA, LEGO Group)

Table 3: Context Variables of the Configuration Model

Finally, even if architects and developers are committed and empowered to design solutions according to architecture principles, the *Presence of Relevant Technical Competences in Organization* is a necessary pre-condition for the actual implementation and evolution. Known in the industry as Conway's law, the mirroring hypothesis claims that "products tend to mirror the architectures of the organizations in which they are developed" (MacCormack et al. 2012, p.2). While this reasoning primarily focuses on the design of reporting structures, few instances in the LEGO Group reveal that the architecture design of a solution may equally be impacted by the presence or absence of specific technical competences. In the case of absence, required skills may still be built, hired or purchased in time to implement designed solutions. Particularly under the pressure of budget or schedule constraints, however, shortcomings in organizational competencies may impact the outcome of architecture design decisions.

Causal Configurations of Architecting

To explain the causality driving decision-making in individual points of architecting, six configurational models are presented that link substantiations of contextual variables to different outcomes. Based on the distinction between innovation-enabling as well as -constraining architecture outcomes, the CMO configurations are grouped according to their contribution to the innovation-readiness of the overall architecture (c.f. Figure 13). In each configuration, one dominant mechanism is at play that determines the specific outcome. The mechanisms are actualized under the influence of distinct salient subsets of the context variables presented in the last section. Subsequently, each of them a causal role in the architecture outcome depending on their actualization or non-actualization. Yet, due to causal asymmetry (Fiss 2011), distinct sets of context variables are relevant for actualizing each individual mechanism.

The configurational models are presented in an order that reflects their prevalence in the LEGO Group over time. Additionally, Figure 14 reveals the approximate timeline of decision-making in each point of architecting and reveals the corresponding mechanism that was actualized. This means that the associated implementation initiative or project could have had a significantly longer duration. The timelines in Figure 14 represent the timespan between initial architecture considerations until architects had decided on a design outcome. For some initiatives, this is a continuously ongoing process. For each of them, two exemplary cases are presented to illustrate the corresponding CMO model's origin in the case evidence and real-world effect in the company.

(1) Order-Taking Role Towards Business Requirements

The first configuration model describes the general situation or an individual initiative where a company's IT department is in an *Order-Taking Role* towards business stakeholders and functional requirements. On the one hand, business responsiveness and alignment denote qualities traditionally associated with an IT department's effectiveness. On the other hand, the single focus on efficient satisfaction of business requirements oftentimes stands in conflict with the implementation of an overarching architecture direction through individual design decisions.

In the configuration model, this contextual situation is characterized by the absence of both architecture principles and the management-endorsed mandate for architects to prioritize architecture quality over competing demands. As the social environment surrounding Situational Architects does not prescribe nor encourage solution design in a certain architectural direction, the focus on functional requirements and potentially the optimization of the project schedule, as well as budget, oftentimes leads to architectural inconsistencies. At the same time, even if architects are intrinsically motivated to implement a specific architecture-driven solution design, the lack of formal artifacts and mandate may actively discourage them from doing so.

In the LEGO Group, this situation was generally prevalent until the summer of 2017 and was described by the Head of EA as "*wild freedom to operate from an architectural point of view*". The case evidence reveals three individual points of architecting characterized by the described context and mechanism. All three of them resulted in monolithic solutions of low granularity and the customization of COTS components, as well as proprietary and tightly coupled integrations.

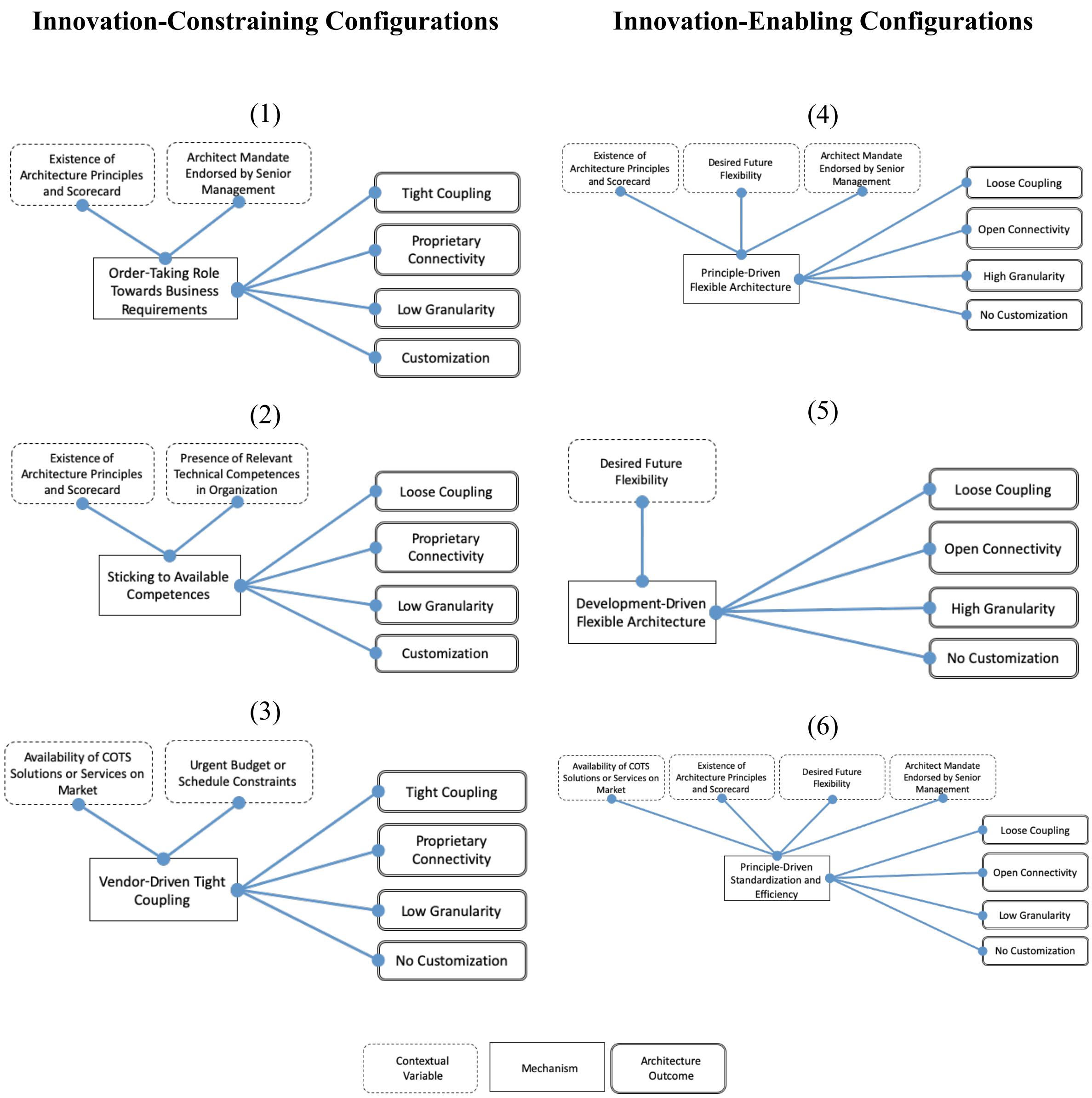

Figure 13: Six Configurational Models of Architecting

The first case covers the implementation of a large-scale distributed resource planning solution that should enable end-to-end supply chain planning in the company. For that purpose, the architecture decision-making began with an evaluation of four different alternatives: building the system in-house, composing it out of multiple distinct vendor-provided solutions or buying the entire solution from one of two potential vendors. All four alternatives were evaluated from both the business and the IT-side. While from an architecture perspective, future flexibility was an important consideration, the technical recommendation to develop a corresponding solution in-house was eventually overruled by business stakeholder's preference for a specific software product despite its architectural misfit. A former SA remembers: "*The decision was made very differently than we would do it today. It was a decision where, if I look back, there was a recommendation made by the technical team. But this was not treated as a recommendation. It was more treated as an input and then more or less completely disregarded and then choosing the solution that business-side of the program team wanted.*"

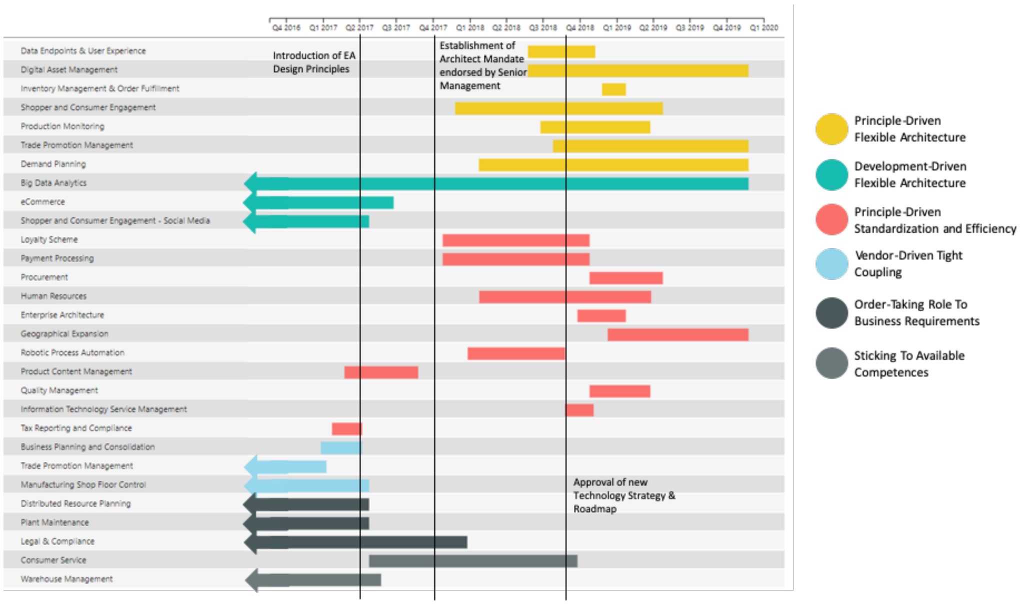

Figure 14: Approximate Timeline of Individual Points of Architecting Grouped by Mechanisms

The implementation of the bought solution subsequently entailed heavy customizations to the system in order to provide required functionality for each use case, which was not covered by the product. Also, the system only offered a very limited extent of open and de-coupled integration interfaces, such that most integrations were implemented based on file transfer or direct database calls. *"Back then we did not have these very clearly stated principles for how we would like to work with technology and how we would like to decide on what kind of technologies we would like to put in place. […] If we had had these things and had the principles we have now, it would have been obvious that the selected solution was not a good choice and that would have saved us a lot of money*" (former SA, LEGO Group). Accordingly, the absence of architecture principles and the lack of management-endorsed mandate put architects into an order-taking role to implement a solution, which had been selected against their recommendation. This resulted in system customizations and tightly coupled integrations.

The same CMO configuration was present in the architecture decision around the refactoring of a custom-developed plant maintenance system in response to the underlying software kernel's end of maintenance. The existing solution was tightly coupled to the ERP backend, which had been customized to provide specific data and functionality for the separate solution. Considering the solution's future flexibility, the responsible SA recommended to move custom functionality into a generic business rules framework within the ERP backend and provide decoupled, open integration endpoints, which the upgraded solution should leverage. "*That was [business stakeholders'] implicit expectation as well. But no compromise on the functionality. This is how it is today, it should look the same tomorrow. [...] They wanted future flexibility. But not at the expense that they are losing whatever functionality. [...] When you change the architecture of such a system in that way, you need to rethink the functional capabilities as well. Otherwise, you probably or very likely end up in the same architecture again*" (former SA, LEGO Group).

Also due technical problems in the design of decoupled interfaces and resultant performance issues, the solution was eventually not designed in a more modern architecture, but simply limited to a technical refactoring that would continue to rely on customizations of the ERP backend as well as tight coupling with the separate plant maintenance solution. "*Instead of doing the big leap and making it version two, we simple did a technical upgrade, making a containment, getting on the latest version of [the software kernel] without changing the architecture at all*" (former SA, LEGO Group).

(2) Sticking to Available Competences

The second configuration model describes the design of solution determined by relevant technical skills and competencies currently available and idle in the company. As mentioned along with the presentation of context variables, a similar point is advanced by the mirroring hypothesis (MacCormack et al. 2012) claiming that a technological architecture will always reflect the structures of the fabricating organization. Similarly, the competencies and technical skills present in the subunits of the LEGO Group's IT department (i.e. project or product teams) had an impact on the architecture of created solutions in several instances. Particularly the presence of individual architects, developers and consultants with knowledge of the preferred vendor's ERP suite often lead to the allocation of new functionality within these systems. Accordingly, the relevant contextual variables for this model are *Presence of Relevant Technical Competences in Organization* and *Existence of Architecture Principles and Scorecard*.

In the absence of architecture principles and scorecard, it is the presence of competences that makes architects stick to them during the design and implementation process. If architecture principles are present, however, it is the absence of relevant skills that actualizes the mechanism and drives the design of solution architecture. In that case, the *Architect Mandate Endorsed by Senior Management* as well as *Urgent Budget or Schedule Constraints* may contribute to the mechanism's actualization, since it is specifically these constraints in terms of time or budget and lack of mandate that prevent SAs from investing into the solution-specific availability of corresponding resources.

In the LEGO Group, this mechanism usually resulted in the customization of an existing system and the establishment of integrations via the home-grown, batch-based integration platform, which offers loosely coupled but proprietary integration endpoints based on legacy technology.

The case evidence reveals two cases denoted by this CMO configuration. The first case occurred during the rollout of the consumer service capability to a new country, which legally requires companies to store personal identifiable information on local servers before extracting them abroad. Based on the LEGO Group's one-instance philosophy, corresponding data had conventionally been stored on global databases hosted in Denmark, such that a local adaptation was required for the rollout. Since no COTS software product could cater for this use case, a solution was designed that would customize the existing ERP system and store the data locally via a de-coupled but proprietary integration to a local database. "*Had we had the right resources, it would have been just as easy. I mean [the ERP suite] is perfectly capable of sending a request to a REST API without anything on top. And building a REST API on a Linux server connected to an SQL server is also not the hardest thing to do. But it requires some resources – at least on the Linux server side – that we did not have at that moment. […] We had the database guy ready. The creation of* *the database took a couple of hours. The creation of the [integration] took a couple of hours and then [the customization to the ERP suite] did not take that much time either. So it was a fairly quick thing to do*" (SA, LEGO Group).

The second case comprises the roll-out of the LEGO Group's homegrown warehouse management system to new factories, which created the need for local adaptations. The large-scale solution had been developed in the previous years with the intention of becoming more independent from upgrades by the company's preferred ERP vendor. Nevertheless, a clean version of the vendor's standard technology stack had been chosen as an underlying development platform due to architects' and developers' familiarity with the technology. A former SA describes this general phenomenon: "*The decision was always or often to move [new functionality into the existing ERP suite] which was a rational decision, because […] we had the competencies, we had the capacity and the resources to do it. So it was typically a rational decision based on the available skills that we had*" (former SA, LEGO Group). Introducing custom database tables as well as business logic into the system, a highly effective solution had been developed that enabled efficient and globally standardized warehouse operations.

The development process itself only consumed a fraction of the cost, which had been anticipated for the purchase of an externally developed solution. "*Some of the foundations behind that was that we wanted to be really independent of [vendor] upgrades. […] I wanted to have it very modularized, because I know there is some basic functionality […] there is a lot of commonality. We wanted to make sure that we do not do duplicate code at all. So that was kind of the mantra. […] We created a lot of web services. Every single database table got a webservice. […] So we built up a lot of services and then in the end, we had a front-end*" (former EA, LEGO Group). This design resembles a service-oriented architecture and enabled flexibility within the boundaries of the solution. Nevertheless, the overall architecture was based on the monolithic paradigm of the ERP vendor's development stack, which was practically customized into an entirely new system. Similarly, local adaptations for new factories introduced additional custom code into the system. As internal webservices were not exposed for outside reuse, integration was established via few exposed interfaces and via the company's loosely coupled but proprietary integration platform.

(3) Vendor-Driven Tight Coupling

The third configuration model captures decisions during which the inherent integration architecture of a vendor-provided COTS solution shapes the solution design implemented within a client company, either due to the absence of architecture direction and mandate or due to a lack of alternative products on the market. Specifically in the absence of architecture principles prescribing a distinct direction, the implementation of a COTS module, which automatically integrates with other components of the vendor's product suite already present in the company, is often seen as a no-brainer decision. Due to the ease of integration and the homogeneity of a global data model, the selection of modules from within a single suite is often a convenient choice. This mechanism grows stronger with every module of the same suite implemented and increasingly leads to an integration-driven, soft lock-in that complicates the adoption of modules from another vendor's suite. Commonly, the technical ease of integration is also accompanied by favorable license agreements.

Even in the presence of a contradicting architecture direction through principles, the same mechanism may, however, also be brought about by a lack of viable alternatives in the marketplace, where no available products offer desired architecture qualities. In this situation, architects need to decide if the solution should be developed internally to adhere to the direction or if proprietary integration should be accepted in order to adopt a standard product. In this instance, it is particularly *Urgent Budget or Schedule Constraints* that may prevent architects from going the extra mile and building a corresponding solution.

From an architecture perspective, the mechanism results in the adoption of a vendor-provided, monolithic (i.e. low granularity) standard solution, which is integrated into the company's IS landscape based on proprietary protocols and tight coupling.

In the LEGO Group, the adoption of modules from a preferred vendor's ERP suite was a strategic principle for many years before the introduction of architecture principles. Accordingly, the described mechanism was generally followed and the corresponding CMO configuration was present in three analyzed cases. For instance, during the implementation of a new business planning and consolidation solution, the preferred vendor's corresponding module was the only option evaluated, which was also due to the installed base of closely connected solutions. A former SA remembers: "*It was a no-brainer and well I remember the money talk of course, but again we did not go to alternative solutions. […] We saw a clear benefit from going with the [Vendor1] product in this case, because it was sitting on the same technology as the rest of the reporting. It was using the same structures, data objects, stuff like that. So we saw that both from an IT-side and from a business architecture side to be the right product* […] *Other companies that might have M&A, they run different ERP systems, they might look at other tools, which could offer some benefits in that connection of loading up files operated by the finance teams. […] But in our case, we do not face anything like that because we run on one platform. I think that was the primary reason why the [Vendor1] product was more or less a no-brainer in this case."*

The second case entails the implementation of a new solution for trade promotion management, in which the preferred vendor's corresponding module was selected due to the ease of integration with existing components. "*In the end it was decided to go with the industry-proven platform and the platform that linked tightly into our existing processes, meaning our ERP, our CRM and our […] planning solution. So from a technical point of view, that platform offered all of the technical integration, because it was a [Vendor1] product […] What we ended up with was a very tight coupling between our planning solution and our CRM and our [ERP] – making it really, really hard to remove from our landscape*" (EA, LEGO Group). Even though no serious budget or schedule pressures existed, the desire to provide a solution quickly did also contribute to the decision-outcome: "*The preference from the business was that they wanted to start fast and they wanted to have all their features from day one*. […] *But I don't think it was the deciding factor. The deciding factor was that in this case, we wanted to play it safe or the management wanted to play it safe*" (EA, LEGO Group). The solution that was eventually implemented did not involve any system customizations, but relied on proprietary integration and tight coupling.

(4) Principle-Driven Flexible Architecture

The fourth configuration model explains how the desire for high flexibility in a solution drives its design in the form of a highly granular and decoupled micro-service architecture. As discussed with the presentation of relevant contextual variables, the *Desired Future Flexibility* of a solution results from the corresponding business process or capability that contributes to the company's competitive advantage by being subject to continuous enhancements. In order for an enabling software solution to keep pace with these changes, its architecture needs to allow for frequent modifications of functionality. A highly granular, de-coupled architecture enables (1) the segmentation of complexity among independent subsystems, (2) the integration of externally created subsystems; and (3) the recombination of existing subsystems into new solutions. In the third research paper of this PhD project (Törmer 2018), these innovation-enabling mechanisms have been labeled as (1) modular upgradability, (2) reproduction and (3) economies of substitution respectively. Additionally, micro-service architectures are associated with further benefits, such as scalability and failover-safety.

Accordingly, the architecture principles in the LEGO Group prescribe a custom-developed, highly granular architecture in strategically differentiating business capabilities to support their requirements for innovation-readiness. The formally defined business capability model identifies these capabilities and provides the baseline for continuous discussions around their strategic importance and the corresponding desired flexibility for solution architectures. Along with the *Existence of Architecture Principles and Scorecard*, it is the *Architect Mandate Endorsed by Senior Management* that prioritizes this architecture against competing constraints, such as shortcomings of competences or business demands for a specific product.

The principle-driven development of a highly granular architecture occurred in seven of the analyzed cases. One example is the development of a new demand planning solution that should simplify the effort for business users by consolidating functionality in one single application and provide a fact-basis for data-driven decision-making. By approaching the initiative from a business capability perspective, architects and business stakeholders jointly concluded that their functional ambitions were beyond what the software market could offer: "*We pushed our business counterparts to start thinking about the capabilities they wanted to address. And then we matched that with what technology that pointed at from a higher perspective […] We are doing things that are way outside what the market is doing and the ambitions here are way above what the market is innovating for. So actually we took it all the way up to [the COO] and* *it is now agreed that this is a differentiating business area and we want to be better than the pack*" (former SA, LEGO Group).

Departing from this joint understanding and in accordance with the principles, the architects decided to custom-build an application by cultivating small-scale, micro-service-based proof of concept solution. Two distinct cloud-based development platforms served as a foundation and the resultant architecture is based on the maximum reuse of standard technology components. Nevertheless, the internal development of the solution allows architects and developers to continuously evolve the solution by reusing, exchanging, and integrating existing – as well as new – technology components.

Comparing this case to one of the previous cases in the Order-Taking Role towards Business Requirements configuration, a former SA reflects: "*And [this learning] is something we have applied in other initiatives now – the demand planning initiative is a good example, where we set the [decision] metrics very clearly upfront saying this is how we want to do the decisions. And then acknowledging that and agreeing with the business counterparts. And that has led to very, very different discussions*."

The second case exemplifying the principle-driven development of a flexible architecture was the replacement of the LEGO Group's production monitoring system, which had been highly customized over the years. Additionally, the existing system supported a range of distinct business capabilities that, according to industry standards, should be executed by separate technology components. As in the previous case, this initiative was approached from a business capability perspective to analyze how distinct capabilities should be supported from a technology perspective. "*We looked into it and, together with business, defined what are the capabilities they need. Because we will not make a one-to-one solution with the PMS. Because PMS has been evolved over 20 years and there are probably functions in there that you do not even need anymore. So we will not make a one-to-one. So we actually want to understand exactly what are the kind of capabilities you want us to solve. When business has told IT what they need of capabilities, we will go out and start building in an architecture that can solve those needs. And we were aligned on that*" (SA, LEGO Group).

Following the architecture principles, an event-driven micro-service architecture was established that relies on few standard components to provide the abstraction of machine-specific details and to enable higher-level differentiation. "*This architecture is about modularity and decoupling. […] We are building many layers in, but we are encapsulating every time everything into a service to enable us for the future change instead of building this big monolith that we have to exchange at once. […] This will enable business to say: 'Can I put in a different kind of order service, because I saw this really, really nice feature being down in the Hannover Messe?' – 'Yeah, let's look into it, because we can just put the order service in here!'*" (SA, LEGO Group).

(5) Development-Driven Flexible Architecture

As with the previous CMO configuration, the fifth model equally explains the design of a highly granular, loosely coupled micro-service architecture. In contrast to the Principle-Driven Flexible Architecture, however, this mechanism is driven by an engineering mindset of architects and developers. In the absence of architecture principles, mandate and satisfactory COTS supply of solutions to a specific business problem, these individuals equally recognize *Desired Future Flexibility* and create evolvable solutions inspired by knowledge from outside the company, software industry trends or problems that have been experienced in the past.

This phenomenon was evident in three of the analyzed cases, one of which was the establishment of the LEGO Group's big data platform. Born out of individual use cases to serve consumer engagement as well as strategic initiatives, the data engineering team sought to evolve its product centric big data engine into a platform that could be reused by the wider organization. During this time, the architecture principles were under development, but had not yet been officially approved or introduced to the organization. While one of the EAs was actively engaging with the big data team, individual engineers were designing the architecture of the to-be platform based on their own previous experience, emerging principles, best practices and trends in the industry. "*We had series of – I think it is more industry trends - some of it like you said about microservices. […] It has been a fairly evolving platform over time, so one of the core principles was the ability to adapt the platform to a new setup, […] also because everything was so* *evolving at the time, and probably still is. […] Then you would use these types of products and then suddenly something comes in and sweeps the market*” (Head of Big Data Engineering, LEGO Group).

Building on top of a cloud-based, open source big data engine, as well asseveral vendor-provided standard components, the platform consists of highly granular services, which are reused across distinct functional areas and particularly in solutions for consumer engagement. The flexible architecture allows engineers to try out new technologies or use cases based on small-scale proofs-of-concept, which then determine adoption or dismissal. Accordingly, the overall solution consists of a highly granular, loosely coupled and open architecture that was developed in parallel to architecture principles instead of being guided by them. *“We were given free hands to do this. So, architectural quality is also something we have been part of defining – where we said: ‘Ok this is what we believe to be right, and this is how we believe to move forward’. And then, actually, trying it out, doing it and then proving a point by just doing it. […] We have quite quickly learned that if you are a lead engineer, […] you are also going to have to live with your choices – and not just saying: ‘Here is a PowerPoint, go implement this.’. You are going to have to face the guys who are going to have to live with it every day – which I think encourages architectural quality by design, because you are going to have to live with it if you screw up”* (Head of Big Data Engineering, LEGO Group).

A second example case revolves around the registration of specific physical LEGO product boxes in the social network LEGO Life to assign ownership to individual consumers. “*We want[ed] to incentivize parents and kids to register their products on the LEGO Life mobile app, so when you get home with a new box, […] you scan the QR code and then you sort of link this product to yourself. So, you have a digital version of your product shelf at home. […] LEGO will of course never market or promote products to kids. It's only taking this data and then promoting to the parent segment of the children*” (SA, LEGO Group).

The underlying functionality required a backend service used by the mobile app which could verify that a scanned code did indeed belong to an actual product that had left the company's factory. From an organizational perspective, the use case entailed the cross-functional challenge of making sure that dedicated codes are printed on product boxes. From a technical perspective, the demands were fairly simple, but were complicated by pre-existing tight coupling among systems and involved the challenge of constructing a highly scalable and flexible solution. Long before the existence of the corresponding architecture direction through principles, the solution was subsequently implemented as a micro-service based, serverless architecture to enable those qualities. "*LEGO Life is really living in the agile world. You need hyper-flexibility. Whenever there is a change, they do not ask if it is possible form a technology point of view. We do the change in the app and then you have follow and that is simply not possible if we were locked into a bought system, for instance. So these [cloud-based services] are a lot more flexible and can follow on the business needs as they come*" (SA, LEGO Group).

(6) Principle-Driven Standardization and Efficiency

The previous two configuration models have been based on the assumption of high *Desired Future Flexibility* and subsequently entailed the design of solutions that would serve strategically differentiating business capabilities. This sixth CMO configuration, by contrast, explains decision-making when the solution under development will underpin a relatively stable – as well as common – business process or capability. In this case, operational efficiency is the primary design goal and, in most cases, is realized by the adoption of a standard COTS solution that is either hosted on premise or provisioned through a cloud service in the form of SaaS or Platform-as-a-Service (PaaS). In these solutions change and innovation should not originate from expensive in-house development, but rather from vendor-provided upgrades that are commonly for included in license agreements. While the in-house development cost of equivalent solutions may in some instances be (or seem) inferior to license cost, the long-term total cost of ownership is in most cases much higher – especially including maintenance or upgrade efforts.

In the LEGO Group, architecture principles therefore prescribe the adoption of standard, and preferably SaaS-based solutions for common business capabilities, which imply low *Desired Future Flexibility*. Naturally, this decision logic can only be followed if the market offers functionally and architecturally appropriate solutions (*Availability of COTS Solutions or Services on Market).* Additionally, the introduction of un-customized COTS solutions requires the adoption of standard business practices, which some business stakeholders may dismiss in favor of existing ways of working. Therefore, the establishment of the *Architect Mandate Endorsed by Senior Management* was a crucial pre-condition for architects to be able to prioritize the principles' direction over competing preferences. The SaaS delivery model by itself encourages the vanilla (i.e. un-customized) adoption of licensed applications, since the client company does not commonly have access to the source code and changes need to be implemented subsequently by the provider company.

Despite the overall goal of ensuring operational efficiency through standard solutions, the solution's innovation-readiness is not limited, but rather is split between the solution vendor and the client company. If the client company does not require solution customization and integration is implemented based on clearly defined, loosely coupled interfaces, the solution's vendor enjoys full flexibility within the implemented component. At the same time, the client company benefits from innovation-enabling flexibility around the solution based on the ability to reuse data and functionality in the composition of other solutions. These phenomena are captured in the third research paper by the phenomena of modular upgradability and economies of substitution (Törmer 2018). Consequently, the architecture outcome of this configuration model is characterized by loose coupling, open connectivity and no customization.

In the LEGO Group, this configuration was present in eleven of the analyzed cases. The first example involves the implementation of a new procurement platform, which should consolidate vendors, remove pain points and inefficiencies during procurement processes and centralize them in one central system. Starting with the assumption that procurement is not a strategically differentiating business capability for the LEGO Group, architects strived for the implementation of a standard COTS solution as called out by the principles. Equally, business stakeholders had over the years come to the realization of the inefficiencies and pain points, which high degrees of customization had caused for them. "*We want to jump on the innovation that our dear software vendor is doing. Because for them, for the software vendor innovation and making new features available is part of the core business, instead of thinking about what kind of improvements and innovations can we at LEGO think of ourselves that we want. So they also want to be inspired by the vendor*" (EA, LEGO Group).

Based on a broad market investigation, two candidate vendors were shortlisted and investigated through extensive functional and technical workshops. As both vendors lived up to architectural quality, the decision for one of them was eventually made based on slight business preferences as well as commercial terms. "*We used the principles and […] the architecture success scorecard to figure out how do we believe those solutions compare to each other.* […] *Even though they were built for the cloud and are software-as-a-service solutions, that doesn't mean that they are the same. So they had different architectures […], but they both comply with our technology principles. So there is no reason to push in one or the other direction. […] In the end the selection has been more a commercial/business decision […], because both solutions live up to our principles*" (EA LEGO Group). Accordingly, the SaaS-based procurement platform was integrated as an in itself monolithic component into the LEGO Group's IS landscape by connecting to its open APIs via loosely coupled integrations.

The second example case deals with a SaaS-based content management solution in the marketing area that provides an intermediary towards online retailers and feeds content in the form of digital assets or descriptions into their webshops. As retailers provide standard APIs for the submission of content in a very specific format, the product's value proposition is to eliminate client company's internal need to keep up with changing formats and interfaces by providing one stable repository, which feeds distinct retail partners. "*The main reason for buying [Vendor2] was getting a platform that takes care of the changes on the webshop side. So as long as we can provide our data in a stringent format, then we are covered from the changes on the other side*" (SA, LEGO Group).

After the specific product was selected by business stakeholders based on functional requirements, the architects ensured its separate evolvability through decoupled integrations. "*I strongly believe that that was the right way and also having the principles saying that we can use cloud, that was a key thing for me. I'm pretty sure I would have not gone down the track of cloud, if it was not in the principles. [,,,] We have not modified the SaaS solution. We are just utilizing the hooks that have been given"* (SA, LEGO Group). In addition to the principles, specifically senior management's endorsement for architecture quality was a decisive factor for the architect: "*One thing is a guideline from a certain department. But if it has not been signed off on a certain level, then it would not have been the case*."

Chapter 7: Discussion

The thesis set out to answer the following research question: *How do companies create innovation-ready IS landscape architectures?* To address this question, the analysis chapter has devised six CMO configurations (Pawson et al. 1997) explaining the decision-making logic involved in individual points of architecting (Figure 13). The explanation of the underlying structures impacting solution architecture outcomes allows for an understanding of which specific contextual factors drive the behavior of Situational Architects while making modifications to a company's overall IS landscape architecture. Additionally, the analysis reveals which decision mechanisms drive the development of innovation-ready outcome architectures and which ones result in innovation-constraining solution designs. These findings provide a mid-range explanatory configuration theory of mechanisms through which innovation-ready architecture is created. Figure 15 depicts how the analysis conceptually relates to the four published research papers.

In the following, the analytical delimitation to single-mechanisms explanations will be discussed, followed by a minor revisit of the case evidence to touch upon interaction effects among them. Subsequently, the findings developed in the pervasive analysis are synthesized with research results from the four published papers to spell out their coherent relationship. Afterwards, the research contributions are placed within the existing state of the knowledge base by revealing implications for academia as well as practice. Before moving to the conclusion of the thesis, generalizability is evaluated along with limitations as well as validity threats.

Interactions among Mechanisms

The analysis chapter of this thesis has focused on the identification of one dominant mechanism in each CMO configuration that is actualized by contemporary contextual conditions and leads to the associated outcome. While this analytical delimitation to a single mechanism per configuration has been a conscious choice made during the elaboration of the research framework, the assumption admittedly implies a certain amount of abstraction that simplifies the phenomenon of interest. The level of abstraction implies a risk of overlooking the interaction between potentially more fine-grained mechanisms. Nevertheless, this decision enabled the rigorous qualitative analysis of the architecting phenomenon and the focus on dominant causal structures shaping the decision outcome. Despite being limited to a single mechanism each, the author argues that the explanatory potential of the presented CMO configurations is already substantial. At the same time between case comparisons allow for a clear distinction between separate mechanisms, while equally discussing their interactions.

Indeed, the case evidence equally reveals that most individual points of architecting are not shaped by just one single mechanism but entail the interaction of several ones. For instance, Vendor-Driven Tight Coupling is primarily driven by the ease of integration among new and existing solutions that each form part of a software suite. At the same time, the available competences in the LEGO Group had for years been built up to support an IS landscape consisting to a large degree of a preferred vendor’s technology setup. As a result, the availability of competences reinforced the architecture choices, which had foremost been made based on the ease of integration. Hence, Vendor-Driven Tight Coupling is in these case instances the dominant mechanism determining the architecture outcome but Sticking to Available Competences has been equally at play in a reinforcing function.

Equally, strong similarities exist between the Principle-Driven and Development-Driven Flexible Architecture configurations. Whereas both entail the desire for high flexibility in the future, the former one is based on the availability of principles as well as mandate and the latter relies on an engineering approach to architecture in development. As a logical consequence, both mechanisms may be at play in the same situation which was the case in the presented design decision on the production monitoring system replacement in the LEGO Group.

Certainly, distinct CMO configurations will also interact in opposing modes of operation during individual points of architecting. Specifically if the environmental conditions in an organization provide the contextual basis for the actualization of distinct innovation-enabling as well as -constraining mechanisms at the same time, opposing forces may be created that will complicate architecture decision-making. These opposing interactions were present in several cases analyzed in the previous section. For instance, the consumer service case's outcome was dominantly shaped by Sticking to Available Competences, but equally entailed the effect of Principle-Driven Flexible Architecture. In the end, the former mechanism simply triumphed over the latter one due to absence of competences and the presence of moderate schedule constraints.

The interaction effects between the Order-Taking Role towards Business Requirements and Sticking to Available Competences may play out in a mutually reinforcing or opposing function – depending on the nature of collaboration between business and IT stakeholders. In the absence of architecture principles, if technologies or requirements prioritized by business stakeholders fit well with available competences, the two mechanisms will reinforce each other. On the other hand, they may equally take opposing effects, if architects aim for the application of existing competences and business stakeholders insist on technologies or requirements that do not fit them. The former was true in the presented case on the technical upgrade of a plant maintenance system. On the one hand, business stakeholders insisted on a one-to-one replacement of the system objecting architects' decision to create a more modern architecture. On the other hand, shortcomings in technical competences prevented the implementation of a modern architecture that could meet performance requirements set out by business stakeholders. Accordingly, the two mechanisms were reinforcing each other and preventing the implementation of a quality architecture. In the other presented case, the technologies chosen by business stakeholders did not fit existing competences in the organization, leaving the second mechanism unactualized.

Synthesis of Findings

The previous discussion only scratches on the surface of interacting effects among distinct mechanisms. Nevertheless, the exemplary cases underline the magnitude of the socio-technical challenges involved in intentional interventions by EAs aiming for change in existing decision-making patterns to guide a company's holistic IS landscape architecture into an intended direction. The same challenge has been addressed by this PhD project's second published research paper (Törmer and Henningsson 2018). The study conceptualizes the LEGO Group's pre-existing IS landscape as a drifting corporate II and reveals how its future trajectory is limited by socio-technical path dependence on existing technology components as well as organizational competences. Departing from these constraints, the analysis portraits the platformization of an II as a process of path constitution, which is triggered by EAs' mindful deviations from existing relevance structures in order to guide collective action.

Based on additional case evidence and a profound analysis of individual points of architecting, this manuscript substantiates the claim made in the second research paper from a distinct and broader theoretical perspective. The three innovation-constraining CMO configurations presented here are the basis of the path-dependent, drifting corporate II conceptualized in the second paper. The three innovation-enabling ones, on the other hand, underpin the constitution of a platformization path. Specifically Figure 14 illustrates a shift in architecture decision-making that substantiates the path constitution perspective. Accordingly, the second research publication and the analysis presented in this document study very similar phenomena from distinct theoretical perspectives. Notably, the configuration perspective adds explanatory power to the process model developed in the second research paper by including a broader set of influencing contextual variables, for instance *Presence of Relevant Technical Competences in Organization*. Moreover, the CMO configurations reveal in detail how individual design decisions are impacted by contextual factors, which may be altered or introduced by EAs to change the relevant decision context. Therefore, the configuration theory caters to the increasingly emergent and de-centralized nature of the architecting phenomenon.

For the conceptual definition of an innovation-ready architecture and the distinction between innovation-enabling as well as -constraining configurations, the findings of this PhD project's third published research paper (Törmer 2018) have been adopted. The generative mechanisms of digital innovation developed in the paper conceptualize the phenomena that characterize an innovation-ready architecture. The fourth published research paper (Törmer and Henningsson 2020), on the other hand, reveals how this target state enables specific business benefits during a company's internationalization journey. Accordingly, the two publications serves as an illustration of the desired future mechanisms that individual points of architecting are seeking to enable. The analysis in the previous chapter, on the other hand, grasps how the underlying decision-making logic may enable or prevent a company from reaching this state.

As a consequence, the findings allow for inferences regarding the interventions conducted by EAs which bring about change in a company's existing practice of architecting to guide the existing IS landscape architecture towards a more innovation-ready state. Based on the analysis conducted in the previous chapter, the most apparent interventions are (1) the development of architecture principles and a corresponding scorecard, (2) the establishment of architects' mandate endorsed by senior management, (3) the dissemination of strategic workforce recommendations towards leaders in functional areas to avoid the absence of relevant technical competences, and (4) the articulation of targeted desired future flexibility – for instance, through the use of a business capability model. Whereas the former two interventions are equally proclaimed in the second research paper to trigger the platformization process, the latter ones are added by the configuration theory.

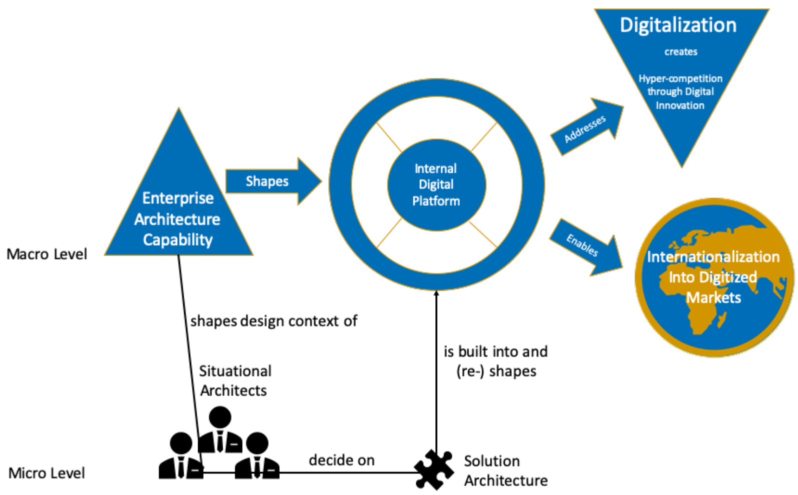

Figure 15: Conceptual Coherence between Individual Research Papers and Pervasive Analysis

Due to the theoretical focus of the analysis, however, these interventions are limited to the specific ones that alter the decision context of Situational Architects. In addition, the first and the second research paper of this PhD project reveal additional EA interventions that are vital for the establishment and operation of a sustainable EA function. Specifically the first research paper (Törmer and Henningsson 2019) investigates the prospective establishment and advancement of the LEGO Group's EA capability. The artefacts and organizational changes mentioned here form fundamental pillars of the capability's value add. Nevertheless, they represent only the tangible and solution-facing outcomes resulting from a significantly broader range of required preparation and learning activities. Specifically strategic interventions targeting senior management stakeholders, which are more evident in the first research paper, embody a vital part of an EA capability's long-term success, but are omitted in this perspective. These activities include, for instance, architecture documentation, technology strategy development, technology incubation, technology investment recommendations or the creation of transparency around complex technology issues to provide a basis for strategic decision-making. Taking distinct theoretical perspectives into consideration, the thesis investigates this dual focus between solution-facing interventions and executive-directed strategic activities. Therefore, the theoretical insights underpin what Hohpe (2016) terms the *architect elevator*, which connects an organization's penthouse with the engine room. Additionally, the first research paper identifies a dual focus between prospective preparation activities as well as reflective learning that in conjunction contribute to the capability's enhancement and the ability for interventions targeting both directions.

Contributions

This PhD thesis provides explanatory theoretical insights that jointly elucidate how companies create innovation-ready IS landscape architectures. By drawing on a rich pool of concrete empirical data, the analysis unifies social, technical and managerial perspectives on architecting to zoom in on the socio-technical mechanisms that shape this process. The resultant mid-range configuration theory provides a conceptual understanding of the architecting phenomenon that has so far been missing in the IS literature. Additionally, the findings allow for inferences regarding how the incumbent practices in an organization may be altered through interventions by EAs or technology managers. By doing so, the thesis integrates existing knowledge on IS evolvability as well as EA and extends the body of knowledge with novel insights.

The theoretical analysis presented in this manuscript cuts across the units of analysis investigated during the project's four published papers. For that purpose, previous theoretical findings and existing as well as novel case evidence have been scrutinized. Nevertheless, each individual research paper provides a theoretical contribution on its own that goes beyond the findings of this overarching, pervasive analysis.

The first published research paper (Törmer and Henningsson 2019) places the EA discipline into the context of the strategic management literature by conceptualizing the discipline as a dynamic capability. The study contributes to the IS as well as strategic management literature by providing a mid-range variance theory, which explains how companies build dynamic capabilities not only through backward looking, reflective learning, but also through prospective, forward-looking activities. These two modes of capability improvement lead to an inherent tension between learning and performing. Additionally, the findings portray EA as a company's orchestrating body for the continuous reconfiguration of technology-enabled business capabilities in response to turbulent digital environments.

The second published research paper (Törmer and Henningsson 2018) acknowledges Ciborra's (2000) argument that the lack of formative control is a prevailing characteristic of corporate IIs due to socio-technical path dependencies on the installed base of technologies in the organization. Against these drawbacks, however, the paper advances a path constitution perspective on the platformization of a corporate II and emphasizes the potential for active influence of human agents on the infrastructure's development trajectory. This influence is exercised through mindful deviations by architects who introduce a previously absent design framework, engage in boundary-spanning communication, and co-evolve minds with ideas to constitute a new platformization path towards a more flexible future state. The path constitution perspective is captured in a mid-range process theory that underlines the importance of human agency during the process of architecting and unifies the quest for formative control with the increasingly emergent nature of architecture.

The third published research paper (Törmer 2018) defines an innovation-ready or evolvable architecture on company-level by introducing a rigorous conceptualization of an internal digital platform that unifies the prevalence of traditional enterprise systems with modern SMACIT technologies. Against this backdrop, the study provides three generative mechanisms through which an internal platform enables speed and efficiency of digital innovation. Additionally, the analysis yields insights into their interaction as well as associated managerial trade-offs. The resultant system theoretic model contributes specifically to the research stream on IS evolvability that was started by Agarwal and Tiwana (2015).

Finally, the fourth research contribution (Törmer 2019; Törmer and Henningsson 2020) provides a practitioner-oriented theoretical model that explains how IS landscape architecture underpins a company's internationalization capability. The model entails three specific mechanisms through which a platformized IS landscape enables a company to overcome distinct forms of distance while venturing into new markets. Additionally, the paper derives practical guidance to technology managers by elaborating on lessons learned in relation to the theoretical insights.

Each of the four published papers zooms in on a specific unit of analysis within the overall chain of reasoning. In sum, the collection of contributions provides theoretical explanations for (1) how a company's internal digital platform – i.e. a platformized IS landscape – enables rapid and efficient digital innovation as well as internationalization in response to competition in the market; (2) how the EA capability is orchestrating the transformation of an IS landscape towards such a platform; and (3) how companies can get started on the journey by establishing and advancing this orchestrating capability. Eventually, the theoretical contribution made in this manuscript underpins and synthesizes these claims by providing a mid-range explanatory theory. This theory unifies all previous insights and reveals how each of the investigated phenomena plays a critical role during the core process of architecting.

Implications for Academia

The implications for academia are two-fold. On the one hand, the theoretical contributions made in this PhD project challenge and extend existing research. On the other hand, the novel insights also point towards fruitful ground for novel research that may be interesting to explore from an academic perspective.

Because the core theoretical contribution is constituted by the conceptual explanatory understanding of the architecting phenomenon, the research findings primarily impact the knowledge base of the IS field. Most importantly, the findings extend previous research on EA and architecting by addressing the increasingly emergent nature of IS landscape architectures. Previous research had mainly assumed a top down, formative approach to EA management (Kaisler et al. 2005; Ross et al. 2006, 2014) which also indicates that the architecture phenomenon is changing in nature. As expressed by Yoo et al. (2012, p. 1401), the "locus of innovation activities is increasingly moving towards the periphery of organizations" implying a need for more federated decision-making – also in terms of architecture. As opposed to large-scale implementation projects of monolithic enterprise systems, companies rely increasingly on agile development, customer-focused experimentation with software solutions, development platforms, and dedicated point solutions (Ross et al. 2019). This trend complicates centralized, top-down decision-making and requires an approach to architecture management that acknowledges and endorses emergent forces, while equally feeding strategic directions into the design process. The theoretical findings advanced by this thesis provide a conceptual understanding of the phenomena underpinning this challenge and offer diverse perspectives on how it can be addressed.

At the same time, the findings complement existing research contributions that have studied the architecture challenge from an IT governance perspective (Boh and Yellin 2006; Gregory et al. 2018). Specifically Gregory et al. (2018) find that the reuse of IT assets across functional departments leads to the adoption of platform architecture-based governance mechanisms in large incumbent organizations. They call out the need for future research on the associated "fundamental changes in other elements of the firm's deep structure, such as the organizing parts and activity patterns connecting various business and IT stakeholders" (Gregory et al. 2018, p.1249). The findings presented here address this gap by revealing the mechanisms at play during the design of solution architectures that bring together stakeholders from business and IT. The CMO configurations reveal that this interactive decision-making is not only shaped by architects' mandate within the company's governance framework, but equally importantly by a proactive architecture direction, commercial considerations, and competences within the organizations.

Moreover, the research results are closely related to Rolland et al.'s (2018) investigation of the interplay between digital options and digital debt in the management of external industry platforms in connection to a client company's own digital infrastructure. They maintain a conceptual separation between vendor-provided platforms as well as a company's own IS landscape and recommend the mindful management of architectural considerations relating to external platforms. In contrast, the concept of an internal digital platform advanced in this thesis conceives vendor-provided platforms as an integral part of the client company's IS landscape. This raises the potential for conflicting design hierarchies or architecture frameworks between the vendor's product platform and the client company's internal platform. These conflicts are discussed in the third published research paper of this PhD thesis and are particularly evident in the CMO configuration of Vendor-Driven Tight Coupling. Extending the findings by Rolland et al. (2018), the CMO configurations developed in this manuscript explain how architects engage in the mindful management of external platforms in order to ensure the innovation-readiness of the client company's IS landscape architecture.

Eventually, the adoption of the technological engineering platform perspective to conceptualize a company's internal IS landscape extends the platform stream of the IS literature, which has so far largely focused on multi-sided platforms (Baldwin and Woodard 2008; Eaton et al. 2015; Eisenmann et al. 2009; Gawer 2014). However, a platform perspective on internal IS landscapes is relevant, since conflicting design hierarchies encapsulated by vendor-provided product platforms may limit a client company's IS evolvability (Agarwal and Tiwana 2015; Rolland et al. 2018). At the same time, Gregory et al. (2018) unveil that the consumerization of IT equally entails platform-based governance mechanisms within organizations. Therefore, the technological platform concept may serve as a relevant lens for future studies investigating how companies achieve IS evolvability or competitiveness in the digital space.

Having placed the theoretical findings in the context of existing academic research, the subsequent potential for future research uncovered by this study becomes apparent. For one, the configuration theory developed here presents six mechanisms of architecting that are revealed in isolation but certainly interact in the creation of architecture outcomes. The interactions during individual design decisions have been discussed on a superficial level, but a more in-depth analysis of this interaction is necessary. This investigation should also explore the decisive contingencies that enable one mechanism to prevail over another within a specific context. Insights into these phenomena would strengthen the theoretical understanding of architecting and allow for the inference of more effective EA interventions to change existing practices. At the same time, a quantitative approach to configuration theory potentially applying Qualitative Comparative Analysis could investigate the phenomenon in the context of a wider population of organizations or cases of architecting.

Within the broader theme of architecting, the previous discussion has touched upon the changing nature of the EA function's challenges which requires architects to enable more emergent, federated decision-making, while equally feeding strategic directions into the process. In addition to the theoretical insights produced by this thesis, more explanatory work is necessary that should grasp the underlying socio-technical phenomena at play. Specifically the phenomenon of architecture governance in agile ways of working within large organizations is currently underexplored. Also, the case evidence and CMO configurations spell out the fact that EAs themselves are seldomly the individuals making specific design decisions. This observation underlines the importance of 'soft' skills in EA management that enable effective change management, the co-evolution of minds and ideas, or the persuasion of relevant stakeholders. As existing research in this area has exclusively taken a socio-technical perspective with an emphasis on strategic or technical aspects, the purely social side has not been addressed thus far.

The adoption of the platform concept for the conceptualization of a company's internal IS landscape additionally leads to new research questions that in the authors view would be relevant to investigate. Particularly the comparison between company-internal and multi-sided platforms may lead to fruitful novel insights that would enable a better understanding of both phenomena. For instance, the three generative mechanisms of digital platform innovation developed in the third research paper are not limited to a company's internal context and may play out similarly or differently in a multi-sided setup.

The IS research community has so far investigated platform competition primarily in terms of multi-sided platforms that make profit by offering spare capacity in a company or the economy to other market participants (Parker et al. 2016). On the one hand, the ability to do so requires an enabling architectural setup that companies need to establish internally first. On the other hand, companies nowadays equally apply an ecosystem perspective to their consumer-facing innovation platforms where similar competition strategies (including lock-in and network effects) are applied in the quest for data collection and cross-selling opportunities. These phenomena will be interesting to investigate from a platform perspective inspired from distinct academic fields, such as IS, marketing, and strategic management.

Euqally, the bottom-line benefits from an internal digital platform – i.e. a platformized IS landscape – should be investigated more thoroughly. The third and fourth research paper of this thesis provide qualitative evidence supporting the existence of business benefits related to internationalization as well as the speed and efficiency of digital innovation. In addition, more concrete and potentially quantitative evidence from future studies could complement these claims and thereby also contribute to the traditional discussion surrounding the true value added by an EA capability.

Finally, the first research contribution places the EA capability as a dynamic capability into the context of strategic management research and identifies opposing forces between learning and performing that need to be managed carefully for the function to succeed. The further investigation of this tension between learning and performing, specifically in the context of distinct instances of dynamic capabilities, constitutes fruitful ground for future research.

Implications for Practice

The rich empirical evidence and theoretical findings presented in this PhD thesis provide a multitude of insights that IS practitioners from distinct hierarchy levels can draw on.

From an executive perspective, the findings should emphasize that the platformization of a company's IS landscape is an investment into future technology-enabled business flexibility. Particularly as competition in the digital space accelerates and primarily physical value propositions are equally affected, this flexibility is a crucial factor for business success in the long run. It is important to understand that, as business capabilities are increasingly enabled by as well as engrained in technological systems, the holistic management of distinct architectural layers becomes a critical challenge in the quest for flexibility, security, and competitiveness in the market. In this context, the EA capability as a dynamic capability fulfills the central role of an orchestrating function for the continuous reconfiguration of a company's resources, capabilities and value propositions in adaptation to changing market conditions.

From an architect's perspective (EA or SA), the insights offered in this thesis provide concrete practical guidance as well as mental models that should guide practitioners embarking on a similar journey. For one, the first research paper's contributions reveal how an EA capability can be built through prospective as well as reflective activities to prepare for an unknown future. Specifically the revealed tension between performance in the present and preparation activities for the future point towards a critical challenge that EAs need to master. Equally, the paper reveals solution approaches through splitting and synergistic integration between activities.

The third and fourth research papers provide illustrations of the characteristics and mechanisms that constitute an innovation-ready architecture. The findings offer concrete guidance for EAs and SAs in terms of the architecture or specific mechanisms that individual design decisions should strive to enable in the future. Simultaneously, the mechanisms point towards a strategic choice of modularity that architects face when designing individual solutions. This choice is grounded in the two options to design individual solutions with an emphasis on either efficiency or speed of digital innovation. The former commonly comprises the adoption of a vendor-provided COTS solution, whereas the latter is realized through the in-house development of a micro-service architecture that affords flexibility for frequent changes in the future. This choice should be made based on the strategic importance of the associated business capability.

Furthermore, the third research paper reveals that the modular upgradability of COTS systems is limited by the implementation of customizations after purchase. In order to allow for the seamless installation of vendor-provided upgrades, COTS systems should be adopted as 'clean' as possible. Simultaneously, the reuse of data and functionality should be ensured by the integration into the client company's IS landscape via decoupled, open interfaces. These design decisions may be complicated by a vendor's product platform that adheres to a proprietary design framework aiming for lock-in. Following the vendor's design framework may undermine the innovation-readiness of the company's internal IS landscape architecture by limiting the innovation mechanisms identified in the third paper.

Finally, the second research paper – and the findings presented in this manuscript – provide mental models that stress the significance of human agency in the practice of architecting. For practitioners, they additionally point towards specific interventions that may be conducted from an EA perspective to change architecture decision-making in a company: (1) the development of architecture principles; (2) the establishment of an architect mandate to prioritize architecture quality over competing demands; (3) the establishment of relevant technical competences in the wider organization; and (4) the articulation of desired future flexibility in individual business areas through a business capability model.

Generalizability and Limitations of Research

Naturally, this PhD project is subject to several limitations. On an overarching level, the theoretical contributions are based on case evidence from a single company which may call external validity into question. Nonetheless, Dubé and Paré's (2003) argument is borrowed to claim that a single-case design is suitable to produce significant research findings, if the inquiry investigates a rare phenomenon in a particularly fine-grained level of detail.

To evaluate the generalizability of the research findings to a wider population of organizations or the specific practitioner context of a single organization, Lee and Baskerville's (2003) four judgement calls should be applied. While the '*uniformity of nature*' judgement call remains a question of faith, '*sufficient similarity in relevant conditions*' depends on the specific new setting. In this context, the high maturity of the LEGO Group's pre-existing IS landscape in terms of business process standardization and integration is an important consideration. In the beginning of the platformization journey, the company's IS landscape already consisted of largely non-redundant systems supporting each functional area – including a one instance ERP system. Most companies in the world are not in such a fortunate situation and may for that reason primarily aim for an efficient architecture through standardization and integration (Ross et al. 2006). The theoretical explanations and implications for practice developed in this thesis may equally apply to a company supported by a less consolidated IS landscape. Nevertheless, the similarity in relevant conditions needs to be assessed carefully.

The '*successful identification of relevant variables*' judgement call may pose the most significant threat to external validity – specifically in the selectionist evolutionary epistemology proclaimed by critical realism. Nevertheless, in the pervasive analysis presented in this manuscript, the adoption of a configurational perspective on architecting specifically aimed for the identification of all relevant variables that impact architecture decisions. Thereby, the analysis also sought to address validity threats of the second research paper, which did not investigate on other factors that could explain the constitution of a new platformization path. Eventually, the '*theory is true*' judgement call may never be answered conclusively. Adopting critical realism's evolutionary epistemology, however, the goal is to advance an adequately robust theory, which in the author's view captures the essence of the studied phenomenon, and leave its empirical examination to future research and application in practice.

On a more detailed level, the individual contributions exhibit more specific limitations. For one, the pervasive analysis and findings presented in this manuscript are based on a configurational perspective, which has been criticized for its lack of determinism and subsequent difficulties for validation.

Moreover, despite the broad analysis of 29 individual cases of architecting, full exhaustiveness of architecture decisions occurring in the LEGO Group over the covered timespan cannot be claimed. On the one hand, the author captured all points of architecting that came to the attention and responsibility of the EA function through architecture forums, technology strategy execution or personal contact. On the other hand, architecture design decisions made in the company's consumer facing marketing and product development departments have only been captured in single instances. Additionally, shadow IT as well as solutions implemented under the EA function's radar may not have been covered neither. Accordingly, no claims in terms of completeness can be made.

Admittedly, the adopted outcome variables reduce the very complex phenomenon of an architecture outcome to four categorial variables and may therefore expose the greatest risk of missing relevant additional ones. Nevertheless, these variables have been based on a thorough review of the IS evolvability literature and the previous empirical study of innovation-enabling mechanisms. Equally, the focus on a single mechanism per CMO configuration introduces delimitations that have been pointed out during the discussion. Along those lines, the author has argued for the explanatory value provided by these configurations. Naturally, a deeper analysis of the interaction effects among individual mechanisms would be fascinating subject for future research.

Moving on to the individual research papers, the case evidence underpinning the fourth research paper – which develops the mechanisms through which platformization enables internationalization – is largely based on data covering the absence of platformization in the past. This evidence reveals the specific challenges that the LEGO Group's unplatformized IS landscape has produced during the previous China journey. More evidence will be necessary to show how the investments into platformization enable future internationalization activities. Nevertheless, the paper takes an insider's view on platformization in the present and future research will address the significance of these interventions for the eventual internationalization journey

Equally, the case evidence underpinning the third research paper only reveals how the generative mechanisms of digital platform innovation took effect in siloed parts of the LEGO Group's IS landscape. Moreover, the data and analysis spell out how the lack of modular platform architecture hinders them on a global scale. The investigation of a more mature internal digital platform should complement these insights to provide further support for the mechanisms. Additionally, the mechanisms are identified based on observable events and the portrayal of experiences by key informants. Even though the evidence and analysis leverage concrete examples for the mechanisms' effects, inferences are established at an admittedly high level of abstraction. Consequently, no conclusions can be drawn on the exhaustiveness of the three mechanisms and future research applying critical realism for the investigation of coexisting mechanisms would be expedient.

Thirdly, the first research contribution investigates the development of a specific dynamic capability to derive findings on the wider class of dynamic capabilities. Although the generalization is supported by theoretical arguments, more evidence is needed from distinct types of dynamic capabilities to warrant external validity of the findings. Also, the quality and performance measures adopted for dynamic capabilities – technical and evolutionary fitness – are highly conceptual and difficult to quantify. Even though the case evidence clearly indicates an increase in the EA capability's quality and performance, these measures are admittedly vague and reliant on stakeholder opinions. Nevertheless, the focus of this study lies on decisions, actions, and activities involved in capability-building instead of its precise performance measures.

Chapter 8: Conclusion

Based on four individual, in-depth explanatory theoretical contributions, as well as the overarching pervasive analysis presented here, this PhD thesis yields an explanatory theory for how companies create innovation-ready architectures. Simultaneously, the findings elucidate how an innovation-ready platform architecture enables digital innovation within a company as well as geographical expansion into new market regions.

The core contribution is made in the form of a mid-range configuration theory that conceptualizes the architecting phenomenon and explains how distinct architecture decision-making mechanisms and subsequent outcomes are actualized by contextual factors. By differentiating between innovation-enabling as well as -constraining architecture outcomes, the impact of individual design decisions on a company's overall IS landscape architecture and evolvability becomes apparent. At the same time, the theoretical explanations allow for inferences regarding potential interventions by EAs who guide a company's overall IS landscape architecture into an intended trajectory.

The findings portray an innovation-ready architecture as a strategic foundation for the digital age and place the EA discipline into the context of strategic management by emphasizing the capability's orchestration function during the continuous process of digital transformation. Finally, the theoretical contributions are underpinned by rich case evidence, which does not only serve theoretical analysis, but also aims to entertain with an in-depth as well as informative narrative.

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Appendix

Appendix 1: Interviews

Interview Theme	Date	Interviewee	Length (hh:mm)
EA Capability Building	13.07.2017	Senior EA (1)	01:23
	01.09.2017	Head of EA	00:45
	06.09.2017	Head of Technology & Security	00:54
	06.09.2017	Vice President for Engagement Technologies and Analytics	00:27
	07.09.2017	Principal EA	01:14
	03.10.2017	Head of EA	01:10
	16.11.2018	Principal EA	01:15
	17.09.2018	Senior Solution Architect (2)	00:37
	15.11.2018	Head of EA	00:56
	10.12.2018	Senior Solution Architect (1)	Not recorded. Interview lasted approx. 60 mins
	04.07.2019	Chief Information Officer (CIO)	01:18
IS Landscape Architecture & Platformization	27.10.2017	Principal EA	01:13
	08.03.2018	Senior Solution Architect (2)	01:04
	19.04.2018	EA Director (3)	01:11
	23.04.2018	Principal EA	01:05
	23.04.2018	Senior Solution Architect (5)	Not recorded. Interview lasted approx. 60 mins
	24.04.2018	Director for Consumer Marketing Platforms	47:07
	24.04.2018	Head of Big Data Platform Engineering	00:34
	10.12.2018	Senior EA (2)	00:42
	05.07.2019	EA Director (2)	00:46
	09.07.2019	Senior EA (2)	00:52
	16.10.2019	Director for Integration and Database	00:52
Technology Strategy Development Process	01.07.2019	Senior Solution Architect (1)	00:51
	09.07.2019	Principal EA	01:02
	25.07.2019	EA Director (3)	59:26
	06.08.2019	Vice President for Manufacturing and Supply Chain Technologies	57:45
	26.08.2019	Program Director for Strategy and Transformation	00:50
Internationalization Journey	03.04.2019	EA Director (3)	00:54
	03.04.2019	Senior EA (1)	00:44
	15.07.2019	Vice President, Finance Business Partner for Chief Operating Officer	01:17

Interview Theme	Date	Interviewee	Length (hh:mm)
Individual Points of Architecting	31.10.2019	EA Director (3)	00:26
	04.11.2019	Senior Solution Architect (1)	00:29
	06.11.2019	EA Director (4)	00:24
	06.11.2019	Senior Solution Architect (5)	00:25
	06.11.2019	Senior Solution Architect (6)	Not recorded. Interview lasted approx. 60 mins
	01.11.2019	Senior Solution Architect (6)	Not recorded. Interview lasted approx. 30 mins
	14.11.2019	EA Director (4)	00:47
	14.11.2019	Principal EA	01:19
	15.11.2019	Senior Solution Architect (7)	00:20
	18.11.2019	Product Owner	00:27
	18.11.2019	Senior Solution Architect (5)	00:23
	19.11.2019	Senior Solution Architect (4)	00:21
	21.11.2019	Director Product Owner for Maintenance	00:49
	22.11.2019	Director for Technology Incubation	00:32
	25.11.2019	Senior IT Consultant	00:23
	25.11.2019	EA Director (5)	00:55
	28.11.2019	EA Director (5)	00:41
	28.11.2019	Senior Solution Architect (1)	Not recorded. Interview lasted approx. 60 mins
	29.11.2019	EA Director (3)	00:29
	29.11.2019	Senior Solution Architect (3)	00:34
	29.11.2019	Senior Solution Architect (3)	00:54
	03.12.2019	Senior Product Manager	00:26
	03.12.2019	Application Architect	00:23
	03.12.2019	Senior Solution Architect (4)	00:18
	03.12.2019	EA Director (3)	00:30
	03.12.2019	Senior Solution Architect (4)	00:18
	04.12.2019	EA Director (5)	00:33
	06.12.2019	EA Director (2)	00:28
	06.12.2019	Head of Big Data Platform Engineering	00:33
	09.12.2019	Senior IT Consultant	00:38

Appendix 2: Configurational Analysis Table

Business Capabilities grouped by CMO Configurations	Contextual Variables: Urgent Budget or Schedule Constraints	Existence of Architecture Principles and Scorecard	*Desired Future Flexibility*	Availability of COTS Solutions or Services on Market	Prensence of Relevant Technical Competences in Organization	Architect Mandate Endorsed by Senior Management	Architecture Outcome: Connectivity	Coupling	Granularity	Customization
Principle-Driven, Flexible Architecture										
Data Endpoints & User Experience	No	Yes	High	No	No	Yes	Open	Loose	High	No
Digital Asset Management	No	Yes	High	No	No	Yes	Open	Loose	High	No
Inventory Management & Order Fulfillment	No	Yes	High	No	No	Yes	Open	Loose	High	No
Shopper and Consumer Engagement	No	Yes	High	No	Yes	Yes	Open	Loose	High	No
Production Monitoring	No	Yes	High	No	No	Yes	Open	Loose	High	No
Trade Promotion Management	No	Yes	High	No	No	Yes	Open	Loose	High	No
Demand Planning	No	Yes	High	No	No	Yes	Open	Loose	High	No
Engineering-Driven Flexible Architecture										
Big Data Analytics	No	No	High	No	Yes	No	Open	Loose	High	No
eCommerce	No	No	High	No	No	No	Open	Loose	High	No
Shopper and Consumer Engagement	No	No	High	No	No	No	Open	Loose	High	No
Principle-Driven Standardization and Efficiency										
Loyalty Scheme	No	Yes	Low	Yes	No	Yes	Open	Loose	Low	No
Payment Processing	No	Yes	Low	Yes	No	Yes	Open	Loose	Low	No
Procurement	No	Yes	Low	Yes	No	Yes	Open	Loose	Low	No
Human Resources	No	Yes	Low	Yes	Yes	Yes	Open	Loose	Low	No
Enterprise Architecture	No	Yes	Low	Yes	No	Yes	Open	Loose	Low	No
Geographical Expansion	No	Yes	Low	Yes	No	Yes	Open	Loose	Low	No
Robotic Process Automation	No	Yes	Low	Yes	No	Yes	Open	Loose	Low	No
Product Content Management	No	Yes	Low	Yes	No	No	Open	Loose	Low	No
Quality Management	No	Yes	Low	Yes	No	Yes	Open	Loose	Low	No
Information Technology Service Management	No	Yes	Low	Yes	No	Yes	Open	Loose	Low	No
Tax Reporting and Compliance	No	Yes	Low	Yes	Yes	No	Open	Loose	Low	No
Vendor-Driven Tight Coupling										
Business Planning and Consolidation	No	No	Low	Yes	Yes	No	Proprietary	Tight	Low	No
Trade Promotion Management	Yes	No	Low	Yes	Yes	No	Proprietary	Tight	Low	No
Manufacturing Shop Floor Control	No	No	Low	Yes	Yes	No	Proprietary	Tight	Low	No
Order-Taker Role towards Business Requirements										
Distributed Resource Planning	No	No	High	Yes	No	No	Proprietary	Tight	Low	Yes
Plant Maintenance	No	No	High	No	No	No	Proprietary	Tight	Low	Yes
Legal and Compliance	No	No	Low	No	Yes	No	Proprietary	Tight	Low	Yes
Sticking to Available Competencies										
Consumer Service	Yes	Yes	Irrelevant	No	No	No	Proprietary	Loose	High	Yes
Warehouse Management	No	No	High	No	Yes	No	Proprietary	Loose	Low	Yes

Appendix 3: Published Research Papers

Research Paper #1

Törmer, Robert Lorenz and Henningsson, Stefan, (2019). "Dynamic Capability Building in the LEGO Group – Prospective Activities vs. Reflective Learning in Preparation for a Turbulent Digital Future ". *In Proceedings of the 27th European Conference on Information Systems* (ECIS), Stockholm & Uppsala, Sweden, June 8-14, 2019. ISBN 978-1-7336325-0-8 Research Papers.

5-15-2019

DYNAMIC CAPABILITY BUILDING IN THE LEGO GROUP - PROSPECTIVE ACTIVITIES VS. REFLECTIVE LEARNING IN PREPARATION FOR A TURBULENT DIGITAL FUTURE

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DYNAMIC CAPABILITY BUILDING IN THE LEGO GROUP – PROSPECTIVE ACTIVITIES VS. REFLECTIVE LEARNING IN PREPARATION FOR A TURBULENT DIGITAL FUTURE

Research paper

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Abstract

The competitive pressures arising from digitalization increasingly favour companies that are able to respond to market opportunities by reconfiguring and integrating digitally-enabled business capabilities. The corresponding organizational challenge to integrate technological as well as managerial knowledge from distinct sources has previously been addressed by the dynamic capabilities framework, which has received major attention in strategic management research during the past decades. Nevertheless, relatively little is known about the intentional creation of dynamic capabilities in preparation for future use. To this end, this paper reports on the digitalization journey of the LEGO Group to investigate the development of its Enterprise Architecture capability. The theoretical analysis approaches Enterprise Architecture as a meta-competence to focus on dynamic capability building. The theoretical model unveils how capability quality and performance are shaped by prospective activities and reflective learning from capability use as well as accumulated experience. Furthermore, the findings position Enterprise Architecture into the theoretical context of strategic management and emphasize the discipline's orchestrating role for continuous transformation in the digital age.

Keywords: Dynamic Capabilities, Capability Building, Enterprise Architecture.

1 Introduction

The permeation of society with digital technologies has been on-going for a while now and the technology wave is not only accelerating, but also changing in nature. While information technology (IT) has traditionally occupied a supporting role for organizations, new business models emerge that have digital components inseparably inscribed into their value proposition (El Sawy, 2003). The economic shift towards this paradigm is commonly referred to as "digitalization" (El Sawy *et al.*, 2016, p.2).

Companies that are able to capture the moment can seize opportunities from new ways of doing business, but the disruptive forces of digitalized business models also pose enormous threats on incumbent firms. Particularly traditional manufacturing industries are facing the danger of having well-established business models disrupted by digitally enabled or infused products from the network economy. Incumbents are therefore embarking on strategic digital transformations to inject digital technology into their physical products, gain agility to develop new products as well as services quickly, and leverage business ecosystems of digital partners for value co-creation (Matt, Hess and Benlian, 2015).

Particularly under the circumstances of this "next-generation competition" (Teece, 2012), specific relevance is attributed to the dynamic capabilities framework, which claims that the long-term profitability of companies hinges on their ability to adapt internal resources and capabilities to changing customer demands and technological opportunities (Teece, 2007). As game-changing innovation increasingly emerges in the digital space, while technology lifecycles shorten and technology transfer increasingly occurs across enterprise boundaries (Teece, 2014), competitive advantage will be difficult to sustain. Consequently, temporary and transient competitive advantage will be created through the development of innovative digital value offerings (El Sawy *et al.*, 2016) and the capacity for continuous adaptation of technology-enabled business capabilities to a company's external environment will determine success or failure for enterprises in the long run (Teece, 2012; Karimi and Walter, 2015).

In contrast to most ordinary operational capabilities, dynamic capabilities are firm-specific, cannot be bought from the outside (Teece 2014), and are "difficult to develop and deploy" (Teece 2007, p.1319). While the strategic management literature is rich in contributions on the mechanisms and effects of dynamic capabilities, the development of such capabilities has only been addressed in few individual research contributions. Agarwal and Selen (2009) demonstrate that the ability to create dynamic capabilities emerges from heavy collaboration between stakeholders, Schilke (2014) identify so-called 'learning-to-learn routines' as antecedents, and Zollo and Winter (2002) employ theories of organizational learning to explain capability building as a result of learning from experience. Yet, the existing theoretical knowledge base falls short of explaining the intentional creation of a dynamic capability in preparation for its future application. Filling this gap will not only add a missing piece to the explanatory puzzle, but also inform prescriptive research and practitioners embarking on the journey.

This paper therefore presents a case study on the creation of the Enterprise Architecture (EA) capability in the LEGO Group to investigate EA as a dynamic capability and shed light on the following research question: *How can a company intentionally build a dynamic capability?* Based on a theoretical analysis of the evidence, a mid-range variance theory is developed that unifies a reflective learning perspective from existing research with the concept of prospective, forward-looking activities.

The remainder of this paper starts with a summary of the academic literature on dynamic capabilities and EA. Then, the case evidence on the development of the LEGO Group's EA capability is presented. The subsequent analysis focuses on its conceptualization as a dynamic capability and develops three specific research propositions. Eventually the paper closes with findings and conclusions.

2 Related Literature

2.1 Dynamic capabilities

Rooted in resource-based view, the dynamic capabilities framework seeks to explain sources of enterprise-level competitive advantage over time (Teece, 2007). Resource-based view assumes heterogeneous distribution of resource configurations among organizations (Peteraf, 1993; Hoopes, Madsen and Walker, 2003) and postulates that durable competitive advantage may emerge from valuable, rare, imperfectly imitable, and non-substitutable resources and capabilities (Barney, 1991). Even though resource-based view does not impose a static view of the world per se, critics have pointed out its deficiency to explain how heterogeneities in resource configurations emerge (Helfat and Peteraf, 2003).

Building on resource-based view, the dynamic capabilities perspective emphasizes that resource configurations among firms and market environments may change over time. Particularly in environments of rapid technological change, sustained competitive advantage relies on "the firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments" (Teece, Pisano and Shuen, 1997, p.516). Accordingly, the framework recognizes that enterprise trajectories are shaped by path dependencies on existing resources and capabilities, but explicitly proclaims managers' active influence through resource allocation in line with market needs and technological opportunities (Teece, 2007). Dynamic capabilities rely on entrepreneurial management that "achieves the value-enhancing orchestration of assets inside, between, and amongst enterprises and other institutions within the business ecosystem" (Teece 2014, p.27). This 'orchestration' capacity enables firms to innovate timely in response to technology or market opportunities (Teece, 2007).

Dynamic capabilities are a "meta-competence that transcends operational competence" (Teece, 2007). In contrast to operational capabilities, which refer to ordinary activities and techniques for making profit in the present, "a dynamic capability is one that enables a firm to alter how it currently makes its living" (Helfat and Winter, 2011, p.2). Based on the reasoning that operational best practices and innovations diffuse quickly in competitive environments, Teece (2014) reveals that strong operational capabilities alone will not lead to long-term success. Instead, "enterprise success depends upon the discovery and development of opportunities" (Teece 2007, p.1320). Addressing this inherent need, dynamic capabilities are conceptualized as a company's capacity to sense as well as seize new opportunities and to continuously reconfigure or transform its assets and structures to maintain evolutionary fit with the environment (Teece, 2007). The continuous engagement in all three activities "is essential if the firm is to sustain itself as customers, competitors, and technologies change" Teece (2014, p.5).

The possession of dynamic capabilities is particularly valuable in international business environments characterized by (1) fast-pace technological change, (2) systemic innovation through combination of products and services to address customer needs, (3) open global trade, and (4) poorly developed markets for the exchange of know-how (Teece, Pisano and Shuen, 1997; Teece, 2007). As digitalization accelerates, industries are increasingly shaped by fast-pace combinatorial and distributed innovation based on digital technologies (El Sawy, 2003). This implies a need for organizations to leverage and integrate globally dispersed knowledge sources in response to market opportunities (Yoo *et al.*, 2012). Consequently, the possession of dynamic capabilities is increasingly relevant in the digital future or what Teece (2012) calls "next-generation competition" (Karimi and Walter, 2015).

To assess the performance of dynamic capabilities, Helfat et al. (2009) introduce the notions of "technical fitness" and "evolutionary fitness" (Helfat et al., 2009, p.7). Whereas technical fitness is a measure of quality and cost, evolutionary fitness describes its bottom-line performance and contribution to competitive advantage when put to use in the organization. Consequently, "even with high technical fitness, a dynamic capability still may not lead to high firm performance in terms of evolutionary fitness" (Helfat and Peteraf, 2009, p.98). Potential causes include over-emphasis of technical fitness or low derived demand for the capability (Helfat *et al.*, 2009).

2.1.1 Building dynamic capabilities

Despite the tremendous research attention that the framework has received in the past decades (Di Stefano, Peteraf and Verona, 2010), relatively little is known in the academic literature on how dynamic capabilities are being built in organizations. Consensus exists in the research community that dynamic capabilities are nonimitable and cannot be bought from outside the organization – i.e. they have to be built internally (Teece, 2014). More specifically, they are enterprise-specific and require "intimate knowledge of both, the enterprise and the ecosystem in which the enterprise cooperates and competes" (Teece 2007, p.28). Collis (1994) and Zollo and Winter (2002) introduce the notion of second-order dynamic capabilities that can be applied to build (first-order) dynamic capabilities. In quantitative empirical research, Agarwal and Selen (2009) elaborate constituent dynamic capabilities to support innovation in the service industry and Schilke (2014) investigate the interplay between second-order, first-order dynamic capabilities and firm performance.

Specifically Zollo and Winter (2002) build on organizational learning theories to explain how dynamic capabilities emerge from accumulation of experience in performing organizational routines and the subsequent articulation as well as codification of knowledge. Even though their foundational knowledge evolution cycle acknowledges the role of external stimuli for organizational learning, their explanatory theory implicitly portraits capability building as a result from previous experience and does not account for deliberate strategic creation of a dynamic capability. Additionally, the theory focuses on organizations as a whole, is purely conceptual and not substantiated with empirical evidence.

In contrast, Helfat and Peteraf (2003, p.1002) point out that improvements in the functioning of a capability are "not limited to learning-by-doing". To shed light on how both, operational and dynamic capabilities, evolve in organizations, Helfat and Peteraf (2003) introduce a capability lifecycle model, which captures generic patterns of capability emergence, development, and progression. Revealing little about capability establishment or deliberate development, Helfat and Peteraf's (2003) model "provides a frame within which subsequent research can examine the processes that shape the capability lifecycle in greater detail" (Helfat and Peteraf, 2003).

Summing up, a small body of descriptive and explanatory research exists on the creation of dynamic capabilities. However, empirical evidence remains scarce and specifically the deliberate creation of dynamic capabilities is explained insufficiently to inform prescriptive research and practitioners.

2.2 Enterprise Architecture

EA refers to the definition and the representation of a company‘s organizing logic for structures, business processes, and IT systems (Ross, Mocker and Sebastian, 2014). The purposeful (re-)design of these elements is a strategic task aiming for coherence between business capabilities and strategic goals to yield a foundation for execution of the business strategy (Ross, Weill and Robertson, 2006).

Focusing pre-eminently on technological components, EA has traditionally been conceived as interconnected layers of IT infrastructure, data, and applications (i.e. IT architecture) that enable appropriate degrees of business process integration and standardization. Following this perception, EA aligns systems as well as processes with a company's IT and business strategy to drive business value from IT (Ross, Weill and Robertson, 2006). More recently, however, practitioners and researchers from the Information Systems (IS) community start to recognize that EA is not a pure IT systems challenge and follow a more holistic view, which accounts for the dedicated business architecture. Therefore, modern conceptualizations include beyond business processes also further organizational components, such as organizational structure, people, skills, incentive systems, accountabilities, and culture (Tamm *et al.*, 2011; Ross, Mocker and Sebastian, 2014; Mocker, Ross and Hopkins, 2015).

The implementation, and refinement of an effective EA enables companies to realize superior organizational performance (Ross, Weill and Robertson, 2006). The extent, to which companies can benefit from EA initiatives, varies and the bottom-line economic value is typically difficult to quantify. Nevertheless, consensus exists in the IS community that a high-quality EA improves organizational performance through several mediating organizational benefits, such as increased operational efficiency or strategic agility (Tamm *et al.*, 2011; Mocker, Ross and Hopkins, 2015). Therefore, EA management, commonly abbreviated as simply EA, is often used as a vehicle for strategic digital transformations.

3 Research Method

The research presented in this paper adopts a positivist case study approach (Dubé and Paré, 2003; Yin, 2013) to develop an explanatory, mid-range variance theory of dynamic capability building in companies. The goal is to develop testable hypotheses about the future to elaborate how phenomena occurred and provide "an altered understanding of how things are or why they are as they are" (c.f. Type II, Gregor, 2006). Such explanatory findings may inform normative theories in the future.

To this effect, the study was designed to initially cover a broad scope based on the collection of empirical data to enable a partially inductive understanding of the capability-building process. Data collection tapped into three sources of evidence: observations, documents and interviews. Direct participant observation data (c.f. Yin, 2013) was collected by one of the authors that for 24 months acted as an integrated member of the LEGO Group's Enterprise Architecture management team on site at the group's headquarters in Billund, Denmark. Observations focused on the actions, decisions, and events through which the capability-building process unfolded. Observation data and information about relevant supporting material (documents), were captured in a structured diary (c.f. Naur, 1983; Baskerville and Wood-Harper, 2016). The diary entries were collected in a case database and each grouped by direct observations, reflections on observations, plans for future research, and supporting diagrams, drawings, or mind-maps. As Baskerville and Wood-Harper (2016) point out, "data validity is a problem in these techniques, partially because of the interpretive nature of the data, but also because of the intersubjectivity of data capture". The research subjects are not only observed, but actively influenced by the researcher. To address this threat to validity, 30 semi-structured interviews (approx. 60 mins duration each) with key informants are used as a secondary source of evidence (Ritchie *et al.*, 2013). The interviews were conducted on the company's premises and supported by an interview guide containing open-ended questions. The informants mainly include Enterprise or Solution Architects as well as senior stakeholders, such as Vice Presidents of Corporate IT. All interviews were recorded and transcribed (Yin, 2013). For further triangulation, internal documents from the company, such as presentations and architecture documentation, are used as further evidence (c.f. Yin, 2013).

We coded the data in two broad phases: The first phase aimed to capture the event time series of the EA capability. Coding categories were generic process codes (Van de Ven and Poole, 1995), including events, actions, decisions, outcomes, and states. To determine concepts and their properties in events, actions, decisions, outcomes, and states, we applied an open coding procedure. The authors jointly coded the data, identifying initial concepts and higher-level categories using a constant comparative method and resolving any disagreements through discussion (Saldana, 2009). The outcome of this coding phase was an event sequence outlining the unfolding of capability-development with an unstructured list of concepts that seemed to be relevant in the process.

The initial findings triggered a second phase of more coding as well as additional data collection targeted at the emergent concepts of importance. In the second phase, we approached the initiative as a theoretical issue of dynamic capability building. Stimulated by the LEGO Group's engagement in forward-looking capability building activities in addition to reflective learning from doing, we turned to the relevant literatures for focal categories of coding. The main focal categories included the nature of activities and deliverables, decisions on their prioritization and evidence for the capability's quality and performance. These categories allowed us to systematically relate the various concepts of the initiative produced in the open coding phase. The emerging themes spurred a new literature search for theoretical arguments, explaining the findings in relation to the dynamic capability literature.

Finally, we used our empirically induced findings and supportive theoretical arguments to create an initial case narrative and a timeline of activities as well as their impact on the EA capability. The narrative is supported with interview quotes for the corresponding concepts of interest to increase its vividness and transparency. Eventually, members of the initiative assessed the representativeness of the findings in our narrative (c.f. Yin, 2013). Largely, the perception concurred with our emergent explanation, revealing the need for only marginal changes to the narrative.

4 Case Evidence

As one of the first brick-and-mortar companies in the world, the LEGO Group made digitalization a fundamental pillar of the overall business strategy already in 2012. To meet present and upcoming challenges, the long-term vision for the toy manufacturer from Denmark is to create a highly adaptive organization, which collaborates closely with external partners to harness an ecosystem of platforms to co-create innovation. Since the implementation of this agenda placed heavy demands for novel functionality on the company's enterprise systems (ES), the need for a new platform architecture became apparent to create the foundation for the company's future digitalization journey. A Principal Enterprise Architect (EA) explains: "*We have global processes, global solutions. That brings in a lot of advantages that things are integrated and tied together, but […] because of this huge, tightly integrated, tightly coupled solution, we have difficulties with reacting fast*" (Principal EA, LEGO Group).

This platform architecture resulted from the fact that architectural decision-making in the LEGO Group had previously not been managed from a global perspective to focus on the long-term flexibility and evolvability of the system landscape. Over the years, the existing IT principles had largely grown obsolete and other influencing constraints, such as cost or functional requirements, have often been prioritized over architectural considerations. Therefore, design decisions were largely shaped by choices of autonomous departments prioritizing local demands. "*We are moving forward very quickly in the more digital space and there were really no principles or no overlying roadmap […]. [This] meant that the decisions were potentially going to be fragmented and the wrong decisions [were] taken for the long term*" (Head of Engagement Technologies & Analytics (ET&A), LEGO Group).

4.1 The year 2017 - establishing the EA capability

In order to trigger the transition towards a centrally guided platform architecture, the LEGO Group established a centralized EA capability in early 2017. "*When we started to talk in more details about what was needed for the future in terms of direction-setting and governance, it became clear in the leadership team that there was a need [for a centralized EA function]*" (Head of EA, LEGO Group). Subsequently, the function was created as a small organizational unit consisting of five former Solution Architects that guide the evolvement of the platform landscape with an integrated long-term perspective. Equipped with a charter of pre-defined responsibilities and deliverables, the team spent the first months after establishment refining its own playing field and future directions. This process started with defining the winning aspiration to "*allow the LEGO Group to identify and realize real options by providing long-term sustainable, scalable and adaptable IT platforms that ensure that the business agenda is not limited by EA choices*" (Source: the LEGO Group). Subsequently, the overarching focus areas and concrete deliverables for the first year were defined (c.f. Figure 1). "*We did not start from blank paper, but [regarding] the IT direction for cloud, data and integration, it was not clear at the time I took over that we were that bad settled on these in our organisation at that point in time. So that […] influenced the prioritization within our team*" (Head of EA, LEGO Group).

Against a pull from outside the team to allocate EAs primarily to advisory tasks in specific projects, the Head of EA prioritized the establishment of several fundamental artefacts and strategic directions to create a conceptual foundation of knowledge and target architectures to draw upon in future communication as well as decision-making. "*I did it to protect the team, to have time for the forward-looking activities. But I think it is very unlikely that a special project will never end up in an EA team. But you really have to keep a healthy balance. And I also think you should consider where you are in your maturity journey with your EA capability*" (Head of EA, LEGO Group).

Consequently, the EA team decided to not only manage and govern the platform architecture in the future, but also lead the platform direction by elaborating long-term strategies for technical integration, data management, and the adoption of cloud computing. In addition to the definition of a high-level target architecture, the strategic directions should also inform decision-making on investments into technical platforms and the establishment of complementary organizational capabilities.

4.1.1 Strategic directions for integration, cloud, and data

More concretely, the integration strategy aimed for a consistent high-level direction for the establishment of a de-coupled, service-based architecture that should integrate more traditional enterprise systems, enable IT flexibility, and spur the reuse of functionality. In order to enable automation and self-service in the provisioning of infrastructure, platform services and specific software solutions, the cloud strategy produced guidance on the selection, integration, and migration to cloud services on all layers of the stack. Eventually, the data strategy created a consistent picture of how to retrieve data from sources for analytical purposes. Even though these directions have been implemented in all new solutions, the transformation of existing landscape components has been limited so far. "*The architectural community is […] taking our principles very seriously. Therefore, they implement solutions that are in line with that. But when we modify existing solutions […] then we are not effectively transforming them into how we want to do things in the future*" (Head of EA, LEGO Group).

4.1.2 EA design principles and system landscape documentation

In addition to the development of strategic IT directions for the platform and their governance, the EA team immediately embarked on the elaboration of two specific artefacts: (1) new EA design principles and (2) the documentation of the entire system landscape. The EA design principles describe the ideal future state of the platform architecture that individual design decisions should strive towards. For instance, they prescribe decoupled integration between systems based on modern technologies and protocols. A corresponding success scorecard safeguards their implementation by evaluating individual solution designs in terms of their impact on the overall platform architecture.

The documentation of the LEGO Group's entire system landscape, on the other hand, provides a clear picture of the as-is situation, demonstrates the complexity of the system landscape, and was initially leveraged to communicate the criticality of following a global EA direction to senior stakeholders. The Head of Technology explains: "*Sometimes we all live in our small silos and we forget how much stuff we have actually put together […] In order to get anywhere, you need to know where you are*" (Head of Technology, LEGO Group). In the sequel, this landscape documentation mainly provided a basis to track the platform's state and elaborate the transition path towards the target platform architecture.

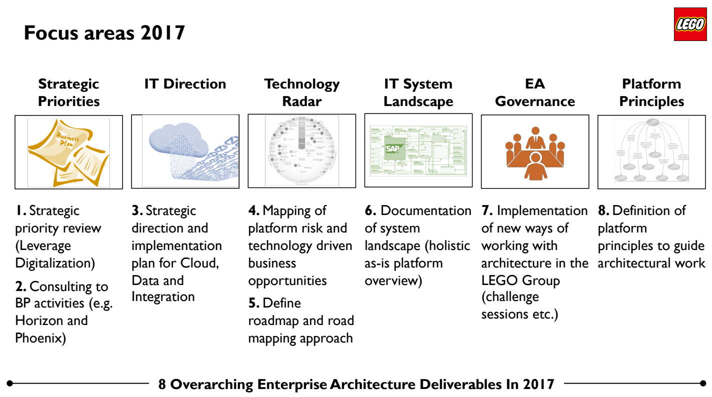

Figure 1. EA Focus Areas 2017 (Source: the LEGO Group)

4.1.3 Engagement with the architecture community and technology radar

Even though the three strategic directions are crucial prerequisites for shaping the platform landscape in the LEGO Group, they would remain fruitless, if not taken to life in the organization. For that purpose, the EA function's design has been rooted in an architecture community of Solution and Application Architects that implement strategic directions in concrete architectural designs and thereby expose the EAs to some of the actual decision-making. This exposure occurred in bi-weekly architecture forums, where individual solution designs are discussed and evaluated, as well as during special projects that involve exceptional risk, high cost, fragile technology, or a strong need for change management. This has allowed the team to steadily keep strategic directions updated based on exposure to actual architectural decision-making. "*We created this kind of hybrid organization with clear deliverables, some of which were actually connected into actual delivery of technology, which meant that the architects were still rooted in that and could not become too ivory tower*" (Head of ET&A, LEGO Group).

Eventually, a technology radar has been created to harmonize ideas and opinions around platform risks and technology-driven business opportunities. This tool collects technology trends and risks in a central repository that enables the architecture community to create internal alignment around the maturity and applicability of specific technology innovations.

4.2 The year 2018 – using and continuously building the EA capability

Starting in late 2017, the Corporate IT organization in the LEGO Group embarked on an agile transformation journey, which also required the EA team to re-evaluate their value-add in the organization and articulate the responsibilities and deliverables in the form of products. While the outcome was shaped by previous focus areas, the process also entailed a realignment with the changing environment in the company (c.f. Figure 2). Defining a "Strategic Advisory" product to cater for strategic consulting activities in special circumstances, projects or assignments, the EAs did not know at this point that they would be spending most of their time in 2018 on this product. Even though the team has also been driving other initiatives, such as the company's cloud journey and community-building, these activities are not of relevance for this study and therefore not elaborated on in this narrative.

4.2.1 ERP suite end-of-life recommendation

A large proportion of the LEGO Group's system landscape consists of a wall-to-wall installation of a large software vendor's enterprise suite – including enterprise resource planning (ERP). Vendor-provided maintenance of these components has been announced to expire in 2025. In the meantime, the vendor had introduced a new enterprise suite that client companies are recommended to migrate to. Although a multitude of companies across industries were facing this 'end-of-life' challenge in early 2018, few had embarked on the journey. In the LEGO Group, the enormous challenge ahead had not been prioritized until the Head of EA initiated investigations.

Subsequently, the EA team was dedicated for two months to investigate if the company should migrate to a new ERP solution at all, if the same vendor should be maintained for ERP, and what potential migration scenarios, if necessary, may look like. Based on a thorough analysis that contemplated all potential options, the team delivered a recommendation that was immediately approved by the Chief Information Officer (CIO). "*That was sort of a determining moment for EA, that the EA team with high pace delivered this recommendation back to the CIO and even CEO. And the direction was accepted*" (Head of EA, LEGO Group). During this process, the EAs did not only rely on the system landscape documentation elaborated during the previous year, but also on strategic IT directions and EA design principles that embody consensus on the architectural road ahead. "*In the ERP replacement strategy as well as the technology strategy, the principles have been applied*" (Principal EA, LEGO Group).

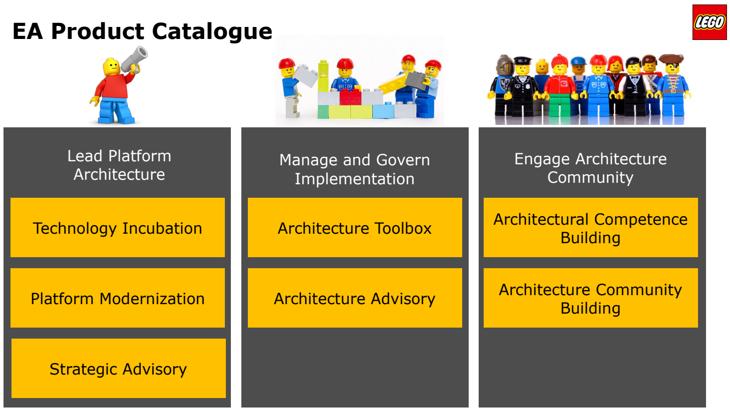

Figure 2. EA Products 2018 (Source: the LEGO Group)

4.2.2 Future platform architecture recommendation

In May 2018, the LEGO Group's CIO, Chief Business Transformation Officer (CBTO), and Head of EA were invited by the Chief Executive Officer (CEO) to present a strategic plan for the future platform landscape. The CEO had been newly assigned in October 2017 and had previously been the CEO of a large Danish manufacturing company where he had driven the digitalization agenda and the transformation of the platform landscape. Specifically based on the artefacts elaborated in 2017 and the ERP end-of-life investigation in 2018, the EA team had an overarching picture of the as-is and to-be state of the platform architecture in place. "*It was the first thing he asked for: 'How does your current landscape look like? Where is it that you are taking off from on this transformational journey and what principles [do] you leverage to steer [...] that transformation?'. And that was when we sort of handed over the principles, that we had developed, to him [...] After showing these artefacts, there was no more questions basically and I do not know what we would have responded, if we could not have delivered*" (Head of EA, LEGO Group).

For the specific purpose of the meeting with the CEO, the EA team used existing artefacts and knowledge to paint a picture of the envisioned future platform architecture. "*We came up with both, a recommendation on what to do with the [ERP] but also with actually quite a good storyline about where our platform has brought us but also what are the pain points that we have today. [...] That has* *been used as a good step up after some discussions with the CEO and the CBTO, on how can we drive this further into a […] technology strategy*” (Principal EA, LEGO Group). Based on the presented ideas, the CEO initiated a program to develop a new technology strategy that should confirm and extend the content. ”*The CEO also quite quickly afterwards came back and said that he wanted a new technology strategy that should embark on some of the ideas that we had, and of course we could use an external company to build this new IT or technology strategy, but he really believed that we were on the right track with our own ideas*” (Head of EA, LEGO Group).

4.2.3 Technology strategy development process

Initiated in June 2018, the program was set out to deliver a technology strategy and a four-year investment roadmap that would enable the company's commercial agenda, address critical technology pain points, drive IT-enabled business flexibility, and afford future digital innovation. From the outset on, the CEO emphasized the role of EA during the process as well as for the outcome. Subsequently, a technology vision, technology principles, and a future-state platform architecture model form the corner stones of the outcome strategy that were largely influenced by previously developed EA artefacts. “*Some of the principles that we have developed back in '17 are very much in line with what we have come up with from a strategic point of view now. We were probably a little bit ahead of curve when developing these principles*” (Head of EA, LEGO Group). Also, the strategy will implement the EA team's recommendation addressing the ERP solution's end-of-life.

Additionally, numerous individual workstreams assessed the current maturity-state of applications and business capabilities in individual functions to create an in-depth as-is picture of the existing architecture. Co-developing desired future ambition levels with business stakeholders, concrete initiatives were developed that will upgrade technology-enabled business capabilities over the four years following 2018. These initiatives are not limited to the replacement of existing systems, but also include active elimination of technical debt to enable future platform landscape flexibility. Simultaneously, new components will only be added in accordance with the platform architecture model and principles.

During this process, the EAs were heavily involved within individual workstreams, but foremost in the global consolidation of initiatives. A Principal EA recalls: “*We helped the stream leads quite a bit in their work on the strategy […] We worked quite intense together in those periods which […] has been highly appreciated - the contribution that we gave them*” (Principal EA, LEGO Group). Additionally, the Head of EA points out that “*the EAs have educated themselves throughout the development of the new principles in '17 and that made it much easier to co-create the direction for the future strategy [because the team was] not on a sort of learning journey*” (Head of EA, LEGO Group).

The individual workstreams were not only facilitated by pre-existing EA artefacts but furthermore produced new artefacts with subsequent usefulness. On the one hand, the application maturity assessment relied on the pre-existence of the system landscape documentation. “*The system landscape mapping […] was a good stepping stone for starting the strategy work. First thing that consultants asked for when they came in is "How does your landscape look like?", similar question asked by the CEO when he entered*” (Head of EA, LEGO Group). “*That has helped in both our ERP strategy as a well as our technology strategy work. Because that gave us the overview on what is it that we are touching*” (Principal EA, LEGO Group). On the other hand, the maturity assessments were also a valuable contribution to the EA's toolbox for future use. “*As part of the strategy [we] had to make […] a capability maturity assessment as well as an application maturity assessment. […] We only could get that happening due to the technology strategy in kind of a pressure cooker way*” (Principal EA, LEGO Group).

The new technology strategy was approved along with a significant dedicated investment budget by the LEGO Group's executive leadership team as well as the board of directors in October 2018. Accordingly, the EA team will shift focus from strategy-making towards an orchestration role during implementation. Even though the strategy will be subject to continuous refinements as the execution progresses, the EA team will spend significantly more time on advisory and implementation tasks than strategy-making. “*With respect to the principles, scorecard but also the landscape work and this ERP replacement strategy work, […] we showed that we know what we are doing and that we have a cer-*

tain experience, knowledge, maturity in the organisation […] and also that to some extent we deserve a seat at the table. They reached out more than ever before for us now" (Principal EA, LEGO Group).

5 Analysis

Unifying the existing academic literature on dynamic capabilities with an analysis of the presented case evidence, this section first conceptualizes EA as a dynamic capability and subsequently develops an explanatory, mid-range variance theory of deliberate dynamic capability building in organizations.

5.1 EA as a dynamic capability

EA entails the purposeful (re)design of a company's foundation for execution to align not only business processes and IT systems, but also structures, roles, and incentive systems with the overall business strategy (Ross, Weill and Robertson, 2006; Ross *et al.*, 2016). Ever since the emergence of enterprise systems, but particularly in the age of digitalization, this foundation for execution encapsulates a growing proportion of a company's operational capabilities to either support value propositions or automate them to a full extent (El Sawy, 2003; Ross, Weill and Robertson, 2006). The design, integration, and orchestration of IT, business processes, and value propositions therefore leverages technological opportunities to develop or support business capabilities in response to market opportunities. This usually requires the integration of IT and business knowledge from dispersed sources within and outside the organization, but eventually leads to superior long-term performance (Ross, Weill and Robertson, 2006; Tamm *et al.*, 2011).

In the LEGO Group, the EA capability entails specific mechanisms that support the sensing as well as seizing of technological and market opportunities and particularly the continuous transformation of technology-enabled business capabilities. Whereas the technology radar and the engagement with selected technology-driven business initiatives primarily focus on the identification and realization of opportunities, the orchestration of technology strategy implementation (including technology principles, future state architecture, and EA design principles) serves the continuous transformation of technology-enabled business capabilities. At the same time, this transformation primarily seeks to enable the seizing of opportunities by creating digital options for digital innovation and the company's commercial agenda in the future. This continuous engagement in sensing and seizing of opportunities, while simultaneously transforming the platform landscape, addresses a long-term perspective of steady digital transformation to reconfigure value propositions in the face of next-generation competition (Teece, 2012; Matt, Hess and Benlian, 2015).

In sum, the LEGO Group's EA capability is a specific dynamic capability, which aims for the purposeful reconfiguration of existing IT-based business capabilities through continuous engagement in sensing, seizing, and continuous transformation.

5.2 Capability building

In order to theoretically analyse dynamic capability building, this paper follows Helfat et al.'s (2009) reasoning that a dynamic capability's contribution to company performance (i.e. its evolutionary fitness) is shaped not only by its technical fitness, but also by market demand and competition dynamics. In other words, the more demand calls for the use of a technically fit dynamic capability, the higher its evolutionary fitness is going to be. Subsequently, technical fitness – defined as "how effectively a capability performs its intended function when normalized (divided) by its cost" – and evolutionary fitness - "how well a dynamic capability enables an organization to make a living by creating, extending, or modifying its resource base" (Helfat et al., 2009, p.7) – are adopted as dependent variables for this study. Zollo and Winter (2002), on the other hand, theorize that experience accumulation through capability use leads to capability improvement – implying an increase in the capability's technical fitness. This effect may be amplified by deliberate investments into reflective learning activities, which refer to a "deliberate process through which individuals and groups figure out what works and what doesn't in the execution of a certain organisational task" and "the codification of knowledge derived from reflection upon past experiences" (Zollo & Winter, 2002, p.340f). Based on this reasoning, proposition one rephrases what is already known from previous research contributions:

P1: The technical fitness of a dynamic capability increases through capability use, resultant experience accumulation, and reflective learning activities.

In the LEGO Group, this effect was observable as improvements in the EA capability's technical fitness resulting from exposure to individual design decisions in the architecture forum, advisory to special projects as well as initiatives, and the orchestration role in the technology strategy development process. Since these activities had the purpose of delivering the capability's eventual value, they are conceptualized as capability use in this study. During technology strategy development, for instance, the EA capability was used to deliver initial artefacts and orchestrate findings as well as initiatives across streams. Based on the resultant experience, the EAs did not only improve their knowledge specific to individual tasks, but also yielded valuable artefacts, such as the application maturity assessment, refined strategic IT directions or updated principles. This process eventually improved the technical fitness of the capability as a whole.

While the mechanism described in proposition one is backward-looking and reflects Zollo and Winter's (2002) theory on organizational learning through experience accumulation, the case evidence furthermore exposes how the EA function embarked on prospective capability building activities that were not preceded by capability use. These activities included the development of strategic IT directions for cloud, data, as well as integration, the EA design principles, and the system landscape documentation. Also, the initial elaboration of the EA winning aspiration, focus areas and deliverables are evidence of prospective activities for an unknown future. The engagement did not deliver the value associated with the EA capability to the rest of the organization but served the unique purpose of increasing its technical fitness for future use. Specifically, the development of strategic IT directions was conducted due to anticipation of future demands instead of current necessity.

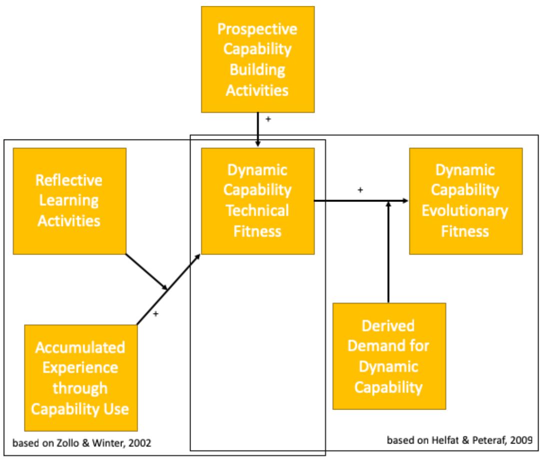

Figure 3. Illustration of the Research Model in the Context of Previous Research

This study's emergent conceptualization of prospective capability building activities therefore includes, but is not limited to, external knowledge acquisition, strategic recruitment, strategic planning, or generic problem-solving on a conceptual level to derive normative guidance and guide future decision-making for action. These activities may also entail what Zollo and Winter (2002) term knowledge codification and articulation. The development of EA design principles in the LEGO Group, for instance, did involve knowledge codification but foremost created new knowledge in the organization through conceptual problem solving and the operationalization of strategic IT directions. Most importantly, prospective activities are not triggered by capability use and experience accumulation but refer to forward-looking capability building. Subsequently, this inductive reasoning justifies proposition two:

P2: The technical fitness of a dynamic capability increases through prospective capability building activities that do not contribute to the immediate delivery of its value.

Combining propositions one and two reveals a strategic choice that organizational units face when investing deliberately into the creation or improvement of a dynamic capability: the allocation of time and resources between (a) prospective activities, on the one hand, which will increase its technical fitness for future application and (b) immediate capability use, on the other hand, to deliver its value while also collecting experience to feed reflective learning.

In the LEGO Group, this tension materialized particularly in the year of the EA capability's establishment as the team has continuously been pulled into special projects for advisory purposes by senior stakeholders to deliver immediate value. The Head of EA deliberately opposed this pull and ensured the allocation resources to the elaboration of strategic IT directions and EA artefacts. This prioritization turned out to be particularly expedient as the resultant artefacts and knowledge have been in high demand during the subsequent year. Prospective capability building did therefore not only contribute majorly to the capability's technical fitness, but through mediation also to its evolutionary fitness. The tension specifically results from the capability's nature as a meta-competence as well as the complexity of its output value. Based on this theoretical argument, the challenge does not seem to be a phenomenon specific to the development of an EA capability in the LEGO Group, but may also emerge in the context of other organizations and meta-competences. This reasoning justifies proposition three:

P3: The strategic creation of a dynamic capability comprises an inherent tension between prospective capability building activities and delivery of value through capability use.

6 Discussion and Conclusion

The case evidence and theoretical analysis reveal that a dynamic capability can be built not only through capability use as well as reflective learning, but also through deliberate forward-looking activities. While previous research contributions mainly focus on organizational learning from previous experience, this study contributes and emphasizes prospective activities to position a dynamic capability for current as well as anticipated future demand. Propositions one and two accordingly form a mid-range variance theory, which explains that the technical fitness of a dynamic capability increases not only through reflective learning from capability use and resultant experience accumulation, but also through prospective capability building activities. Figure 3 harmonizes these findings in a consistent picture with the findings of previous research. Since reflective learning activities rely on – and amplify the effect of - previous experience accumulation, the concept is depicted as a moderating variable.

Furthermore, proposition three postulates that these two modes of investing into the technical fitness of a dynamic capability lead to an inherent tension between prospective activities and reflective learning from capability use during creation or enhancement. This tension between "building capabilities for the future while ensuring success in the present" (Smith and Lewis, 2011, p.4) is a well-known phenomenon from the literature on organizational ambidexterity and has been studied at various organizational levels (O'Reilly and Tushman, 2013). Smith and Lewis (2011, p.12) emphasize the importance of awareness as well as acceptation of such tensions and suggest resolution "either through splitting and choosing between tensions or by finding synergies that accommodate opposing poles".

Prospective capability building activities entail conceptual problem solving and external knowledge acquisition, but may also include the codification of conceptual knowledge that did not result from previous experience. This methodological overlap with reflective, experience-based learning activities may offer potential for synergistic integration. Nevertheless, this study explicitly emphasises the split between the two opposing poles. This finding stresses the role of entrepreneurial managers that create awareness of the tension, anticipate future demands on a dynamic capability, and ensure long-term technical and evolutionary fitness by prioritizing corresponding prospective activities.

Reporting on the creation of an EA capability, the case evidence covers a discipline that has received tremendous attention in practitioner circles but has suffered from a shortage of theoretical considerations in academia. By conceptualizing EA as a dynamic capability, this study places the discipline into the theoretical context of strategic management. As industries are increasingly shaped by digitalization and hyper-competition, the long-term, holistic management of technology layers and business architecture will continuously gain importance in enabling business flexibility. Therefore, the EA capability will be a central element for explaining and prescribing how companies adapt their resources and capabilities to changing customer demands and opportunities in quest for competitive advantage.

6.1 Implications for practice

This study produces two implications particularly relevant for practitioners. For once, the theoretical model provides concrete guidance to managers embarking on the journey in terms of which types of activities to invest resources into when deliberately creating a dynamic capability. Particularly in preparation for a vague future, the anticipation of future demand on the capability and identification of appropriate prospective activities may be vital to ensure long-term technical and evolutionary fitness.

Secondly, the study stresses the tension between prospective activities and reflective learning based on capability use that practitioners should be in awareness and acceptance of. Even though this implication may seem trivial, a successful balance between capability building and capability use relies on the exploration of synergies between the two, the identification of stakeholder demands, and a clear prioritization of deliverables to satisfy outside requirements while also prioritizing long-term interests.

6.2 Limitations and validity threats

Naturally, the research presented in this paper is subject to several limitations. First, the evidence and analysis investigate the development of a specific capability in one organization to derive findings on the wider class of dynamic capabilities. Although the generalization is supported by theoretical arguments, more evidence is needed from a wider population of companies and distinct types of dynamic capabilities to warrant external validity of the findings. Secondly, the quality and performance measures adopted for dynamic capabilities – technical and evolutionary fitness – are highly conceptual and difficult to quantify. Even though the case evidence clearly indicates an increase in the EA capability's quality and performance, these measures are admittedly vague and reliant on stakeholder opinions. Nevertheless, the focus of this study lies on decisions, actions, and activities involved in capability-building instead of its precise performance measures. Furthermore, the bottom-line business value of the function is highly conceptual and will only emerge long-term. Even though the threats to validity have been addressed during the research process, especially key informant bias remains a concern.

6.3 Conclusion

Complementing previous research that portraits dynamic capability building as learning from experience, this study makes a theoretical contribution by revealing how a meta-competence can be built strategically from scratch. Based on the existing literature and an in-depth case study on the creation of the EA capability in the LEGO Group, a mid-range variance theory is developed that equally extends our theoretical understanding of dynamic capabilities and provides guidance to practitioners.

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Research Paper #2

Törmer, Robert Lorenz, and Stefan Henningsson. "From Drift To Central Guidance: A Path Constitution Perspective On The Platformization Of An Information Infrastructure." *In Proceedings of the 26th European Conference on Information Systems (ECIS) 2018European Conference on Information Systems*. Association for Information Systems. AIS Electronic Library (AISeL), 2018.

FROM DRIFT TO CENTRAL GUIDANCE: A PATH CONSTITUTION PERSPECTIVE ON THE PLATFORMIZATION OF AN INFORMATION INFRASTRUCTURE

Research paper

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Abstract

Responding to competitive pressures arising from digitalization, traditional companies are increasingly turning towards platform strategies to gain speed in the development of digital value propositions and overcome rigidities of pre-existing information technology landscapes. Based on a case study of the LEGO Group's digitalization journey, this paper elaborates how brick-and-mortar companies can break away from a drifting information infrastructure and trigger its transformation into a digital platform. The case analysis conceptualizes information infrastructure evolution as a path-dependent process and develops a process model on the creation of a new 'platformization' path through mindful deviations by architects that guide collective action. This perspective depicts the transformation journey as a process of socio-technical path constitution that is shaped by deliberate human interventions and emergent forces from path dependencies.

Keywords: *Information Infrastructure Transformation, Digital Platform, Path Constitution, Path Dependence*.

1 Introduction

While information technology (IT) has traditionally occupied a supporting role for organizations, new business models emerge that have digital components inseparably inscribed into their value proposition (El Sawy 2003). The economic and societal shift towards this digital paradigm is commonly referred to as “digitalization” (El Sawy et al., 2015, p.2). Companies that are able to capture the moment can seize opportunities from new ways of doing business, but the disruptive forces of digitalized business models also pose enormous threats on incumbent firms. Particularly traditional manufacturing industries are facing the danger of having well-established business models disrupted by digitally enabled products or services from the network economy. Incumbents are therefore embarking on digital transformations to inject digital technology into their physical products, gain the agility to develop new products as well as services quickly, and leverage business ecosystems of digital partners for co-creation of value (Matt et al. 2015).

At the heart of this digital transformation rests an increased orientation towards digitally enabled platform-based business models (Cusumano and Gawer 2002; Eaton et al. 2015; Eisenmann et al. 2011; Gawer 2014; Tiwana 2013). The platform is the third elementary type of value configuration, as identified by Stabell and Fjeldstad (1998), and platform markets comprise a large and rapidly growing share of the global economy (Eisenmann et al. 2011). Responding to competitive pressures from digital natives, traditional brick-and-mortar companies are nowadays equally adopting digital platform strategies (Ross et al. 2016).

However, little is known in the academic literature on how digital platforms come into being or how they are constructed (de Reuver et al. 2016). Simultaneously, companies’ IT trajectories are subject to path dependencies and irreversibility that complicate corporate IT platform innovations (Fichman 2004). Consequently, addressing this phenomenon requires an insider’s perspective on how such dependencies can be overcome to create new development trajectories for corporate IT landscapes. This paper therefore presents a case study to elaborate how the LEGO Group is constituting a new ‘platformization’ path to gradually transform the company’s information infrastructure. Thereby, the study sheds light on the following research question: *How can a company trigger the transformation of its drifting information infrastructure into a digital platform?*

The remainder of this paper is structured as follows: First, the academic literature on digital platforms, information infrastructures, and path constitution is revealed. Then, a recap of the LEGO Group’s ongoing digitalization journey and the case evidence expose how the brick manufacturer is re-architecting and transforming its information infrastructure into a digital platform. The subsequent analysis develops a path constitution perspective on this process. Eventually the paper closes with findings and conclusions.

2 Theoretical Background

2.1 Information Infrastructures and Platforms

The academic literature on technological platform management mainly consists of two separate research strands that a small, emerging body of research is beginning to bridge. On the one hand, the economic theoretical perspective has conceptualized platforms as two-sided markets and has produced insights on platform competition (Gawer 2014; Thomas et al. 2015). The majority of platform research within the context of information systems (IS) follows the technological engineering perspective, on the other hand, which studies platforms as technological architectures that drive platform innovation (Gawer 2014). Conceptualizing a platform as a stable core and variable peripheral components, this research strand explains how modular architectures spur organizational agility by providing a technological architecture to innovate upon in production and design (Ghazawneh & Henfridsson 2013; Selander et al. 2013; Gawer 2014; Eaton et al. 2015).

More recent evidence suggests that firm-internal enterprise platforms and infrastructures, such as enterprise resource planning (ERP) systems, play a key enabling role in leveraging digital technologies for innovation (Sedera et al. 2016; Lokuge & Sedera 2016; Henfridsson & Bygstad 2013). Particularly ERP systems “are increasingly serving as a platform to which other tools can be added in order to take advantage of shared data resources” (Yoo et al. 2012, p.1400). Sedera et al. (2016), on the other hand, reveal that not all enterprise platforms are suitable to support digital platform innovation and their impact remains unclear (Sedera et al. 2016; Jansen et al. 2006; Damanpour 1991).

The concept of an information infrastructure (II) is to a large extent overlapping with the one of a platform and has therefore often been applied to study similar phenomena (c.f. Tilson et al., 2010). Both concepts describe shared socio-technical systems that consist of a set of IT capabilities, are emergent in nature, and evolve in a path-dependent nature to serve initially unknown user needs (Hanseth & Lyytinen 2010). Nevertheless, a platform and an II are distinct phenomena that exhibit decisive differences. Platforms are built into a design context, which remains under central control by architectural principles that form a design framework (Hanseth & Lyytinen 2010). In a similar vein, Baldwin & Woodard (2008) argue that a platform is constituted by a common architecture containing specific design rules that create a modular architecture. As a result, a platform entails a core of stable modules and a periphery containing components that are more variable over time (Baldwin and Woodard 2008). II, by contrast, are unbounded, open, shaped by heterogeneous and autonomous actors, and lack global control (Star & Ruhleder 1996; Henfridsson & Bygstad 2013). Also, II are more heterogeneous in nature and serve the connectivity of disperse communities. Hanseth & Lyytinen (2010, p.1) argue that II are “recursively composed of other infrastructures, platforms, applications, and IT capabilities”.

The development and evolvement of II bares an idiosyncratic coordination challenge (Grisot et al. 2014; Hanseth & Lyytinen 2010), which originates from the fact that most IIs are distributed across a diverse set of actors who develop II “in modular increments, not all at once globally” (Star, 1999, p.382). Therefore, lack of control is a fundamental attribute of II development (Ciborra 2000). In the pursuit of individual goals, distributed actors leverage parts of the II’s pre-existing components – referred to as the installed base (Grisot et al. 2014) – to append new socio-technical elements (Sanner et al. 2014). Simultaneously, it is rarely possible to redesign the II from scratch, II development consequently always “wrestles with the inertia of the installed base and inherits strengths and limitations from that base” (Star & Ruhleder 1996, p.113).

In recognition of these constraints, II development has been framed as ‘installed base cultivation’, which denotes the incremental modification of the installed base until it comes as close as possible to a desirable scenario (Hanseth 1999). Accordingly, most extant research on II development tends to see path dependence as a near-inexorable force on the development trajectory, leaving incremental, path-deepening innovation as the only option for development.

2.2 Path Constitution

Within the general path dependence literature (c.f. Sydow et al. (2009) and Vergne & Durand (2010)), this perspective corresponds to the phenomenon of path-dependent processes that are non-ergodic – processes that are “unable to shake free of their history” (David, 2001, p. 19). The conceptualization is built around an understanding of phenomena as being driven by mutually interacting variables that generate feedback loops and nonlinear dynamics (Maruyama 1963; Masuch 1985; Stacey 2007). Consequently, this perspective entails an ‘outsider’s view’ that neglects the active engagement by human actors as path evolution is determined by contingencies and cannot break out unless exogenous shocks occur (Sydow et al. 2009).

The concept of path creation, on the other hand, takes an ‘insider’s’ view on path-dependent processes (Garud et al. 2010) and stresses the active involvement of agents driven by ‘a logic of control’ in shaping the evolutionary path (Garud & Karnoe 2001; Sarasvathy 2001; Karnøe & Garud 2012). Agency is distributed and emergent through the interactions of actors and artefacts that constitute action nets (Karnøe et al. 2008).

At the heart of path creation lies a process of mindful deviations by embedded agents "from existing artifacts and relevance structures fully aware that they may be creating inefficiencies in the present, but also aware that such steps are required to create new futures" (Garud & Karnoe 2001, p.6). Consequently, innovation trajectories are less deterministic than assumed by the path dependence view.

Integrating the two perspectives, Meyer & Schubert (2007) as well as Sydow et al. (2012) introduce the notion of path constitution to account for the entanglement of history and human agency in the process of technological innovations. Both contributions define a path as a non-ergodic process of interrelated events through which one of multiple initially available options gains momentum such that the entire process may lead to a lock-in – even though the eventual solution was not predictable at the beginning of the path. Processes involved in a path may be partly or entirely influenced by knowledgeable human actors (Sydow et al. 2012; Singh et al. 2015), but are independently characterized by irreversibility, momentum, and potentially lock-in situations (Sydow et al. 2012).

Additionally, Singh et al. (2015) reveal that path trajectories are shaped by sequences of reinforcing and transforming episodes that determine if a path eventually results in a lock-in or not. While reinforcing episodes continuously reduce the availability of options, transforming episodes make additional options actionable and thereby contribute to the prevention of lock-in situations (Singh et al. 2015).

3 Research Method

The research presented in this paper adopts a case study approach (Dubé & Paré 2003; Yin 2013) to develop a process model of how a company can re-architect its II to trigger the constitution of a new platformization path. The goal is not to develop testable hypotheses about the future, but to elaborate how and why phenomena occurred and provide "an altered understanding of how things are or why they are as they are" (c.f. Type II, Gregor, 2006, p.624). Such explanatory findings may be suitable to inform normative theories in the future. Since the inquiry investigates a rare phenomenon in a particularly fine-grained level of detail, a single-case design is suitable to produce significant research results (c.f. Dubé and Paré, 2003).

Recognizing the lack of previous research on how incumbent companies in traditional industries can develop digital platforms, we searched for a case that could enable in-depth exploration of the process this transformation entails (e.g. Patton 1990). The platformization initiative in the LEGO Group seemed to be such a situation because it includes several of the typical characteristics associated with how the challenge commonly is portrayed: an IT landscape that was originally crafted to have a supporting role enabling the company's core business activities; a rapidly transforming environment where existing and new competition embrace digital technologies to reinvent offerings, customer interactions, processes as well as complete business models; and a spurring awareness of the transformational need that had created financial resources and managerial attention to potentially progress the company towards the objective of a business enabled by a digital platform. Importantly, the LEGO Group is known as an industry leader in digitalization (El Sawy et al. 2015) and generally considered a healthy as well as well-functioning company. As such, there was an initial prospect to explore a well-run company that made substantial investments to achieve a particular target state and to reflect on the experiences of this journey.

For this purpose, the study was designed to initially cover a broad scope and was based on the collection of empirical data to allow for a partially inductive understanding of the transformational process. Data was collected from three sources of evidence: observations, documents and interviews. Direct participant observation data (c.f. Yin, 2013) was collected by one of the authors that for twelve months acted as an integrated member of the LEGO Group's Enterprise Architecture management team on site at the group's headquarters in Billund, Denmark. Observations focused on the actions, decisions, and events through which the transformational process unfolded. Observation data and information about relevant supporting material (documents), were captured in a structured diary (c.f. Naur, 1983; Baskerville and Wood-Harper, 2016). The diary entries were collected in a case database and each grouped by direct observations, reflections on observations, plans for future research, and supporting diagrams, drawings, or mind-maps. As Baskerville and Wood-Harper (2016) point out, "data validity is a problem in these techniques, partially because of the interpretive nature of the data, but also because of the intersubjectivity of data capture". The research subjects are not only observed, but actively influenced by the researcher. To address this threat to validity, ten semi-structured interviews with key informants are used as a secondary source of evidence (c.f. Ritchie et al., 2013; Yin, 2013). The interviews were conducted on the company's premises and supported by an interview guide containing open-ended questions. The informants mainly include Enterprise or Solution Architects as well as senior stakeholders, such as Vice Presidents of Corporate IT. All interviews were recorded, transcribed and added to the case database (Yin 2013). For the purpose of further triangulation, internal documents from the company, such as reports, presentations, emails, and architecture documentation, are used as a third source of evidence (c.f. Yin, 2013).

We coded the data in two broad phases, with distinct objectives. The first phase of coding aimed to capture the event time series of the transformational initiative. Coding categories were generic process codes (Van de Ven & Poole 1995), including events, actions, decisions, outcomes, and states. To determine concepts (such as invention, capacity and frustration, and network) and their properties (e.g. efficient/inefficient, success/failure) in events, actions, decisions, outcomes, and states, we applied an open coding procedure. The authors jointly coded the data, identifying initial concepts and higher-level categories using a constant comparative method (Corbin & Strauss 1990) and resolving any disagreements through discussion (Saldana 2009). The outcome of this coding phase was an event sequence outlining the unfolding of the initiative with an unstructured list of concepts that seemed to be relevant in the process.

The initial findings, triggered a second phase of more coding as well as additional data collection targeted at the emergent concepts of importance. In the second phase, we approached the initiative as a theoretical issue extending and challenging our findings. Stimulated by the emerging event sequences around the path-dependence of the existing IT setup and LEGO Group's attempt to address this by introducing new architectural principles to adjust the direction of work, rather than embarking on an extensive transformational program, we turned to the relevant literatures for focal categories of coding. The main focal categories included the company's IT setup, evidence of path dependence as well as creation, and mindful deviations in the form of actions. These categories allowed us to systematically relate the various concepts of the initiative produced in the open coding phase. The emerging themes spurred a new literature search for theoretical arguments, explaining the findings in relation to the II and digital platform literatures.

Finally, we used our empirically induced findings and supportive theoretical arguments to create an initial case narrative and a timeline for the development process by tracing the order of events and underlying mechanisms. The narrative is supported with interview quotes for the corresponding concepts of interest to increase its vividness and transparency. Eventually, members of the initiative assessed the representativeness of the findings in our narrative (c.f. Yin, 2013). Largely, the perception concurred with our emergent explanation, revealing the need for only marginal adjustments to the narrative.

4 Case Evidence

As one of the first brick-and-mortar companies in the world, the LEGO Group has made it a top management agenda to leverage digitalization as a fundamental pillar of the overall business strategy. To meet present and upcoming challenges, the long-term vision is to create a highly adaptive organization, which collaborates closely with external partners to harness an ecosystem of platforms to co-create value.

As the implementation of this agenda resulted in several "digitalization moves" (El Sawy et al., 2015, p.2), which placed heavy demands for novel functionality on the enterprise IT platform, the need for a new complementary IT platform soon became evident. An Enterprise Architecture (EA) Director explains: "We have a fairly complex landscape, but still […] one big system […] which is being used all over the globe. […] We have global processes, global solutions. That brings in a lot of advantages that things are integrated and tied together, but […] because of this huge, tightly integrated, tightly coupled solution, we have difficulties with reacting fast" (EA Director, Corporate IT, LEGO Group). Business processes have been standardized and integrated to a large extent on non-redundant, global enterprise platforms that enable efficient operational transactions. The tight coupling between systems, however, undermines IT flexibility as change requests and upgrades imply ripple effects on other landscape components.

This platform architecture results from the fact that architectural decision-making in the LEGO Group has previously not been managed from a global perspective to focus on the long-term flexibility and evolvability of the system landscape. Over the years, the existing IT principles had largely grown obsolete and other influencing constraints, such as cost or functional requirements, have often been prioritized over architectural considerations. Therefore, design decisions did often not follow a coherent architectural framework and were largely shaped by choices of autonomous departments that were prioritizing local demands.

"We are moving forward very quickly in the more digital space and there were really no principles or no overlying roadmap […]. [This] meant that the decisions were potentially going to be fragmented and the wrong decisions [were] taken for the long term" (Head of Business-Enabling Technologies , Corporate IT, LEGO Group). According to the Head of EA, "there has been wild freedom to operate from an architectural point of view. […] Because we had a distributed EA landscape before, […] nobody took the end-to-end responsibility of those priorities that go across the platform. […] We did have a capability within the organization […] BRMs and what were called EAs, but […] they weren't actually doing EA. They were people doing solution architecture for each of the different vertical areas and there was a complete lack of an overall view of the architectural landscape" (Head of EA, Corporate IT, LEGO Group). At the same time, some design decisions involved "less optimal solutions, because [the architects] wanted to stay within [the] platform. […] I think we got too many solutions that are a little bit artificially engineered, so they fit into what we had and thereby we stuck also to stuff that we know (EA Director, LEGO Group). The company's holistic IT landscape therefore evolved in the form of an II with lack of centralized architectural control.

While the existing enterprise platform is a "rock-solid, carefully designed and thoroughly tested platform" (El Sawy et al., 2015, p.23), a new complementary so-called "engagement" platform was initiated to satisfy the future demand of rapidly adding prototype functionality for innovative digital products and services in an ad-hoc manner. This platform should be rich in digital options and enable the implementation of innovative value propositions without limitations by technical debt (c.f. Woodard et al., 2012). Integrating with the traditional enterprise platform in a loosely-coupled manner, a new digital platform based on micro-services as well as application programming interfaces (APIs) should emerge (El Sawy et al. 2015). Consequently, the platform would also embody the option to open interfaces up for external innovation by ecosystem-partners when appropriate.

4.1 Enterprise Architecture in the LEGO Group

In order to address these issues and trigger the transition from a distributedly-managed II towards a centrally guided digital platform, the LEGO Group has recently established a centralized Enterprise Architecture capability. "When we started to talk in more details about what was needed for the future in terms of direction-setting and governance, it became clear in the leadership team that there was a need [for a centralized EA function]" (Head of EA, LEGO Group). Subsequently, the function was created out of well-experienced former Solution Architects that were re-skilled for the new positions. "We did not bring in new people […], because we needed people who had an internal understanding of our landscape" (Head of Business-Enabling Technologies , LEGO Group).

The new EA function is a small organizational unit consisting of six Enterprise Architects (EAs) and guides the evolvement of the platform landscape with an integrated long-term perspective. "I hope and I already see that we have more time to look ahead and to figure out how we are going to create a platform for the LEGO Group that allows for the flexibility and the speed that we see around us, but also that we see our colleagues in the business asking [for] more and more" (EA Director, LEGO Group). The goal is to build scalable, adaptable and flexible IT platforms that have digital options embedded to make sure that new technologies can be seamlessly integrated. "We will not let EA or bad architectural choices limit future business opportunities" (Head of EA, LEGO Group). "We will get to a state with a more agile platform […] that will be more [flexible] towards future demands […] and we will optimize the cost of operating what we have" (CTO and Vice President, Corporate IT, LEGO Group).

4.2 Strategic IT Directions

Starting out with these overarching goals, the team's specific strategy and focus areas (c.f. Figure 1), emerged in a cognitive process of sense-making that was shaped by various stakeholders. Most notably, this process revealed the need for long-term strategic directions for data management, internal as well as external integration, and cloud adoption going forward. "It was not called out – to start with – that EA should lead such big initiatives. […] It was first when the team met and we started to talk about what the biggest challenges for our platform are, that it became clear" (Head of EA, LEGO Group).

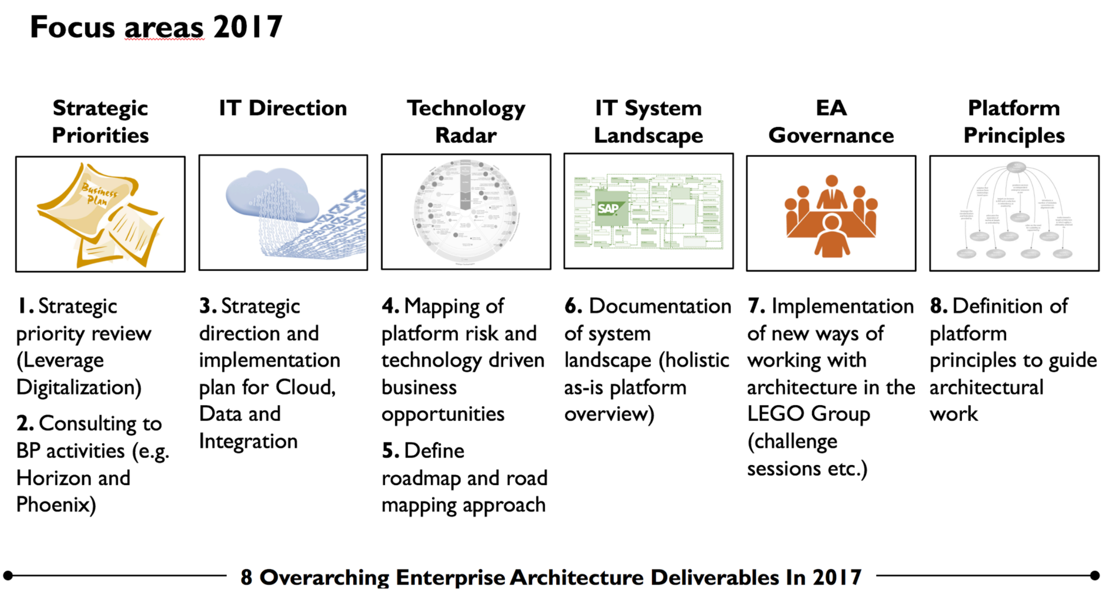

Figure 1. EA Focus Areas 2017 (Source: the LEGO Group)

"Most companies that are in the retail or consumer-facing sector are very much moving away from that monolith concept and towards the whole idea of micro-services and contact solutions" (Head of Business-Enabling Technologies, LEGO Group). In contrast to the management of large-scale enterprise systems, the challenge for IT departments in the digital age will rather be the identification, implementation, and composition of specialized services and modules to support desired value propositions. Along with this paradigm shift, also the tasks and responsibilities of the EA function are changing. For the IT organization to gain agility, Solution- and Application-Architects will need to operate in close collaboration with business stakeholders and require autonomy to build or compose specific solutions with minimum constraints. "That is where the EA role becomes so critical in terms of setting the right principles and ensuring that what we do gives people or technology the freedom, but is done in a way that is right for the organization long-term. So, I think it becomes a more important role" (Head of Business-Enabling Technologies, LEGO Group). Therefore, the EA function needs to manage the paradox between generativity and control, which the academic literature mainly identifies in the context of platform ecosystems (Yoo et al. 2010). "And that is where the EA role becomes so critical in terms of setting the right principles and ensuring that what we do gives people or technology the freedom, but is done in a way that is right for the organization long-term. So, I think it becomes a more important role" (Head of Business-Enabling Technologies, LEGO Group).

Consequently, the EA team decided to not only manage and govern the platform architecture going forward, but also lead the platform direction by elaborating long-term strategies integration, cloud adoption, and data. The development and implementation of these strategic directions is primarily an organizational, rather than a technical, challenge as the EAs have to convince key stakeholders of the expediency and feasibility of strategic architectural choices. “As an EA, you often need to convince a lot of people[,] stand up for things [and] have a certain power-base” (CTO, LEGO Group). This journey requires careful stakeholder management within the organization based on powerful storylines, the demonstration of value from new technologies, but also the adaptation of own ideas towards constructive outside opinions. A Senior EA describes the challenge of spreading strategic architectural directions within the company’s IT department: “They need to catch fire. […] We have to change the mindset not with a big bang, but more: ‘See what we have found! Do you agree?’ […] not just because it is something new, but because we actually strongly believe that it is something that can make us even more agile” (Senior Enterprise Architect, Corporate IT, LEGO Group).

4.3 System Landscape Documentation

In addition, the EA team has elaborated a documentation of the LEGO Group’s entire system landscape that provides a clear picture of the as-is situation, demonstrates the complexity of the system landscape, and is currently leveraged to communicate the criticality of a new architectural direction to senior management and all relevant stakeholders. In the future, this landscape documentation will mainly provide a basis to track the platform’s state and elaborate the transition path towards the target platform architecture. The CTO explains: “Sometimes we all live in our small silos and we forget how much stuff we have actually put together […] In order to get anywhere, you need to know where you are. So creating an as-is picture is absolutely necessary in order to know, where would we be heading […] If you just talk about the future all the time, people will say ‘Good show, that is fun to hear. Let’s go back to reality and do our daily work!’. Then you become this paper-tiger, which is a threat for all architects” (CTO, LEGO Group).

4.4 Engagement with the Architecture Community

The strategic directions will remain fruitless, if not taken to life in the organization. For that purpose, the EA function’s design has been rooted in an architecture community of Solution- and Application-Architects that will implement strategic directions in concrete architectural designs and thereby expose the EAs to some of the actual decision-making. “We created this kind of hybrid organization [...] which meant that the architects were still rooted in [the delivery of technology] and could not become too ivory tower” (Head of Business-Enabling Technologies , LEGO Group).

In order to spread the strategic directions within the organization, the EA team has, on the one hand, developed new EA design principles, an architecture success scorecard, and new architecture panels in the LEGO Group. The EA design principles are following the lighthouse metaphor and describe the ideal future state of the platform architecture that individual design decisions should strive towards (c.f. Haki & Legner, 2013). The success scorecard safeguards their implementation by evaluating individual solution designs in terms of their impact on the overall platform architecture. In addition, the architecture panels provide a forum where individual solutions are challenged against the principles and all architects engage in discussions around architectural quality. As the principles and the scorecard are guiding a multitude of diverse stakeholders from within and outside the architecture community, the specific content has been carefully elaborated in close collaboration with a variety of heterogeneous opinion leaders to provide meaningful guidance to all distinct perspectives and interpretations. In the future, the artefacts will be continuously refined by new insights from strategic directions and should feed the centrally-developed guidance into the architecture community to guide platform evolvement.

For this purpose, the vitalization and empowerment of the architecture community is one of the most crucial challenges for the EA team to foster close collaboration as well as cross-fertilization. An important step in this context has been the establishment of the mandate for all architects to enforce architectural quality in individual solution designs over other potentially contradicting interests. This authority is considered a vital step by the EA team to trigger the change in direction from a drifting II towards a digital platform. "What I do hope that we will not see happening in the future anymore is that project leaders […] take architectural decisions because of time-pressures, [or] budget constraints […] I think for these kind of situations we are in a good shape" (EA Director, LEGO Group).

While the development of the strategic directions is still on-going, the introduction of new EA design principles and the success scorecard in the architecture community are already making an impact on design decisions in the LEGO Group. For once, the two artefacts have triggered changes of mindset and discussions around architectural quality in the community. "I have already seen […] that it gives people the ability to take a step back and look at the decisions that we have made and actually question: 'Are they the right ones?'. And I was not really expecting that so much, but […] I am quite encouraged" (Head of Business-Enabling Technologies, LEGO Group). Additionally, discussions around the principles as well as the scorecard have also lead to revisions and modifications of actual solution designs under construction and their implementations are making the first impact on the overall system landscape. Nevertheless, these steps only constitute the small beginning of a long journey of transforming the LEGO Group's II into a digital platform.

5 Analysis

This section provides a detailed analysis of how the LEGO Group is embarking on path constitution to re-architect its drifting infrastructure and introduce transforming processes through collective action that will eliminate path dependencies and pave the way towards a flexible digital platform (c.f. Figure 2).

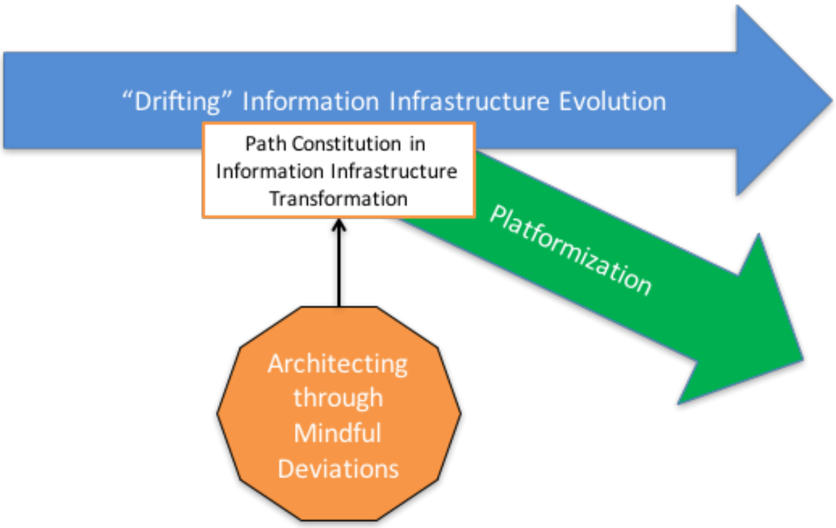

Figure 2. Conceptual Process Model: Creating a new 'Platformization' Path in the Transformation of an Information Infrastructure

5.1 Path-Dependence of Drifting Information Infrastructure

Before the establishment of cross-functional, long-term architectural guidance, the company's II evolved in a path-dependent process of functionally distributed actors bolting individual solutions onto the installed base to satisfy specific business requirements. As this process unfolded, tight coupling as well as architectural debt of the overall IT landscape increased. At the same time, the II's flexibility was incrementally reduced and progressively limited the company's options when implementing new IT solutions. This lead to an installed base that favored novel IT capabilities to be appended in the same architectural style as previous solutions, because the associated development effort was perceived inferior to what would have been required for more sustainable architectural designs. Since this behavior increased architectural debt even further, the process was self-reinforcing in nature.

Consequently, the organization was progressing on a socio-technical path of drifting II evolution (c.f. Hanseth, 1999) that was beyond the influence of human actors and incrementally reducing actionable technology options. In individual lock-in situations, this path lead to the implementation of artificially engineered solutions to stick to familiar systems despite the availability of more efficient alternatives.

5.2 Mindful Deviations and Path Creation

Particularly due to this socio-technical path dependence, the central architecture function has been intentionally designed with strong roots in the architecture community and composed of experienced architects from within the organization with deep knowledge on the II's installed base. Subsequently, the team mindfully deviated from existing structures and artefacts in several ways aiming for the establishment of a long-term sustainable architectural design framework that would create new transforming evolution paths in the system landscape and increase actionable technology options.

For once, against the predefined strategy of simply governing the platform architecture going forward, the team identified the need for fundamentally new strategic directions for integration, cloud adoption, and data. As the development of these strategies is met by resistance from individuals in the company, the architects are faced with the challenge to mobilize minds, span organizational boundaries, and co-evolve stakeholder minds with ideas (c.f. Garud & Karnoe, 2001). For this purpose, the team is involving key stakeholders into the strategy-development processes to create commitment and equally modifying ideas while at the same time challenging mindsets in the organization – well-aware that the outcome "from these processes may be very different from what was initially conceptualized" (Garud & Karnoe 2001, p.19). According to Garud & Karnoe (2001), the management of this tension between commitment and flexibility is a crucial challenge of path creation processes and carefully choosing the right extent of deviation is critical for success.

Another mean of deviation has been the development and maintenance of new architectural design principles. Although this deviation has occurred within the regular responsibilities of the function, the new artefact does constitute a breaking departure from existing practices and meanings that will impact the frames and actions of a large stakeholder audience (c.f. Garud & Karnoe, 2001). As with the strategy-development processes, the principles have been equally shaped through an engagement process of heterogeneous stakeholders that required architects to be persistent to their initial ideas while equally maintaining flexibility for modifications to reach superior outcomes. In this context, the ability to span boundaries and present " an idea in ways that are understandable by others" (Garud & Karnoe 2001, p.14) has been crucial to mobilize stakeholders and provide meaningful guidance to the architecture community.

By introducing the architecture design principles and the success scorecard to the organization, the team strives for the guidance of collective action to constitute a new path of platformization (c.f. Figure 2). This approach resembles the concept of installed base cultivation in II development and Rolland et al.'s (2015) approach for intentional cultivation of existing architectures over time. In contrast to installed base cultivation, which tends to view path dependencies as a near-inexorable force (Hanseth & Lyytinen 2010), however, the LEGO Group's approach is primarily focusing on the constitution of new paths through small incremental steps. The development of individual solution architectures within the system landscape will be guided by the central design framework and thereby make incremental contributions to the constitution of the overarching platformization path.

In this context, the attainment of the mandate to enforce architectural quality over other constraining factors in the design of individual solutions is a key deviation from predominant relevance structures in the LEGO Group to break away from the path of drifting II evolution. As both, the principles and the scorecard, are continuously refined based on results from the strategy-development processes, the routes of more fine-grained individual paths, which constitute the overall platformization path, will be subject to periodic change. Nevertheless, the overall direction will remain constant and gradually transform the system landscape into a purposefully architected digital platform.

Eventually, the generation of momentum around future directions was additionally amplified by the documentation of the current system landscape that emphasizes the need for change – not only to the architecture community, but also to senior management. The landscape documentation therefore elucidates the path-dependent nature of the II's evolvement and simultaneously supports the mobilization of minds for a new path trajectory.

So far, the path-creating impact of these deviations is mostly observable in terms of organizational momentum, mindset changes, and the redesign of several individual solutions. Even though these are just small steps in a large journey ahead, they indicate a clear junction from the II's previous development trajectory. The continuation of this transformation towards a digital platform will require the path's sustainment in the future.

6 Findings and Conclusions

The case evidence and analysis reveal how a company can re-architect its distributedly-managed, drifting II and trigger the incremental transformation towards a centrally-guided digital platform. This perspective contrasts the notion of extensive transformational programs. In the case of the LEGO Group, the need for this transformation emerged from corporate II's limited flexibility and the lack of cross-functional, long-term guidance of its development trajectory. By establishing and vitalizing an integrated, long-term architectural vision, the corporate II is brought under a central design framework and will subsequently be gradually transformed into a more flexible platform that will be better suited to enable the company's progressing digitalization journey. While previous case studies of the LEGO Group have elaborated on this journey in the wider context of the entire company (El Sawy et al. 2016; Andersen & Ross 2016), this research contribution provides a process model that explains the underlying architectural journey.

Particularly, the conceptualization of architecting as a process of path constitution elucidates how an organization can break away from the prevalent development trajectory of an II shaped by socio-technical path dependence. Such a perspective is relevant, as the existing research on II development has tended to see path dependence in II development as a near-inexorable force that cannot be overcome. In contrast, within the path dependence literature, active path creation by path-breaking development has increasingly been demonstrated to be a viable, and necessary, option for the long-term survival of an institution (Alvarez & Barney 2007; Garud et al. 2010).

While Ciborra (2000) emphasizes general lack of formative control in II development as well as evolution, this study acknowledges the infeasibility of top-down management by control but additionally proclaims the active influence by human actors under the recognition of emergent forces. Drawing on the concept of path constitution allows for the elucidation of this balance between constraining path dependencies and intentional path creation that actors need to manage when engaging in deliberate II transformation. The observations also confirm earlier findings by Rolland et al. (2015) who stress the path-dependent nature of architecture practices.

Additionally, this paper discloses in detail how the path dependencies of an existing II are addressed by individual actors mindfully deviating from existing structures to guide collective action and cultivate the installed base of the II through small incremental steps into the intended development trajectory. For this purpose, the case evidence explores which specific deviations the central architecture unit in the LEGO Group is embarking on to trigger the constitution of a new platformization path. By taking an insider's view on this process, the analysis shows that the creation of new paths in a traditional brick-and-mortar company requires not only the conquest of socio-technical path dependence in terms of IS (i.e. technology, tasks, and people), but also the modification of relevance structures and mindsets of stakeholders in the IT organization.

This observation stresses the significance of human agency in II development and underlines the importance of boundary spanning communication as well as the co-evolution of minds and ideas (c.f. Garud & Karnoe, 2001). To introduce path-creating II development, the battles need to be fought at the social level and changes, in terms of ways of thinking, need to be achieved first. Subsequently, through new strategic directions, principles, and other guiding communication, this allows for technical changes in the II to take place. In the LEGO Group, the hybrid setup of the architecture community as well as the pro-active engagement with key stakeholders ensure buy-in in the organization for architecture initiatives and prevent the architects from moving into an ivory tower. The findings therefore also support Singh et al.'s (2015) proposition that path constitution is equally emergent as well as deliberate in nature and may entail periods of stronger path-dependence, while offering opportunities for deliberate intervention by human actors at any time.

7 Limitations and Future Research

As in any research, this study is subject to limitations and validity threats that should be addressed in future research. For once, although the case evidence indicates a juncture in the current development trajectory of the LEGO Group's II, it remains to be seen if this path can be sustained and if the architects' deviations will truly create a path towards platformization. It is therefore impossible to evaluate how effective the disclosed deviations are up to this day and if the case evidence should be utilized to derive normative conclusions. Nevertheless, the paper takes an insider's view on path creation in the present and future research will address the significance of these interventions for the eventual path evolution. Eventually, this paper only presents evidence from a single case. Before generalizing any conclusions to a wider population of organizations, more evidence is required to evaluate, if other companies are facing equal challenges and are able to solve them through similar strategies.

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Research Paper #3

Törmer, R. L. 2018. “Internal Digital Platforms and Generative Mechanisms of Digital Innovation,” in Proceedings of the 39th International Conference on Information Systems.

Internal Digital Platforms and Generative Mechanisms of Digital Innovation

Completed Research Paper

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Abstract

As digitalization puts increasing competitive pressures on companies to innovate in the digital space, corporate information system (IS) landscapes are increasingly serving as platforms that facilitate the development of digital value propositions on top of existing data and functionality. Beyond the boundaries of a single firm, the enabling role of multi-sided digital platforms for innovation is a well-researched phenomenon. Internal digital platforms, on the other hand, have received less attention in the IS community. Their part in the quest for digital innovation remains unclear. In a critical realist research approach, this paper investigates the digitalization journey of the LEGO Group and identifies three generative mechanisms – modular upgradability, economies of substitution, and reproduction –, through which an internal digital platform enables speed and efficiency of digital innovation within a company. Based on Systems Theory, a holistic conceptualization of an internal digital platform is developed that unifies traditional enterprise systems with modern digital technologies. Consequently, the analysis elaborates how the interactions among these heterogeneous components shape digital innovation in a company and develops the generative mechanisms that together form a system-theoretic model. Furthermore, the findings reveal the strategic choice of granularity that companies are facing during design of individual platform components. Therefore, the study does not only contribute to IS theory, but also provides relevant implications for practitioners.

Keywords: Digital Platform, Digital Innovation, Generative Mechanisms

Introduction

While information technology (IT) has traditionally occupied a supporting role for organizations, new business models emerge that have digital components inseparably inscribed into their value proposition (El Sawy 2003). The economic and societal shift towards this digital paradigm is commonly referred to as "digitalization" (El Sawy et al. 2016, p.2). Companies able to capture the moment can seize opportunities from new ways of doing business, but the disruptive forces of digitalized business models also pose enormous threats on incumbent firms. Incumbents are therefore embarking on digital transformations to inject digital technology into physical products, gain agility to develop new products or services quickly, and leverage business ecosystems of digital partners for co-creation of value (Matt et al. 2015).

As companies increasingly compete based on digital value propositions, "the role of corporate IT infrastructures is likely to transform" (Yoo et al. 2010, p.732) to support distributed innovation by providing generativity for the integration of dispersed digital capabilities. In this context, Agarwal and Tiwana (2015) proclaim the evolvability of information systems (IS) as a strategic capability that organizational survival depends on. Simultaneously, digital transformation entails an increased orientation towards digitally-enabled, platform-based business models (Cusumano and Gawer 2002; Eaton et al. 2015; Eisenmann et al. 2011; Gawer 2014). Responding to competitive pressures from digital natives, traditional brick-and-mortar companies are therefore nowadays equally adopting digital platform strategies (Sebastian et al. 2017).

Nevertheless, the academic literature on digital platforms so far primarily focuses on multi-sided platforms (Gawer 2014) that enable semi-coordinated innovation between ecologies of firms (Baldwin and Woodard 2009; Eaton et al. 2015; Eisenmann et al. 2009; Selander et al. 2013). Conceptual and architectural similarities (Baldwin and Woodard 2009) tentatively justify the hypothesis that internal digital platforms (c.f. Gawer 2014) could produce an equal effect within the boundaries of a company. However, research on the effect of internal platforms on digital innovation remains scarce and with inconclusive results (Sedera et al. 2016). Internal digital platforms are different from multi-sided platforms as they integrate a multitude of heterogeneous "digital capabilities used throughout the organization to support its different functions" (Yoo et al. 2012, p.1400). Similarly, they serve more heterogeneous users – i.e. internal employees as well as external business partners (including customers). In contrast, multi-sided platforms are commonly investigated within the context of a single product or functional domain characterized by a clear platform owner who governs its architecture (Eaton et al. 2015). Therefore, the investigation of internal digital platforms presents promising research territory to appreciate how companies can foster digital innovation as well as to extend our understanding of how digital platforms in a more general sense can be architected to cope with functional and user heterogeneity.

Accounting for these characteristics, the Theory Development section of this research conceptualizes an internal digital platform as a company's holistic IS landscape (i.e. the collection of technology infrastructure, business logic, as well as data) that adheres to a modular design framework to ensure the (near) independence of its subsystems through standardized interfaces. Subsequently, the study sheds light on the following research question: *How does an internal digital platform enable digital innovation?*

This research question is addressed by an approach similar to analytic induction (Patton 2002). Based on the existing platform literature, the high-level proposition that internal digital platforms enable digital innovation in a company guides the empirical analysis of this research. Subsequently, a case study of the LEGO Group based on 18 months participatory observation and 20 complementary interviews is conducted to substantiate this claim and discover more fine-grained concepts and relationships that explain the phenomenon beyond the initial hypothesis. During this inductive analysis, Systems Theory perspective (Simon 1962) is applied to develop a conceptualization of an internal digital platform and guide data analysis as well as the identification of generative mechanisms that explain the hypothesized effect. Systems Theory is an expedient theoretical lens, since it allows for the analysis of how the inherent characteristics of a platform enable problem-solving in the real world, and subsequently the theoretical explanation of how these characteristics enable speed and efficiency of innovation through digital solutions. In combination, the deductive and inductive analyses yield three generative mechanisms (modular upgradability, economies of substitution, and reproduction) as explanatory propositions that together form a system-theoretic model of how internal digital platforms enable digital innovation.

The remainder of this paper starts with the introduction of Systems Theory as the theoretical research lens, a review of the academic platform literature, and a delimitation of digital innovation for the context of this study. After the presentation of the research method, the case evidence of the LEGO Group's ongoing digitalization journey is revealed. The subsequent analysis conceptualizes internal platforms based on Systems Theory and develops the theoretical model of generative mechanisms through which an internal digital platform enables digital innovation. Eventually the paper closes with a discussion, findings and conclusions.

Related Research

Systems Theory

Systems Theory has been established by Simon (1962) to describe and explain how complex systems of physical, biological or social nature emerge and evolve under the forces of natural selection. Specifically, the theory suggests that "complex systems will evolve from simple systems much more rapidly if there are stable intermediate forms than if there are not" (Simon 1962, p.473). This means that *hierarchic systems* consisting of nested subsystems are better-suited for survival in natural selection than non-hierarchic ones.

Specifically *nearly decomposable systems* – characterized by strong interdependencies within and weak interdependencies among subsystems – are particularly well-suited to "survive the fitness competition" (Garud et al. 2009). Simon (2002) argues that this strength directly results from the (near) independence of subsystems, such that each component can evolve through mutation, crossover and natural selection in isolation from changes in other subsystems.

The assembly of complex systems exhibits structural similarities with human problem-solving through selective trial and error (Simon 1962). To solve a problem, human beings commonly test multiple solution paths and leverage the observation of consequences to guide the continuous search process. Similarly, stable configurations in complex systems provide the basis for further composition and the information about them leads to a process of rapid evolution through *selectivity* (Simon 1962). At the same time, if a problem is similar to one solved before, humans simply apply the same solution paths that lead to earlier success and thereby minimize or eliminate the search process of trial and error. In complex systems evolution, this phenomenon resembles reproduction and the associated inheritance of essential component characteristics (Simon 1962).

In the context of man-made systems, the characteristics of a nearly decomposable system have been captured by the concept of modular architecture (Ulrich 1995). This architecture provides a scheme that maps each functional element of a complex system to exactly one subcomponent. Additionally, the architecture's design rules define decoupled interfaces between components to enable their compatibility through "specific thin crossing points" (Baldwin and Woodard 2009, p.23; Ulrich 1995). Analogous to weak interdependencies among nearly decomposable subsystems, decoupled interfaces ensure that changes made to one component do not require adjustments to other components in order for the overall system to work correctly. The modularity of a product or system allows companies to realize economies of scale as well as scope in production and simultaneously serve customer needs more closely through wider variety of potentially customized configurations (Baldwin and Clark 1997; Baldwin and Woodard 2009; Garud and Kumaraswamy 1995).

If a system or product additionally exhibits upgradability – i.e. if its higher order components do not constrain overall system improvements through innovation in lower order components (modular upgradability) – companies will additionally harvest economies of substitution (Garud and Kumaraswamy 1995). "Economies of substitution exist when the cost of designing a higher performance system, through the partial retention of existing components, is lower than the cost of designing the system afresh" (Garud and Kumaraswamy 1995, p.96). The associated organizational benefits include the reutilization of existing knowledge on retained components, savings in testing as well as production cost, shorter product development time, and continuity in customer experience (Garud and Kumaraswamy 1995). Additionally, modular upgradability creates competency-enhancing knowledge from designer's experience with the architecture and allows them to improve overall performance through component refinement based on customer-feedback (Garud and Kumaraswamy 1995). Furthermore, the retention and addition of distinct components enables companies to apply a real options approach to system development that minimizes the risk of compromising overall system integrity (Baldwin and Clark 2000).

Platforms

The academic literature on technological platform management mainly consists of two separate research strands. On the one hand, the economic theoretical perspective has conceptualized platforms as two-sided markets and has produced insights on platform competition. In this vein, platforms act as conduits of market transactions that drive transaction efficiency and reduce search costs in the exchange of goods and services (Gawer 2014; Thomas et al. 2015). One of the most central issues in this context has been the establishment of platform leadership in a business ecosystem through effective governance mechanisms, such as boundary resources (Baldwin and Woodard 2009; Eaton et al. 2015; Gawer 2014).

The technological engineering perspective, on the other hand, studies platforms as technological architectures that drive platform innovation (Gawer 2014). For this purpose, they are classified into stable core and variable peripheral components that interact via standardized interfaces (Baldwin and Woodard 2009). This conceptualization explains how modular architectures spur product variety by providing a technological architecture to innovate upon in production and design (Eaton et al. 2015; Gawer 2014; Ghazawneh and Henfridsson 2013; Selander et al. 2013). This architecture may be used only within the boundaries of a single company or across several organizations. Gawer (2014) accordingly distinguishes between internal platforms, supply-chain platforms, and industry platforms.

In the context of IS, the platform concept is increasingly utilized to conceptualize how individual companies can holistically structure their landscapes of IS to effectively enable business in a digital age (El Sawy et al. 2016; Sebastian et al. 2017). Specifically "the proliferation of digital tools or digital components allows firms to build a platform not just of products but of digital capabilities used throughout the organization to support its different functions" Yoo et al. (2012, p.1400).

Recent evidence suggests that internal enterprise platforms, including enterprise resource planning (ERP) systems, play a key enabling role in leveraging digital technologies for innovation (Henfridsson and Bygstad 2013; Lokuge and Sedera 2016; Sedera et al. 2016). Particularly large-scale IS "are increasingly serving as a platform to which other tools can be added in order to take advantage of shared data and resources" (Yoo et al. 2012, p.1400). Sedera et al. (2016), on the other hand, reveal that not all enterprise platforms are suitable to support digital platform innovation and their impact remains unclear (Jansen et al. 2006).

As a consequence, the critical, enabling role of IS platforms for digital innovation has been recognized, but little is known about the individual causal effects by which this process unfolds. This raises difficulties for researchers to explain ambiguous research results and for practitioners to design platforms effectively. Therefore, an in-depth investigation of the underlying mechanisms at work in this phenomenon are relevant for the IS community. Drawing on Systems Theory and the technological engineering perspective from the platform literature, the Theory Development section conceptualizes internal digital platforms.

Digital Innovation

The enabling role of a company's IT resources for producing innovation outputs has been subject to previous research in the IS literature on the value of IT (e.g. Bhatt and Grover 2005; Joshi et al. 2010; Pavlou and El Sawy 2010). Instead of architectural characteristics of IT resources, however, these research approaches mainly find the use of specific IT resources or the possession of complementary organizational capabilities to be an antecedent of innovation. Yoo et al. (2012, p. 725), on the other hand, express that digital innovation "requires a firm to revisit its organizing logic and its use of corporate IT infrastructures".

This research adopts a broad conception of digital innovation to include not only digital product and service innovation, but also process innovations in management and operations. The definition of Crossan and Apaydin (2010, p.1155) is borrowed that defines innovation as "production or adoption, assimilation, and exploitation of a value-added novelty in economic and social spheres; renewal and enlargement of products, services, and markets; development of new methods of production; and establishment of new management systems". Accordingly, digital innovation will always produce improvements in process efficiency (i.e. time or cost) or product effectiveness (high-quality new products; c.f. Pavlou and El Sawy 2010). Along with new-to-the-world innovations developed within a company, this definition also includes reproduced or imitated innovations from outside the organization. Following Yoo et al. (2010), the definition is, however, delimited to only those novelties that rely on digitization – i.e. the encoding of analog information in digital format.

Research Method

This research adopts a critical realist approach to understand the underlying mechanisms that constitute an internal digital platform's enabling effect on digital innovation. Generative mechanisms in terms of causal structures or laws are at the heart of explanatory theory in the stance of critical realism (Archer et al. 2013). This perspective is rooted in the philosophy's combination of a realist ontology with an interpretive epistemology (Mingers et al. 2013). As a consequence, there is a conceptual separation between "a domain of causally operative structures or systems; the events that they generate; and those events that are empirically observed" (Mingers 2004, p.8). Generative mechanisms originate from enduring physical, social, or conceptual entities that have powers or tendencies to act in specific ways (Archer et al. 2013; Mingers 2004). These causal laws continue to exist even if they may not always be observable in the form of empirical regularities (Bhaskar 2013; Mingers et al. 2013).

Critical realism is based on the recognition that knowledge is socially constructed and its creation is a process that builds upon existing theories and research results to generate new insights (Mingers 2004). To account for this view, this study follows a research process similar to analytic induction (Patton 2002), which exhibits close resemblances to what Archer et al. (2013) describe as retroduction (Mingers 2004). Based on the existing platform literature, the starting point of the study is a general proposition that internal digital platforms enable digital innovation within companies. Subsequently, a case study (Dubé and Paré 2003; Yin 2013) is conducted to substantiate the claim with empirical data and describe the process through which the effect unfolds. The inductive analysis of the case data furthermore allows for the discovery of more fine-grained concepts as well as relationships that form the generative mechanisms, which explain the phenomenon in the real world. Eventually, these mechanisms are formulated in the form of three propositions that together build a system-theoretic model.

The platformization initiative in the LEGO Group was selected as a case for investigation, since it exhibits the typical contextual conditions that emphasize the criticality of an internal platform for digital innovation. The company's IS landscape is being challenged to cater for a rapidly-changing business environment populated by existing and new competitors that apply digital technologies to reinvent value propositions, customer interactions, business processes as well as complete business models. Based on the foremost physical value proposition and the simultaneously growing need for digital innovation, the case allows for the identification of enabling mechanisms in both, the traditional world of manufacturing and the modern world of digital products, services, as well as customer engagement. More generally, the case evidence reports on a well-functioning company that has been recognized as an industry-leader in digitalization (El Sawy et al. 2016) and is making substantial investments into the transformation journey.

The study is built on three sources of evidence. The primary source entails direct participant observation data (c.f. Yin, 2013) by the author, who for 18 months acted as an integrated member of the LEGO Group's Enterprise Architecture (EA) team on site at the group's headquarters in Billund, Denmark. Observations focused on actions, decisions, events, trade-offs, as well as opinions and were documented in a structured diary (c.f. Baskerville and Wood-Harper 2016). The 70 diary entries containing multiple pages each were collected in a case database and each grouped by direct observations, reflections on observations, plans for future research, and supporting diagrams, drawings, or mind-maps. As Baskerville and Wood-Harper (2016, p.184) point out, "data validity is a problem in these techniques, partially because of the interpretive nature of the data, but also because of the intersubjectivity of data capture". The research subjects are not only observed, but actively influenced by the researcher. To address this threat to validity, 20 semi-structured interviews with key informants are used as a secondary source of evidence (c.f. Ritchie et al., 2013; Yin, 2013). The interviews were conducted on the company's premises and supported by an interview guide containing open-ended questions. While some interviews focused on the current architecture state of the company's IS landscape, others captured the on-going transformation journey or zoomed in on the specific characteristics of the IS landscape that enable or constrain architects in the development of new solutions. The informants mainly include Enterprise or Solution Architects, Platform Managers, as well as senior stakeholders, such as Vice Presidents. All interviews were recorded, transcribed and added to the case database. For the purpose of further triangulation, company-internal documents, such as reports, presentations, emails, and architecture documentation, form the third source of evidence (c.f. Yin, 2013).

The research process started with a broad review of the relevant platform literature. Based on the initial hypothesis that internal digital platforms enable digital innovation within companies, data collection in the case company and reflection passed into a theoretical analysis of the observed phenomena to explain "what the world must be like for this to occur" (Mingers et al. 2013, p. 796). The observation that all software systems and digital components in an IS landscape can be conceptualized as clusters of functionality of distinct sizes that solve a specific problem in the real world lead to the adoption of Systems Theory as a theoretical lens.

Inspired by the emergence of complex hierarchical systems, the subsequent analysis focused on the granularity of individual IS landscape components and how they evolve to address individual business problems in the real world. Based on the recognition that isolated parts of the case company's IS landscape conform with the emerging conceptualization of an internal digital platform, while others do not, the investigation examined how the inherent characteristics of the 'platformized' subsets enable speed and efficiency in developing novel digital products or services. This phase relied on paragraph-level coding of the collected evidence for platform characteristics and causal relations to speed or efficiency in developing digital solutions. Generative mechanisms may be "possessed, unexercised, exercised, unactualized and actualized independently of human perception or detection [...] depending upon the play of countervailing mechanisms" (Archer et al. 2013, p.6 ff). Therefore, the analysis sought to identify causal structures beyond observable events based on architects' experience with the IS landscape. This resulted in three generative mechanisms that subsequently gained support by examining the absence of their effects in the 'un-platformized' parts of the IS landscape. In addition, the analysis revealed preliminary insights into the interplay and tensions between the mechanisms. Eventually, the findings were used to create a preliminary case narrative that was assessed by the key informants to evaluate its representativeness (c.f. Yin, 2013). As their perceptions barely differed from the evidence and explanations provided in the narrative, only minor adjustments were required.

Case Evidence

As one of the first brick-and-mortar companies in the world, the LEGO Group made digitalization a fundamental pillar of the overall business strategy already in 2012. To meet present and upcoming challenges, the long-term vision for the toy manufacturer from Denmark is to create a highly adaptive organization, which collaborates closely with external partners to harness an ecosystem of platforms to co-create innovation. Since the implementation of this agenda placed heavy demands for novel functionality on the company's enterprise systems (ES), the need for a new platform architecture became apparent to create the foundation for the company's future digitalization journey (El Sawy et al. 2016).

The LEGO Group's Current IS Landscape

The LEGO Group's physical value proposition relies on a mature operating model that is implemented in a core of largely non-redundant ES to enable efficient operational transactions through globally standardized and integrated business processes (c.f. Figure 1). "*The centerpiece of our architecture is built around our SAP capabilities [, which] support almost, if not all, business processes within the LEGO Group. So they are the heart of our landscape. Around that, we have more specialist or specific capability features provided by different kinds of systems […] A lot of the systems that we use are to some extent relying on information coming from our core SAP systems*" (Enterprise Architect (EA) Director, LEGO Group).

The reliance on off-the-shelf ES has been a strategic choice in the company to leverage externally-created systems or modules and tailor them towards specific needs through configuration and customization. Thereby, system support for core enterprise processes is established faster and cheaper than it would be possible through in-house development. "*What makes us believe that we as the LEGO Group are better able to build an ERP system than the likes of SAP, Oracle, Microsoft, Safe, whoever you can find in the ERP market. […] Sometimes we believe that we are also a software-developing house. But that should not be for the core functionalities that you can buy in the market*" (EA Director, LEGO Group).

The establishment of technical and business process integration among distinct landscape components relies on several mechanisms. "*From a transactional mindset, we have been able to utilize the SAP platform to a very high degree, meaning that it is the built-in ways of integrating modules that has been utilized*" (Senior EA, LEGO Group). While integrations among core SAP systems are established through proprietary point-to-point (P2P) connections, the reuse of data and functionality by other systems relies to a large extent on a custom-developed, batch-based integration system. "*We developed that before Enterprise Service Buses (ESBs) really came into the marketplace. So there we worked with a data provider and a subscriber concept. And a lot of systems around our landscape, they subscribe to some sort of data coming out of [… the ERP system], where all data is born and raised […] But when [the integration system] stops for whatever reason, it does not take long before the other systems cannot work. So you can say that is tightly coupled*" (EA Director, LEGO Group). Accordingly, the integration system "*can be used in many cases, but for API- (application programming interface) or service-based architecture, it is not that well-suited*" (Senior EA, LEGO Group).

Therefore, very few siloed parts of the landscape have started to rely on decoupled API-based integration – either pier-to-pier (P2P) or via a central ESB. In addition to very few core enterprise components, such as manufacturing, engineering, and supply chain management, API-based integration is mainly applied in consumer- and customer-facing experiences in the periphery of the landscape.

While this IS landscape has been the foundation for an extremely successful operating model that enabled the company's double-digit growth for more than a decade after 2004, technical complexity is increasingly limiting its upgradability and evolvability. For once, the abundance of tight coupling among ES limits the speed of implementing changes or system upgrades due to ripple effects and the subsequent need to modify other landscape components as well. "*We have global processes, global solutions. That brings in a lot of advantages that things are integrated and tied together, but [...] because of this huge, tightly integrated, tightly coupled solution, we have difficulties with reacting fast. Our change request process takes forever. An upgrade takes a long time*" (EA Director, LEGO Group).

In addition to tight coupling among landscape components, the customization and extension of existing off-the-shelf ES additively hinders the implementation of changes or upgrades. "*We buy a lot of software, but we also abuse the same amount of software [...] So we modified the code. [...] But it provides a nightmare every time we need to do an upgrade. That are long periods of time*" (EA Director, LEGO Group).

Furthermore, the LEGO Group's IS landscape is currently challenged with increasing needs to integrate purpose-specific and potentially cloud-based applications and services into the IS landscape quickly. "*Most companies that are in the retail or consumer-facing sector are very much moving away from that monolith concept and towards the whole idea of micro-services and contact solutions*" (Head of Engagement Technologies & Analytics, LEGO Group). "*I have seen a major shift from best-of-suite to best-of-breed. And this means that you are looking at other third-party software vendors and their ways of handling certain business processes. And this is also shifting the need of how to integrate. [...] This is very much driven by the whole paradigm of using services and APIs*" (Senior EA, LEGO Group).

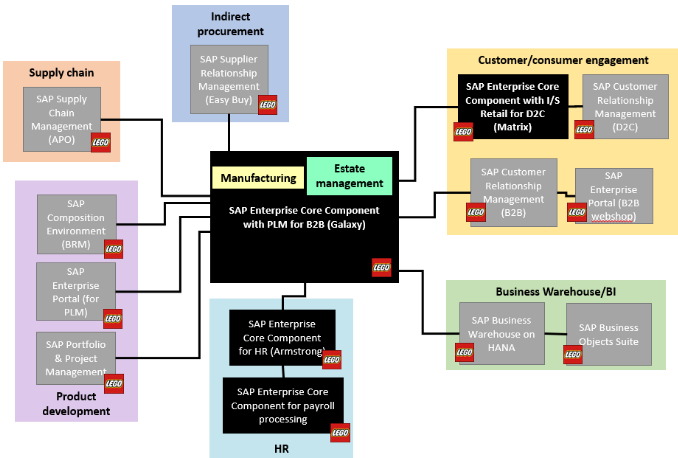

Figure 1. The LEGO Group's core enterprise systems excluding surrounding components

The LEGO Group's landscape architecture results from the fact that architectural decision-making in the company has previously not been managed from a global perspective to focus on the long-term flexibility and evolvability of the IS landscape. Over the years, the existing IT principles had largely grown obsolete and other influencing constraints, such as cost or functional requirements, have often been prioritized over architectural considerations. Therefore, design decisions did often not follow a coherent architectural framework and were largely shaped by choices of autonomous departments that were prioritizing local demands. According to the Head of EA, "*there has been wild freedom to operate from an architectural point of view. [...] Because we had a distributed EA landscape before, [...] nobody took the end-to-end responsibility of those priorities that go across the platform. [...] We did have a capability within the organization [...] BRMs and what were called EAs, but [...] they weren't actually doing EA. They were people doing solution architecture for each of the different vertical areas*" (Head of EA, LEGO Group).

Platformization in Silos

In some instances, however, a consistent architecture within isolated parts of the overall landscape did result in locally-optimized platforms that enable flexibility and evolvability. In the context of core ES, very few systems, such as a 3D model repository system, rely on decoupled integration via APIs to allow for the implementation of upgrades, or changes without implying ripple effects on other landscape components.

Particularly in the periphery of the landscape, the so-called consumer engagement platform emerged that allows for the rapid development of content-based digital experiences and a two-way interaction with customers as well as consumers. The Director for Consumer Marketing Platforms (CMP) explains: "*Our department's platform [...] was actually made to support the LEGO.com strategy that was coined four years ago. And that had a COPE – create once, publish everywhere – focus. We created a stack where we had, what we call, content catalogues [...] at the bottom that were created with text, images, videos, and relations to other content objects. Then we indexed that in a search engine aggregated with other sources and make that available through APIs. And on top of that, we have some experience-related microservices that the different experiences then can get data from*" (c.f. Figure 2; Director for CMP, LEGO Group). The platform does not only feed digital experiences with content, but also allows for the collection of user-generated content (UGC), which then feeds the company's big data engine to derive insights.

Over the years, the platform has produced distinct digital experiences, including the LEGO Group's websites for children and adults, distinct games and various TV apps. Most prominently, the LEGO Life app was launched in early 2017 as a fun, creative, engaging, and not least safe social network for children. In April 2018, the app had been downloaded six million times and every month upwards to a million children are sharing their LEGO creations, playing online, and engaging with other users around the world. As icing on the cake, LEGO Life has been rewarded with two Webby Awards – a leading award program honoring excellence on the internet. The social network has also contributed to the LEGO Group's nomination as one of the top ten most innovative companies in consumer electronics by Fast Company.

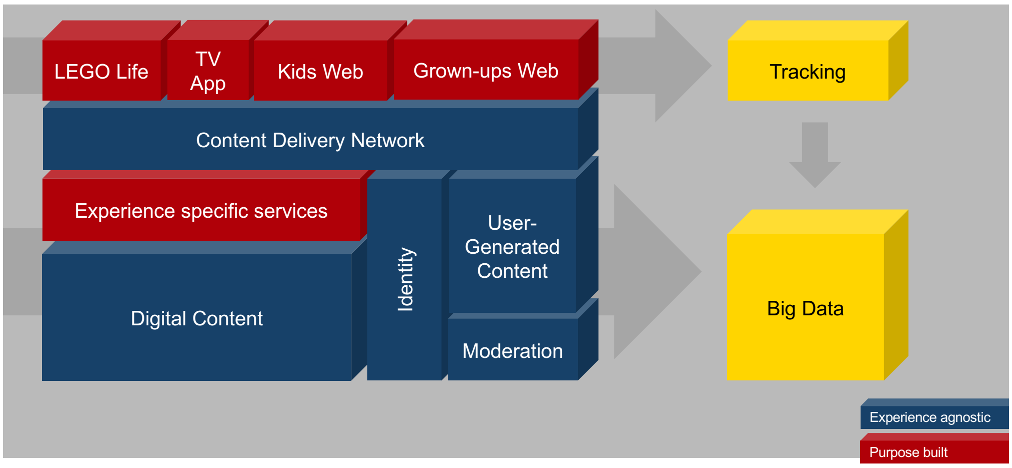

Figure 2. The LEGO Group's consumer engagement platform

The initial development and continuous improvement of these digital experiences is enabled by the platform's architectural design as well as the corresponding organizational structure. "*As a technician, we see a lot of buzz-words come and go. And yes, we articulated that our platform is a micro-service platform. [...] We try to minimize dependencies between products and communicate through APIs and that is what drives the agility within the platform. But yes, that somehow correlates with the term micro-service architecture [...] Our whole setup as an organization is towards providing as much decision-power to individual teams as possible, so they can execute. And that is both, on technology decisions, but also on technical dependencies*" (Director for CMP, LEGO Group).

On the one hand, this architecture allows product teams to introduce changes to individual experiences or services in isolation from other platform components. "*We run continuous delivery. [...] If you did not have an API-based infrastructure, then I do not think that is possible, because it would mean too many versions of testing [...] If you look at this picture [c.f.* Figure 2*], if all of these components were hard-coded against each other, so if you even change a little bit in moderation, you would have to change something in the* *app, even though it has nothing to do with each other in daily life. So that's going to be very tough. [...] So all the backend services, [...] we deploy whenever it makes sense for us to redeploy something. And because it is API-based, as long as you do not do a breaking change in the API, it should continue fine*" (Head of Big Data Engineering, LEGO Group).

On the other hand, the elimination of dependencies furthermore allows for service-reuse across experiences. "*When LEGO Life came along, we just created a new experience-specific microservice to cater for that specific need and then we reused the whole stack underneath. And obviously, LEGO Life also had other requirements towards functionality and then we built that as micro-services on the side*" (Director for CMP, LEGO Group). The reuse of services saves valuable development time and thereby also reduces the cost of introducing novel experiences. "*It allows you to not only do things faster, but also saves you quite a lot of development time, but also cost. [...] You just pay for the scaling, you do not pay for the redevelopment and the redeployment of a tool*" (Head of Big Data Engineering, LEGO Group). As a consequence, the Kids Web – a content-based and mobile-optimized web experience – was for instance implemented within one month based on the reuse of underlying services. "*We only did a specific slice of the content services already made available for LEGO Life, we just tweaked it a little bit, published a new endpoint specifically for this experience. And then it was only a front-end task. [...] It is only an experiment. But we are going to iterate on this and they are going to release multiple times a week to make this a better experience*" (Director for CMP, LEGO Group).

Despite the tremendous benefits that arise from service reuse, the architecture design entails an inherent trade-off between reusability and the ability to introduce changes to individual services or experiences in isolation. "*If multiple experiences are pulling on the same service and you need to change the interface out towards those experiences, then it gets really ugly, because then you need to update all of those experiences or versions or whatever you do. [...] You need to find the right place to actually have reusability where you get the benefit. It is a trade-off*" (Director for CMP, LEGO Group). Therefore, some of the platform's components and services are designed for specific use by an individual experience, while the vast majority is experience-agnostic.

Simultaneously, the department purchases as many parts of the technical stack as possible from external cloud providers – ranging from infrastructure-as-a-service (IaaS) to function-as-a-service (FaaS). Some of the platform's components are moreover based on externally-developed systems that are adopted in standard form and tailored towards specific needs through reuse. This strategy enables product teams to develop experiences quickly, since they only need to design those services that cannot be bought from providers. "*When we are in the cloud, we are standing upon the shoulders of giants. [...] We are reusing a lot of managed services and just purpose-fitting it on the top. [...] Some of the service is bought, some of it is built, and the content is ours*" (Director for CMP, LEGO Group).

Towards a Holistic Internal Digital Platform

Due to the architectural differences between core ES and the consumer-facing engagement platform, the two landscape components have previously been regarded as separate platforms within the LEGO Group as well as in case study research (c.f. El Sawy et al. 2016; Sebastian et al. 2017). The architectural disparity of the two worlds makes the global reuse of data and functionality particularly challenging. Product data is, for instance, hand-carried from the enterprise product lifecycle management system into the product catalogue of the consumer engagement platform, since the establishment of appropriate APIs on the enterprise side would be too cumbersome to justify the effort in the short run. "*That is error-prone. [...] We see some pains here and it is tedious work and you need to do it every half year, because we have new products and so forth. [...] As you can see, some of this is designed around the core, because the core is a problem – or was a problem*" (Director for CMP, LEGO Group). At the same time, some functionality, such as the emission of LEGO VIP loyalty points, does integrate from engagement experiences into the core ERP system. These integrations rely on tight coupling, such that the implementation of change is, again, slowed down by subsequent ripple effects. "*SAP [...] was never meant to do what the LEGO Group made it do – which means, because of the tight coupling, it becomes very hard to do anything without changes in both systems*" (Head of Big Data Engineering, LEGO Group).

While the conceptual distinction between enterprise and engagement platform still has its purpose in the company, a more integrated platform view is currently on the rise (c.f. Figure 3). "*I see [the distinction] to some extent applied in our organizational structure. [...] From a system perspective, we do not necessarily* *make that hard of a differentiation anymore […], because they are more and more learning that they rely on each other. We need to collaborate, we need to make the systems interchangeable, make the systems work together, talk together, share information*" (EA Director, LEGO Group).

At the same time, core ES are slowly adopting similar architectural characteristics that were previously exclusively applied in the engagement world. "*On the enterprise part, we like to apply more of the principles and the ideas of what you would do more in an engagement world. On the engagement part, we see that in order for them to work properly, they need a lot of data and integration with the enterprise platform*" (EA Director, LEGO Group). Currently, this is primarily evident in the LEGO Group in terms of a new integration strategy for core ES focusing on decoupling and interaction via APIs to enable more flexibility in the core, but also to provide agility towards the periphery of the IS landscape. "*I have a strong feeling that a big paradigm shift is coming to us. […] Things are kind of shifting now and the technology stack is moving in a way that we can use it for whatever purpose. So it is more your ability to orchestrate and to use your components that can create an integration-scenario that fits various purposes – both, experience-based as [well as] your enterprise*" (Senior EA, LEGO Group).

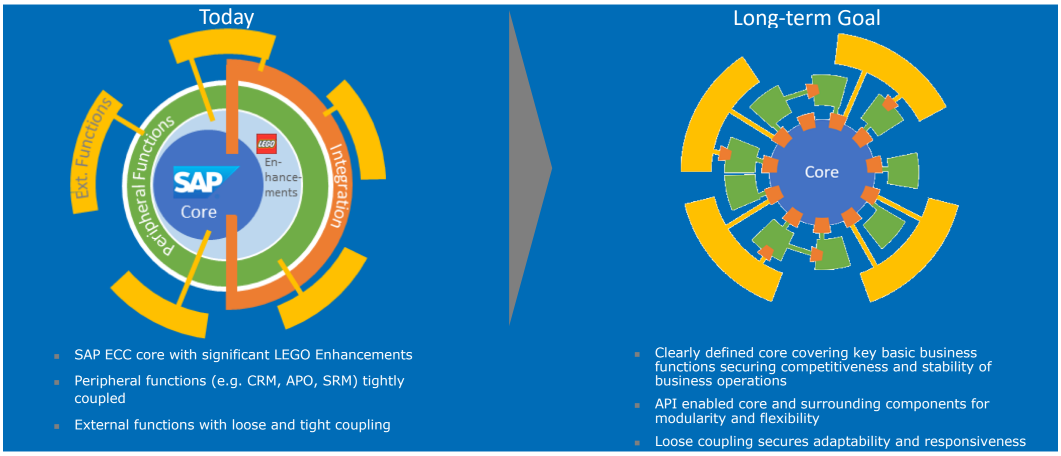

Figure 3. Long-term platform goal in the LEGO Group

Additionally, digital SMACIT (social, mobile, analytics, cloud, and Internet of Things - IoT) components are slowly becoming evident in and around the company's core ES. The collection of sensor data in operations, for instance, is based on a cloud-based micro-service architecture that combines data from distinct ES to provide insights into the operation of production machinery as well as quality control. Other examples include mobile business applications or social components in ES. "*We see that nowadays in the way we use Yammer and we started to use Microsoft Teams internally to collaborate, you see these kinds of capabilities coming more and more also from larger software components that we are looking at. […] The way we will collaborate three to five years from now will be different than today*" (EA Director, LEGO Group). Particularly the upcoming end-of-maintenance of the LEGO Group's SAP suite in 2025 and a corresponding replacement strategy are expected to provide a big step forward in this journey.

An integrated platform architecture designed from a long-term, end-to-end perspective will enable the LEGO Group to realize the benefits on a global scale that have until now only been witnessed within silos. However, the current IS landscape imposes some barriers to the speed of digital innovation in core ES and towards the periphery of the landscape.

Theory Development

Drawing on Systems Theory and the existing platform literature, this section provides an analysis of the case evidence and reveals three generative mechanisms, by which internal digital platforms enable speed and efficiency of digital innovation within companies.

A Systemic Perspective on Digital Innovation

For this purpose, the conceptualization of an internal digital platform starts with a company's IS landscape containing the collection of all technology infrastructure, business logic, and data that serves internal employees and external business partners. This set includes more traditional ES, such as ERP systems, but also modern SMACIT technologies. Existing research on digital transformation and innovation has tended to maintain a conceptual distinction between digital technologies and a company's ES (c.f. Sebastian et al. 2017; Sedera et al. 2016). However, as vendors increasingly design SMACIT technologies into the core of their offerings, traditional off-the-shelf ES are nowadays incrementally penetrated with the traits of digital technologies. Examples include, but are not limited to, real-time, in-memory analytics in ERP systems, cloud-based enterprise platforms, and the application of IoT in operations. Therefore, the two worlds are increasingly blurring and a conceptual distinction is not maintained in this study.

Instead, the conceptualization by Hanseth and Lyytinen (2010) is adopted in this study that defines a platform as a large-scale, socio-technical system that consists of a set of IT capabilities, is emergent in nature, and evolves dynamically to serve initially unknown user needs. A platform is built into a design context, which remains under central control by a design framework of architecture principles (Hanseth and Lyytinen 2010). This framework provides an architectural scheme that defines the mapping of functionality to subsystems and the standardized interactions between them (Baldwin and Clark 1997; Ulrich 1995). For the purpose of this research, a company's IS landscape that adheres to such a global design framework will be conceptualized as an internal digital platform. A digital platform is accordingly a complex hierarchical system made up of a core of stable subsystems and a periphery containing subsystems that are more variable over time (Baldwin and Woodard 2009).

A company's IS landscape is by definition a complex hierarchical system "that is composed of interrelated subsystems, each of the latter being in turn hierarchic in structure until we reach some lowest level of elementary subsystem" (Simon 1962). The overall landscape may consist of several large-scale ES, each consisting of multiple modules and applications, but may also include several standalone components on the first sub-hierarchy of the complex system, such as a single-purpose software-as-a-service (SaaS) application or an isolated micro-service. This means that the span (c.f. Simon 1965) of the overall system will be very high in most companies. Despite the severe differences in size, all of these subsystems share the commonality of being complex hierarchical systems in themselves. Moreover, subsystems on the lower levels of the hierarchy will be more granular. For illustrative purposes, a software component, software class, or even a line of code may be considered on a very low level. For the analytical purpose of this study, however, an application or a micro-service is the lowest expedient subsystem to consider. Accordingly, the analysis implicitly focuses on the application or service layer of the technical stack and assumes hosting infrastructure as well as network connectivity as given elements, if not stated otherwise.

The first generative mechanism is rooted in the need for interactions among individual subsystems, which evoke functionality and exchange data via certain interfaces to fulfill the purpose of the overall IS landscape. A mobile app may, for instance, call functionality of an ERP system to perform a transaction or retrieve master data. If a company's IS landscape follows a common architecture framework that enables these subsystems to interact via decoupled, stable, and standardized interfaces, the overall system is modular (Ulrich 1995). Following the conceptualization of this study, the IS landscape is then by definition a digital platform (Hanseth and Lyytinen 2010).

In addition to subsystem compatibility, a modular architecture will also standardize subsystem interactions and minimize mutual dependencies. Moreover, the architecture framework will avoid system redundancies by mapping functionality to subsystems in a bijective function (Ulrich 1995). Consequently, individual changes will require the modification of only one subsystem and may be implemented without creating ripple effects on other subsystems. This implies that the performance or functionality of higher-level assemblies can be improved through the refinement of individual lower-level subsystems. In a digital platform, individual components, such as a singular micro-service or a larger-scale enterprise application, may be refined, tested, and deployed in isolation eliminating the need for the same procedure on the entire platform. Hence, the platform will allow for more rapid and efficient implementation of innovative changes.

The LEGO Group's IS landscape described in the case evidence does not fulfill the conceptualization of an internal digital platform presented here, since it does not follow a common architecture framework and its subsystems do not interact via decoupled, stable, and standardized interfaces on a global scale.

Nevertheless, siloed parts of the overall IS landscape reveal the first generative mechanism's effect. On the one hand, the lack of modular upgradability due to tight coupling in core ES impedes digital innovation in the company by slowing down the implementation of changes or upgrades in individual subsystems. On the other hand, the isolated section of the consumer engagement platform does conform to the internal digital platform concept. In this area, it is particularly the ability to implement and deploy changes to individual micro-services in isolation from other platform components that enables speed and efficiency in the development of digital experiences. By revealing the generative mechanism's effect in parts of the IS landscape and its absence in other parts, the evidence provides support for proposition one:

P1: An internal digital platform enables speed and efficiency of digital innovation in a company through modular upgradability of individual subsystems.

It is important to emphasize that an internal digital platform may still contain individual subsystems that follow a distinct design framework incompatible with the global one. An off-the-shelf ERP system, for instance, may follow a vendor-defined architecture that aims for customer lock-in within a suite. In the analysis of a company's internal platform, these subsystems are then considered monolithic or integral in themselves and will constitute the "elementary subsystem" (Simon 1965, p.16). Nevertheless, the platform construct adopted in this study requires that the interactions among these elementary systems still conform to the architecture scheme of the overall platform. Another elementary subsystem is, for example, a micro-service that only consists of several lines of code and potentially a data source.

The second generative mechanism is based on the option to assemble new intermediate subsystems by reusing functionality and data from existing software systems, such as micro-services, individual applications, or large-scale ES that expose individual functionality via APIs. The existing components thereby constitute stable subassemblies that provide a specific solution to a known problem in the real world – e.g. a business process step or a customer experience. If a company faces a heretofore unsolved business problem whose digital solution promises value-creation, the problem can simply be reduced to a combination of previously solved ones – "to show what steps lead from the earlier solution to a solution of the new problem" (Simon 1965, p.480). These solution steps are subsequently implemented in one or several novel subassemblies and eventually slotted together in combination with pre-existing subsystems to create ("new to the world") digital innovation. Due to the infancy and instability of the newly developed components, this innovation will by definition occur in the periphery of the platform, despite potential reuse of subsystems from the core. The reliance on stable subassemblies for known problems enables selective trial-and-error (c.f. Simon 1965) or rapid prototyping for novel business problems. By relying on the partial retention of existing components, the company is able to realize economies of substitution and innovate with higher speed as well as efficiency. In addition, the freshly emergent intermediate subsystems form the stepping stones for future solution approaches to build upon.

This mechanism is particularly evident in the customer engagement platform of the LEGO Group. By relying on a foundation of existing subsystems (i.e. micro-services) that each provide a solution to a real-world problem, product teams are able to approach new problems by comparing them to previously-solved ones. The examples of LEGO Life and LEGO Kids Web revealed in the case evidence illustrate that the development of new digital experiences is not only faster, but also cheaper, if pre-existing services can be reutilized. At the same time, lack of modularity in the LEGO Group's core ES impedes economies of substitution when relying on their functionality or data. This observation implies that the mechanism's effect in the LEGO Group would be amplified by a holistic internal digital platform, that ensures global subsystem interactions via decoupled, stable, and standardized interfaces. The case evidence therefore provides support for the second generative mechanism described in proposition two:

P2: An internal digital platform enables speed and efficiency of digital innovation in a company through economies of substitution in the periphery.

Although Garud and Kumaraswamy (1995) argue that modular upgradability is a necessary precondition for realizing economies of substitution, the two concepts play disjunct roles in enabling digital innovation in the platform context. Modular upgradability refers the incremental refinement of existing solutions to business problems and describes the ability to deploy individual subsystems in isolation. Economies of substitution, on the other hand, emphasize the idea of reuse and describe the economic benefits of doing so when solving novel business problems through combinatorial innovation (c.f. Yoo et al. 2012).

The third generative mechanism starts with the recognition that designing a system through partial retention of existing components will not always be cheaper than building (or buying) a system from scratch (c.f. Garud and Kumaraswamy 1995). In these cases, a company will not be able to realize economies of substitution. Particularly additional initial design costs of creating components for reuse instead of one-time use may not be justified in the ES context. For instance, the in-house development of an ERP system based on granular micro-services for reuse only makes sense for very few manufacturing companies in the world. This fact results from the availability of off-the-shelf software systems or cloud service offerings by vendors that develop best practice digital solutions to known business problems experienced by a larger population of companies. Economies of scale enable the vendors to offer solutions at a lower price than a client's in-house development cost of comparable solutions. For known and stable business problems experienced by a multitude of companies, the in-house development of custom solutions is therefore not expedient. Instead, companies rely on "reproduction" (Simon 1965, p.473) of the corresponding solution, either through purchase of an on-premise system or the adoption of a vendor's cloud offering. Both alternatives could, in turn, be part of a vendor's product platform.

This innovation will initially always occur in the periphery of the platform. If the corresponding solution is solely used for a limited period of time, it may never move closer to the core. However, off-the-shelf software components are commonly used for an extended period of time after purchase and may therefore become part of the platform core. This mechanism allows companies to leverage digital innovation efficiently through reproduction – not only by means of a system's initial purchase and adoption, but also by leveraging subsequent continuous upgrades that are commonly provided by vendors. These upgrades ensure the continuous optimization of performance within individual subsystems and contribute to the overall evolution of the company's digital platform. The extent to which a company can benefit from digital innovation through reproduction critically hinges on the ability to integrate externally-created subsystems into the internal platform architecture. This ability benefits from the modularity of both, the internal digital platform and the subsystem to be integrated. Furthermore, performance improvements through vendor-provided upgrades depend on the modular upgradability of the overall platform.

In the LEGO Group, this mechanism is mainly apparent from the reproduction of external software systems into the consumer engagement platform. Specifically the adoption of purpose-built software components allows product teams to focus their efforts on approaching new business problems and relying on stable solutions for common problems in technical or business domains. Also in the context of ES, the LEGO Group has made the deliberate strategic choice to leverage externally-developed subsystems for efficient digital innovation. In the past, the interoperability of these systems has been ensured by leveraging the built-in integration architecture of the vendor or the own-built integration system. Both options, however, do not allow for decoupling of subsystems and conflict with API-based integration that most modern enterprise applications apply. Therefore, integration between new system components and core ES requires extensive refactoring, which increases the time and cost of onboarding innovative solutions. In very few instances, however, ES rely on decoupled integration to other landscape components and elucidate that this facilitates the implementation of upgrades or changes. By revealing the mechanism's effect in the LEGO Group's consumer engagement platform and its absence in non-modular core ES, the case evidence provides support for proposition three:

P3: An internal digital platform enables efficiency of digital innovation in a company through reproduction of externally-created subsystems.

While the three generative mechanisms are heretofore elaborated in isolation, the case evidence furthermore reveals a countervailing interaction between economies of substitution (P2) and modular upgradability (P1). Under the assumption of perfectly stable interfaces between subsystems, both mechanisms contribute to speed and efficiency of digital innovation. If the development or modification of a subsystem does, however, create requirements for changes to interface specifications, high degrees of reuse imply ripple effects on reusing subsystems that slow down the implementation of change. On the other hand, economies of substitution rely on the reuse of existing platform components. Consequently, the architectural platform design comprises an inherent tension between the mechanisms of modular upgradability (P1) and economies of substitution (P2). In the LEGO Group's consumer engagement platform, this tension creates the necessity for several experience-specific services (c.f. Figure 2) that undermine economies of substitution, but allow for more rapid adjustment of interface specifications.

Discussion and Conclusion

The case evidence and theoretical analysis reveal three generative mechanisms - modular upgradability, economies of substitution, and reproduction –, through which internal digital platforms enable speed and efficiency of digital innovation within companies. Based on a holistic conception of an internal digital platform, these mechanisms explain how the consistent, end-to-end architecture of a company's IS landscape plays a decisive role for the ability to innovate in the digital future. Specifically decoupled interactions via standardized interfaces among individual platform components is an inherent architectural characteristic that is essential to all three mechanisms. Nevertheless, the conceptualization adopted in this study goes beyond the concept of a micro-service or service-oriented architecture. Instead, this research acknowledges the continuous prevalence of commercial off-the-shelf software and the increasing ubiquity of everything-as-a-service (XaaS; incl. FaaS, SaaS, platform-as-a-service (PaaS), and IaaS) in companies. By unifying the heterogeneity of subsystems in one conception, the impact of their interactions on platform evolvability and on digital innovation within the company becomes apparent. The theoretical findings therefore extend previous research on the LEGO Group's digitalization journey which kept a distinction between core ES and digital customer engagement (c.f. Andersen and Ross 2016; El Sawy et al. 2016).

Implications for Research

The case evidence shows that the internal platform concept adopted in this research describes one end of a continuum that may be desirable for companies to approach. However, few - if any - internal digital platforms will reach the ideal state of perfect modularity in reality.

For once, an inherent tradeoff exists between the modularity and upgradability of a complex technological system that arises from the need to evolve to a new architecture while the system is being used – "a transmutation akin to rebuilding a ship plank by plank even as it is sailing" (Garud and Kumaraswamy 1995, p.72). This need commonly creates individual module redundancies as well as overlap or introduces coupling between previously de-coupled components. In the context of internal digital platforms, this research accordingly identifies a tension between the generative mechanisms of economies of substitution (P2) and modular upgradability (P1). Secondly, considering the price of modularity (c.f. Garud and Kumaraswamy 1995), individual subsystems aiming for the immediate creation of business value may occasionally be implemented in consciousness that they will undermine the modularity of the overall digital platform. Especially in the periphery of the platform, none-reusable subsystems are implemented particularly often during rapid prototyping. Thirdly, corporate IS landscapes are to some extent shaped by emergent forces that make an idealistic architecture through formative management by control extremely difficult (Ciborra 2000). A previous case study on the LEGO Group reveals how this challenge can be addressed through path constitution to introduce central architecture guidance and deliberately steer the platform evolution into an intended trajectory (Törmer and Henningsson 2018). Albeit, the power of emergent forces will make an idealistic architecture close to impossible to implement.

Consequently, an internal digital platform will contain some degree of technical debt and hardly ever live up to the ideal picture of modularity painted during theory development. In comparison to multi-sided digital platforms, however, suboptimal modularity is less problematic in an internal digital platform since interface specifications do not imply a contract towards external business partners. Therefore, a company may accept to undermine modularity in some instances for practical reasons at the expense of unrealized benefits. Nevertheless, the case evidence reveals that the identified generative mechanisms may already materialize, if only individual subsystems of a company's IS landscape conform to the platform concept. This observation justifies the hypothesis that the extent, to which a company can exploit these mechanisms, increases with the proportion of its IS landscape that is 'platformized'.

In multi-sided platforms, the mechanisms of modular upgradability (P1) and economies of substitution (P2) are equally fundamental concepts for enabling distributed innovation across organizational boundaries (Baldwin and Woodard 2009; Tiwana 2013). Even though the reproduction mechanism (P3) may also take effect in a multi-sided platform, it is particularly relevant for the internal digital platform concept, primarily due to most companies' reliance on vendor-provided solutions to common business problems. While the mechanism allows for efficiency of digital innovation, it also creates the challenge to ensure overall platform evolvability despite the availability of financially attractive, yet architecturally conflicting vendor platforms.

Eventually, the findings do not imply that internal digital platforms are a silver bullet that create digital innovation in isolation. Instead, they rely on complementary organizational structures and knowledge resources for the mechanism to take full effect. If modular upgradability, for instance, is not exploited for the independent deployment of changes or upgrades – ideally by independent product teams for continuous integration -, the mechanism may not materialize. This contingency of IS resources on complementary organizational resources to create value and competitive advantage in organizations has been acknowledged in previous IS research (c.f. Bhatt and Grover 2005; Drnevich and Croson 2013).

Implications for Practice

This study produces three implications particularly relevant for IS practitioners. For once, the research findings reveal that platform components can be designed with an emphasis on efficiency of digital innovation through reproduction (P3) or on speed and flexibility through economies of substitution (P2). While the former commonly refers to the purchase of an integral component accessible via APIs, the latter is associated with the in-house development of highly granular digital subsystems (i.e. micro-services). This implies that architects face a strategic choice of granularity when designing individual solution architectures that should be aligned with the business capability that the individual solution supports.

Furthermore, the case evidence reveals that the modular upgradability of commercial off-the-shelf systems is limited by the implementation of customizations after purchase. If the specific system does, however, offer decoupled interfaces, customizations as well as extensions should be implemented in the periphery of the platform and may benefit from economies of substitution by reusing other subsystems. In this way, standard components can be kept clean to enable implementation of vendor-provided upgrades.

Eventually, the adoption of vendor platforms as part of an internal digital platform bears an idiosyncratic management challenge, if the vendor's product platform adheres to a proprietary design framework aiming for lock-in. The inherent architecture often facilitates integration with the vendor's other modules but may conflict with the company's internal platform architecture. This can undermine the modularity of the company's internal digital platform and subsequently hinder the three mechanisms identified in this study.

Limitations and Validity Threats

Naturally, this study is subject to limitations and validity threats that should be addressed in future research. For once, the case evidence reveals how the generative mechanisms take effect in siloed parts of the LEGO Group's IS landscape and spells out how the lack of modular platform architecture hinders them on a global scale. The investigation of a more mature internal digital platform should complement these observations to provide further support for the mechanisms. Secondly, the mechanisms are identified based on observable events and the portrayal of experiences by key informants. Even though the evidence and analysis leverage concrete examples for the mechanisms' effects, inferences are established at an admittedly high level of abstraction. Consequently, no conclusions can be drawn on the exhaustiveness of the three mechanisms and future research applying critical realism for the investigation of coexisting mechanisms would be expedient. Eventually, the single case presented in this paper should be amended by evidence from distinct organizational settings before generalizing the findings to a wider population of companies.

Conclusion

The three generative mechanisms developed in this research confirm and enrich the initial hypothesis that, as multi-sided platforms do across firm boundaries, internal digital platforms have an enabling effect on digital innovation within companies. The findings reveal in particular that these mechanisms are not limited to the periphery of an internal digital platform, but equally touch upon core ES and thereby underline the significance of their interactions. Therefore, a holistic contemplation of internal digital platforms is not only expedient for the purpose of this study but may also inspire future research to investigate how these interdependencies shape digital innovation within companies.

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Research Paper #4:

Törmer, R. L., and Henningsson, S. 2020. "Platformization and Internationalization in the LEGO Group," *in Proceedings of the 52nd Hawaii International Conference on System Sciences*.

A short version of the paper has been published as:

Törmer, R. L. 2019. "Becoming Ready for Internationalization: The Role of Platformization in the LEGO Group," *in Proceedings of the 40th International Conference on Information Systems*.

Platformization and Internationalization in the LEGO Group

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Abstract

Internationalization, to expand a firms territorial footprint, is an important but difficult strategic act for a growing business. Simultaneously, digital technologies are increasingly shaping businesses world-wide and by implication also their internationalization activities as well as strategies. Using experiences from the LEGO Group, the toy-manufacturer well-known for its iconic modular bricks concept, we explain how the transformation of the Information Systems (IS) landscape towards a platform architecture is a key enabler for internationalization. Platformization of the IS landscape contributes to mitigate the issues of psychic distance that needs to be overcome when expanding internationally. Based on the insights gained from the LEGO Group, we provide lessons learned for CIO's when enabling an internationalization strategy.

1. Internationalization Drives Business Growth

In today's global economy, a firm's internationalization strategy is more important than ever. Internationalization, the process of increasing the territory covered by a business' operations across national borders, fuels business growth by reaching new customer groups, connecting to new suppliers and engaging with new innovation ecosystems. The opportunities to expand the business within an international environment have been augmented during the last decades, supported by improved trading laws and regulations. Digital technologies have contributed to the opportunities by enabling coordination of complex supply networks and communication transcending geographical space.

Yet, for the many companies, international expansion remains a hardship. While rising purchasing power in emerging economies creates incentives for established companies to continuously penetrate highly attractive markets [18], the fundamental differences between regions of foreign markets presents barriers for their internationalization ambitions. These barriers are typically referred to as the psychic distance [16, 18] that needs to be overcome when transcending geographical borders. Psychic distance describes the economic, cultural, juridical, institutional and geographic difference between the locations where the firm currently operates and the locations that are subject for expansion.

For the LEGO Group, the Denmark-based toy manufacturer well-known for its modular bricks-concepts, internationalization is one of the key strategic pillars to reignite business growth (see Appendix for a description of the research method). From the brink of bankruptcy, the toy-manufacturer has over the last decades experienced strong double-digit annual growth. While the company is still growing, the last few years have shown a saturation in the current markets. Strategically focused on expanding its international footprint to markets previously not seen as attainable because of the psychic distance, the LEGO Group is rethinking its approach for market entry and reconsiders its capabilities for internationalization.

In this context, the abilities of the company's IS landscape to support the reinvigorated internationalization ambitions has come into consideration. Specifically inspired by large digital platform companies' successes delivering highly diversified offerings that are attractive also for 'the long tail' of customers, the LEGO Group is investing into the platformization of its IS landscape to better support internationalization ambitions.

Focusing on these efforts and their effects, we present the role of platformization in the LEGO Group's past, present and future internationalization journey. Based on the premise that a company's internal digital platform enables responsiveness to local market demands and legal requirements [27], the case data reveals how the pre-existing IS landscape has constrained the company's internationalization activities in the past. Furthermore, the evidence elaborates how the company's current platformization

URI: https://hdl.handle.net/10125/64451
978-0-9981331-3-3

efforts are enabling international expansion in the future by mitigating some of the barriers associated with psychic distance.

2. Internationalization and Psychic Distance

For more than five decades, the field of international business (IB) has produced research contributions to describe, explain, and predict how companies internationalize [20] and has mainly been dominated by three theoretical perspectives: internationalization theory, the Uppsala model of internationalization, and the eclectic paradigm. Independently from research subject or theoretical orientation, Rugman et al. [20] emphasize that the center of IB theory and management practice continues to evolve around the role of 'distance' for transferability, recombination, and exploitation of organizational capabilities.

The core argument of internationalization theory is that (intermediate and output) market imperfections across national borders create incentives for firms to internalize intermediate markets and establish facilities abroad instead of exporting to foreign markets [4]. In this context, the concept of firm-specific advantages has been developed to explain why certain enterprises are particularly well-suited to benefit from internationalization activities. This point has also been picked up by the Uppsala model, which initially sought to explain the incipient internationalization process of firms from small, domestic markets. Johanson and Vahlne [15, 16] paint the internationalization process as cumulative and path-dependent on a firm's previous expansion pattern, experience as well as knowledge base. Therefore, internationally inexperienced firms typically start by entering foreign markets through exports and subsequently progress by establishing sales subsidiaries and potentially production facilities through direct investment [16].

At its core, the Uppsala process model suggests that distinct forms of distance - i.e. cultural, economic, institutional, geographic distance (c.f. Figure 1) - produce cost of employing firm-specific advantages abroad and thereby potentially outweigh the benefits of doing so. Combining these distinct forms in the concept of psychic distance, Johanson and Vahlne [7, p.13] accordingly predict that companies will initially expand into foreign markets where these forms of distance are particularly low and subsequently "enter new markets with successively greater psychic distance". In a similar vein, Hymer [14] refers to liability of foreignness that needs to be offset by firm-specific advantages in relation to a certain country.

In subsequent refinements of the original Uppsala model, Johanson and Vahlne [17] first proclaim that competitive success in a foreign market primarily depends on powerful relationships with actors in a host country's business network. The absence of such relationships constitutes a liability of outsidership that prevents companies from overcoming psychic distance and realizing country-specific advantages [17]. Rugman et al. [20], on the other hand, call for more research focus on regional strategy and advance the notion of interregional foreignness, which describes resource recombination barriers caused by psychic distance between cross-national market regions. A later adaptation by Vahlne and Johanson [29] puts specific emphasis on the evolution and learning mechanisms in multi-national enterprises (MNEs). Resulting from opportunity-seeking resource commitments, knowledge-development processes enrich and enhance specific capabilities - embodying firm-specific advantages - that are crucial for overcoming psychic distance associated with foreign markets.

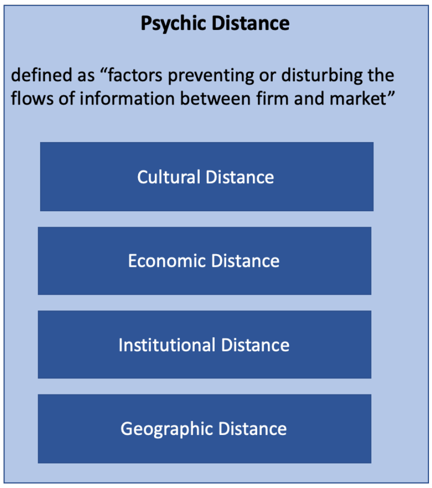

Figure 1. Dimensions of Psychic Distance according to Johanson and Vahlne [15]

The increasing significance of digital technologies for businesses across industries "has profoundly changed the character and the geographic distribution of IB activity" [1, p.500]. At the same time, IB research has only addressed this change to a limited extent [26]. Specifically, on the level of individual organizations, IB studies have primarily focused on the impact of e-commerce and the influence of major Internet companies [26]. In the context of international expansion of traditional MNEs, "theoretical exploration of potential uses of these new technologies are yet to emerge" [5, p.77].

Among the few existing contributions, Santangelo [21] argues that ICTs allow companies to build capabilities, which enable the expansion of corporate activity across national boundaries. “Therefore ICT can be viewed as a platform for entry into new products as well as an enabler of fusion of technology” [12, p.701]. Scrutinizing the Uppsala model in the context of digital companies, Coviello et al. [7] add macro-level influences, such as digitalization, as a central dimension to the process model. They argue that “digitization has the potential to impact [...] the firms’ ability to manage the liabilities of foreignness and outsidership [and] enables greater transferability of firm-specific assets” [3, p.1153]. In a similar vein, Eduardsen [10] proclaims that the Internet along with the rise of e-commerce has reduced the relevance of distance. Therefore, it is nowadays “commonly assumed that the Internet is an enabling technology, making internationalization a viable growth strategy for even the smallest firm” [4, p.160].

3. IS Landscape Platformization

The academic literature on technological platform management mainly consists of two separate research strands. On the one hand, the economic theoretical perspective has conceptualized platforms as two-sided markets and has produced insights on platform competition. In this vein, platforms act as conduits of market transactions that drive transaction efficiency and reduce search costs in the exchange of goods and services [11]. Specifically Tiwana [22, p.50] reveals that “by tapping into both mass markets and long-tails of those markets through extensive customization by end-users, [multi-sided platforms] can capture a larger extent of the market than even mass-produced products”.

The technological engineering perspective, on the other hand, studies platforms as technological architectures that drive platform innovation [11]. For this purpose, they are classified into stable core and variable peripheral components that interact via standardized interfaces [2]. This conceptualization explains how modular architectures spur product variety by providing a technological architecture to innovate upon in production and design [9, 11]. This architecture may be used only within the boundaries of a single company or across several organizations. In the context of IS, the platform concept is increasingly utilized to conceptualize how individual companies can holistically structure their internal landscapes of IS to effectively enable business in the digital age [22, 23, 27]. Within the context of this study, an IS landscape refers to a company’s holistic collection of all technology infrastructure, business logic, and data that serves internal employees across business functions and external business partners. Specifically “the proliferation of digital tools or digital components allows firms to build a platform not just of products but of digital capabilities used throughout the organization to support its different functions” [28, p.1400].

Capturing the increasing orientation towards platform thinking in practice, terms, such as “platform coring” [12, 25] and “platformization”, have emerged in the IS literature to describe the commercial transformation from products to (multi-sided) platforms [3, 6] or the establishment of large-scale platform architectures to spur innovation within as well as across organizations [5, 28]. According to Benlian et al. [3, p.724], platformization “builds on decoupling and characterizes the process in which an entity (a provider organization) creates access and interaction opportunities centered around a core bundle of services (the platform) within an ecosystem of consumers, complementors, and other stakeholders”. While their conceptualization subscribes primarily to the multi-sided platform notion, this study follows the technological engineering perspective on platforms. Consequently, platformization is conceptualized as the socio-technical process of transforming a large-scale IS towards a platform architecture. This architecture is characterized by a core of stable functionality, a periphery of increasingly variable components, and component interactions via standardized, de-coupled interfaces [27].

4. Case Evidence: The LEGO Group’s Journey in China

As one of the first brick-and-mortar companies in the world, the LEGO Group made digitalization a fundamental pillar of the overall business strategy already in 2012. To meet present and upcoming challenges, the long-term vision for the toy manufacturer from Denmark is to create a highly adaptive organization, which collaborates closely with external partners to harness an ecosystem of platforms to co-create innovation. Since the implementation of this agenda placed heavy demands for novel functionality on the company’s enterprise systems, the need for a new platform architecture became apparent to create the foundation for the company’s future digitalization journey and commercial agenda.

4.1. The LEGO Group’s Past IS Landscape

The LEGO Group’s physical value proposition relies on a mature operating model that is implemented in a core of largely non-redundant enterprise systems, which enable efficient operational transactions through globally standardized and integrated business processes (c.f. Figure 2). In the past decade, the company's IS landscape has been shaped by the strategic direction to leverage externally-created off-the-shelf enterprise systems wherever possible. As a result, the centerpiece of the landscape largely relies on non-redundant SAP systems that have been configured as well as customized to specific company needs.

The establishment of technical and business process integration among distinct landscape components relies on several mechanisms. While integrations among core SAP systems are established through proprietary point-to-point (P2P) connections, the reuse of data and functionality by other systems relies to a large extent on a custom-developed, batch-based integration system. In addition, few parts of the IS landscape have started to rely on decoupled API-based integration. Particularly in the periphery of the landscape, the so-called consumer engagement platform emerged that allows for the rapid development of content-based digital experiences and a two-way interaction with customers as well as consumers. Over the years, the platform has produced distinct digital experiences, including the LEGO Group's websites for children and adults, distinct games, various TV apps and the social network LEGO Life.

While this IS landscape has been the foundation for an extremely successful operating model that enabled the company's double-digit growth for more than a decade after 2004, technical complexity is increasingly limiting its upgradability and evolvability. For once, the abundance of tight coupling among enterprise systems limits the speed of implementing changes or system upgrades due to ripple effects and the subsequent need to modify other landscape components as well. In addition to tight coupling among landscape components, the customization and extension of existing off-the-shelf enterprise systems furthermore hinders the implementation of changes as well as upgrades. Furthermore, the LEGO Group's IS landscape is currently challenged with increasing needs to integrate purpose-specific and potentially cloud-based applications and services quickly.

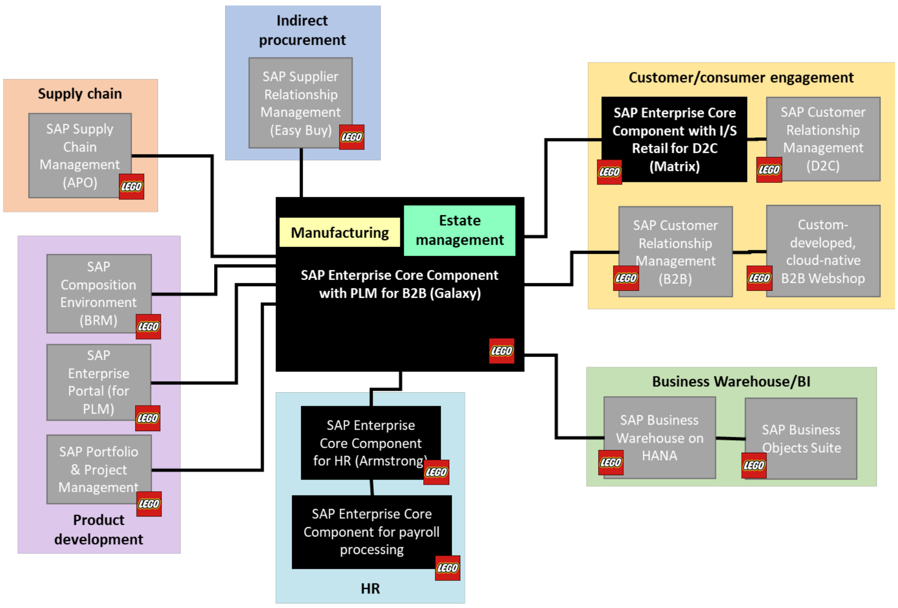

Figure 2. The LEGO Group's core enterprise systems excluding surrounding components

4.2. Common Technology-Related Challenges for Foreign Companies Entering China

The Chinese market exhibits several specific characteristics, which commonly pose very challenging demands on foreign companies optimized for western market conditions. For once, China generally imposes peculiar legal requirements that are cumbersome to fulfill from an information technology (IT) perspective. For instance, special tax receipts need to be printed on the tax bureau's dedicated printing machines, which are specially designed and integrated into the tax system.

Secondly, the specific legal requirement that foreigners are not allowed to publish content on the internet in China specifically complicates marketing operations. Consequently, a Chinese party in the middle is required to publish marketing material on behalf of foreign companies. Thirdly, data protection laws require that personal identifiable information remains stored on servers within the country. This regulation mainly complicates the use of CRM systems or consumer engagement solutions.

Eventually, the “Great Firewall of China” makes data import and export eminently challenging, since systems have to leverage VPN (Virtual Private Network) or MPLS (Multiprotocol Label Switching) connections to integrate with systems hosted outside of China. These connections are very strictly governed by authorities and require special approvals that can only be obtained through long-lasting application processes. Moreover, the connections are subject to legal requirements that each introduce additional complexity from a technical perspective. For instance, VPN connections should not allow users within China to access the internet in the outside world.

4.3. The LEGO Group’s Market Entry and Penetration in China

The LEGO Group’s relations with the Chinese market date back to the 1980s and have for a long time relied on a single retail customer to sell LEGO products in China out of production in Europe. It was not until 2012 that the LEGO Group established a sales company in China to target additional wholesale customers under the holistic Asian market group. Due to the market’s increasing commercial importance and in aspiration of market proximity, the decision to build a factory in Jiaxing was announced in 2013. Almost simultaneously, a Hub office in Shanghai as well as a dedicated market group were established around 2014 that underlined the market’s strategic importance for the organization and implied dedicated operations in the country. The Jiaxing factory eventually ramped up production in 2015. Over the years, the LEGO Group has continuously realized very strong growth in the Chinese market. Through the 2014-16 period, Gross Revenue has tripled and Market Contribution has more than quadrupled. The LEGO Group is reaching approximately 2 million children in China, with an ambition to reach more than 9 million in 2025. Looking towards, 2020 the company aims to grow Consumer Sales 30 percent annually and improve financial profitability through seeking continuous improvement and economies of scale.

However, the company’s increasing operations in China have been accompanied by a complex technology roll-out, which started out by reusing as much of the existing enterprise systems as possible without introducing new redundancies (incl. the single instance enterprise resource planning system). This roll-out has posed specific demands on the operating model and IS landscape.

China’s reporting legislation requirements have been addressed by implementing deviations from the LEGO Group’s globally standardized business processes. The LEGO Group is very committed to legal compliance and these requirements imply exceptions to global standards that subsequently undermine operational efficiency for business and IT. “*The tax regulation and the tax thinking was something we had to understand and adapt our global template to. […] [SAP] probably provided some [of that functionality] but a lot of the models are LEGO models in our global template of optimizing manufacturing efficiency in Western Europe*” (Principal Enterprise Architect (EA), LEGO Group).

Due to content publishing regulations, own-developed LEGO apps had not been provided to the Chinese market for several years. Particularly for the publication of digital experiences, the LEGO Group has partnered with Chinese internet company Tencent to provide safe and imaginative digital LEGO content that supports children’s needs of learning, development and entertainment. “*There is a technical gap to the consumer in that the consumer does not have access to our traditional way of engaging with consumers – being Facebook, Google, Twitter – these traditional platforms. It is very difficult to put up a web-shop in China because of the legal restraints. […] The consumers are on different platforms [… and] consumer engagement is a pre-requisite for success in any space*” (Senior EA, LEGO Group).

The requirement to store personal identifiable information on local servers mainly impacted the operation of CRM and digital consumer engagement solutions (e.g. LEGO Life) within the country. Based on the LEGO Group’s one-instance philosophy, these systems would conventionally host functionality and data in centralized data centers in Europe that are merely accessed via a client user interface. Establishing a second instance for these systems within China would challenge global business process standardization, complicate data integrity as well as analysis, and subsequently also reduce IT efficiency.

Also, the connectivity of local solutions through the Great Firewall of China is currently realized through MPLS connections allowing for access to enterprise systems, but preventing access to the public internet. Again, since the LEGO Group is particularly committed to legal compliance, the implementation of these requirements is of highest strategic priority. “*So far, we have had a network connection directly through the Great Firewall that we have been able to utilize for our own corporate data. [… We are not] allowed to use this gateway or tunnel through to the Chinese consumer, because there are requirements to network providers in China*” (Senior EA, LEGO Group).

4.4. Platformization of the IS landscape

In order to address previous restrictions on digital innovation posed by a highly efficient, but tightly coupled IS landscape, the LEGO Group established a centralized Enterprise Architecture (EA) capability in early 2017. Subsequently, the establishment and continuous construction of this capability initiated the transition towards a centrally guided, flexible platform architecture that should "*allow the LEGO Group to identify and realize real options by providing long-term sustainable, scalable and adaptable IT platforms that ensure that the business agenda is not limited by EA choices*" (Source: the LEGO Group). This transition has been further accelerated by the development of a new Technology Strategy and Roadmap for the entire organization that puts the goal of an agile platform architecture at the core of dedicated significant investments into technology for the future. Thereby, the strategy seeks to enable the company's commercial agenda (including geographical expansion), address critical technology pain points, drive IT-enabled business flexibility, and afford future digital innovation. "*If implemented correctly, […] that would enable us to choose more local components whereas the core components can remain unchanged. […] However, that requires a conscious integration effort in defining what is global, what is local, what is core, and what is periphery – also on the process layer"* (Senior EA, LEGO Group).

While the LEGO Group has adapted to the Chinese market through ad-hoc solutions to the operating model and IS landscape so far, China is only the first of multiple countries that will imply such adaptations. In order to fulfill the strategic ambition to expand global presence and reach 200 million children by 2025, the LEGO Group will continuously focus on new emerging markets that may bear similar challenges. This will not only depend on the successful transition towards a more flexible platform architecture, but will also require an overarching architecture game plan of how specific (legal) requirements of new market regions can be addressed. *"China is a very different market to what a market entry in traditional LEGO terms had meant previously. We had been used to entering markets in the western hemisphere – mainly Europe and North America. And they have been not entirely alike, but culturally and legally widely aligned. However, as the LEGO Group is expanding its geographical reach, we are experiencing more and more diverse cultures, frameworks, and also now the impact of very diverse technology platforms in countries we are entering"* (Senior EA, LEGO Group).

5. How Platformization enables Internationalization

The case evidence reveals how the LEGO Group's past market entry and penetration in China have been enabled as well as constrained by the company's existing global IS landscape. Even though the company's journey in China has been highly successful from a business perspective, the reactive adaptation of global solutions, which embody standardized business processes and have been optimized for the European as well as North-American markets, has created specific barriers to the efficiency and effectiveness of establishing local business operations.

For once, compliance to local legislation in terms of reporting as well as data protection has been established through cumbersome customizations and workarounds within the global ERP template that had previously been optimized for homogeneous legal requirements in Western Europe and North-America. This procedure complicated market entry and limited future system flexibility. The LEGO Group's deliberate investment into IS landscape platformization, on the other hand, is enabling future adaptation to local legislation through (1) more seamless adoption of vendor-provided software upgrades, (2) smoother connectivity to third-party solutions and (3) architecturally sound implementations of local exceptions to the global template. The ability to adapt to local legislation more efficiently and effectively lowers the impeding effect of institutional distance on the internationalization process. This reasoning supports mechanism 1:

M1: *A platformized IS landscape enables a company to overcome the psychic distance to a specific market region by increasing responsiveness to peculiar local legislation.*

Operating in the consumer-goods industry, the LEGO Group is following a customer engagement strategy. By offering digital experiences to consumers as well as shoppers, generated data is leveraged to develop new value propositions and improve existing ones. Consequently, two-way interactions with consumers and shoppers are a necessary pre-condition to derive insights into behavior as well as preferences and to ensure that value propositions remain relevant. Specifically in the context of cross-national cultural differences, data-driven insights play a vital role for establishing local responsiveness to customer needs. Applying this strategy in foreign market regions, a company can overcome the cultural and economic dimensions of psychic distance more effectively and efficiently by leveraging data-driven insights to learn about purchasing behavior and country-specific customer preferences.

On the one hand, the technical ability for digital two-way interactions has been identified as a generic affordance offered by platforms in the IS literature. Additionally, the case evidence reveals that the ability to develop digital experiences for customer engagement and tailor them to country-specific as local payroll solutions. Since most of these platforms are loosely affiliated actors that perform business transactions through standardized, public application programming interfaces (APIs), the IS landscape's affordance to support such connectivity is a vital capability to support the internationalization process. By facilitating connectivity to digital partner networks, a platformized IS landscape therefore allows

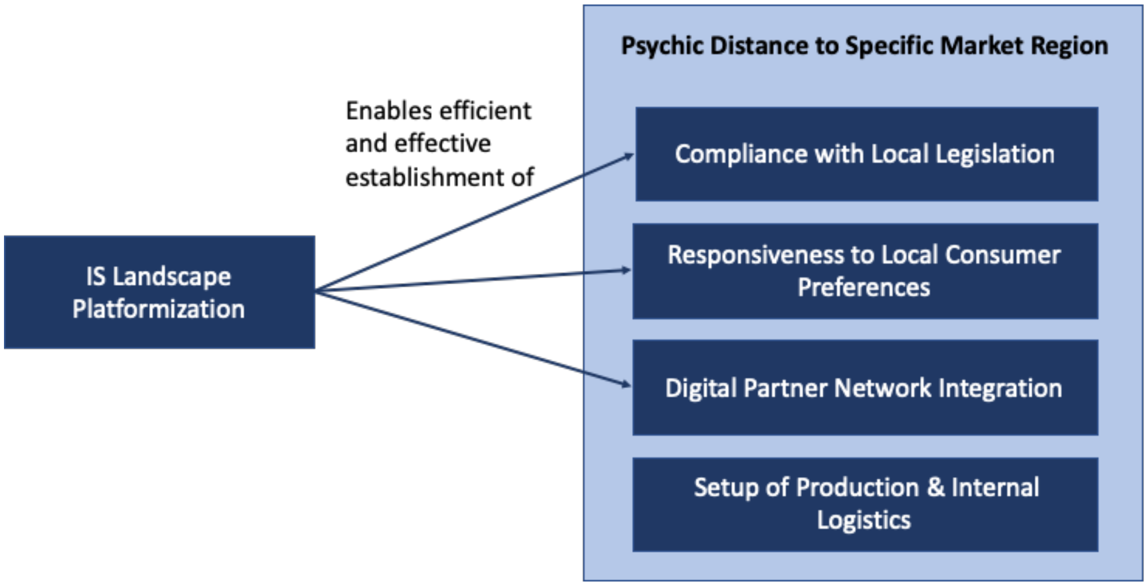

Figure 3. Research Model: Mechanisms through which IS Landscape Platformization enables Internationalization

legislation relies on the platformization and subsequent flexibility of a company's IS landscape. Consequently, the case evidence supports mechanism 2:

M2: *A platformized IS landscape enables a company to overcome the psychic distance to a specific market region by increasing responsiveness to local customer preferences through customer engagement and data-driven insights.*

In addition to internally-developed digital experiences, this ability may equally hinge on digital partnerships with local technology platforms to publish content in compliance with local data legislation. The LEGO Group, for instance, has entered a partnership with a local platform company to outsource the publishing capability for China. Moreover, the continuous internationalization journey reveals a need to connect to a large quantity of heterogeneous technology platforms in distinct countries – not only for customer engagement, but also for business capabilities from the traditional enterprise world, such companies to overcome institutional and geographic distance more efficiently as well as effectively. Subsequently, the "liability of outsidership", which has been advanced by network perspectives in internationalization research, can be mitigated. Accordingly, mechanism 3 follows from this reasoning:

M3: *A platformized IS landscape enables a company to overcome the psychic distance to a specific market region by enabling connectivity to digital partner networks and platforms.*

While mechanisms 1, 2 and 3 reveal how platformization does enable a company's internationalization capability, the case evidence does not point towards any facilitating mechanism regarding the setup of production and internal logistics specifically. The LEGO Group simply applied its template of highly standardized and integrated business processes for production in China. The only local adaptations required for the specific market were related to legal requirements for reporting and taxation during the movement of money or goods. Even though these requirements did impact the efficiency and effectiveness of setting up business operations in China, they are caused by local legislation, relate to cultural as well as institutional distance, and are therefore explained by mechanism 1.

Taken together, the three mechanisms elaborated in this section form the foundational pillars of our theoretical model depicted in Figure 3. The model reveals the overall finding that companies can deliberately invest into IS landscape platformization to remove barriers to internationalization and enable future market entry as well as penetration in potentially less attractive market regions with higher compounded distance. By building the capability to overcome distinct forms of distance associated with a specific market region more effectively and efficiently, the commercial attractiveness of any foreign market will subsequently be increased for the company. This observation relates to Tiwana's [25, p.50] argument that multi-sided platforms hold dramatically superior market potential in comparison to products "by tapping into both mass markets and long-tails of those markets through extensive customization". Similarly, the platformization of an internal IS landscape enables the delivery of highly diversified offerings that are attractive also for 'the long tail' of customers.

6. Lessons Learned

With basis in the LEGO Group's work to platformize its IS landscape to enable its reinvigorated internationalization ambitions, we have distilled three lessons learned to guide IT managers when embarking on a similar journey.

6.1. Platformization is not a silver bullet

The hardship of internationalization has been a known issue for a long time. Gradually, some of the barriers for internationalization have been lowered, with the reduction of legislative barriers and the build-up of sophisticated logistics networks. These changes affect everyone equally and give no firm a particular edge towards competitors. Platformization addresses the internationalization problem from a different angle: increasing the firm's ability to deal with it. In contrast to lowered barriers, increasing the ability to deal with the barriers gives a competitive edge towards customers that can be hard to imitate.

It is, however, important to recognize that platformization is not a silver bullet that immediately makes internationalization unproblematic. What we saw in the LEGO Group case was that the initiative has the potential to contribute towards easing some part of the economic, juridical and institutional issues. There are clearly large parts of these issues that platformization does not solve. In addition, we could not find any evidence that platformization contributes towards solving the geographical issues with internationalization. Therefore, platformization in itself does not solve the internationalization problem, but it helps towards a resolution.

6.2. Platformization is a journey, not a project

The IS landscapes that large incumbent firms have today have been built over decades with additions and incremental changes to what already existed. Present systems typically count in hundreds or even thousands. Anyone who has been involved in a major system replacement knows the hard work that goes into the retirement of components, introduction of new ones, and the management of interdependencies to other system components.

It follows that complete IS landscapes as not re-architected as one large effort, where the IT management pushes a completely new setup. In the LEGO Group, platformization is a gradual journey that in its essence took its starting point with the establishment of an EA department to oversee that each change to the IS landscape would move it towards the ideal platform architecture. It was also recognized that this journey may never be completed. Other priorities would always interact with the architectural priorities to form the actual IS landscape. Priorities of cost, time, specific functionality or software vendor preferences will make their mark. The importance, however, is that the journey continues by the pace that is possible to mount and that - as shown by the LEGO Group's case - also gradual increases in platformization can have substantial impact on the enablement of an internationalization strategy.

6.3. Start where it hurts the most

Any journey has a start. This start should be adapted to where the problems are. Because every company is unique, working in a different industrial context, the internationalization issues will be differently prevalent in these contexts. For example, a financial company is likely to find the major challenges of internationalization to be in the juridical and institutional differences between existing and new markets. Geographical distance may be a minor issue for digital financial products. In contrast, a firm with a strong design-focus addressing a private consumer market would likely find the most prevalent barrier to internationalization in differences between consumer likings. In addition, different markets contribute their specific characteristics. In one country, the juridical distance can be particularly salient, but in another one the institutional distance is the major hurdle.

Naturally, when thinking of the platformization journey, it is important to tailor the endeavour to the specific internationalization strategy of the firm. A basis in an understanding of the industry conditions of internationalization and a view of the key countries targeted as the first step of the expansion, is important to channel initial platformization efforts to where they are critically needed. In the LEGO Group, considering the industry context and the ambition to grow presence in China, this put a focus on the key issue of how to engage with a partner network and the ability to customize product to the Chinese-speaking consumer. This insight guided the initial investments in platformization as well as marked that in these specific areas the degree of platformization should remain as a key priority when continuously crafting the IS landscape in the future.

7. Conclusions

As business capabilities are increasingly embodied in enterprise systems and digital experiences, the IS landscape becomes a strategic resource underpinning a company's ability to expand internationally. In this contribution, we have identified three mechanisms through which the platformization of a company's IS landscape enables the efficient and effective establishment of (1) compliance with local legislation, (2) responsiveness to local consumer preferences, and (3) digital partner network integration. In combination, these mechanisms do not guarantee, but facilitate triumph over psychic distance to a specific market region by addressing distinct subordinate forms of distance on their own. Consequently, IS landscape platformization may enable companies to invest into market entries that would not have been profitable otherwise.

In addition to the high-level recommendation that companies targeting far-reaching international expansion should invest into the platformization of their IS landscapes, this paper additionally provides several lessons learned for CIO's embarking on the journey. These lessons particularly emphasize the continuous – and probably endless - nature of the platformization journey, the orchestrating role of the EA capability during the process, and the need to align platformization efforts with strategic priorities in the company.

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Appendix: Method

The research presented in this paper adopts a case study approach [30] to explore how the platformization of a company's IS landscape enables its internationalization capability. The goal has been the construction of an explanatory theory to elaborate how and why phenomena occurred. Since the inquiry investigates a rare phenomenon in a fine-grained level of detail, a single-case design is suitable to produce significant research results [8].

The study was designed to initially cover a broad scope and was based on the collection of empirical data to allow for a partially inductive understanding of the platformization initiative in the LEGO Group. Data was collected from three sources of evidence: observations, documents and interviews. Direct participant observation data [30] was collected by one of the authors that for 28 months acted as an integrated member of the LEGO Group's EA management team on site at the group's headquarters in Billund, Denmark. Observation data and information about relevant supporting material (documents), were captured in a structured diary [19]. The diary entries were collected in a case database and each grouped by direct observations, reflections on observations, plans for future research, and supporting diagrams, drawings, or mind-maps. Thirty semi-structured interviews with key informants are used as a secondary source of evidence [30]. The interviews were conducted on the company's premises and supported by an interview guide containing open-ended questions. The informants mainly include Enterprise or Solution Architects as well as senior stakeholders, such as Vice Presidents of Corporate IT. All interviews were recorded, transcribed and added to the case database [30]. For the purpose of further triangulation, internal documents from the company, such as reports, presentations, emails, and architecture documentation, are used as a third source of evidence [31].

Based on an initial analysis of the case data, we approached the initiative as a theoretical issue extending and challenging our emergent findings. Stimulated by the emerging event sequences around the platformization of the LEGO Group's IS landscape, we turned to the IB literature to analyze the phenomenon in the context of the field's existing theory. Finally, we used our empirical observations to create an initial case narrative that is supported with interview quotes to increase its vividness and transparency. Eventually, members of the initiative assessed the representativeness of the findings in our narrative [31]. Largely, the perception concurred with our emergent explanation, revealing the need for only marginal adjustments to the narrative.

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