How Digital Transformation Affects Large Manufacturing Companies' Organization

Short Paper

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Abstract

In light of emerging digital technologies, executives across industries are rethinking their companies' business models and organizational structures. To meet future customer expectations, large manufacturing companies in particular are challenged to integrate two distinct worlds: the physical world (i.e. the design, production, and maintenance of complex hardware products) and the digital world (i.e. software, data analytics and digital services). Large manufacturing companies often possess various business units, a diversified business model portfolio, and complex IT landscapes including traditional, embedded, and digital IT types. Hence, they face specific organizational issues, which so far have only received limited attention among professionals. Based on 16 in-depth expert interviews with companies across the Internet of Things (IoT) ecosystem, we have identified six main issues regarding how digital transformation will affect large manufacturing companies' overall organizational structure.

Keywords: Digital Transformation, Internet of Things, Large Manufacturing Companies, Organization, Organizational Transformation

Introduction

Executives across industries are challenged to rethink current business models as well as their companies' organizational structures. Innovative technologies, such as sensors and data analytics, are altering how business is conducted[1]. This goes far beyond leveraging online media for cross-channel sales or improving internal efficiency, as it also refers to the transition from selling physical products to digital solutions including data-enriched offerings[2]. General Electric (GE), for instance, has been well known for selling high quality industrial equipment and maintenance services for over 100 years. However, recently GE faces new fields of competition from non-traditional competitors such as IBM or SAP. Consequently, the industry giant drives its business focus towards digital services, "deriving new efficiencies and other benefits through advanced analytics and algorithms based on the data generated by [its] equipment"[3]. This merger of the

[1] For a good primer on such effects of digital technologies, see: Ross, J. W., Sebastian, I., Beath, C., Mocker, M., Moloney, K., and Fonstad, N. 2016. "Designing and Executing Digital Strategies," in *Proceedings of the 37th ICIS*, Dublin.

[2] For further information, see: Davenport, T. H. 2013. Analytics 3.0. *Harvard Business Review* (91:12), p. 64.

[3] For an in-depth discussion of GE's case, see: Iansiti, M., and Lakhani, K. R. 2014. "Digital Ubiquity: How Connections, Sensors, and Data Are Revolutionizing Business," *Harvard Business Review* (92:11), pp. 91-99.

physical and digital worlds, often referred to as Internet of Things (IoT), has recently gained significant management attention. The IoT entails a vision that virtually any physical object can be connected to the Internet enabling new digital services[4]. Large manufacturing companies like GE or Royal Philips, with several business units and a strong track records in product excellence, have been struggling to develop and sell such IoT solutions[5]. While servitization has been on the agenda of many manufacturing companies for more than two decades, the majority have only recently started to offer hybrid value propositions, consisting of physical hardware components and digital services[6]. One of the main reasons for a hesitant IoT adoption might be specific hurdles companies face when offering IoT solutions. One of the critical barriers is the unsuitability of current organizational structures to execute digital strategies and to develop and market IoT solutions[7].

Several studies investigate interesting aspects in this regard. They provide different organizational frameworks for IS/IT, address the interaction between IT and business entities, or define pricing models of IT services[8]. Other studies examine new (executive) roles responsible for the digital transformation including chief digital officers and their deviating responsibilities compared to existing IT management positions[9]. Overall, these studies cover two different types of IT: a) Traditional IT, usually seen as an internal cost center, focusing on excellence and risk reduction to enable a company's operational efficiency; and b) a new type of innovative IT, applying iterative, agile innovation approaches to develop digital services. However, the IT landscape of large manufacturing companies is more complex; entailing a third type of embedded IT. This type of IT refers to the development of embedded software in hardware products, such as the code to operate an X-Ray machine. Hence, the current discussion falls short in respect to large manufacturing companies. Furthermore, current scientific literature is dedicated to single organizational challenges. Yet, for executives with a strong strategic perspective, it is not so much about solving single issues, but rather the identification and execution of a broad set of organizational issues on a company level.

Against this background, our research aims to achieve two distinct goals. First, in this paper, we aim to identify major IoT organizational issues large manufacturing companies face in light of their digital transformation. To identify these issues, we conducted 16 in-depth expert interviews with 11 case companies across the IoT ecosystem. According to our analysis, the core of the problem lies with the uncertainty executives face of where and how to allocate and align digital capabilities within their organizational structures. Along this challenge, our preliminary findings describe six major IoT organizational issues and offer first insights into how large manufacturing companies currently address these issues in practice. Second, in a subsequent step, we plan to further deepen our understanding of organizational archetypes executives might use to design their organizations and to address the identified major IoT organizational issues. We plan to derive actionable guidelines by identifying related contingency factors for each archetype.

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[4] Atzori, L., Iera, A., and Morabito, G. 2010. "The internet of things: A survey," *Comp. networks* (54:15), pp. 2787-2805.

[5] For a detailed analysis of Royal Philips' case, see: Mocker, M., Ross, J. W., and van Heck, E. 2014. "Transforming Royal Philips: Seeking Local Relevance while Leveraging Global Scale," *MIT CISR Working Paper* No. 394, pp. 1-30.

[6] A comprehensive study on service business is offered by: Fischer, T., Gebauer, H., and Fleisch, E. 2012. *Service business development: strategies for value creation in manufacturing firms*, Cambridge: Cambridge University Press; For early studies explicitly focusing on the role of digital technologies in servitization strategies, see: Fitzgerald, M., Kruschwitz, N., Bonnet, D., and Welch, M. 2013. "Embracing digital technology: A new strategic imperative," *MIT Sloan Management Review* (55:2), pp. 1-12; and Grubic, T., and Peppard, J. 2016. "Servitized manufacturing firms competing through remote monitoring technology: An exploratory study," *J. of Manufacturing Techn. Mgmt.* (27:2), pp. 154-184.

[7] For a more detailed understanding on why internal organizational structures pose one of the main challenges to IoT adoption, see: Porter, M. E. and Heppelmann, J. E. 2015. "How Smart, Connected Products Are Transforming Companies," *Harvard Business Review* (93:10), pp. 96-114; and Bilgeri, D., and Wortmann, F. 2017. "Barriers to IoT Business Model Innovation," in *Proceedings der 13. Internationalen Tagung Wirtschaftsinformatik*, pp. 987-990.

[8] Two interesting articles include: Peppard, J., and Ward, J. 2016. *The Strategic Management of Information Systems: Building a Digital Strategy*, Chichester: John Wiley & Sons; and Cherbakov, L., Bravery, A., Goodman, B. D., Pandya, A., and Baggett, J. 2007. "Changing the corporate IT development model: Tapping the power of grassroots computing," *IBM Systems Journal* (46:4), pp. 1-20.

[9] For further information, see: Peppard, J., Edwards, C., and Lambert, R. 2011. "Clarifying the ambiguous role of the CIO," *MIS Quarterly Executive* (10:1), pp. 31-44.

This will enable us to provide executives with actionable recommendations, such as what conditions are ideal for implementing certain organizational archetypes in order to master digital transformation.

Foundations

The research context of this paper is aimed to explore how digital transformation affects large manufacturing companies' organization. Hence, this study builds upon a broad field of existing IS and organization literature. In particular, three research streams are suited to inform our research. The studies of interest include (1) early research on new IT organizations including emerging (executive) roles such as chief digital officer; (2) established IS literature on the positioning of traditional corporate IT units and (3) more general organization literature on business unit collaboration in multi-business companies.

New corporate (IT) entities. A growing research stream investigates the establishment of new executive roles and corporate units to manage digital transformation and build up digital skills. In this regard, recent papers controversially discuss the potential new role of chief digital officer and her responsibilities in comparison to existing IT management roles like chief information officer. Other studies focus on potential new entities such as "unified data organizations" or "customer success management units"[10]. Besides academic contributions, practitioner-driven concepts such as IT research company Gartner's "Bimodal IT" have gained popular attention. The vision of "Bimodal IT" refers to two different types of IT – traditional IT as a support function and innovative IT focusing on new digital products and services – each envisioned to be covered by separate entities within large companies[11].

Role of traditional IT. The IS literature offers an established research stream on the role and structure of traditional corporate IT departments and their interplay with business units. The studies provide organizational frameworks for IS/IT, including different models of how to structure corporate IT departments[12]. Further studies address the interaction between IT and business entities, discussing different concepts of alignment and fusion. In these studies, discussions on the organization of IT services and proposals to solve the tension between IT and business are built on a traditional understanding of IT[13].

Business unit collaboration. Since the popularization of the multi-business unit firm, cross-business unit (BU) collaboration has been a topic of interest to practitioners and scholars. Past studies focused on how to exploit synergy potential and foster cross selling activities[14]. More recent articles offer two interesting insights[15]. Firstly, they identify the need to re-evaluate the importance and means of BU collaboration in an IoT era. This is particularly true for product-dominant firms aiming to provide services (solutions), which contain various elements supplied by different BUs. Secondly, scholars have historically associated a lack of teamwork skills as main driver for a lack of collaboration, while recent studies address the pitfalls of existing collaboration frameworks, emphasizing the role of adequate conflict management.

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[10] Two recent, well received articles in this regard, include: Haffke, I., Kalgovas, B. J., and Benlian, A. 2016. "The Role of the CIO and the CDO in an Organization's Digital Transformation," in *Proceedings of the 37th International Conference in Information Systems (ICIS)*, Dublin; and Porter, M. E., and Heppelmann, J. E. 2015. "How smart, connected products are transforming companies," *Harvard Business Review* (93:10), pp. 96-114.

[11] For a better understanding of the concept of "Bimodal IT", see: Mesaglio, M., Adnams, S., and Mingay, S. *Kick-Start Bimodal IT by Launching Mode 2*, Gartner, April 2, 2015, available at https://www.gartner.com/doc/3021418.

[12] One of the classic, still relevant articles on the role of traditional IT is: Agarwal, R., and Sambamurthy, V. 2002. "Principles and models for organizing the IT function," *MIS Quarterly* (1:1), pp. 1-16.

[13] Gordon, S. R., and Gordon, J. R. 2002. "Organizational options for resolving the tension between IT departments and business units in the delivery of IT services," *Information Technology & People* (15:4), pp. 286-305; and Bharadwaj, A. P., Sawy, O. P., Pavlou, P. P., and Venkatraman, N. P. 2013. "Digital business strategy: toward a next generation of insights," *MIS Quarterly* (37:2), pp. 471-482.

[14] For further information, see: Vizjak, A. 1994. "Exploiting your synergy potential: promoting collaboration between business units," *Long Range Planning* (27:1), pp. 25-35.

[15] Two interesting articles offering these new insights include: Neu, W. A., and Brown, S. W. 2005. "Forming successful business-to-business services in goods-dominant firms," *Journal of Service Research* (8:1), pp. 3-17; and Weiss, J., and Hughes, J. 2005. "Want collaboration?," *Harvard Business Rev*iew (83:3), pp. 93-101.

Major IoT organizational issues

In order to meet future customer expectations, manufacturing companies are challenged to integrate the physical world (i.e. the design, production and maintenance of complex hardware products) and the digital world (i.e. software enabling data analytics and digital services). Early studies investigate how mergering these two worlds affects company structures. For instance, Porter and Heppelmann focus on single unit companies, business functions, and discuss related organizational developments[16]. Their observations include intensified coordination between existing, and an introduction of "completely new and critical" functions, such as data analytics or customer success management. However, large manufacturing companies often possess various business units, a diversified business model portfolio, and sometimes even the ambition to provide an own IoT platform. Examples include GE (Predix), Siemens (Mindsphere), Bosch (Bosch IoT Suite) or Schneider Electric (EcoStruxure). Such large manufacturing companies face specific organizational issues, which thus far have only received limited attention among professionals. Based on in-depth expert interviews and a review of related IS literature, we identified six main issues how digital transformation will affect large manufacturing companies' overall organizational structure (cf. Figure 1).

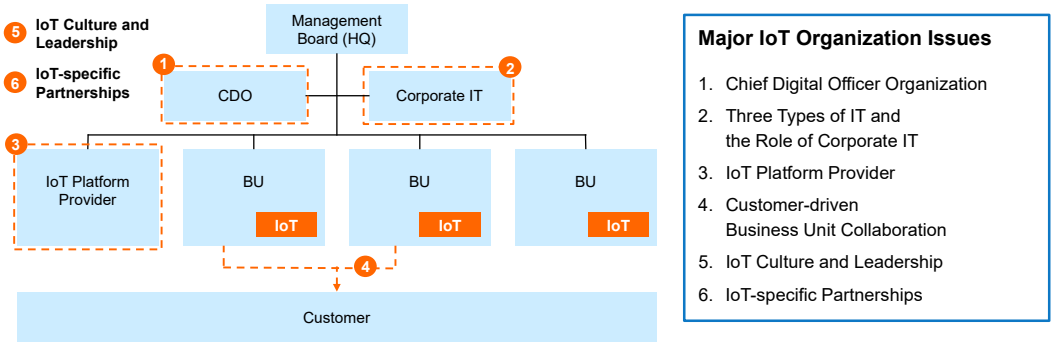

Figure 1. Overview of major IoT organizational issues

Chief Digital Officer Organization

Many large manufacturing companies are currently considering announcing or have recently announced a chief digital officer (CDO). Whether as member of the management board or in a leading corporate position, a CDO's typical responsibilities include overseeing and driving digital transformation. As indicated earlier, some professionals and academics see a clear need for this new (executive) role in order to orchestrate and manage all kinds of new digital activities. Others question the potential delegation of responsibility, as the following statement from case company Lambda illustrates:

"*As a CEO you cannot simply introduce a new executive role, delegate responsibility for digital transformation and expect the whole initiative to fly. A truly successful digitalization will require full CEO attention and commitment.*" (Head of Industry 4.0, Lambda)

Furthermore, while it seems evident that companies are in need of new digital skills and competencies to successfully transform their businesses, for large manufacturing companies it remains often unclear where to position new functions within the existing organizational structures and how to design newly introduced entities. A fact, emphasized by case company Beta:

"*We ask ourselves, which IoT specific competences should be concentrated on a corporate level and in which cases an integration into BUs would be more appropriate.*" (IoT Initiative Project Lead, Beta)

A Head of Digital Operations, from case company Delta, added in the same vein referring to the degree of concentration of new corporate functions; specifically whether to introduce several specialized corporate units or aggregate different functions "under one roof":

[16] The merger of the physical and digital worlds as well as first anecdotal evidence on organizational consequences are well elaborated in: Porter, M. E., and Heppelmann, J. E. 2015. "How smart, connected products are transforming companies," *Harvard Business Review* (93:10), pp. 96-114.

"*Concentrating a broad field of IoT competences within one digital corporate unit would allow us to better coordinate all related activities. However, aggregating IoT related activities might lead to redundancies and inefficiency in traditional corporate units*" (Head of Digital Operations, Delta)

Three Types of IT and the Role of Corporate IT

The increasing debate about IT of different speeds has currently been focusing on a distinction of two main IT types. On one hand, classical or traditional IT activities are associated with ERP systems, support functionality and slow development cycles. On the other hand, new digital IT functions include agile and iterative procedures and the ability to develop innovative new digital services[17]. This understanding has recently also been adopted by emerging research literature[18]. However, large manufacturing companies are confronted with a third type of *embedded* IT, covering the development of embedded software features in hardware products. Hence, current discussions fall short in respect to large manufacturing companies, as a Head of Business Development from case company Alpha highlights:

"*X-Rays have been equipped with software for the last 30 years, enabling customer-driven features, derived from deep market knowledge. While everybody is talking about old and new IT, in our case the picture is more complex.*" (Head of Business Development, Alpha).

In this context, many of our case companies reported an increasing rivalry between traditional IT units, newly designed IoT entities, and embedded IT teams in BUs, to claim emerging IoT responsibilities. For the majority of companies, the corporate IT unit has been an internal cost center, focusing on excellence and risk reduction to ensure overall operational efficiency – i.e. providing classical IT services. In contrast, embedded IT teams, focused on the translation and implementation of business requirements into technical requirements – i.e. developing embedded IT components. These embedded IT teams usually located in BUs, have ever since been difficult to align with corporate IT units[19]. Under these circumstances, many executives now scrutinize whether their existing IT units possess the necessary skill set to develop new innovative digital services requiring application of highly iterative design approaches – i.e. accomplishing digital IT activities. In addition, as a manager at case company Gamma emphasizes, corporate IT units, with classic cost center history, are unfamiliar with competition:

"*Internal IT departments have never been challenged to succeed under market conditions, therefore they are not able to operate competitively or offer attractive market prices. I have not seen any positive example so far and I am also not expecting to do so in the future.*" (Head of Product & Marketing, Gamma)

At the same time, IT departments often accumulated substantial political power and might be valuable internal partners regarding the back-end operation of digital services and connections to companies' ERP systems and legacy infrastructure. The Head of Digital, of case company Eta summarizes this tension:

"*We are currently engaged in controversial discussions about the responsibilities we want to assign to our traditional corporate IT and how to structure the unit to foster exchange with other company units.*" (Head of Digital, Eta)

According to our case companies, there are currently three existing dominant archetypes that define how the collaboration between different IT and business units are orchestrated. In the first archetype, the traditional corporate IT unit does not gain any new IoT related responsibilities and is clearly separated from digital and embedded IT entities, which are conjointly developing IoT solutions. We found this scenario to be mainly applied by companies without sufficient in-house IT expertise, relying on external IoT platform providers. In the second archetype, while digital and embedded IT entities are again mainly responsible for the development of new IoT solutions, the corporate IT unit internally supplies certain functions, such as

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[17] For a detailed definition of the two types of IT in "Bimodal IT", see: Mesaglio, M., Adnams, S., and Mingay, S. *Kick-Start Bimodal IT by Launching Mode 2*, Gartner, April 2, 2015, available at https://www.gartner.com/doc/3021418.

[18] In addition to the article of Ross et al. 2016, already referred to in footnote 1, another recently published research article building upon the concept of "Bimodal IT" is: Haffke, I., Kalgovas, B., and Benlian, A. 2017. "Options for Transforming the IT Function Using Bimodal IT," *MIS Quarterly Executive* (16:2), pp. 101-120.

[19] For a profound overview on strategic management of information systems, see: Peppard, J., and Ward, J. 2016. *The Strategic Management of Information Systems: Building a Digital Strategy*, Chichester: John Wiley & Sons.

back-end operations. With this archetype, large manufacturing companies can utilize their existing resources within corporate IT, while relying on new entities to gain speed in IoT domains. With the third archetype, all IT and IoT related activities are newly coordinated under one roof with the corporate IT unit taking a leadership role. While this might allow for an optimized use of existing resources, it remains unclear if classical IT units are able to fulfil such a comprehensive role. The companies in our sample seem to share these concerns as we could not find any company, which applied this third archetype.

IoT Platform Provider

Large manufacturing companies, which aim to offer hybrid IoT solutions, i.e. solutions consisting of smart hardware products and digital services, are in need of a software platform to operate these IoT solutions. In this respect, companies have two major options at their disposal. Firstly, manufacturers can rely – in one way or another – on external cloud providers, such as Amazon Web Services and Microsoft Azure, by using and adopting their software and services. Such collaborations can have various forms, ranging from simple service contracts to collaboratively running joint ventures. Secondly, large manufacturing companies can start from scratch developing their own IoT platform. The benefits of developing an independent IoT platform can be diverse and range from ensuring data ownership and privacy to ambitions for becoming an independent ecosystem hub. Motives, also revealed by case company Beta:

"*We predict data will become the new currency in future. Therefore, we aim to build a growing ecosystem of partners surrounding our own independent IoT platform and to position ourselves at the center of value capturing.*" (Product Owner of IoT solution, Beta)

In either case, large manufacturing companies are confronted with the question of preference between a single platform for the whole company or customized systems of individual BUs. While the latter might be more costly, due to redundancies and a need to ensure interoperability of systems, individualized platforms are potentially more suited to support a rich portfolio of IoT solutions across market segments.

"*Based on our legacy, we currently possess five different software platforms, which are operated and maintained by separate BUs. We asked ourselves if one size can fit it all and decided to leave the respective BUs with the freedom to keep their existing platforms. However, we are continuously improving the interoperability of the existing systems.*" (Manager Digital Company, Alpha)

A further question is whether such an IoT platform should face market responsibility. Depending on the adopted strategy, companies have to establish a new entity, either in form of an internal cost center or an internal and external service provider. In the latter case, the company's IoT platform provider needs to provide internal services to enable IoT solutions as well as generate revenues with external services at the same time. In this case, BUs offering IoT solutions might be reluctant to indirectly subsidize the development of new platform features, through co-development or internal pricing. This is illustrated in the example of Beta:

"*When we conjointly develop new IoT solutions with our internal IoT platform unit, they pass on all the development costs for new platform features to us, and claim generated revenues for their own P&L rather than really supporting us in developing IoT solutions.*" (IoT Initiative Project Lead, Beta)

Customer-driven Business Unit Collaboration

Many large manufacturing companies are struggling to incentivize their business units to collaborate. While this is a well-known organizational hurdle that large companies face, thus far a lack of cross-BU collaboration has manly hindered companies to utilize synergies and successful cross selling[20]. However, in an IoT context, the ability to offer complex IoT solutions rather than single components becomes critical for long-term economic success. The problem seems to be mainly driven by internal pricing conflicts, where BUs prefer to sell hardware components externally with a profit margin, rather than supplying internally at cost. A manager of the case company Alpha for instance claimed:

[20] For two examples, see: Martin, J. A., and Eisenhardt, K. M. 2010. "Rewiring: Cross-business-unit collaborations in multibusiness organizations," *Academy of Management Journal* (53:2), pp. 265-301; and Vizjak, A. 1994. "Exploiting your synergy potential: promoting collaboration between business units," *Long Range Planning* (27:1), pp. 25-35.

"*We are still searching for efficient collaboration mechanisms, which help us to foster the collaboration between our BUs to provide IoT solutions. We perceive this as one of the key comparative advantages we will need to outperform traditional as well as new competitors.*" (Manager Digital Company, Alpha)

Another aspect of this IoT organizational issue refers to the emerging need to manage customer relationships on a corporate level. Referring back to Porter and Heppelmann's related Harvard Business Review article, a new function labelled "customer success management" should cover "primary responsibility for customer relationships after the sale" as well as collecting and analyzing the data generated by smart products in order to "identify how customers could benefit from additional product capabilities and services". Extending on this idea, we should not only emphasize the need to integrate different functions, such as sales, marketing, and IT, but also enable corporate customer relationship management across BUs and divisions, which will require close collaboration and information exchange.

"*Today it's unacceptable if I have been a motorcycle customer for 20 years in Munich, move to Zürich and then get treated as if I were a completely new customer. The same holds true if I, as a motorcycle owner, decide to buy a car from the same manufacturing company.*" (Head of Industry 4.0, Lambda).

IoT Culture and Leadership

On average, large manufacturing companies needed decades to reach their current size, thus building upon a long success record. They are characterized by a mindset of stability and a firm culture of clear responsibilities and organizational hierarchy. While they do change from time to time, so far these changes have been rather slow and incremental in nature. The digital transformation now challenges many of the core beliefs of manufacturing companies' executives as well as their employees.

"*While we are currently training all our employees, especially those with leadership responsibilities, it remains a huge challenge to alter the old understanding how to conduct business, which was so predominant and successful for such a long time.*" (Director Alliance Management, Zeta).

In addition, large manufacturing companies have a wide range of managerial frameworks at their disposal to foster digital transformation. Yet, certain popular management styles well known from software companies cannot be applied at large manufacturing companies without major adjustments, as indicated by the following statement:

"*We currently experiment with different leadership models. Some, including small, independent and agile development teams, proved to be very beneficial. Others, such as 'swarm concepts' were more difficult to implement and failed due to a lack of employee acceptance.*" (Head of Product & Marketing, Gamma)

IoT-specific Partnerships

Industry experts and scholars unanimously agree on the importance of partnerships and ecosystems in an IoT context[21]. Despite the awareness, many companies still lack the appropriate capabilities to identify interesting and non-traditional partners and to establish long-term relationships in an IoT context. As the Head of Industry 4.0 of a large telecommunication provider reflects, one of the main reasons refers to the inability of large corporates to identify promising use cases:

"*One of the main reasons, why large manufacturing companies are struggling to establish strategic partnerships, lies in their lack of fantasy for new customer needs, missing courage to enter novel paths and a general absence of fail- and experimentation culture.*" (Head of Industry 4.0, Lambda)

Large manufacturing companies lack the appropriate operational frameworks to execute new partnerships. For example, only a one size fits all type of collaboration contracts exists, which has been designed for large volumes and classic buyer-supplier relationships. It is hardly possible to process new forms of relationships with such operational frameworks, as illustrated by a Product Owner from case company Beta:

[21] Two insightful studies on the importance of partnerships in an IoT context include: Westerlund, M., Leminen, S. and Rajahonka, M. 2014. "Designing Business Models for the Internet of Things," *Technology Innovation Management Review* (4:7), pp. 5-14; and Vermesan O. and Friess P. (eds.) 2013. *Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems*, Aalborg: River Publishers.

"*We receive a lot of interesting requests from start-ups proposing collaborations on promising IoT topics. However, when we send them our legal contracts, in line with standard procedures, we usually scare them off. While this is very frustrating for us, we were not able to bypass corporate legal requirements so far.*" (Product Owner of IoT Solution, Beta).

Conclusion, Limitations and Next Steps

Drawing on in-depth case study research, this paper sought to better understand IoT organizational issues and to start identifying organizational archetypes to address these issues. Although prior research has provided valuable input on organizational challenges in the IS literature[22], our study is motivated based on a lack of practitioner-oriented publications providing insights how in particular large manufacturing companies address IoT specific organizational issues in practice. Furthermore, by describing a differentiated analyses of IT types in large manufacturing companies, including traditional, embedded, and digital IT types, we hope to provide a valuable contribution to the general IS domain, which to date has remained undertheorized. The results of this research should be assessed in light of its limitations. The generalizability of qualitative case-study research is limited. While 16 purposefully selected experienced professionals from eleven companies across the IoT ecosystem were interviewed, further studies should be conducted, targeting additional industries and company types. The findings are of a preliminary nature and we hope that this short paper can build a fruitful foundation for further extended studies.

Overall, our research aims to achieve two distinct goals. First, in this paper, we identified major IoT organizational issues that large manufacturing companies face in light of their digital transformation. Second, in a subsequent step, we plan to advance this study by investigating different archetypes of governance structures and their suitability to address the identified IoT organizational issues. We aim to derive actionable guidelines by identifying related contingency factors for each archetype. This will enable us to provide executives with actionable recommendations, under what conditions to implement which organizational archetypes in order to master a digital transformation. We see a broad range of promising research avenues for us and fellow researchers to conduct interesting studies in this regard. For instance, some of our interviewed experts mentioned well-known organizational concepts, including corporate ventures, spin-offs or acquisition activities. They described their companies' plans to locate IoT innovation activities outside of the company, aiming to successfully integrate them at a later stage. Rather than seeing such initiatives as another IoT organizational issue, we perceive them as a potential remedy to overcome certain IoT organizational issues discussed in this paper. Furthermore, we are convinced that the emerging IS research stream that focuses on fostering a fusion of IT and digital entities and understanding IT strategy as a digital business strategy, is well suited to inform this research[23]. Finally, future work might include more in-depth analyses of the identified IoT organizational issues, including their applicability to turbulent versus stable industries or a dedicated investigation on the features and role of embedded IT.

About this Research

This paper is of an explorative nature, applying a qualitative multiple-case study approach, based on semi-structured interviews[24]. The authors followed a two-step procedure to derive the presented results. In the first phase, we conducted 15 informal pre-study interviews with executives from various companies to select practically relevant topic clusters to discuss with interviewees. Complemented by insights from latest research, we then identified the most critical issues to be included in an interview guideline. In the second phase, eleven case studies of eleven companies across the IoT ecosystem were analyzed. The case studies were selected with regards to their suitability for this research, applying the following criteria: 1) Case firms are established manufacturing companies within the process of digital transformation or closely related ecosystem partners; 2) the manufacturing companies have had digital transformation on their agenda for at least five years and have already implemented or adapted their corporate structure in one way or another;

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[22] This paper presents a small and by no means exhaustive selection of research contributions.

[23] For a primer on digital business strategy, see: Bharadwaj, A., El Sawy, O. A., Pavlou, P. A., and Venkatraman, N. 2013. "Digital Business Strategy: Towards a next Generation of Insights," *MIS Quarterly* (37:2), pp. 471-482.

[24] Eisenhardt, K. M. 1989. "Building theories from case study research," *Academy of Mgmt. Rev.* (14:4), pp. 532-550.

3) interview participants are qualified experts from different functions and positions able to provide deep insights into the organizational structure of their companies or closely related manufacturing partners. Based on the importance of ecosystems and business networks in an IoT context, we decided to include closely related ecosystem partners (i.e. software companies and telecommunication providers) into our sample to also cover their views on the organizational challenges of large manufacturing companies. In the early days of IoT competition, the organizational structure and any plans to transform it are perceived as critical company information, therefore a large majority of interviewees insisted to stay fully anonymous.

No.	Case	Industry	Number of employees	Interviews (Partners)	Roles of interview partners (anonymized)
1	Alpha	Manufacturing	More than 300'000	3(3)	Vice President Innovation; Head of Business Development; Manager Digital Company
2	Beta	Manufacturing	More than 300'000	2(2)	Product Owner of IoT Solution; IoT Initiative Project Lead
3	Gamma	Manufacturing	Between 200'000 and 299'999	2(3)	Head of Product & Marketing; Manager Platform Services; IoT Project Manager
4	Delta	Manufacturing	Between 100'000 and 199'999	1(1)	Head of Digital Operations
5	Epsilon	Manufacturing	Between 100'000 and 199'999	1(1)	Manager Business Model Development
6	Zeta	Manufacturing	Between 100'000 and 199'999	1(1)	Director Alliance Management
7	Eta	Manufacturing	Between 20'000 and 49'999	2(2)	Member Digitalization & Industry 4.0; Head of Digital
8	Theta	Software	More than 300'000	1(1)	Principal Solutions Architect
9	Iota	Software	Between 20'000 and 49'999	1(1)	Director Manufacturing Industry
10	Kappa	Telco Provider	Between 100'000 and 199'999	1(1)	Director Industry Area Telecom
11	Lambda	Telco Provider	Between 20'000 and 49'999	1(1)	Head of Industry 4.0

Table 1. List of case studies and interview partners

In total, 16 in-depth expert interviews have been conducted so far (cf. Table 1)[25]. The majority of interviews were conducted face-to-face in order to receive good-quality data, yet a few interviews had to be conducted via phone due to accessibility constraints. The expert interviews were held in German and English and were audio-recorded and fully transcribed. All interviews followed the same case protocol, including open questions like: What are the major IoT organizational issues your company is currently facing? Where and how did your company allocate and align digital capabilities within your organizational structure? What was the reasoning for implementing certain organizational structures? Additional material (e.g. companies' websites, internal presentations, brochures) were analyzed to ensure data triangulation. Three researchers analyzed the data independently, first looking at each case separately, and then comparing the companies in a cross-case analysis. Single interviewees were contacted again via phone to confirm quotes added to provide explicit examples and emphasize important aspects of IoT organizational issues. Further advancing this study, will allow us to elaborate in more depth on the validity tests used to validate our interviews[26].

Besides discussing major IoT organizational issues, our interviewees granted valuable insights into their company's organizational strategies and the underlying reasoning. In a next step, applying a qualitative content analysis method[27], we plan to identify organizational archetypes. This method will allow us to analyze the interviews based on inductive category building, utilizing a systematic, rule-and-theory-based procedure. The transcripts will be coded by two independent researchers, aiming to avoid misinterpretation and coding bias. For the codings we plan to use the software MaxQDA. The coding and categorization process shall be of an iterative nature, until we reach a saturation point in identifying organizational archetypes. We aim to discuss remaining disagreements and unresolved questions with fellow researchers. Ideally, we will be able to discuss and verify the identified archetypes with a selection of interviewees.

[25] Besides the interviews listed in Table 1, we informally talked to seven executives of well-known global firms, who disagreed to be mentioned in this study. Their insights are contributing to the presented results.

[26] For further information, see: Yin, R. 2013. *Case study research: Design and methods*, Thousand Oaks: Sage.

[27] Mayring, P. 2002. "Qualitative content analysis – Research instrument or mode of interpretation?," in *The role of the researcher in qualitative psychology*, M. Kiegelmann (ed.), Verlag Ingeborg Huber, pp. 139–148.