Final Report

Digital Transformation of Traditional PBOs and Modern PNWs: Changing Management Practices in Project Society

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# Table of Contents

Acknowledgments 1  
Brief Introduction to the Research 3  
Research Questions/Objectives 4  
Research Framework: Concepts and Brief Literature Review 6  
  Digitalization 6  
  Traditional Project-Based Organizations (PBOs) and Modern Project Networks (PNWs) 6  
  Managerial Practices in Project Society 7  
Methodology 8  
Primary Results and Discussion of Findings 10  
  Seesaw Turbulences in the German Case 10  
  Smooth Developments in the Swedish Case 11  
  Cross-Case Comparison and Discussion 12  
Practical Application of Findings and Conclusions 14  
References 15  
Appendix A List of Outputs and Publications 17  
Appendix B Comparison of Planned Deliverables in Research Agreement to Actual Project Deliverables 18  
Appendix C Biographical Sketches of Principal Investigators 19
Digitalization is a phenomenon occurring across sectors and nations, affecting technical processes, organizational forms, and managerial practices. Project management, which is often used as an agent for change, plays a significant role in driving and implementing digital transformation. In today’s project society, several distinct forms of project organizing are common. Among them are: (1) project-based organizations (PBOs), which are common in traditional sectors like construction, and (2) project networks (PNWs), the most favorable form of project organizing in modern service and creative industries (Lundin, Arvidsson, Brady, Ekstedt, Midler, & Sydow, 2015). While PBOs are typically studied in an “organization-centric” (Maoret, Massa, & Jones, 2011) manner, PNWs deserve to be studied in their own right; that is, on the network level rather than on the organizational or field level of analysis (e.g., Manning & Sydow, 2011). In both types of projects, organizing digitalization plays a significant role and affects managerial practices, yet little is known as to how these changes may unfold and how managers can prepare for this transformation.

To analyze the digital transformation of traditional PBOs and modern PNWs, a two-step research design was applied. In the first step, cross-sectional interviews with project members were conducted—about half of them in Sweden and the other half in Germany. Based upon the findings obtained in the initial interviews, two comparative cases were analyzed in depth in both countries. Both cases dealt with the construction industry, providing insights on two different levels. First, the study offered findings with regard to traditional PBOs as they are common in construction, which is known as a very mature industry. Second, the case studies also uncovered modern PNWs of subcontractors, external partners, and service providers, such as those from the IT consulting industry. The latter took on a leading role in implementing digitalization across various sectors, particularly in construction. The research started as explorative, not limiting the range of possible findings. Despite that, it was expected that PNWs might be better prepared for digital transformation than PBOs. In fact, a range of structural configurations and managerial practices in both settings were observed as an outcome of digital transformation. We posit that these configurations and practices are likely to enable and, at the same time, constrain the transformation process. A better and more nuanced understanding of these processes allows us to contribute to scientific research and project management practice.
Research Questions/Objectives

The overall research question of this study is:

How does digitalization affect managerial practices in the two prominent forms of project organizing: PBOs and PNWs?

Digitalization has gained momentum around the globe and is rapidly changing production processes (sometimes labeled as Industry 4.0) and connecting material items with internet applications (Internet of Things). This transformation not only reaches economic processes, it also affects society as a whole; for example, by changing the nature of work and by creating new products and services for consumers. In this transformation, the role of project management is vital:

- First of all, there is a digitalization of the environment. Specifically, many projects today are concerned with the utilization of digital opportunities in various fields of application. For example, projects are set up in order to introduce, implement, or transform production processes and/or the delivery of products and services into digital ones. Existing research in the field of strategy and project management has applied external analyses to screen and qualify changing environments of the firm or project with regard to uncertainty and complexity (e.g., Lenfle, 2011; Petit, 2012). Yet, there is little research on the influence of digitalization on project-based organizing as a recent phenomenon. In addition, most of the approaches to external analysis refer to singularities or somewhat bounded influences. Digitalization, on the contrary, is spreading across all parts of society and will have a major influence on our future work and life.

- Second, we can observe the digitalization of projects and other forms of organizations. Projects and more permanent organizations are adapting their internal processes and work organization. For example, cloud-based software applications are implemented to collaborate more easily. Moreover, the availability of big data allows organizations to ground their decisions in a broader information base (Ashton, 2009). From project management research, we have learned a lot about software-based tools and procedures that support the planning and execution of projects (e.g., Voropajev & Scheinberg, 1992; Hazir, 2015). These approaches conceptualize digital tools as being instrumental to project management. However, little research has focused on how digitalization transforms projects and organizations as a whole. Thus, the sociomaterial dimension of digitalization deserves more attention in project management research.

- Finally, digitalization is pushing the project management profession. Over the last decades, due to support by PMI and IPMA in various qualification and certification programs, project management has become a profession in its own right (Hodgson, 2002). This is also reflected in career paths that, more often than in the past, build on project-based experiences by managers. The role and tasks of project members are contingent on the other two dimensions of digitalization as mentioned previously. This means that the nature of the project manager’s work also changes with ongoing digitalization; for example, more coordinative and integrative tasks and fewer routinized planning tasks. Existing research in project management provides insights into how the project management profession has developed, but so far it does not consider the impact of digitalization.

Specifically, we want to answer the following research questions:

1. Which managerial practices are established in PBOs and PNWs to react to environmental changes based on digitalization?
2. On the level of projects and their embeddedness in organizations and interorganizational networks, which mechanisms enable and constrain digitalization?
3. How does the project management profession develop vis-à-vis digitalization?

Thus, the overall aim of the study was to gain knowledge that is relevant for project management with regard to how the digital transformation can be approached, influenced, and shaped proactively by managerial practices. A context-sensitive approach will provide nuanced insights into these two forms of project
organizing—PBOs and PNWs—for two countries, Sweden and Germany. By pursuing a comparative approach, the study seeks to:

1. Identify not only drivers, but also barriers that may counteract digital transformation on the project, organization, network, and field levels of analysis;

2. Delineate promising practices as to how project management can leverage digitalization for innovation and change; and

3. Develop context-specific implications, taking into account pluralism in forms of project organizing and institutional contexts.
Research Framework: Concepts and Brief Literature Review

We review relevant sources from three strands of literature: digitalization; traditional project-based organizations (PBOs) and modern project networks (PNWs); and managerial practice in project society.

Digitalization

The current trend toward digitalization and the rapid development of new technologies with their effects on management, work, and employment are one of the central topics regarding the future of Western societies (Brynjolfsson & McAfee, 2011; Evangelista, Guerrieri, & Meliciani, 2014). While some refer to a “second machine age” (Brynjolfsson & McAfee, 2014) or “computerization” (Bowles, 2014; Frey & Osborne, 2013), in Germany particularly, the term “Industrie 4.0” characterizes the observed trend of digitalization (Hirsch-Kreinsen, 2016). All of these diagnoses emphasize that the development is not only about the implementation of new technologies, but rather the integrated use of data as well as the possibility of linking physical objects—such as machines or tools—virtually (Ashton, 2009). This, however, opens up completely new opportunities in terms of planning, regulating, and organizing processes within and among organizations. To investigate the influence of digitalization on project management, we follow others (e.g., Manning & Sydow, 2011; Floricel, Bonneau, Aubry, & Sergi, 2014) and use structuration theory by Giddens (1984) as a sensitizing device. This theory allows for a focus on the interplay or duality of structure (e.g., hierarchy, rules, processes, and procedures) and agency in social practices, allowing us to understand how they are actually performed within and across organizations. The recursive understanding of the relationship between structure and agency goes beyond simplistic conceptualizations of contingency and enables an understanding of “embeddedness” as a process. For digitalization, this means that digitalization is not an external condition that simply deserves a reaction. It is more likely that—following structuration theory—project management practitioners include these technologies into their practice (Orlikowski, 1992), and thereby (re-)shape the form of digitalization. In other words, project management is not only affected by digital transformation. At the same time, project management is an important ingredient in this transformation process. Some project management consultants directly point to this facet with claims such as “We are the digitalizers” (Hales, Peterson, Pena, Dessibourg, & Chen, 2017).

Traditional Project-Based Organizations (PBOs) and Modern Project Networks (PNWs)

Both PBOs and PNWs are affected by digitalization. At the same time, these organizational forms are means to shape digitalization. PBOs are organizations whose business is mainly made up by projects; they have been typically studied in an “organization-centric” (Maoret et al., 2011) manner in several publications for a rather long period of time (Hobday, 2000). One might even say that PBOs belong to an area in which project practices have developed with increasingly fine-graded details. Through the sequence of editions of A Guide to the Project Management Body of Knowledge (PMBOK® Guide) (PMI, 2017), there has been a promotion on how to run projects from a practical point of view, in particular projects coordinated by a PBO. Therefore, it is likely that management and coworkers of PBOs have developed practices and routines in such a way that they can handle increasingly complex projects. Repetition, however, leads to the development of recipes and rules of thumb to be used in various situations, which may not always be appropriate. Algorithms are taking a form which, in turn, facilitates the use of more and more advanced digital forms of integration.

The focus on PNWs, typically carrying out a series of projects in which at least three organizations repeatedly collaborate, is a more recent development. Nevertheless, this organizational form has also been subject to research (see DeFilippi & Sydow, 2016 for a recent review). Like PBOs, PNWs deserve to be studied in their own right; that is, on the network level rather than
on the individual, organizational, or field level of analysis. PNWs come in a variety of shapes, more often than not involving PBOs, especially in the role of the “network orchestrator” (Paquin & Howard-Grenville, 2013). One important implication of this is that project procedures are less stabilized for PNWs, as described by Lundin et al. (2015). Organizations such as PBOs often collaborate in PNWs, together with professionals from different cultures and industries. It is likely that this kind of “pluralistic integration” leads to friction (Ekstedt, Henning, Andersson, & Elvander, 1994). This friction may hamper activity, but may also be a source of genuine creativity, leading to something novel and valuable (Amabile, 1996). One may benefit from using good ideas from many sets of knowledge environments or from the dynamics of the confrontation itself. Even if PNWs frequently resemble a rather loose ensemble of organizations, they definitely need means to integrate. Digitalization may support the capacity of actors to cooperate in a network, but this needs further exploration, as does the role of PBOs in such networks.

Managerial Practices in Project Society

As indicated with the literature on digitization, PBOs, and PNWs, managerial practices are subjected to pressure due to working with new rules and new technologies in both organizational forms. Neither the mindsets for traditional PBOs and modern PNWs, nor the organizing practices and tools, are keeping pace with each other. Entrepreneurial practices and openings play a definite role for PNWs (cf. Ferriani, Cattani, & Baden-Fuller, 2009), while ingrained practices are common among PBOs (cf. Ekstedt, Lundin, Söderholm, & Wirdenius, 1999). Consider, for example, new digital building planning and design techniques, which are likely to not only affect work processes and managerial practices within the general contractor as the PBO, but also the coordination practices of the PNW that the general contractor is orchestrating. Similar developments are likely to take place in modern service and creative industries, in which startups are likely to take on the orchestrating role, or the PNW is organized in a more shared manner with a participative form of network governance and more symmetrical power relations. In both cases, however, the network management may be assisted by a network administrative organization (Provan & Kenis, 2008) using digital technologies for coordination or coordination support. From our structuration perspective, it is important to note that such technologies are not simply available to the organization or the network, but are intertwined with new project management techniques for inclusion into daily work or managerial practice (Orlikowski, 1992).
Methodology

Following a multiple-case-study design (Yin, 2013), we collected in-depth qualitative data for two comparable cases in Germany and Sweden. This allowed us to zoom into two interorganizational projects (IOPs) in an established industry (construction). In addition, we have started to collect data on the project networks that these IOPs are embedded in and how they have developed over time. This approach will enable us to understand the coconstitutive role of the interorganizational networks in supporting the coordination of the two IOPs under scrutiny. By simultaneously considering the field in which the two IOPs and their respective networks are embedded, we uncover how projects and project networks co-evolve and eventually transform.

The cases were both selected based on initial information about the projects, including information about the use of a new technology: building information modeling (BIM). Over the last decade or so, this technology has been developed into a usable tool for the architectural, construction, and engineering (ACE) industry, and now promises to not only support the coordination of IOPs in this industry, but also to significantly affect respective processes and practices. Using 3D representation and, more importantly, a common database with extremely detailed information, BIM provides a digital version of the physical assets of a building that can be used for a variety of purposes throughout the life cycle, starting from its basic design through its construction, to its later use, including maintenance and repair management. Furthermore, BIM increases the transparency of the whole process by providing an “integrated digital record of all steps taken during the planning, engineering, and delivery of buildings” (Whyte & Hartmann, 2017: 591; see Oraee, Hosseini, & Papadonikolaki, 2017 for a comprehensive review of the literature on BIM).

In the German case, named “Southern Link” to guarantee anonymity, the temporary task is the construction of an office building. The building will be located in the city center of a major German city on a property measuring roughly 10,000 square meters. The goal of the project is to create 30,000 square meters of space across floors, as well as the construction of a roof spanning the 1,600-m² atrium. The initiator of the IOP was an international project developer who sold the building even before the construction phase had started.

The project developer will nevertheless remain the owner of the construction project until closeout. In this role, the owner continues to be the client of the architect, the project management unit (an external consultancy), the general contractor, and other project partners who retain direct business relationships with the project developer. The project developer, together with the new owner, have already found a tenant who has signed a 10-year rental contract for the new headquarters. Despite this rather long-term perspective, both former and current owners placed emphasis on multitenant usability, meaning the building needs to be planned and constructed in such a way that new tenants may enter the office space years later, without the need for major reconstruction.

In the Swedish case, which is called “Northern Link,” the task was, and still is, to develop buildings right in the center of a major city. The owner of the project—a real estate company—is in charge of the project from the very beginning to the very end. The owner asked an architectural firm, with which contacts have developed well over time, to come up with ideas on how the site could be used in terms of reconstructed and new buildings. The architects presented their ideas and they were well received by the owner. The next step was for the owner to contact a major construction firm to come up with plans for the construction work. However, the owner and the construction firm could not agree on how to carry out the project. The construction firm favored tearing down all of the buildings on the site and starting from scratch. The result of the disagreement was that the major construction company was cut out of the project entirely, and the project was divided into three parts, where three different construction companies were awarded approximately one-third each.

Data on both cases were collected primarily via interviews with upper and middle managers in the PBOs involved in the still-ongoing IOPs. Due to privileged access, we were able to supplement these interviews in the German case by ethnographic observations on the interorganizational level (e.g., in project meetings). The interview data from Sweden were supplemented with insights from site visits. Given the limited duration of the overall research project (less than two years), we have also started to include retrospective information on past projects and the history of the organizations and networks. In addition, we collected company-internal documents such as project documentation, presentations, and reports of portfolio meetings, and
then stored them in two case study databases, together with the interview and observational data. In total, 20 interviews were conducted alongside data collection in 40 hours of field observation and from 20 documents.

For data analysis, a qualitative approach has also been used (Miles, Huberman, & Saldaña, 2014). First, we categorized the original data (quotes and observations) into themes by an iterative coding procedure using a practice-based lens and the idea of plasticity, that is, the transformative ability of the project as an artifact of project relationships as well as project management techniques. Then we integrated the findings into a framework of practices that differentiates project-, network-, and field-level mechanisms. Due to its iterative nature, switching back and forth between analyzing data inductively and mobilizing a practice lens and prior knowledge about plasticity, this form of data analysis is best described as abductive (Locke, Golden-Biddle, & Feldman, 2008). Moreover, we examined rival explanations in order to increase confidence in our findings. A cross-case analysis will reveal consistent patterns and help to identify contingencies.
Primary Results and Discussion of Findings

In the following, we will first report findings from the two construction sites starting with the German, and followed by the Swedish case. With the help of a cross-case analysis, we will then elaborate our understanding of project plasticity, a construct we are trying to distill from the data that supports the coordination IOPs embedded in project networks. As will soon become clear, the dynamics in the two cases turned out to be quite different, despite many case similarities. Above all, the German case was plagued by severe turbulences, while the Swedish case has developed more smoothly so far.

Seesaw Turbulences in the German Case

The construction of the Southern Link building by the German IOP stood out in at least two respects right from the start. Both idiosyncrasies originated from the strategy of the original owner, in other words, the project developer. First, the building is now supposed to be environmentally friendly and have a convincingly sustainable design. In practice, this led to the use of construction materials that may be recycled after the end of the building life cycle. The two dominant materials are the timber used for the structure of the building and a comparatively smaller portion of concrete. A block-type thermal power station is used for efficient power supply, and e-mobility parking lots are installed in the basement of the building. This has proved to be challenging for the project management unit responsible for consulting with the project developer, as well as selecting partners, because providers of this type of hybrid construction are still scarce and the expertise of the selecting organization is limited. Second, the construction project was chosen as a pilot project for BIM, and the team working on this project was, in fact, using BIM for the first time. So it was particularly important to secure a certain BIM capability and initiate the respective learning.

When the project started, the basic IOP had been set up and the core team assembled. The project developer had selected a leading project management unit and, from the very beginning, insisted that all planning activities be based on an integrated BIM model. Jointly, the project developer and the project management unit recruited an architect (for the basic design), four planning offices (building physics; fire safety; heating ventilation, air conditioning, and refrigeration [HVACR]; and mechanical, electrical, and plumbing engineering [MEP]), and two civil engineering firms (one with the necessary BIM capability and one of them being the HVACR planner). The civil engineering firms belonged to the same holding company. At this stage, the final purpose of the building had not yet been clarified. Back then, the idea was to set up a hotel rather than an office building. Moreover, the fabric of the building (wood/steel/concrete) had not been determined yet; however, in the center of the building there was to be an open square for light, design, and regeneration purposes.

Over the course of the project, more partners were chosen jointly by the project developer and the project management unit to complement the project team. Most importantly, a second architect was commissioned with the Southern Link project because the original architect did not have either the capacity for detailing the design or, as it turned out, any BIM capability. Apart from the second architect, another HVACR planner (as a subcontractor of the first architect) also came in, and four planning offices were involved. Consequently, the IOP became more complex, already comprising 10 organizations before the general contractor was selected, not to mention the many subcontractors necessary to complete the building who needed to be selected. Moreover, a new dynamic arose as the rental contract was signed with a large enterprise that wanted to use the building as its new German headquarters. The tenant immediately requested some adaptations, which did not entirely fit the multitenant approach originally planned. For example, the tenant asked for more e-mobility parking lots in the basement of the building, with significant repercussions for the electric infrastructure. Furthermore, redundancies for emergency situations (e.g., cooling system, secondary power supply, etc.) were requested. At that time, it also
became clear that the supplier of the prefabricated hybrid components did not have an in-house partner with the competencies to do the construction planning. Instead, the supplier unilaterally selected a well-regarded local partner. The initial offer by this prospective partner, however, was way above the price expectations. The client decided to stop the negotiations for the duration of a moratorium.

Meanwhile, with the help of the project management unit and an additional engineering firm, the client focused on tendering processes and started a new tender in order to select a general contractor. During the same period of time, the project management unit identified alternative providers for the prefabricated hybrid components, allowing for a potential change of partners in the IOP. Few tender offers came in; meanwhile, the client insisted on starting the construction. Additionally, in their offers, the general contractors and HVACR subcontractor asked for substantial premium fees if they had to apply BIM. At that point, the client decided completely against BIM in favor of continuing with older technologies including computer-aided design (CAD) and paper-based planning. During the years of actual construction, further selection decisions came up for resolution by the general contractor.

Smooth Developments in the Swedish Case

The Northern Link IOP covers the fundamental reconstruction of several buildings in the center of a major Swedish city. Besides having many floors above street level, the buildings have seven levels below street level. The construction work is also becoming quite complicated because a decision was made to keep the old frames and walls, even parts of the facades, more or less intact. The busy traffic around the buildings causes major logistical challenges. The total IOP comprises the reconstruction of several large buildings at the same time that a new, much smaller building is to be added. Even though the whole project covers 80,000 m² of space across different floors, the design alternatives and space availability at work sites are very limited because of existing frames and walls. Deliveries have to be made just in time to avoid bottlenecks in the construction process.

At an early stage, not unlike the case of Southern Link, though for a different reason, the total project had to be reconsidered. The reason was that the plans included a hotel; however, it was soon discovered that another major hotel was to be erected close to the building site. The hotel part was abandoned, and the plans had to be reconsidered, affecting both the construction companies and the owner in terms of what the site should include. In practice, use of the buildings had to be considered in marketing terms as well. Limited space for construction meant that a lot of coordination work had to be done in order to make it possible for the construction companies to work together on the site.

A major real estate company owns and has been in charge of the whole Northern Link project from the very beginning. The real estate company has also been the main actor in most respects over time. As an owner, it has considerable project management experience, so that no external consultant had to be involved in the IOP. What is more, the owner had the capability to act as the lead organization or orchestrator of the IOP, which also included BIM use and the project network from which the IOP emerged.

However, despite these stabilities, there were major changes at the start of the IOP, long before the idea of using the site for a hotel was reconsidered. In the beginning, the Northern Link owner asked an architectural firm to come up with ideas of how the buildings and the area involved could be adapted for future use. The owner approved the basic ideas and asked one major construction company to make plans for developing the buildings in the area. However, the owner disliked the plans because the construction company wanted to tear down all the buildings on that piece of land and start construction from new. The owner’s disapproval of this resulted in the construction company being cut out of the project.

The total venture was then divided by the real estate company into three different parts, which were distributed among three construction companies, each getting about one-third of the complex. The three companies, which then took over as general contractors, are competitors in a sense, but they still needed to cooperate closely, since the space for construction and logistics at the site was very limited. The actors recurrently met at the site to solve problems; for example, those of overlapping bars and transport logistics. Because one part of the building complex was meant to be a hotel, and the hotel idea was dropped after construction started, the whole venture had to be renegotiated with the construction companies.
The owner also played the leading role when it came to digitalization by specifying BIM as a requirement for participating in the project. Generally speaking, the owner and project developer turned out to be the main actors when choosing which kinds of IT systems should be used. The three general contractors simply had to meet these demands, which in turn affected their subcontractors. The owner offered access to an on-site BIM lab to its project partners. This lab made it possible to coordinate design and work from different specialties, like electricity, ventilation, and pipes (MEP and HVACR). The owner convened regular meetings in the lab, sometimes on a weekly basis. When coordination in space (and time) did not work perfectly, which is common in complex building projects like this, the specialists gave each other homework to do by the next meeting to better meet these demands. In fact, the owner, the general contractors, and lots of subcontractors and architects were coordinated via BIM, complemented by virtual design in construction (VDC). Today, support from these systems, in one form or another, is an important part of the daily work at the construction site. Even the subcontractors use the systems to a significant extent. The owner actually runs other projects where paper drawings have been abandoned totally, and laptops and mobiles are used from the design phase to guide assembly work at the building site.

Besides BIM and VDC, there is an IT system for logistics, which is much needed in this case because of the location, which requires that all materials have to be delivered in a “just-in-time” manner. Another IT system used by all the parties involved is related to security. This is a system that also has to meet the demand from the legal system of authorities. Some of the interviewees talked about efforts toward an ideal situation, whereby the different systems directly matched, making total and instant coordination possible. But this is not the case yet.

There are also other signs of close cooperation between different actors in this IOP. For one period, the project managers from the owner company worked together in the same office as the project managers from one of the general contractors. The organizations and professions seemed to work in parallel to a great extent—almost overlapping. There were also people from the owner company that worked together with the managerial personnel at the construction site.

Digitalization made it potentially possible, at least from a longer-term perspective, to change and simplify the traditional setup of actors in a building IOP. Actually, this had already happened. The owner of the Northern Link project managed at least one other building project without the support of a general contractor. The IT technology facilitated a wide supply of specialists in a resourceful network, which made it possible for an in-house project manager to choose and hire suitable subcontractors directly.

Knowledge and training related to digitalization can also cause tension in the traditional project organization of construction activity. We observed two phenomena in the Northern Link case. The first was related to formal education. Several of the young project managers, IT-related overhead personnel, and architects took BIM courses in college. It has been difficult to confront that kind of knowledge with the experience-based knowledge of the established traditional builders. In turn, the traditional builders have problems understanding why one would abandon a proven concept in favor of BIM. The other phenomenon is the upsurge of BIM and IT consultants today. In this case, there is one very important consultant, associated with Stanford University, who is promoting VDC. This seems to be a wider concept than BIM. BIM is predominantly related to virtualization and design, while VDC aims to make the whole construction process digital, including BIM.

The confrontation between the ingrained traditional construction culture and the culture embracing digitalization may also lead to a search for new organizational solutions. A pluralistic integration may be a force of creativity, especially in a project environment, as we have experienced when one layer of management can be skipped—the broker function of general contractors (Ekstedt et al., 1994).

Cross-Case Comparison and Discussion

Table 1 summarizes and compares the two IOPs with regard to the three dimensions of project plasticity that all point to significant, if not transformative change, but somehow the IOPs continue to exhibit some stability. This stability, we argue, is important to keep the coordination of the IOPs going. Based on this comparison, the construct of project plasticity will be specified in a later publication.
### Table 1. Case comparison with regard to three plasticity dimensions.

<table>
<thead>
<tr>
<th>IOP PLASTICITY DIMENSION</th>
<th>SOUTHERN LINK</th>
<th>NORTHERN LINK</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Artifact</strong></td>
<td>• From efficient hotel to sustainable office building</td>
<td>• From hotel to office building</td>
</tr>
<tr>
<td></td>
<td>• Adaptations in design including a new atrium at the center of the building</td>
<td>• From tearing down to accepting existing frames and walls</td>
</tr>
<tr>
<td></td>
<td>• Turn toward Smart Building Applications (e.g., application control)</td>
<td></td>
</tr>
<tr>
<td><strong>Relationship</strong></td>
<td>• Adding a second architect, changing an engineering firm due to lack of expertise</td>
<td>• From one to three general contractors</td>
</tr>
<tr>
<td></td>
<td>• Structural engineering firm delegates its entire work package to subcontractor</td>
<td>• Meetings and recurrent problem solving are engaging many actors at the site; the BIM lab facilitates instant communication and changes of detailed design</td>
</tr>
<tr>
<td></td>
<td>• Hybrid-construction (wood-steel elements) provider hires engineering office for help with design</td>
<td></td>
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<td></td>
<td>• Project management unit is replaced</td>
<td></td>
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<tr>
<td><strong>Tools</strong></td>
<td>• From BIM importance to negligence</td>
<td>• Constant, if not increasing, relevance of BIM, supported by training and additional IT systems</td>
</tr>
<tr>
<td></td>
<td>• Additional isolated IT solutions, no integrated IT solution yet</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Asynchronous planning, BIM models run locally without real-time synchronization</td>
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</tbody>
</table>
Practical Application of Findings and Conclusions

The research findings have implications for the organization and the technology. In terms of organization, both projects are certainly IOPs; that is, a lot of partners changing over time who collaborate in these projects to come up with useful results. These projects are not only embedded in time, but also make use of a lot of relationships. We still have to explore to which extent past relationships matter based on what is going on today, and to what extent future relationships may matter. Regarding the technology, it seems quite clear that IT helps to integrate project coordination. The same is true for the visualization that comes with it.

An economic problem that comes along with BIM, and which has not yet been settled, is that there are significant costs in setting up the BIM model, and those who profit most from it may only be those who are in the use phase of the building. This is an economic dilemma that has not really been addressed yet.

We have also seen in both projects that at least some additional BIM literacy is required, along with some additional capabilities. Otherwise, the technology will not be used in any effective manner. What is more, new roles are likely to be created, most obviously the one of the BIM manager and the BIM administrator or coordinator. And, at least for now, a lot of nexus work at interorganizational boundaries has to be done. This is required to compensate for the lack of technical integration.
References


Appendix A—List of Outputs and Publications

1. A webinar on the topic “How Digitalization Affects Project Management—Evidence From Two Case Studies in the Construction Industry” took place 24 September, and was well attended by 1,224 live participants. The webinar is now available on demand, and has had over 16,000 views within three months. The user rating of the webinar is excellent as well, with an average score of 4.3 out of 5.

2. A scientific article has been published in Project Management Journal:

3. A second scientific article is still in progress. It has the working title “Dynamics of Project Networks—Organizing for the Plasticity of Projects.” It has been submitted for presentation at the IRNOP Conference 2020 in Uppsala, Sweden, and it will be submitted for publication in a scientific project management or general management journal afterward.

4. A Joint Research Meets Practice Workshop was conducted with a PMI chapter in Germany. The event took place on 21 March 2019 in Berlin, in a representative downtown facility of Microsoft. The meeting was well attended.

5. Preliminary results were presented and discussed at three international conferences: Academy of Management Conference in Boston, Massachusetts, USA, European Group for Organization Studies in Edinburgh, Scotland, and European Academy of Management Conference in Lisbon, Portugal.

6. At the Academy of Management Conference 2019 in Boston, Massachusetts, USA, Jörg Sydow and Timo Braun hosted a Professional Development Workshop (PDW). The PDW was sponsored by seven divisions of the Academy of Management and brought project management topics to the forefront of the conference.

7. A practitioner workshop with companies participating in research was conducted in September 2019. The project team was able to extensively engage in conversations with practitioners, collect additional data, and study the Swedish case further. Part of the workshop was an on-site tour to see their work at the construction sites.
# Appendix B—Comparison of Planned Deliverables in Research Agreement to Actual Project Deliverables

<table>
<thead>
<tr>
<th>TYPE</th>
<th>PLANNED</th>
<th>REALIZED</th>
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<tbody>
<tr>
<td>Conference paper on the explorative qualitative pre-study results</td>
<td>Presentation at two of the following conferences: European Academy of Management (EURAM) Conference in Reykjavik, Iceland, Tilburg Temporary Organizations Conference (TTOC), European Group of Organization Studies (EGOS), Tallinn, Estonia, and/or IRNOP 2018, Melbourne, Australia.</td>
<td></td>
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<tr>
<td>Workshop with companies participating in research</td>
<td>Uppsala University</td>
<td>Conducted in September 2019</td>
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<tr>
<td>Joint Research Meets Practice Workshop with a PMI chapter in Germany; field validation of “Action Guide”</td>
<td>Freie Universität Berlin, Germany, jointly with PMI</td>
<td>Conducted in March 2019</td>
</tr>
<tr>
<td>One-hour webinar for practitioners</td>
<td>PMI</td>
<td>Conducted in September 2019</td>
</tr>
<tr>
<td>Submission of journal paper on qualitative pre-study results</td>
<td>Project Management Journal (PMJ)</td>
<td>Successfully published in PMJ</td>
</tr>
<tr>
<td>Conference paper(s) on case study results</td>
<td>Annual meetings of the Academy of Management (AOM), Chicago, Illinois, USA, European Group for Organization Studies (EGOS), Hamburg, Germany, and European Academy of Management (EURAM) in Reykjavik, Iceland</td>
<td>See above</td>
</tr>
<tr>
<td>10-page final report</td>
<td>White paper online publication through PMI</td>
<td>Submitted in February 2020</td>
</tr>
<tr>
<td>Journal paper(s) on combination of quantitative and qualitative study results</td>
<td><em>International Journal of Project Management</em> or other journal on similar level</td>
<td>Paper in progress, submitted to IRNOP conference 2020, publication in journal afterward</td>
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</table>
Appendix C—Biographical Sketches of Principal Investigators

Timo Braun is professor for organization and management at Darmstadt Business School (Hochschule Darmstadt, Germany) and associated scholar at Freie Universität Berlin (Germany). His current research on interorganizational projects and underlying project networks—together with Jörg Sydow—has been honored with the Global Research Award 2018 of the International Project Management Association. He is the project lead of the PMI project “Digital Transformation of Traditional PBOs and Modern PNWs: Changing Management Practices in Project Society.” He has also founded the scientific network “temporary organizing,” which is supported by the German research foundation and engages junior and senior scholars to collaboratively work on related topics. He is a member of the Editorial Board of the International Journal of Project Management, and his research has been published in the British Journal of Management, International Journal of Project Management, Project Management Journal, International Journal of Human Resource Management, and the Scandinavian Journal of Management. For more information visit: http://timobraun.com.

Eskil Ekstedt is a professor of business administration and an associate professor of economic history. He has had academic positions at the University of Uppsala, the FA institute, University of Stockholm, and The National Institute for Working Life. He was an expert to the Swedish State Commission on Productivity, the Swedish State Commission on Competence, and the Swedish State Commission on Labour Law. He has participated in several EU-based programs on work-life issues. Mr. Ekstedt was the founding editor of the scientific publication series “Work Life in Transition.” His research has been focused on knowledge formation, temporary organizations, and projects related to structural change of business and work-life. He is one of the authors of the books Neo-Industrial Organising, Renewal by Action and Knowledge Formation in a Project Intensive Economy (Routledge, 1999), and Managing and Working in the Project Society, Institutional Challenges of Temporary Organizations (Cambridge University Press, 2015). His latest publication is “Project Work, a challenge to traditional work life institutions,” IJMPB, 2018.

Rolf A. Lundin is professor emeritus of business administration at Jönköping International Business School (JIBS), Sweden, and courtesy professor-in-residence at Umeå School of Business and Economics (USBE), Sweden. Professor Lundin received his doctorate from the University of Chicago in 1973 in management science. He was the founding dean of USBE, and also served as dean of JIBS. He was the founding editor of the Scandinavian Journal of Management. Most recently, he has published on projects and temporary organizations. He was the lead author of the Cambridge University Press book with the title Managing and Working in Project Society. He has not only studied projects, but also practiced project management in his deeds.

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PMI is the world’s leading association for those who consider project, program, or portfolio management their profession.

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