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Challenging construction project management institutions: the role and agency of BIM actors

Petra Bosch-Sijtsema and Pernilla Gluch

Department of Technology, Management and Economics, Division of Service Management and Logistics, Chalmers University of Technology, Gothenburg, Sweden

ABSTRACT

The use of building information modelling (BIM) has opened up for new roles. Previous studies on BIM roles focused on their duties, formal responsibilities and legitimacy, but few studies pay attention to how BIM actors (BIM coordinators and strategists) act to support increased BIM usage. Applying the theoretical construct of institutional work, this paper aims to create an understanding of the role and agency of BIM actors. Based on observations and semi-structured interviews with BIM actors and managers, the findings show: (1) purposive actions of BIM actors to promote and diffuse new BIM practices; (2) tensions between creating new BIM practices and maintaining existing construction management institutions; (3) BIM actor as an interface between the BIM technology and its users. Focusing on the BIM actor's role and agency gives insights into the hard process of changing and/or disrupting traditional construction management institutions and creating new practices arising from increased digitalization.

KEYWORDS

BIM actor; professional roles; institutional work; case studies

Introduction

A major discussion in the Architecture, Engineering and Construction (AEC) industry is the digitalization of the built environment through multiple types of technologies and developments. One of the developments that supports digitalization is building information modelling (BIM). BIM provides a platform for visualization, collaboration, automation, integration and communication between the different actors in the AEC industry (Bosch-Sijtsema et al. 2017; He et al. 2017; Zhang et al. 2018). BIM is not only a stand-alone technology, rather it is connected to other technologies, for example, virtual reality and laser scanning. BIM, in combination with other digital tools, is used over the full life cycle of construction and connects data and information from the design phase to construction and finally to the management, operation, renovation and demolition of the building.

While a large amount of literature has viewed BIM as a technology platform and mainly focused on technical issues and general benefits for the AEC industry, some recent studies also adopt a socio-technical approach in relation to digitalization and BIM (e.g. Davies and Harty 2013; Bosch-Sijtsema et al. 2017). Literature related to management of information systems states that the implementation and use of new information technology (IT) can lead to a technology-mediated change in organizational ways of working. These changes can concern inter-group relationships, division and responsibilities among people, development and transfer of knowledge, and development of new routines, roles, and ways of working (Orlikowski 2000; Leonardi and Barley 2010). A recent study focusing on drivers for a successful BIM implementation in the AEC industry discussed the importance of organizational change attributes in terms of vision and mission, management support, changed norms and attitudes and the presence of change agents (Liao and Teo 2018). Thus, when discussing BIM in this paper, the socio-technology informed concept of BIM management is applied, acknowledging that BIM not only means technological change but also management aspects such as changing social norms and practices of various professional roles (Gu and London 2010; Sebastian 2011; Jaradat et al. 2013; He et al. 2017). Consequently, this implies that the

CONTACT Petra Bosch-Sijtsema petra.bosch@chalmers.se

introduction and implementation of BIM require new and/or updated professional responsibilities and role descriptions.

A number of recent studies have discussed various BIM roles (Akintola et al. 2017; Davies et al. 2017; Uhm et al. 2017; Hosseini et al. 2018; Jacobsson and Merschbrock 2018; Bosch-Sijtsema et al. 2019). While some of these studies make a clear distinction between different types of roles like BIM managers, BIM coordinators and BIM modellers (Davies et al. 2017), others stated that the difference between BIM managers and BIM coordinators is fuzzy and that the roles perform similar duties (Hosseini et al. 2018; Bosch-Sijtsema et al. 2019). Several studies also discussed the competencies and duties of BIM roles; based on a literature review (Jacobsson and Merschbrock 2018), document analysis of job advertisements (Uhm et al. 2017; Hosseini et al. 2018) or BIM guidelines (Davies et al. 2017), a survey (Bosch-Sijtsema et al. 2019) or interview data (Jaradat et al. 2013; Akintola et al. 2017). Some even proposed that specific BIM roles might become less relevant in the future when other actors in the construction process increase their BIM knowledge (Akintola et al. 2017; Hosseini et al. 2018). However, only a few of these studies addressed the actual actions of BIM actors to support BIM usage and implementation (exceptions are Akintola et al. 2017; Jacobsson and Merschbrock 2018). This calls for a broader perspective of BIM incorporating an intertwined mixture of technologies, norms and practices here called 'BIM management'. A perspective taken up by several researchers, for example, in studies that show the implementation of BIM from a more micro-perspective in terms of changing practices on site (Mäki and Kerosuo 2015) and the change of practices through daily work by practitioners (Kokkonen and Alin 2016).

Technologies are known to change professional institutions in the AEC industry (Hughes and Hughes 2013). Thus, it is suggested that new practices and norms in BIM management will have implications for current construction project management institutions (Kokkonen and Alin 2016). The BIM actor plays a role in this process. Suddaby and Greenwood (2009, p. 176) stated that 'an institution may take the form of juridical regulations, informal rules or codified social arrangements, norms of conduct, or cognitive structures that provide understanding and give meaning to social arrangements'. Drawing on Kadefors' (1995) work, Urup (2016) argued that a construction project represents a site in which multiple institutions are present and where multiple actors negotiate their meaning and interests. In this paper, the institution consists of the regulations, norms, informal rules and cognitive structures that are defining standard construction project management practice. Professionals like the BIM actors play an important part in the process of creating or disrupting institutions within this context. In such a way, the role and agency of the BIM actor in the ongoing process of changing construction project management institutions becomes relevant. In order to gain insight into the agency of the BIM actor and how this agency is accomplished through technology, the theoretical lens of institutional work is applied. Institutional work is defined as 'the purposive action of individuals and organisations aiming at creating, maintaining and disrupting institutions' (Lawrence and Suddaby 2006, p. 215). With its practice approach, focusing on the doing and becoming of institutions, it has been argued as a viable concept for understanding the interrelation between professionalization processes and broader patterns of institutional change.

Even if several studies pointed out the rise of new BIM roles, there is little research on how their professional roles and practices are formed in the everyday work life, with in-depth empirical studies being particularly scarce. Therefore, the aim of this research is to create a deeper understanding of the roles and purposive actions, i.e. agency, of the BIM actor, which includes both BIM coordinator and BIM strategist/manager.

To study the agency of BIM actors, a comparative case study of five firms in the Swedish AEC industry was applied. A mixed methodology approach, combining an interview study and observations, was used to investigate how BIM actors maintain, create, and/or disrupt construction project management institutions so these better align with the use of BIM.

BIM in construction

The context of the study is primarily within the Swedish AEC industry, in particular, the building construction, which includes both residential and commercial buildings. Swedish construction often works with medium-sized building projects due to the size of the local market. Earlier studies have shown that these types of projects have a particular process, with norms of conduct that can be defined as an institutionalized practice (Kadefors 1995; Lieftink et al. 2019). Especially in the building construction, larger construction firms frequently use BIM, whereas

the use among small and medium-sized construction firms is sporadic and dependent on the client and project (Bosch-Sijtsema et al. 2017).

The development and implementation of BIM have been viewed by many researchers as a change factor in the way of working (see Hartmann and Fischer 2007; Froese 2010; Kokkonen and Alin 2016). Research concerning BIM has focused on both the technical development as well as on managerial and processual aspects (He et al. 2017; Zhao 2017). The literature has discussed a number of benefits of BIM in terms of supporting innovation, developing new work practices, and creating more efficient construction projects (Froese 2010). A downside discussed by Zheng et al. (2017) is however that companies tend to focus more on individual maximization of BIM within their own firm than on inter-firm cooperation which hampers the widespread use of BIM. BIM's effects on collaboration are also discussed in the literature since how it is designed can enable a closer integration and communication between different stakeholders in a project (Hartmann and Fischer 2007; Jaradat et al. 2013; Zhang et al. 2018) and helps actors to take responsibility for external/internal alignment and coordination of actor needs (Jacobsson and Merschbrock 2018). Liao and Teo (2018) discuss critical drivers for BIM implementation and find that the main drivers are on the organizational level, i.e. BIM vision, management support, leadership as well as people who can support the change towards BIM in terms of changing attitude and practices. The BIM actor can be perceived as such a change agent (Bosch-Sijtsema et al. 2019).

Theoretical framework: institutional work

An institutional work perspective focuses on understanding how, why, and when human actors work to shape sets of institutions, as well as the factors that affect their ability to do so, and the experience of these efforts for those involved (Hampel et al. 2017). In contrast to most other institutional approaches, institutional workplaces the spotlight on the actor (Lieftink et al. 2019). Serving as a catalyst for the integration of a practice perspective and institutions (Hampel et al. 2017), the construct of institutional work focuses on professionals as agents in the creation, maintenance and disruption of institutions as well as the practices and intentional actions (agency) of actors in institutional change (Lawrence and Suddaby 2006; Scott 2008; Muzio et al. 2013). In institutional change processes, professionals are 'the preeminent crafters of institutions, facilitating and regulating a broad range of human activities' (Muzio et al. 2013, p. 706).

Institutional work builds on the concept of embedded agency (Hampel et al. 2017), which concerns how human actors confront institutions on a day-to-day basis and at the same time are part of and affected by them (Lawrence et al. 2009; Hampel et al. 2017). For the development of new roles, this means that professions are not only key mechanisms for, but also primary targets of, institutional change (Muzio et al. 2013).

With its focus on everyday work, the concept of practice is important in the theoretical construct of institutional work (Hampel et al. 2017). Practices origin from sociology of practice and represent 'embodied, materially mediated arrays of human activity centrally organised around shared practical understanding' (Schatzki et al. 2001, p. 2). Practice is viewed as a bridge between people's efforts and the institutions at which the effort is aimed (Hampel et al. 2017). Adopting an agentic and practice-oriented perspective, institutional work is argued to enable an understanding of how the interaction between actors, structures and objects shapes practices in a specific organizational setting (Lawrence and Suddaby 2006).

A part of this research has focused on actors maintaining or creating institutions (Zilber 2002; Lawrence et al. 2013) in which organizational members are active carriers. However, not only actors are carriers of institutions, but also symbols, relations, artefacts and routines (Scott 2008). Hampel et al. (2017) discussed three means through which institutional work takes place: (a) symbols, language and narratives; (b) objects and materiality; and (c) relationships. So far, few studies have focused on theorizing the mechanisms and techniques that professionals use to facilitate institutional change processes (Muzio et al. 2013). Thus, even though artefacts and materials are mentioned as possible carriers of institutions, scholars have so far primarily emphasized the cognitive and linguistic notions of symbols, language, and narratives in institutional change, and neglected the material aspects (Jones and Massa 2013). According to Jones and Massa (2013), work is coordinated and accomplished through objects that shape humans as well as their environment. Objects thus embody cultural ideas, but also enable agency by how they act as conduits of experience and knowledge. This means that institutions have an inescapable material dimension that is part of the agency performed by actors in their

Table 1. Overview of collected data (for the experience in industry as well as knowledge in BIM we use a scale of 1–3 of which 1 = little experience/junior and 3 is much experience/senior).

Case	Size firm	Observation in hours (h)	Interviews	Interviewee experience in industry/BIM (scale 1–3)
A: Construction	Approximately 17,500 employees	3 × 5 h = 15 h	6 Managers	3/1
		2 × 8 h = 16 h	2 ICT managers	3/3
			7 BIM strategists	2/3
			2 BIM coordinators	2/2
B: Construction	Approximately 14,500 employees		2 BIM strategists	3/3
			1 BIM coordinator	3/2
C: Construction	Approximately 8000 employees	1 × 6 h = 6 h	3 Managers	3/1
			1 ICT manager	3/3
			1 BIM strategist	3/3
			2 BIM coordinators	1/2
			1 BIM coordinator	3/3
D: Architecture	Approximately 160 employees	3 × 5 h = 15 h	2 Managers	3/2
			2 BIM strategists	3/3
			2 BIM coordinators	2/3
E: Architecture	Approximately 150 employees		1 ICT manager	2/3
			1 BIM strategist	1/2

attempt to change them, but also that materiality reciprocally exercises some kind of agency in changing the social dimensions of institutions (Pinch 2008; Raviola and Norbäck 2013; Gluch and Svensson 2018). The role of objects in shaping institutions is rooted in the literature of sociology of science and technology, for example, SCOT (e.g. Pinch 2008), but is hardly discussed in institutional theory. BIM is an example of such an object.

Research approach and methodology

To address the phenomenological dimensions of institutional processes related to increased use of BIM practices, an interpretive approach was applied, recognizing how individuals make sense of and apply meaning to institutionalized practices (Suddaby and Greenwood 2009). For this, a qualitative method, Bryman (2008) has been applied in which a combination of interviews and observations were used.

To gain a more detailed and contextual understanding, a case study approach was chosen including five different firms – three construction firms and two architecture firms – from the AEC industry that all operate in Northern Europe (see Table 1). All firms had at the time of study actively used BIM in their design and construction processes. They were selected primarily based on their membership in a Swedish non-profit organization (BIM Alliance Sweden) that promotes implementation, management and development of BIM, making them likely to act to change current institutions.

Before we started with the interviews a number of observations were performed in construction firm-led design projects of two of the construction firms A and C and one of the architecture firms – Case D – was a member of one of the projects. The observations are mainly used in the beginning of the research and triggered the research on the role of the BIM actor. After these observations, interviews were held in order to obtain more data on this particular role. The observations support the understanding of the findings, on the first hand in order to understand the situation of the BIM actor and secondly to create meaning out of the data in combination with the interview answers. The observations gave unique insights into the day-to-day working practices (McDonald 2005) and the role of the BIM actor in relation to the project team, and data were collected through extensive notes, photographs and a structured observation guideline (the guideline focused on time, actors, activities, artefacts, technology used, individual or group activities, and sketches of the setting). The observed projects worked with an integrated or concurrent engineering approach in which the multidisciplinary and inter-organizational design project teams work together for a full day at a collocated workplace at the construction firm's site. For Case A and D, we observed three full project workdays of 5 h each and for Case C we observed one full workday for 6 h (total of 21 h of observation). After the design project observations and while we started with the interview study, a two-day strategic network meeting of BIM coordinators, strategists and ICT managers at Case A was also observed (total of 16 h of observation).

Semi-structured interviews were conducted with a total of 36 representatives from the five case companies. The interviews focused on gaining insight into the developments of BIM, its consequences for the industry, the development of new professional roles, as well as the particular BIM actor in their firm. This

facilitated reflection and deepened understanding of the practice performed by BIM actors. Interviews were held either individually or in small groups of two to four persons and included project managers, BIM coordinators, ICT managers or BIM strategists/specialist working with the technology. The roles that are included in the term BIM actor are in line with the roles defined by a Swedish non-profit organization (BIM Alliance Sweden). The BIM strategist/specialist is comparable to a BIM manager as used in other countries. While in some other countries the BIM modeller, coordinator and manager are clearly distinguished roles (see, e.g. Davies et al. 2017), this is not always the case in Sweden due the size of the market and the many small- and medium-sized players in the market (see Bosch-Sijtsema et al. 2019).

The interviews were taped and transcribed and lasted between 1 and 2 h. The selected interviewees were either BIM actors (BIM strategist or BIM coordinator) or had a management role working close to the BIM actors. In total, 8 BIM coordinators, 13 BIM strategists/specialists, 4 ICT managers and 11 managers were interviewed (Table 1). The interviewees had different levels of experience in BIM, especially the management roles had less practical experience but were seniors in the AEC industry making strategic ICT decisions. While the BIM actors often were experienced in BIM but had less experience in the AEC industry. The BIM actors often worked both at the organizational level as well as in projects and not all BIM actors worked full-time with BIM but had other tasks as well. In Table 1, the different interviewed roles are mentioned as well as their experience in the AEC industry and knowledge/experience in BIM (for the experience in industry as well as knowledge in BIM we use a scale of 1–3 of which 1 = little experience/junior and 3 is much experience/senior). On average, the interviewees had 13 years of working experience in the AEC industry. From the interviewees, 9 were female and 27 were male. For a detailed account of demographics of the interviewees, see Appendix A.

The empirical data were systematically put through stages of naming data, comparing data incidents, and memoing (Corbin and Strauss 2008). The interviews, as well as the observation notes, were coded and organized in themes and categories; following the theoretical framework provided by the institutional work construct; this included BIM actors in terms of creating, maintaining, and disrupting institutions in the AEC industry, and BIM technology as the means through which agency is enacted. Adopting a practice lens, four key aspects related to the role of the BIM actors were used in this analysis: how they work, where/when in the process they work, who they interact with, and what are the prospects of the role.

To meet ethical considerations, all participants were informed prior to the interview about the study and how the data and results would be used and by whom. They were also informed that the interviews would be recorded and transcribed, but that all confidential and/or identifying information would be removed before any publication. Their participation was voluntary, and the questions were designed so that they could refuse to answer. Finally, the results were presented and discussed in an informal and smaller BIM-related forum representing the industry in which four of the five companies were present and could reflect over the findings.

Findings

Interviewees from all the five case firms emphasized the importance of the BIM actor, which was also noted during the observations where the BIM actor played an active role during the design discussions. Thus, it is clear that the BIM actors have and will continue to play an important role in advancing the use and development of BIM. The question raised is thus not if but how they do that. Below, the practices of BIM actors are discussed in relation to their role as advocates for the technology implementation and use as well as the tension of BIM actors' practices between creating new versus maintaining existing construction project management institutions. Furthermore, the section discusses how the BIM actor is perceived as an interface between technology and its users.

Promoting the usage of BIM management

Interviewees from several cases (Cases B, C, D and E) mentioned that BIM actors show their usefulness as experts in terms of testing out pilot projects and demonstrating what is possible, thereby promoting and establishing BIM management and adapting the construction project management institution toward digitalization. Furthermore, the majority of the 21 interviewed BIM actors discussed that they want to make the role of BIM and the BIM actor more visible in construction projects. Today, BIM actors teach others and give internal training inside the organizations as well as in projects. Some of the BIM actors were advocating diffusion of BIM management

through traveling around the country and giving seminars and training to others inside as well as outside of their own firm concerning the technology of BIM, which is exemplified with the following quote:

> Our BIM coordinator held a number of courses for a group, in order to increase the knowledge level so that they could receive the benefits of the model. (Case C)

Similarly, others viewed BIM actors as 'BIM ambassadors'.

> We have had development engineers who have come to our firm, and the idea of them was actually that they would work two years with BIM, learn everything and then go out as ambassadors. (Case A)

In relation to the development of the professional role of a BIM actor, several interviewees (Cases A, B, C and E) mentioned that they had created internal networks for BIM actors to meet and share experiences and discuss possible hindrances and future possibilities. One such a two-day network meeting was observed within Case A; where they discussed the role, strategy and sharing good examples amongst the BIM actors of the firm. Thus, within these networks, how to implement and diffuse BIM was a major topic as well as sharing good BIM practices, as described in the following quote:

> We will have a little more frequent (network) meetings to come, just to work smart together, find good ways of working, and when someone has done something good in a region we can set it up so that everyone can take part of it. (Case B)

Tensions between creating and maintaining institutions

From the interview data, it is found that BIM actors indeed promote the use of BIM and thus create new norms and practices. Here, several interviewees forwarded the specific tasks they perform; new developments and pilot tests and defining BIM strategies, training and sharing information concerning BIM use. However, the actors also struggle with tensions, negotiations and conflicts between BIM management and traditional construction project management. Here, interviewees from all cases mentioned that, on the one hand, the BIM actors are promoting BIM management and thereby trying to change current institutions, but, on the other hand, they often maintain existing habits or adapt to existing institutions, thus consolidating and maintaining the current institutions of construction project management. Below, a number of examples of these tensions perceived by BIM actors are presented. The first example displays the problem of stepping outside one's institutionalized role:

> There is a small risk when you are a site manager for example, and you should also become a BIM coordinator, you are not really psyched with this, and there is a risk of falling back on the old working methods, you take other slightly more urgent questions first and do not really see what a BIM coordination can provide for now, … but it [the focus] is a lot on how to solve the problems that are urgent here and now. (Case B)

Another example mentioned by several interviewees was that BIM actors often have to adapt, such as changing the level of digital practices to the competence level of the internal users this was seen both in the design project observations as well as discussed by interviewees. The competence level of internal as well as external project members is often lower than that of the BIM actors, who adapt their practices to the level of knowledge present in the group, which implies that it becomes difficult to create new practices in the project.

Another aspect is that the BIM actors feel that time, as well as a heavy workload, is an issue, with the result that job ambitions and development of new knowledge is often adapted to the project pace and the lack of time within many projects. This time issue was expressed as follows by interviewees:

> Time in projects is often not enough in order to develop a BIM approach. (Case D)

> It is similar with BIM coordination, due to a lack of time, one does not always see the advantage of working with BIM coordination because you have so many acute things that need to be solved here and now. You do not see this time saving yet and you postpone working with it … but we work traditionally because we have so much to do in our usual business. (Case B)

Especially, due to the lack of time and the project structure, it is sometimes difficult to enact new practices and some are not selected consciously. Several of the interviewees from different case firms (i.e. B, C and D) mentioned that the dominant focus on time and costs constrains the development of new BIM-related work practices. An example of failing to adopt BIM is mentioned below.

> I feel that we often say that we 'do BIM' but it is very often we choose to do things the way we've always done, instead of developing a new BIM approach. (Case D)

Within the AEC industry, many different companies cooperate to develop a project. This way of

working has implications for working as a BIM actor. The BIM actors employed by the construction firms are working within the projects as well as the organization. However, architecture consultancies are more dependent on the client or construction firm they work with. While they sometimes sell the role of BIM actor (BIM coordinator) and the resulting expertise to a client, within a project and at other times they are dependent on the knowledge and requirements of other parties how to work with new digital practices. Interviewees from the architecture firms D and E, mentioned that they had to adapt their practices to the project participants' expertise (clients, other consultants and sometimes construction firms) and, therefore, felt restrained in diffusing their knowledge on BIM. Something made even more complicated due to a lack of a shared methodology which is described in the following quote:

> No, it all depends on … we are more, or have in any case been, recipients of the construction requirements and the presentation of how BIM will be used in the project, this is from project management direction, from the client or construction firm, what they have for approach to it. So, I can say that it varies a lot how the projects are structured and I think it's also because it lacks a … Swedish methodology for how to do it. (Case E)

There was also evidence of defending and negotiating practices in which the BIM actors need to defend themselves against existing roles as well as to find a balance between existing roles.

> The general picture (of others) is that we only sit and play with the model. (Case C)

In our observations of design meetings, and confirmed in the interviews, the role of the BIM actor was not always clearly stated, and it was therefore up to the BIM actor to negotiate their own role in each construction project and sometimes this causes overlap with the role of the project manager in terms of making decisions and facilitating discussions around a BIM model in the design phase. In other cases, the BIM actor and the project manager had more clearly defined roles and tasks and in these cases, the BIM actor complemented the project manager's role. However, the empirical data show that the BIM actor was expected to have competences, experience, and personal characteristics that resemble that of project managers, for example, good cooperative and communicative skills, being flexible yet structured, and an ability to mediate enthusiasm. Thus, in several cases, the new role infringes on the institutionalized role of the project manager and the overlapping knowledge domains and distinction between these two roles is something that especially the construction firms (Cases A, B and C) discuss.

Some interviewees from the case firms discussed attacking the institutional standards and how they feel they have a constant battle to get any change through the industry. Several interviewees discussed that they have to be patient, pedagogical and communicative to influence current heavily institutionalized practices. Words like 'fighting', 'hanging in there' and applying pedagogical approaches were mentioned by several of the interviewees and represent examples of the tensions between the creating and maintaining of the competition between multiple institutions.

BIM actors situated in the interface between technology and its users

From the interviews of all cases, it was found that, with new ways of working, the BIM actors were perceived as mediators situated in the interface between the technology and its users. This is done by being diplomatic and pedagogical in terms of explaining the technology and its possibilities and supporting others.

Several interviewees discussed the lack of knowledge of employees or project members as a major hindrance for the BIM actor. The BIM actor is perceived to be pedagogical, informative and communicative in order to educate and inform users of the technology. One construction firm mentioned on the question of how a BIM actor should be as follows:

> To be pedagogic is super important, we are going out to teach people this (BIM) and disseminate this further. (Case B)

According to interviewees, the BIM actor is expected to support employees to use the technology as extensively as possible and, through this, diffuse the usage of BIM. Below are some quotes regarding how the interviewees see the future development of the BIM actor.

> We must use the model and the information it may contain to its maximum, otherwise we will not have the impact that we're after. This becomes the role of the BIM coordinator - to get to this. (Case A)

Another interviewee mentioned that BIM actor's role in the future would, besides pushing for increased BIM use, also be a creator of opportunities:

> Support knowledge and experience. Ensure that the tool is used as extensive as possible. Create opportunities. (Case A)

Discussion

The findings have indicated three main aspects: (1) the practices performed by BIM actors, as they attempt to promote and create new BIM management adapted institutions; (2) the tensions perceived by BIM actors in creating new intuitions versus maintaining existing construction project management institutions; (3) the role of the BIM actor as a perceived interface between the BIM technology and its users.

The role of the BIM actor has emerged due to new technological developments and the implementation and use of new ICT in the AEC project-based industry. The study found that the role has high expectations in terms of prospect to promote and develop new work practices within the industry. These high expectations were shown in the high demands placed on them as well as the very positive view on the new role as a change agent. In applied research on the AEC industry, the new trend toward digitalization has been portrayed as a key for solving communication and information sharing issues within the industry (e.g. Dossick and Neff 2010; Froese 2010) and high hopes have been placed on BIM usage for changing existing institutions.

Our findings show that the emerged actor, i.e. the BIM actor is advocating and ensuring the value and acceptance of the technology within the project network, as well as developing practices for the use of the technology, i.e. promoting and diffusing the use of BIM within their firms and across organizational boundaries through their participation in construction projects. This is in line with earlier work on the role of practitioners in changing and improving practices in relation to BIM use and implementation (cf. Mäki and Kerosuo 2015; Kokkonen and Alin 2016). The findings, furthermore, show that BIM actors are, on the one hand, creating new institutions through the development of new practices, but, on the other hand, negotiating, competing with, and adapting to the existing institutions within construction project management. BIM actors are thus purposive agents in diffusing BIM management through promotion, training, information, setting up new role descriptions, responsibility areas and developing internal education in several of the case companies, as well as developing new digital practices within construction projects. However, the BIM actors also maintain institutions through adapting practices, negotiating and defending existing roles within the industry. The role showed examples of failing to enact on practices or not selecting a practice that would support the development of new practices, but that would confirm or maintain the traditional institutions, often due to a lack of time and project structure. Furthermore, BIM actors were attacking standard practices in terms of which new responsibilities need to be negotiated and other roles are replaced or even taken out. The role of the BIM actor clearly shows a tension in that, on the one hand, they are involved in processes of co-creation in developing new practices, competing against existing practices as well as existing roles, and, on the other hand, they constantly negotiate their particular tasks and responsibility, as well as their role. In our observations we found that the BIM role can infringe on the role of the project manager, which is in line with earlier work of Akintola et al. (2017) and Hosseini et al. (2018) who discuss the overlap of the BIM role with the role of the project manager and that the role might disappear when the project manager obtains more BIM skills.

The new role of BIM actor is furthermore perceived as an interface between the technology and its users, in order to translate between the material object and the human actors. The implementation of new technology introduces a role who becomes an actor that is expected to employ and diffuse agency to change the current institution through technology. From the findings, it was sometimes difficult to separate the role clearly from the technology. Therefore, the actor is not only a representation but is also bound by the technology, and the actor's abilities to change existing institutions is vested in the power given to the technology. Thus, the agency of these actors becomes intertwined with the development of digital practices that are needed to work with the new technology. Our study shows that it is not the technology itself that evokes institutional change, as often emphasized in earlier literature, but rather the revised working practices in terms of interrelations between different parties, that form around the deployment of the technology as well as the new professional roles that are developed. The relationship between the new technology and the BIM actor is therefore intertwined and the new role is also perceived as an agent who not only can create and promote new institutions but possibly also change existing institutions that are incompatible with digitalized construction project management. This is in line with earlier work stating that individuals and professionals can shape institutions and have been argued to be influential agents or crafters of institutions in terms of defining, interpreting, mediating and applying institutional change (e.g. Scott 2008; Muzio et al. 2013).

Conclusion

The paper contributes both to the institutional work literature and to construction project management literature. By studying the role of the BIM actor within the project-based AEC industry, the study contributes with empirical evidence of institutional practices of an emerged role in an industry setting that is characterized by being heavily institutionalized and difficult to change. For the construction project management literature, the study contributes with knowledge on how BIM actors, as an interface between the technology and its users, promote and diffuse BIM management institutions in terms of practices, norms and technology, thus challenging the standards of construction project management.

Through a multi-method and multi-case approach, interviews were held with 36 interviewees representing five case firms consisting of construction and architecture firms, furthermore, 21 h of observations were performed in two construction firm-led design projects and 16 h in BIM network meetings. The interviews showed some of the practices that BIM actors use to promote BIM use. But data also showed that BIM actors simultaneously create and maintain traditional construction project management institutions.

BIM as technology and practice has been discussed much, both in the literature as well as in the AEC industry, but few studies emphasize the professional role of the BIM actor. The focus on the BIM actor's agency (purposive actions) for diffusing the usage of BIM gives insights into the difficult process of changing and disrupting traditional institutions and creating new practices. The practical contribution of the study is twofold. The study gives insight into the difficulties of BIM actors and their particular tasks and practices and could help develop the role further towards a role supporting the new trend towards digitalization. Finally, the digitalization of the industry will have an impact on the current institutions and this study can show what activities and practices can disrupt and create new institutions towards a more digitalized built environment.

The role of the BIM actor is both creating and maintaining the construction project institution and becomes an important role to study further. In studying the role of a BIM actor, it is relevant to focus on the materiality and the technology of BIM. This material dimension is often neglected (Pinch 2008). Without this technology, there would not be such a role as BIM actor, which implies that the power of the role is vested in the material and in technology. Therefore, future research on BIM management combining institutional work and materiality is a promising theme.

Limitations of the study are that the study has been performed in Sweden and is primarily based on a multiple case study methodology, which makes it more difficult to generalize the results. However, the results were discussed with an industrial reference group for validation purposes.

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ORCID

Petra Bosch-Sijtsema http://orcid.org/0000-0001-8141-9759
Pernilla Gluch http://orcid.org/0000-0003-0026-0112

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Appendix A

Case	Interviewees	Gender	Role	Experience industry (years)	Experience BIM (1= junior/3 = senior)
Case A					
	1	F	ICT manager	28	3
	2	F	Manager	4	1
	3	F	Manager	4	1
	4	M	BIM coordinator	4	2
	5	M	BM coordinator	25	3
	6	M	BIM specialist	4	2
	7	M	ICT manager	18	3
	8	F	BIM specialist	18	3
	9	M	Production manager	16	1
	10	M	Project manager	12	1
	11	M	BIM specialist	5	2
	12	M	BIM specialist	19	3
	13	F	Project manager	16	1
	14	M	BIM specialist	4	2
	15	F	Manager	16	1
	16	F	BIM specialist	8	3
	17	M	BIM specialist	16	3
Case B					
	18	M	BIM strategist	21	3
	19	M	BIM strategist	21	3
	20	M	BIM coordinator	13	2
Case C					
	21	M	BIM strategist	12	3
	22	M	ICT manager	16	3
	23	M	BIM coordinator	2	2
	24	M	Manager	17	1
	25	M	BIM coordinator	2	2
	26	M	Project manager	25	1
	27	M	BIM coordinator	15	3
	28	M	Design manager	20	2
Case D					
	29	F	BIM strategist	12	3
	30	F	BIM strategist	12	3
	31	M	Manager	20	2
	32	M	Manager	20	2
	33	M	BIM coordinator	8	3
	34	M	BIM coordinator	8	3
Case E					
	35	M	BIM strategist	5	3
	36	M	BIM strategist/ICT manager	7	3