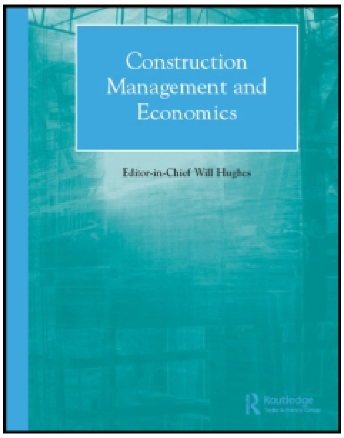

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On the emergence of roles in construction: the qualculative role of project management

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On the emergence of roles in construction: the qualculative role of project management

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Within construction, roles are generally thought of in terms of a division of labour, tasks and responsibilities, established through contractual and/or cultural relations. Moreover, roles are also presumed to be relatively stable. Drawing upon actor network theory, roles are re-conceptualized and it is argued that roles are emergent and that they depend upon the tools and devices with which the project managers are equipped. A case study of the construction of a skyscraper, the 'Turning Torso', in Malmö, Sweden highlights the hybrid role of project management. In some instances project management may act as a mediator having qualitative effects on the project while in other instances project management may only be an intermediary, merely speeding up the process by conveying the concerns of others. The concept of qualculative project management is introduced to account for this emerging hybrid role. The analysis shows the ways in which the budget and other devices participates in enacting a qualculative role for project management, while simultaneously being involved in negotiating boundaries between professional roles in construction as well as the qualitative and quantitative properties of the building.

Keywords: Roles, emergence, construction process, project management, budgeting.

Introduction

Large-scale construction projects are notoriously known for budget overruns. Typically this is attributed to either a lack of information or asymmetrical information on the part of the parties involved. While the former either refers to the inherent difficulties of grappling with the future due to unexpected design or technological changes (Winch, 2002) or to cognitive constraints imposed by insufficient data and poorly developed modelling and forecasting techniques (Fortune, 2006), the latter refers to the opportunism of the parties involved and their propensity to strategically misinform others about the construction project's costs and benefits (Winch, 2002; Flyvbjerg *et al*., 2003; Flyvbjerg, 2007). Disparate as these explanations may be, they both suggest that the formal role of construction management is to control and correct the budget by developing either better forecasting techniques or incentive schemes to curtail misrepresentations. In both instances, the budget is considered as a (more or less) correct representation of the project that can provide construction management with input for taking action. The question of whether the budget can play another, more active role in shaping the role of construction management has not yet been examined.

The aim of this paper is to re-conceptualize the role of the budget and construction management.

Drawing upon actor network theory (Callon, 1998; Latour, 2005; Bekke Kjær and Mouritsen, 2007; MacKenzie *et al*., 2007; Harty, 2008) we explore how the budget and other calculative devices such as architectural drawings and simulation models can have a performative effect shaping roles in construction management. Roles are considered as emergent and provisional outcomes of the interactions between people and their calculative devices; interactions that enable qualifications and calculations. The notion of qualculation (Cochoy, 2002; Callon and Law, 2005; Callon and Muniesa, 2005) is introduced to capture this double-sidedness. In making our argument we draw upon a case study of a large-scale construction project—the construction of a skyscraper, the Turning Torso, in southern Sweden.

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The paper is structured as follows. The next section positions our theoretical approach relative to previous research on roles in project and construction management and introduces the concept of qualculation. Our case-based approach is described in the third section. The fourth section presents three episodes from the construction process, each of which demonstrates different aspects of how the role of construction management and the role of the budget are constituted through their interaction. In the fifth section we discuss the emergent nature of 'role construction',[1] the proposed qualculative role for construction management and highlight some of the implications that our study may have for construction management. Our conclusion is presented in the final section.

Different perspectives on roles in project and construction management

The issue of roles in construction—of who does what—is generally cast as a matter of establishing a division of labour, tasks and responsibilities that capitalizes on the skills of those involved, minimizes (transaction) costs and delivers the building to the client on time, without budget overruns and according to the client's specifications (Winch, 2002; Bechky, 2006; Hughes, 2006). The role of construction management, and project management in general, is to ensure that the client's (predefined) needs are satisfied, e.g. by establishing the project coalition; managing the budget and balancing competing demands for quality, scope, time and cost; managing the contractual relations; and adapting the specifications, plans, and approaches to the different concerns and expectations of the various stakeholders (Walker, 2002; Winch, 2002; PMI, 2004). Accordingly, the role of project management is to be the 'guardian of efficiency', while others are the 'guardians of relevance', i.e. the ones defining project needs, requirements and goals (Kreiner, 1995, p. 337).

Although much attention is given to developing tools and methodologies that can enhance efficiency by either providing better information for budget estimations (Newton, 1991; Bowen and Edwards, 1998; Cicmil and Hodgson, 2006; Fortune, 2006) or deterring project management and other key decision makers from providing misinformation as to a project's costs and benefits (Flyvbjerg, 2007), there are other contributions that argue that it is necessary to move away from these information-based and rationalized approaches and develop a contextually grounded understanding of project and construction management (e.g. Jönsson, 2004; Clegg *et al.*, 2006). One of the more salient approaches is the cultural perspective (Henrie and Sousa-Poza, 2005), which emphasizes that the multiple rationalities and cultures characterizing (mega)projects cannot be captured/tamed in contractual arrangements (Pitsis *et al.*, 2003; Clegg *et al.*, 2006). Seen from this perspective, the role of the project manager(s) is to manage relationships, i.e. manage project team culture by cultivating the values and beliefs and motivating project members to actively engage in realizing the project goals. Building a shared project culture through social interaction and communication is the prime means by which project management can facilitate coordinated action (Jönsson, 2004; Clegg *et al.*, 2006).

The information-based and the cultural perspectives provide complementary perspectives on roles in construction management, but they have a tendency to gloss over or ignore the ways in which the tools that project managers use 'work' not only to make construction management possible but also to change the role of construction management. Instead, roles are presumed to be relatively stable, dictated by contractual and/or cultural relations. As noted by Scott (1992) and recalled by Walker (2002), professionals and professional organizations like architects and design firms have autonomous roles. Project management has a less autonomous and relationally defined role, e.g. 'to achieve the objectives of the client' (Walker, 2002, p. 6). As an alternative to these perspectives we suggest that roles in construction are not given, but emerge endogenously through construction management's use of technical artefacts.

The qualculative role of project management

Drawing upon actor network theory (ANT) we suggest that budgets and other tools that project managers use are not just innocent representations of the world around them. Rather, they are devices that 'do things' (Latour, 1987; Muniesa *et al.*, 2007, p. 2). The term 'device', is our shorthand description for 'inscription device', i.e. 'any set-up, no matter what its size, nature and cost, that provides a visual display of any sort' (Latour, 1987, p. 68). Devices are performative, i.e. active in building the world they are said to represent (Callon, 1998; Latour, 1999; Callon, 2007). The argument for this resides in the premise of actor network theory—relational materiality—that insists that all entities, human and non-human, achieve their form/qualities qua their relations with other entities. An actor is enabled or made to act by people and many other things—the actor is constituted through their interactions (Latour, 2005, p. 46).

Viewed from this perspective, a construction project is an association of heterogeneous entities. Callon (2007, pp. 319–20) uses the notion of socio-technical agencement to describe the relationships between these entities. Agencements 'are arrangements endowed with the capacity of acting in different ways depending on their configuration' and the ways in which project management unfolds is not just a matter of what the project managers, project members or other interested parties do. It also depends on all the 'things' they are using, e.g. on the building materials, machines, budgets, drawings and other calculative devices. All of these artefacts are either mediators or intermediaries, i.e. have the ability to transform, translate, modify or distort the meaning, which they are supposed to carry, or to merely transport or convey information from one situation to another (Latour, 2005, p. 39).

If the budget is seen as a monetary representation of the construction project that merely depicts the costs involved and provides project management with the necessary monetary information, then the budget acts as an intermediary. In this commonplace role, the budget is no longer questioned. It just transports information about the costs to the decision makers without any transformation. All the work that goes into making a budget, i.e. the mobilization of other mediators has been black-boxed. It is taken for granted (as an intermediary only). If the budget or other objects are considered mediators, then they are granted the capacity to 'do things' and not merely transport information. The notion of mediator adds uncertainty by questioning the taken-for-granted role of objects (as intermediaries) and in this research context, by suggesting that the role(s) for the construction budget and other objects can be transformed and also be actively involved in shaping the construction project they represent. The distinction between intermediary and mediator differs from that of others working on the role of objects in construction (e.g. Winch, 2002; Flyvbjerg, 2007 on budget estimations and forecasts) since it opens up the possibility that roles and relations between the budget and construction management can be reversed during the project.

Following from this the role of project management can take two forms: one being the more formal(ized) role in which project management acts as an intermediary transmitting information in the form of e.g. contracts, budgets, drawings, etc., between the client, the architect, the constructor and other stakeholders; the other being when project management acts as a mediator transforming the project by e.g. actively engaging in negotiating and managing social relations, as suggested by the cultural perspective. Although this conceptualization of the role of construction management may seem analogous to the distinction between the information-based and cultural perspectives (made above), there is a marked difference. ANT's ontological symmetry between artefacts and humans allows for considering their interactive and constitutive role in ways that the two other perspectives do not. Viewed in this perspective, the roles that the construction manager, budget and other calculative devices play in the realization of a construction project cannot be entirely specified from the outset. These roles are emergent—they are 'co-constructed' in interaction with people and the devices as the construction project unfolds.

In order to capture what type of role(s) the manager and devices may play we draw upon the notion of qualculation. The concept, originally introduced and applied in consumer research (Cochoy, 2002), is also used to address the organization of economic markets and calculative agencies in general (Callon and Law, 2005; Callon and Muniesa, 2005) as well as in studies of the 'greening' of firms, their products and users (Reijonen, 2008). Common to these contributions is that the concept is used to redefine calculation (in the quantitative sense) to include judgement and evaluation (in the qualitative sense). Calculation and judgement are not considered as opposites, but as a matter of degrees, that can take many forms dependent upon the equipment in use. The budget, for instance, enables construction management not only to calculate the costs but also to make a qualitative judgement as to which direction the project should take, i.e. it enables construction management to qualculate. The budget may also be linked with other devices in a stream or 'cascade' (Latour, 1990). For example, architectural and engineering drawings can, in addition to visualizing project qualities like construction design, also be used as input for economic calculations when construction management seeks to further identify and estimate cost budget items. Also, by 'staying on budget', project management simultaneously reinforces the budget's value as a managerial tool, because there is a qualitative aspect to 'staying on budget'—it carries the professional 'best practice' virtues of being in control.

The concept of qualculation is introduced to capture the complex interplay between roles, devices, values and calculative skills involved in the 'commercial management of projects' (Lowe and Leiringer, 2006).

Research method

The empirical material presented in the next section is based upon a case study of the construction of the skyscraper 'Turning Torso' (for pictures see Figure 1 in the Appendix and http://www.turningtorso.com/) Malmö, Sweden, currently one of the highest residential buildings in Europe. Given the research question and actor network theory's methodological implication of 'following' the actor or actant (Latour, 1987), a case-based processual approach is well suited. The construction of this skyscraper, commissioned and built by the Malmö branch of the nationwide cooperative housing association, HSB-Malmö (in the following referred to as HSB), took about five years, from January 2001 to February 2006. Data collection took place from October 2004 to February 2006 and was primarily based on document-based studies, interviews and visits to the construction site. The interviewees included: the head of project management, the head of project marketing, the senior architect from the Swedish company Samark responsible for the building's interior design, two architects from the city planning office, a Swedish quality consultant and 'structural checker' responsible for auditing structural design, representatives from the owner organization, including the former and current CEO and the person responsible for daily operations and services in the building. In total, 10 interviews with 11 people were conducted, each lasting on average approximately 90 minutes. All interviews were recorded and transcribed.

Following ANT, interviews are not sufficient. They need to be complemented with documentary material or 'paper work' (Latour, 1990; Justesen, 2005). This material included public city plans, consultancy reports, memos, decision protocols, drawings, pictures, movies, press releases, and articles in local newspapers and magazines. Furthermore, crafting a case requires not only a particular method but also a narrative style that reconstructs chains of related events (Latour, 1987; Czarniawska, 1998; Hernes and Weik, 2007). This was accomplished through a systematic reading of the empirical material with regard to (1) the (re)scheduling of construction activities; (2) changes in budget and design; and (3) the role(s) of the various parties involved, but notably the project manager and the customer/client/owner, HSB. We have traced how the budget becomes associated with various actors and calculative devices and have identified three critical episodes that demonstrate the qualculative role of construction management. Our abilities to 'follow' the actors in real time has been limited to final phases of the construction process, given the fact that data collection did not start until 2004. We have, therefore, used documents such as original architectural drawings to prompt the interviewees in their accounts of the chain of related events; an approach similar to the one taken by Latour (1996) in his study of a failed public transport system in France. The aim is to explain the project events with the help of the involved actors, which means that the study's scope is limited by the boundaries proposed by the actors themselves. The boundaries of this study are partially set by the fragility of our interviewees' memories. One boundary that we regrettably failed to negotiate was an interview with the architect and engineer Santiago Calatrava.

Three episodes from the Turning Torso case

The Turning Torso is a spectacular building. With its 54 storeys and 190 metres in height it is truly a towering structure in a city otherwise characterized by low-rise architecture. Modelled after a sculpture by the Spanish architect/engineer Santiago Calatrava, the building consists of nine segments of five-storey pentagons that rotate around the building's vertical core so that it turns 90 degrees from the bottom to the top. The building is supported by an exterior steel structure highlighting its distinctive spiralling that has associations with a twisting human spine.

The building is, however, almost as scandalous as it is spectacular—it has been subject to extensive criticism because of enormous budget overrides, lack of managerial control, time delays, etc. Table 1 provides a chronological overview of the most important events and unexpected changes in the project that opened it up to these criticisms.

Construction management was organized as follows. The client and CEO of HSB hired a project manager in autumn 2000 and together they established a project steering group that included the CEO/client, the project manager and his second in command, a person from the main contractor, NCC. Initially (in January 2001) the project was divided into two major tasks—design and construction work. With regard to the former, Calatrava's office was responsible for architectural and construction design, according to a fixed price contract of US$5.3 million. Excluded from this contract was the design of apartments. This task was given to a Swedish architectural firm, Samark, which was also responsible for liaising with the Calatrava office and managing the distribution of drawings between Calatrava's office and the project steering group. A Swedish quality consultant was hired to audit the drawings from Calatrava's office and to provide detailed construction drawings. As for the concrete construction work, this task was divided in two: groundwork and constructing the tower. In contrast to the fixed price contract with the Santiago Calatrava office, these contracts were negotiated in the course of the construction process. The tower contract, for example, was originally (in February 2002) a cost plus fixed fee contract combined with an incentive scheme linked to the tower's cost budget baseline. Approximately one year later the contractor, NCC, concerned about the economic repercussions of the significant design changes to the tower, initiated a renegotiation of the contract. After months of negotiations, by September 2003, they agreed upon a new cost plus fixed fee contract. In terms of payment and risk re-distribution this contract generated a fee of approximately 21 million SEK, which was somewhat

Table 1 Project chronology

1999	– In the spring: the project is planned as a 25 storey building/77 metres. – The CEO of HSB-Malmö meets with Calatrava during the summer. – By the autumn: the building is projected to have 7 cubes/42 stores/160 metres and to be finished by May 2001.
2000	– Calatrava revises the drawings and the building is projected to have 9 cubes/45 stores/186 metres/130 apartments. The estimated total cost is 550M SEK. Project completion is scheduled for 2002. – **The architectural drawings are revised again in the autumn, increasing the commercial area from 14 797 square metres to 17 723 square metres.** – **The total costs are re-estimated as a consequence and set at 728M SEK of which construction (of ground and tower) totals 455M SEK. Project completion is still scheduled to be in 2002.** – In December the board of HSB-Malmö finalizes their decision to build the Turning Torso.
2001	– Project management negotiate and sign a fixed price contract in US$5.3 million with the architect in January. – Breaking ground ceremony: 14 February 2001. – **In the spring the architectural and construction drawings are revised; adding 3 metres to the radius of the building to ensure vertical stability, and reducing the number of floors below ground from 4 to 3.** – **Also in the spring, CEO calls for a 'risk seminar' resulting in an estimated risk of an additional 100M SEK to the budget cost.** – Excavation underground begins May 2001 and is completed by December 2001.
2002	– **The foundation slab was finished by March, the number of floors below ground was further reduced to 2 and construction below ground was finished in June.** – Construction of ground floor begins in August and is followed by the casting of the core structure above ground for the first cube with five floors. – **Project management receives construction drawings for the tower construction in May. Drawings renegotiated in subsequent meetings in June in order to ensure horizontal stability of base-floors in each cube. New drawings in place during autumn.** – **From February to July 2002 project management and architects re-estimate material use, e.g. adjusting the use of steel *up from the projected 1700 tons (the actual use was 4400 tons, i.e. an additional 2700 tons of which 2000 tons concerns reinforcements of the tower and the remaining 700 tons concerns related ground work).*** – This leads project management and contractor in May to re-estimate the time needed for above-ground construction from 16 to 19 months. – **CEO calls for a project meeting about 'prospective budget overrides' in May. Further investigations needed during autumn to qualify the decision of whether or not to abort the project. Sunk costs estimated to 200M SEK in September.** – Total costs are re-estimated: from 845M SEK in April to 988M SEK in September. – Total time for construction is re-estimated: from $2^{1}/_{2}$ years in January to almost 4 years in December.
2003	– First cube with five floors above ground is finished in March. – Contractor for tower takes initiative to renegotiate the combined fixed fee and incentive-based contract during spring. In September a new contract is in place which combines cost plus a 10M SEK fixed fee for already incurred costs, with incurred cost plus 8% fee for the remaining tower construction. – The 27th floor was reached by December. – Further re-estimation of costs for tower construction, interior design, and related consultancy. In December, total cost was re-estimated to 1255M SEK.
2004	– Total costs were re-estimated: in April expected to be 1392M SEK, and in May 1600M SEK. – Reaching and celebrating the 54th floor in December.
2005	– The 54th floor/190 metres was completed by February 2005. – In June the total costs are re-estimated to be 1500M SEK. – Malmö city celebrates the construction in August 2005. – The inhabitants began moving in November 2005.
2006	– Construction is completed in the beginning of 2006. – All of the apartments have been rented by March.

less than originally stipulated in the incentive contract. Had the incentive contract, however, not been renegotiated, the contractor would then presumably have had to pay back a substantial part of the fee to HSB because of the tower construction's significant cost budget overrun.

In a metaphorical sense, the name Turning Torso summarizes what is at stake in many construction projects—there are many unexpected twists and turns along the way from project idea to realization. In what follows we present three episodes from the construction process (highlighted in bold in Table 1). The first episode illustrates the active role that the budget can play in interaction with project management in initiating building redesign. The second episode highlights how the budget, on the one hand, serves as input for management's costs control decisions and, on the other hand, how budgetary calculations are superseded by engineer-calculations regarding tower stability. The third episode considers the selection of materials for the tower construction, and illuminates how and to what extent the budget can assist management in prioritizing between project qualities (space and stability) and costs. Taken together, the three episodes illustrate how the conditions of project management change through interaction with the budget, drawings, engineer calculations and the emerging building, and how these artefacts, in turn, enact different roles for project management as events unfold.

First episode: redesigning and enlarging the Turning Torso

Originally HSB planned on constructing a 77 metre, 25 storey residential building, but upon receiving Calatrava's drawings it became clear that these plans had to be revised. According to the client and CEO:

> One of the first things we discovered was that the plan of 75 metres and seven cubes would not suffice. We discussed everything from three to five storeys in each of the cubes, but ended up changing the plan to 133 metres … and we believed that the seven cubes and 133 metres would be sufficient, but it turned out that it would be very difficult to absorb the sharp angles of the windows [and walls] resulting from the 90 degree twist [of the building].

If they were to stick with the idea of twisting the building 90 degrees and avoid having windows and walls with too sharp angles, then the height of the building had to be increased. Calatrava revised the drawings by June 2000, adding two cubes to the structure and increasing the number of storeys to 45 and the height to 186 metres. This allowed them to preserve the building's kinetic qualities while simultaneously taking prospective user needs into account.

However, HSB had yet to decide whether or not they would build this nine-cube building. Based on Calatrava's revised drawings, the cost of constructing a building with 14 797m^2 for apartments and offices was estimated to be approximately 550 million SEK. The drawings and cost estimations were presented to HSB's board in early autumn 2000, and were the subject of intense debate for the rest of the year. Although production costs had initially been Board's prime concern, over the course of their meetings they became increasingly interested in the project's revenue side, a concern not previously articulated. Once production costs had been made visible in the budget, new concerns emerged among the HSB board members regarding the (potential) revenues that they felt were missing in the calculations. As project management began making a more realistic budget, new distinctions were made between what could be considered as commercial, non-commercial and technical areas, leading to new calculations of the potential revenues. The prospect of additional revenue led to a redesign of the building. The commercial area was increased from the originally planned 14 797m^2 to 17 723m^2, adding another 178 million SEK to the 550 million SEK budget. Nevertheless, HSB approved of the project and the revised budget of 728 million SEK in December 2000.

One could contend that this is just an illustration of poor cost estimation that could have been avoided had better costing tools been used, but to do so glosses over the complex interplay and co-dependent relation between construction redesign and budgetary revisions. By prompting project management to reconsider and alter the building's design the budget also changed the role of project management, making it a hybrid of professional project management 'virtues' about 'staying on budget' *and* design. Design is, however, usually assumed to be the domain of autonomous professional architects (Scott, 1992; Walker, 2002), but in this instance construction management negotiated such boundaries and had both of these professional roles. The hybrid role of project manager–architect is emergent, co-produced through interactions with the budget and architectural drawings. The project manager–architect played an active role in shaping the emerging budget and architectural drawings, i.e. in making both calculations and judgements. This hybrid role not only involves negotiating quantities such as the size of the cost budget, it also involves negotiating project scope and design qualities, such as the absolute and relative size of the building's 'technical' and 'commercial' space, and by implication stakeholders' needs. This is an example of *qualculative* project management.

While this episode focuses on how this hybrid role emerges and is shaped through interactions with the budget and the architectural drawings at a point when the building has yet to materialize in concrete and steel, the next two episodes explore how this role is conditioned by the building's subsequent materialization.

Second episode: the disappearance of the third floor below ground

Excavation for the foundations (May to December 2001) resulted in a circular hole 14 metres deep and 34 metres wide, a hole much larger than originally planned. This is attributed to two things: one, during the dig they discovered that the underlying limestone had large cracks that would allow for in-seeping sea water. By digging deeper they could, however, make the necessary 'room' to fill the limestone cracks with massive concrete. Two, wind simulations (conducted by an independent laboratory in spring 2001) had shown that the building would not be sufficiently stable (vertically) unless additional width was added to the building's base, so the foundations' radius was increased.

Once excavation had been completed project management had to plan the concrete fill for the foundation slab by first contending with the question of how much concrete to use. The revised drawings that had added three metres to the radius of the building in order to ensure vertical stability provided part of the answer. With the width being fixed in this way, there was basically only one parameter that could be changed—the thickness of the foundation slab. Originally Calatrava had planned for having four floors underground, but when he had to revise the architectural drawings in response to the wind simulation results, Calatrava agreed to fill the fourth floor underground with concrete. Time had, however, become an issue, intervening in project management's decision regarding the foundation slab's thickness. In order to speed up the construction process project management decided, contrary to Calatrava's drawings, also to fill up the third floor underground with concrete. According to the structural checker and the head of project management, filling up the third floor with massive concrete and steel would, in addition to ensuring stability, also eliminate time-consuming construction work, thus allowing them to save some costs.

While the fourth floor's disappearance may be explained with reference to the importance attached to wind simulations, engineering calculations, and stability concerns relative to budgetary concerns, this is not the case with the rather sudden disappearance of the third floor. In this instance, budgetary concerns commanded more attention than the design considerations. Yet, the budget also played a role in enhancing stability, because prompting management to fill up the third floor with concrete not only saved time and money, it strengthened the building's foundation. Hence, the budget played a more versatile role than normally conveyed in the literature, as actively shaping the project. From the client's point of view the disappearance of these two floors was not controversial:

> It was never really a discussion and we considered it [the space] to be sufficient. We dug all the way down to the limestone and they calculated exactly how much concrete to fill [for the foundation slab]. It was quite natural that it should be like this.

Compared to the first episode where the role of project management was active in shaping the spatial design and increasing the building area, project management had a different role in this second episode, namely one of reducing space (underground). Everything in the project depended upon the building having a stable foundation. Yet, stability was not an issue from the outset. It emerged with the new drawings two months after the project was approved. In short, the conditions for the project—and for project management—were transformed as the skyscraper materialized. As long as the building was only inscribed in architectural drawings and in the budget, then these devices allowed project management to play an active role in designing (parts of) the project. However, as the building further materialized through excavations, simulation models and the casting of the foundation slab, the role of project management was more constrained, but also more clearly defined by the unexpected stability issue. The building required that project management take the emerging stability issue into account, a requirement which, in turn, was linked to and reinforced by drawings, new engineering calculations and laboratory simulations. Neither project management nor anyone else could live with an unstable building. Prior decisions, priorities and trade-offs concerning cost, time and quality/specifications had to be reconsidered in the light of this emerging new condition and requirement.

Third episode: selecting materials for the tower

Once the foundation and the (remaining) floors below ground were completed, the next task confronting project management was to decide in more precise terms how to construct the tower—they had to decide on what quantity of steel and what quality of concrete was needed. A project meeting was held in July 2002. This time, Santiago Calatrava participated with a quite large delegation from his office. Some 15 people joined the meeting, and the most important item on the agenda was once again the structural stability of the tower. This time it was the horizontal stability of the base-floor of each of the nine cubes that gave cause for concern. Project management was afraid that the proposed structure would give way over time, especially at the perimeter so that the floors would eventually slope downwards away from the building's core. When confronted with these calculations, Santiago Calatrava asked to be left alone with his team. After an hour and a half of deliberations Calatrava announced that they were returning back home to redo the structural design, so as to accommodate these new concerns. As a consequence, some additional 2000 tons of steel were added to the tower. The major steel reinforcements were twofold: the base-floors on each of the nine cubes were reinforced and an additional 11 pillars of steel were incorporated close to the façade.

Two qualities of concrete were considered for the tower—one stronger than the other. Not only was the stronger concrete, K60, more expensive than the ordinary concrete, K46, it was also in more scarce supply and, therefore, deemed more likely to delay the construction process. To avoid this, management decided only to use the highest strength concrete, K60, closest to the ground and in some limited area in the core structure, and to use the ordinary and cheaper concrete, K46, in the rest of the tower. Although the choice of concrete is informed by budget cost concerns, these were also negotiated against stability concerns: closer to the ground, budget cost concerns were weaker than stability and design concerns, and K60 was the preferred choice. However, higher up in the tower K46 could be used without sacrificing stability, and budget concerns were again given primacy. This, in turn, had design implications—by using a weaker concrete, they also had to use more of it making the walls, floors and ceilings thicker and taking up space that otherwise could have been used for living space and technical installations. Had they used the stronger, more expensive and relatively scarce concrete (K60), then this precious space would not have been 'lost'. Management did not have this option, however, because money and time had become very scarce resources indeed. At this point in time, the project was not only substantially delayed but there was a substantial override of the 728 million SEK budget because of the stability issues.

This episode is perhaps our most clear cut example of the budget's role as input in managerial decision making, as prescribed in the 'best practice' project management literature. They used the budget as a means to rank concrete alternatives according to their cost, and based on this they opted for a lower cost concrete (K46). Yet, as this episode also illustrates, it is only under specific conditions that the budget can play this taken-for-granted, 'best practice' role. It was first possible once the stability issue had been resolved with the help of the stronger and more expensive concrete, K60. Again, the budget is versatile, playing the dual role of being both weak and strong when the decision about concrete qualities is made.

Discussion: project management challenges in practice

The concept of qualculative project management is introduced as a means of explaining what happens in practice—that roles are malleable and emergent, shaped through interactions between humans and the devices that they elaborate and use. The three episodes recounted in the previous section suggest that the construction budget can assume different roles in the hands of project management. The role of project management is not independent of the budget, and seems to be defined in relation to it in a stream or cascade of devices (Latour, 1990).

As the first episode shows, the construction budget is linked to the architectural drawings in a double movement that goes from the drawings to the budget, and from the budget to the drawings while simultaneously changing cost calculations, designs and roles in construction. The budget is not just an intermediary (input) supporting management control and efficiency: equipped with the first 550 million SEK budget, management not only exercised cost control, but also participated in refining the building design to accommodate concerns about the budget's revenue side. A more refined calculation involving project management's distinction between technical and commercial area is an integral aspect of this double movement. The distinction articulates the project's revenue potential as a concern to be taken into account, which, in turn, opens the architectural design for further exploration, i.e., an important qualitative and economic dimension emerges in the project. The (provisional) outcome is a revised set of architectural drawings, a revised and enlarged 728 million SEK budget and, this is important to our argument, project management plays a hybrid role as manager–architect. In this hybrid role, and owing to the refined budget calculation, management makes a qualitative difference to the architectural design by negotiating more space. In the hands of board members and project management the 728 million SEK budget and revised drawings come to constitute the authorized blueprint and plan for action. Matters of concern had transformed (provisionally) into matters of fact.

In the last two episodes of the Turning Torso case, the budget cost concerns are stronger than the spatial concerns but weaker than stability concerns, and together the cost and stability concerns translate prospective useful space into concrete. The more conventional budget cost concern makes the task of management simpler; a task that is about producing project quality in the form of innovative spatial designs is reduced to the quantitative issue of staying on the budget. It is the budget that sets the premises, and by accepting this in its subsequent decisions management makes the potential users 'pay' in terms of loss of useful space. The budget had become a matter of fact, as if it were beyond negotiation. Management had little discretion to exercise judgement about the spatial implications. Rather its role was that of an intermediary. But if the budget cost concern is strong, why then is there such a large deficit in the authorized 728 million SEK budget? As already suggested there are other and stronger concerns about the building's stability, a project quality the scope and significance of which emerged unexpectedly only a few months after the 728 million SEK budget had been approved. In the last two episodes we also learned that cost budget concerns had a background of concerns regarding the building's stability; the budget was weaker than the wind simulations concerning vertical stability and the subsequent engineering calculations concerning the horizontal stability between floors. In both instances, the cost budget came to pay for the quality of stability.

What the three episodes suggest is that the cost budget is as much an output from the construction project as it is an input. However, the puzzling cost budget overrides cannot be satisfactorily accounted for unless the question of terminating the project is also addressed. The issue of a more or less realistic budget and prospective budget overrides had been on the agenda since the project's inception, but took a dramatic turn during autumn 2002, in the wake of the horizontal stability issue. Project management began to calculate and evaluate what consequences terminating the project would have. With construction below ground completed, the first floor on the ground just about to be completed, and the structure for the first cube on the way up, the building was more visible for all concerned—project members, city planners and political representatives, visitors at the international housing exhibition, citizens of Malmö, and the media. Much money, concrete, steel, effort and prestige had already been invested. The project team had calculated the sunk costs as being in the vicinity of 200 million SEK. Taken together these investments and the increasing materialization and visibility of the Turning Torso added weight to the decision to continue the project rather than terminate it. During autumn 2002, the project had materialized to a 'point of no return', as if becoming and being irreversible (Callon, 1991)—and the cost budget had to pay. Table 2 shows forecasts for the major construction cost items, in million SEK.

The stability in the cost forecast for the Calatrava office is due to the fixed price contract. The façade estimate increases quite significantly in September 2002, at which point in time project management was still negotiating bids for the façade and the contract had yet to be signed. For the other items related to the construction and (re)design of the tower, i.e. tower construction, steel, interior design and associated consultancy, costs increased significantly over the four years. In short, with the building's materialization, the importance of the budget declines—its role is relegated to that of a (passive) intermediary of other and more important concerns regarding structural stability, design and the maintenance of a high profile project.

Table 2 Excerpts from *Internal Report*, May 2005, excluding construction cost items below 50 million SEK and costs for marketing, administration, building site, etc.

	January 2001	September 2002	July 2004
The Calatrava office	52	55	50
Façade	107	139	111
Tower construction**	55	127	208
Steel	19	26	61
Interior design	67	108	150
Consultancy***	8	33	88

** Concrete construction, excluding related ground work which incurred a 46 million SEK cost when completed in June 2002.
*** Includes construction and interior design, excluding the Calatrava office.

Although some may characterize these developments as the result of insufficient upfront planning and an instance of 'throwing good money after bad', this raises the questions of who is to decide what is (in)sufficient, good or bad, and when are they to decide on this evaluative matter. The three episodes from the Turning Torso case suggest that evaluation is an ongoing matter, i.e., a process that is dependent on a stream of devices for calculation and judgement (evaluation) and that it can only be completed and stabilized (provisionally) through the mobilization of these devices. They assume an important role in the 'framing' of project evaluations (Callon and Muniesa, 2005; Kreiner and Løth Frederiksen, 2007), e.g. when reaching a compromise between the size of the budget and the size of the building's commercial area at the point of project appraisal.

The Turning Torso is not a rare and strange project in this respect, but a rather common one in that budget and design are dynamically linked in a process of mutual adaptation and elaboration, i.e. qualculation as an ongoing process. In contrast, for projects in which the budget determines the design (or vice versa), this mutual adaptation is ruled out and qualculation is cut short by a rigid distinction between design (quality) and budget (economic calculation). Construction management pressing for and policing an 'early spec freeze' by mobilizing the cost budget would be an example of this distinction being enforced, but to establish such a strong link to the budget carries other unexpected costs.

Staying within the budget might compromise other (more) valuable goals, such as whether the construction is interesting and relevant. Securing stability is a general goal and requirement in construction that in the case of the Turning Torso was emergent in terms of its precise scope and implication. Sometimes stability can coexist with the budget and can be achieved within and without appearing in the budget as in the second episode where two floors underground disappeared. The price of this was a loss of space. At other times there is a conflict and the budget has to give way and 'pay' for stability. Sorting out what, where, when and how much to 'pay' for stability requires, however, detailed knowledge about the specific conditions of the project—conditions and knowledge(s) that, in turn, are emergent, dependent upon and produced through a stream of progressively elaborated devices.

Moreover, managing project relevance and interest rather than taking it for granted is an important challenge for construction management (Kreiner, 1995). We have sought to extend this insight by highlighting how the devices are linked, elaborated and mobilized, and what roles they can assume in construction management. In more specific terms, the challenge is to consider the possibility that the budget which construction management is holding in its hands can assume several roles that puts construction management in different roles. If the role of the budget is taken too literally as an input (only), construction management research and practice can paradoxically come to rule out the important qualculative questions of project relevance and quality while failing to take account of the associated uncertainties and risks: is it better that the building falls down than that the budget does? In the Turning Torso case, this kind of emerging qualculative challenge puts construction management in a different (unexpected) role. The budget has construction management as one spokesperson: it is in the client's interest to have a realistic budget and stay within it. There are also the engineering calculations with their spokespersons from which the stability issue emerges: it is in the client's interest to secure the production of a stable, well-designed building. If only the budget had been mobilized when managing this challenge, the qualculative role would have been cut short, and 'costs' upon completion would presumably have been much higher—as no one could live with an unstable Turning Torso, and there are only a few that could not live with budget overrides.

The qualculative role and challenge in construction management is about the juxtaposition of the devices and their spokespersons, and how to decide which message carries most weight. For those few that could not live with the budget overrides, the budget was mobilized to distribute responsibility. The CEO and project owner were given notice before project completion with reference to the budget override. In this sense, the budget served as a means for a hierarchal strategy urging for more cost control and efficiency. Management is held accountable for the economy. Budget outcomes are thus linked to a formal role and competence, but this also shows that (construction) management is subsumed and conditioned by other requirements and criteria. The conditions for making knowledge claims differ. Management is required to justify its actions in relation to a budget, while the engineers and architects are required to justify their actions in relations to techno-science and design. Since management is 'only' required to manage the symbols (budgets) while the engineers and architects also are required to manage the objects of the symbols (concrete, steel and building design), their powers and responsibilities differ. The engineers and architects calculate and control the concrete and steel and make the design decisions that produce budget overruns and economic concerns. The engineers and architects are not held accountable, but management is through the economy (budget).

Construction management is located at the intersection between these three formal professional roles—it is, as we have argued, an emerging hybrid role that negotiates the boundaries. Living with the uncertainty concerning the different roles, thus opens up a new qualculative role and challenge in construction management. It is ongoing and concerns the links between the devices, their progressive elaboration and mobilization, strength and (mutual) adaptation, and this challenge is also what differentiates the role of qualculative construction management from the more conventional bureaucratic role of (cost) control. In short, the implication and challenge is to consider how strong the links should be between devices such as the budget, the engineering calculation and the architectural drawing.

Conclusion

The case study focuses on the emergent roles that the budget and other devices can have in managing the construction project. We show how they not only participate in enacting emergent roles for project management; they also simultaneously assume an important role in negotiating professional roles in construction and the building's emergent properties. The case study also highlights the hybrid role of project management—in some instances project management may act as a mediator having qualitative effects on the project while in other instances project management may only be an intermediary, merely conveying the concerns of others and not intervening in the defining and redefining of a project. We introduced the concept of qualculative project management to account for this emerging hybrid role and to denote that project management can span from bureaucratic control to relational control, but with the little (important) twist that the tools and devices with which project managers are equipped can also intervene in and transform these processes.

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Notes

1. We would like to thank the guest editors for bringing this wording to our attention.

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Appendix

Figure 1 'Turning Torso', October 2004