CIRCULAR PREQUALIFICATION AND BIDDING PRACTICES AT CONTRACTOR FIRMS

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Developing new prequalification and bidding practices are paramount to the implementation of circular building and refurbishment. Understanding these practices are essential as prequalification and bidding represent the two most important competitive parameters for contractor firms. However, little is known about the actual prequalification practices and bidding practices at contractor firms due to the sensitivity and confidentiality of the subject. The purpose of this paper is to investigate through activity theory how practices of prequalification and bidding in contractor firms may support or hinder a circular transformation of refurbishment and new building. It is based on an integrative literature review that will review, critically appraise, and synthesise representative literature in an integrated way to generate new frameworks and perspectives on the research question. The study points at the barriers and levers for a circular transition of contractor firms. The main findings are related to five central dilemmas that contractor firms are facing in the process towards circular prequalification and bidding practices identified from the activity system. The five dilemmas include: 1) scalability within the organisation and knowledge sharing, 2) interpretation of sustainable requirements, 3) narrow profit margin and poor business cases, 4) underdeveloped circular markets and 5) the traditional practices of tendering. In conclusion, this paper will generate new insights on prequalification and bidding practices for both researchers and practitioners into the possibilities and obstacles for renewing the building industry and transforming it towards a circular future.

Keywords: sustainable building; bidding; competitiveness; contractor selection

INTRODUCTION

The construction industry faces substantial sustainable challenges. In response, sustainable initiatives in the Danish construction industry are emerging such as: 1) an increase in Deutsche Gesellschaft für Nachhaltiges Bauen (DGNB) certifications, 2) the launch of a voluntary sustainability class in the Danish Building Regulations, 3) the European reporting system Level(s) for sustainable buildings (Birgisdottir and Haugbølle, 2019) and 4) a number of pilot and development projects (Huovila *et al.,* 2019; Leising *et al.,* 2018). The sustainable trends are further amplified by the significant increase in the global population growth and thus, straining the available natural resources. As a result, current practices need rethinking towards the aim of

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achieving a circular economy and by that take greater social responsibility to reduce the negative environmental impacts. The term circular economy includes principles related to the increase of material productivity, eliminating waste, maintaining the value of materials and enable systems for closed-loop processes of materials and energy (Adams *et al.,* 2017). The potential is immense, as the construction sector is responsible for generating 35% of the world's total waste as well as producing and consuming around 40% of all materials on a global scale (Faezi, 2014).

New sustainable trends enhance the pressure on construction companies to change their business models. Several studies emphasise that the development towards a circular construction industry requires new business and ownership models (Adams *et al.,* 2017; Leising *et al.,* 2018; Hart *et al.,* 2019). However, the literature points to the fact that it remains unclear which changes are needed and how innovation of business models can translate into practice (Hart *et al.,* 2019; Adams *et al.,* 2017). The past decade of research concerning business models has focused on establishing a theoretical grounding (Teece, 2010), developing models and tools e.g., business model canvas and value proposition design (Osterwalder and Pigneur, 2009; Osterwalder *et al.,* 2014), and mapping the diversity of business models (Gassmann *et al.,* 2014). Other research in the field has focused on developing sustainable and circular business models (Schaltegger *et al.,* 2016; Boons and Lüdeke-Freund, 2013; Lüdeke-Freund *et al.,* 2019). Still, the majority of the studies are focused on consumer goods or new digital products and services, while few studies are focusing on long-term capital goods such as buildings nor contractor firms. Circular economy business models rethink traditional business models, but the perspective is product-oriented aimed to break the shorter life cycles by suggesting that products must be long-lasting, reusable or recycled (Lüdeke-Freund *et al.,* 2019). The construction industry must be considered with a different logic to encompass the longer life cycles of capital goods, flexibility in building design, the procurement of unique "products", and services that include several repairs or refurbishments during buildings' lifetime.

Focusing on the practices and processes of the contractor firms are therefore paramount to the implementation of circular construction both in relation to refurbishments / renovation projects and new building projects. In particular, understanding the tendering practices are essential, as prequalification and bidding represent the two most important competitive parameters for contractor firms. Therefore, contractor firms must be prepared to visualise the planning of sustainable and circular issues from the early process of prequalification for the specific building project to the hand-in of the final bidding material. The focus of contractor firms is chosen; thus, the delimitation is not to include the activity system of building clients with the awareness that the inter-organisational activities are also highly relevant in terms of understanding the contractor firms' practices.

The research objective of the paper is to synthesise current findings within the academic literature in order to generate new understandings and frameworks on contractors' prequalification and bidding practices through the application of activity theory.

RESEARCH DESIGN

This study applies activity theory as the theoretical basis for the data collection and processing, which is conducted as an integrative literature review. Activity theory is applied as a framework to structure and synthesise the main concepts and ideas retrieved from the integrative literature review. Activity theory (Engeström, 2018) is

chosen, as the analysis of the integrative literature study will encompass an activity system aimed to illustrate the process-related descriptions of contractor firms practices within prequalification and bidding.

Activity theory

The strength of activity theory is the application of an organisational perspective on changes of practices in organisations (Engeström, 2018) rather than an institutional or a political perspective. Thus, the organisational perspective allows for a deeper understanding of which practices counteract and enable certain objectives with the perception that organisations are dynamic and flexible, where institutional conditions do apply. However, the practices of contractor firms are not necessarily determined solely as a result of a governed institutional framework. Activities and practices within prequalification and bidding described in the academic literature are categorised into activity theory's six dimensions in order to identify the internal levers and barriers for a circular transition. An analysis of the contractor firms' activity system will examine the dominant interactions between the organisational activities, hence the possibilities for participating, influencing and contributing to circular building projects.

An activity system consists of a triadic relation between a "Subject" and an "Object" mediated by "Tools and signs" and controlled by "Rules", "Community" and "Division of Labour". Changes in an activity system are driven by internal tensions and/or tensions in relation to other activity systems. Activity theory differentiates between four types of development dynamics: Primary and secondary tensions internally in an activity system as well as tertiary and quaternary tensions externally between activity systems (Engeström, 2018).

Integrative literature review

The integrative literature review applies a systematic approach for evaluating the available research that is relevant to the research objectives. The process includes identifying, assessing and interpreting selected academic literature within the subject. Thus, the following overall five-stage integrative review involves (Russell, 2005): 1) research problem formulation, 2) literature search, 3) assessment of data, 4) data analysis and 5) interpretation and presentation of findings. The methodology of the integrative literature study is chosen to critically review and synthesise the represented literature in an integrated form to demonstrate new conceptual frameworks (Torraco, 2016) by application of activity theory. Furthermore, the integrative literature review comprises less information about the individual papers/studies in detail, because the emphasis is on the presented common ideas, concepts and relevant findings stated in the papers. As a result, the quality assessment is essential to critical review and identify the general trends of the research (Khoo *et al.,* 2011).

The delimitation of the literature search focused on key findings towards three main directions when searching for articles online in the databases of the university library and Google Scholar: 1) Contractor firms' prequalification and bidding process, 2) sustainable building transition, and 3) business models and innovation. The method of the quality assessment was to evaluate the individual articles in terms of relevance to the research area including omitting studies conducted in countries differing excessively from Nordic construction practice e.g., developing countries. In addition, the chosen literature is based on recent research within the past ten years to avoid "out-of-date" publications and include peer-reviewed articles to ensure content quality. Moreover, the examination consisted of accentuating the most frequently

identified barriers and potentials for circular bidding processes mentioned in the academic literature. 56 articles were selected as "primary studies" for full review and evaluated in terms of research objective and motivation, chosen methodology, important findings and reflections on relevance/research quality. 29 studies were eliminated, and the remaining 27 studies constituted the chosen data sample for the presented results.

FINDINGS AND DISCUSSION

Potentials of Circular Tendering

Transforming business models in contractor firms are subject to special circumstances due to ambiguity in performance requirements, non-linearity in project execution, an increasing level of emerging complexity throughout the project phases and a strong project focus. Therefore, innovative initiatives usually only translate into practice in the individual project without any possibility for repetition (Orstavik *et al.,* eds. 2015), which is further hampered by complex supply chains (Van den Brink *et al.,* 2017). The strong project focus of firms and buildings as capital goods are challenging the contractor firms both internally as a result of their own tendering practices and externally as a result of the current set of rules assigned to the contractors (Fig 1).

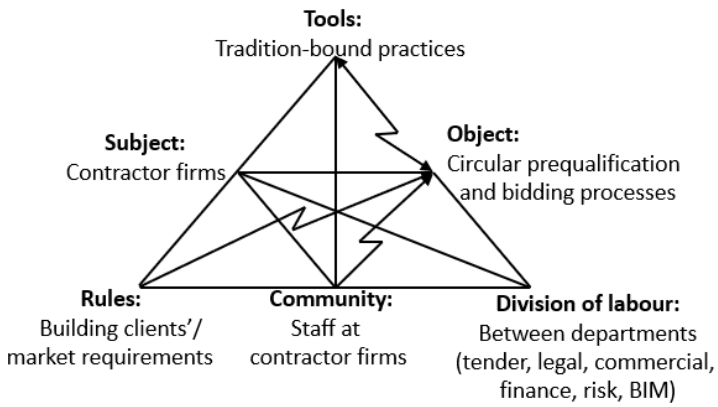

Fig 1: Activity system of contractor firms (Modified from source: Engeström, 2018)

The complexity of the amount of information and stakeholders involved in today's building projects combined with a focus on short-term goals in individual project execution (Van den Brink *et al.,* 2017) are hindering innovative processes. Tradition-bound predefined mechanisms of cost-efficient driven and risk-minimising decisions in the early project phases characterise the practices of contractor firms (Hartono and Yap; 2011; Urquhart *et al.,* 2017). Circular solutions require extra investments (Kozminska, 2019) and funding together with unforeseen costs and risk (Brooks and Rich, 2016) in which contributes to the majority of current building projects resorting to traditional standard procedures.

While current practices in the construction industry are mostly demonstrating barriers to implement circular tendering processes, there are new emerging trends in which rethink the traditional practices. In the following, five central dilemmas towards a circular transformation of construction are identified based on contradictions in the activity system of contractors.

Scalability within the organisation and knowledge sharing

The first dilemma is connected to the constraint between the community and the objective (Fig 1). The community for contractor firms consist of the internal staff in

the organisations and a contradiction to the objective includes a knowledge gap concerning sustainable construction (Hwang *et al.,* 2018; Adams *et al.,* 2017; Häkkinen and Belloni; 2011). Thus, participating in sustainable projects entail contractor firms to possess other competencies in addition to their core competencies. Traditionally, sustainability has served as an additional consulting service in the construction industry among designers and engineers. Nonetheless, the increased amount of sustainable building projects is initiating other stakeholders to participate in the sustainable agenda (Hwang *et al.,* 2018). The growing demands from building clients and the importance of contractor firms' function and role regarding circular implementation in practice, obligate contractor firms to acquire knowledge and skills within sustainable practices (Brooks and Rich, 2016). Examples include practices related to certification schemes, testing of materials, and waste handling (Kozminska, 2019) to maintain a competitive advantage in the bidding processes of sustainable building projects. However, this raises the dilemma of ensuring production teams at the building site having adequate knowledge and skills in order to follow the speed and be well-prepared for the implementation of the solutions written in the tender. Correspondingly, there is a balance of aiming to win sustainable projects as a winning strategy, but also guarantee that all parts of the organisation through education and valuable knowledge sharing can deliver the promised results.

The interpretation of sustainability requirements

The second dilemma is related to the constraint between tools, rules and objective (Fig 1) as the interpretation of circular construction and sustainability may reflect in vague descriptions and difficulties with adapting methods and tools. Hence, sustainability in the construction industry remains at the development stage. The lack of standardisation is generating confusion in two ways; 1) the building clients' ability of setting accurate and clear sustainable requirements and 2) the contractor firms' ability of responding to the requirements regarding cost estimations and time planning. The applied rules for the contractor firms include great dependency on building clients' requirements. Therefore, contractors must accommodate a myriad of needs and considerations (Winch and Cha, 2020) combined with high flexibility in terms of providing service to different types of building client organisations (Haugbølle *et al.,* 2015). The literature highlights the importance and necessity of increased legislation in the area (Brooks and Rich, 2016; Nordby, 2019). Furthermore, contractor firms are not, in principle, a passive stakeholder who is solely dependent on other stakeholders choosing to operate in a circular direction. Cooperation with building clients is essential for driving the circular agenda, but the contractors can also help to shape the market as active players by providing relevant inputs to building clients and legislative bodies. Hence, contractor firms can profitably visualise their innovation potential to influence and challenge the building clients' standpoint by moving from reactive to proactive innovation as a response toa changing environment (Meng and Brown, 2018).

Moreover, current tools and methods available for sustainability assessments generate difficulties for contractor firms to incorporate in tenders. There are several uncertainties in the methods (e.g. Life Cycle Costing (LCC) and Life Cycle Assessment (LCA) calculations) for demonstrating the expected operational costs and environmental benefits by choosing sustainable building projects due to the lack of standardisation (Häkkinen and Belloni, 2011). In addition, calculating circular tenders increases the complexity in terms of predicting the actual building project costs and, consequently, associated unforeseen costs and risks (Brooks and Rich, 2016). The

risks include e.g., extra investments due to additional tests and permissions of reused materials (Kozminska, 2019).

Narrow profit margin and poor business case

The third dilemma concerns the constraint between tools and objective (Fig 1). The tradition-bound practices (Pardalis *et al.,* 2019) are playing a significant role in contractor firms' activity system, which work against the change in a circular direction (Kozminska, 2019). Contractors are focused on short-term aims of winning the subsequent building project (Van den Brink *et al.,* 2017) and therefore, practices are influenced by establishing winning strategies (Tan *et al.,* 2010). The strong focus is on evaluating the bidding from a profitable perspective determined by risk assessments (Hartono and Yap; 2011; Urquhart *et al.,* 2017). Moreover, "project strategic importance" is also playing an important role, when contractor firms are choosing to bid (Hartono and Yap; 2011). The chosen strategy ensures the right positioning in the market e.g., by aligning potential projects with the track record or entering a new market opportunity.

The traditional perception of a contractor firm is characterised by strong market forces, profit optimisation and competitive adaptation. However, it is equally important to understand that contractors are subject to certain terms and conditions. Contractor firms are responsible for handling a large number of cash flows, which typically need to generate a net profit margin of at least 5% for each completed building project (Zhang *et al.,* 2020). Thus, scrupulous planning of the production to avoid budget overruns is crucial. There is consequently a great risk associated with changes in practices because the financial margin profit is a condition of existence. As a result, both young and experienced contractor firms are reticent about adopting innovations. Hence, younger firms are afraid that changes will damage their business and experienced firms are focusing on increasing their area of expertise (Pardalis *et al.,* 2019). The literature suggests the need for developing new sustainable business models to enhance the economic incentives among the stakeholders (Adams *et al.,* 2017; Leising *et al.,* 2018; Hart *et al.,* 2019; Kozminska, 2019). Nevertheless, the literature does not provide concrete suggestions on how circular business models should be implemented in practice including the role of the involved stakeholders in the construction industry value chain nor the necessary adaptations of the contractor firms' internal and external practices. Furthermore, the literature fails to explain how innovative solutions can demonstrate a sustained impact on the overall processes within the construction firms' organisations instead of focusing on innovation in individual case studies (Brockmann *et al.,* 2016; Chegut *et al.,* 2019; Martiskainen and Kivimaa, 2018).

Underdeveloped circular market

The fourth dilemma relates to the constraint between rules and objective (Fig 1), as the status quo in the construction industry is generating difficult conditions for circularity. The circular market is underdeveloped due to the lack of economic incentives among stakeholders in the value chain combined with unsuitable building regulations (Nordby, 2019; Zhao *et al.,* 2018) as well as technical challenges related to material recovery (Hart *et al.,* 2019). Consequently, the business case is poor for contractor firms to reuse or recycle material streams, as the construction industry follows the linear economy which supports a market of acquiring virgin materials at lower costs, more readily accessible and the assurance of meeting required building regulations or certifications (Hart *et al.,* 2019). Many studies also refer to the need for

a new circular service provider/recovery market to drive the transition (Van den Brink *et al.,* 2017; Nordby, 2019; Leising *et al.,* 2018).

Contractor firms must respond to the conditions of procuring building materials, which meet the building regulations in terms of load-bearing ability, toxic compound levels and "Conformité Européene" (CE) marking. Reused materials contain the complicated documentation process of meeting several requirements, tracking the suitable materials including sufficient amounts, testing and recovering the materials, and finally, planning for the correct storage of the materials (Hart *et al.,* 2019; Kozminska, 2019). The circular market terms for contractor firms to manage in practice are associated with great liability risks as there is no security of material supply, no formal authorisation procedure in place, and not the least, the market for reused and recycled materials is currently non-existent (Nordby, 2019). Thus, circular initiatives entail many additional resources, and expenses compared to the alternative option of purchasing virgin materials.

The traditional practices of tendering

The fifth dilemma refers to the constraint between rules and objective (Fig 1). The construction industry's tender and contract forms generate difficult conditions for applying a circular economy in practice (Aarseth *et al.,* 2017; Pomponi and Moncaster, 2017). The traditional closed and controlled approach only allows few main stakeholders to drive the project objectives and by that hampering the flexible open dialogue among multiple stakeholders needed for co-creating sustainable initiatives at an early project stage (Aarseth *et al.,* 2017). The literature emphasises that the procurement of contractors must prioritise different aspects than only cost or price (Loosemore and Richard, 2015) and non-traditional procurement systems such as integrated project delivery and partnering might be considered as sustainable drivers due to the increased level of integration and collaboration (Tang *et al.,* 2019; Häkkinen and Belloni, 2011).

Although contractor firms' individual considerations for self-survival should not be underestimated, there are trends towards the creation of shared value with the aim of combining market competition and at the same time serve fundamental societal needs. By creating shared value, contractor firms must address societal issues from a shared value perspective and invent new practices in the organisation to address them. In addition, the traditional role of contractor firms is being challenged because the benchmark is not solely focused on efficiency and profit within in-house production, but the perception expands the link between societal and economic progress (Porter and Kramer, 2011). In the academic literature, the awareness is mainly concentrating on the building clients and designers for driving the sustainable agenda (Häkkinen and Belloni, 2011; Zhao *et al.,* 2018). Nonetheless, contractor firms are often functioning as the key stakeholder to all the other stakeholders in the value chain from the building clients, designers, engineering consultants to the subcontractors, procurement partners, waste management companies and demolition companies. Moreover, contractor firms possess valuable knowledge of building material characteristics and practical experiences in construction solutions.

Building projects with untraditional contract forms create a new platform for contractor firms' involvement in the very early dialogue together with the project stakeholders to address the project's sustainable objectives (Tang *et al.,* 2019). Also, these types of projects allow contractor firms to complete projects where other parameters are considered instead of the narrow focus on the lowest pricing and time

optimisation. General contract forms often result in contractor firms entering the project at the late planning phase. Consequently, allocating almost no room for contractor firms' input and participation in the decision process. Excluding contractor firms' involvement in relation to the fostering of innovative and sustainable solutions is criticisable, because contractor firms are ultimately responsible for implementing the chosen solutions.

CONCLUSIONS

The main findings of this study include five central dilemmas that contractor firms must address within their own practices in the transition towards circular prequalification and bidding. The five dilemmas represent a substantial part of the complex reality that contractor firms face in the circular transition of traditional bidding practices. Although, the preparation of tendering is the foundation for contractor firms, the understanding of the bidding processes is limited due to the confidential and commercially sensitive nature of the subject.

The first dilemma is about the acquisition and scaling of sustainable knowledge within the organisation. The second dilemma relates to the interpretation of sustainable requirements and the associated uncertainties of available methods and tools. The third dilemma focuses on the contractors' problematic terms and conditions of handling large cash flows and generating a reasonable net profit margin for each completed project. The fourth dilemma refers to the underdeveloped circular market, which is currently inadequate to compete with the existing market. The final and fifth dilemma discusses the traditional practices of tendering and how alternative tender and contract forms can accelerate circular implementation.

This study is limited to examine the activity system of contractor firms. However, further research could gainfully include the activity system of building clients to expand the field of knowledge within enablers and barriers for circular bidding processes. The procurement methods of building clients are particularly valuable to investigate further, as the culture of procurement helps to dictate the green agenda and the contractor firms' level of flexibility towards adopting circular initiatives.

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