Challenges found in handover of commercial buildings

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Abstract

This paper examines the handover process in Norwegian construction industry, focusing on commercial buildings. Improving handover processes reduces the number of conflicts, increases user value, improves indoor climate along with securing overall building performance, both in closing construction phases as well as throughout the building lifetime. As little research is found on the subject, a collective project was initiated by the municipality of Trondheim. This case study is limited to a single, environmentally certified, office building in Norway. The paper aims to determine main delay and defect causes. Finally, some countermeasures are identified. A literature review along with a document study was performed. Seven semi-structured, case specific interviews were conducted in addition to a pilot study consisting of three interviews on the same topic. The case respondents are project managers from contractor and client with extensive experience from the Norwegian construction industry. Several causes in contractor-client interfaces were identified. Among the most critical were late changes and decision-making, lacking understanding of limitations and potential in design-build contracts, conflicting interpretation of specification of work along with complex technical installations. Possible countermeasures are found to be strict decision planning, sufficient time buffers, early reconciliation of client expectations together with sufficiently detailed specification of work and significant specialist knowledge in complex technical coordination. This paper investigates a little scrutinized part of Norwegian construction projects in an effort to better commercial building performance and profitability. Future research on multiple construction projects would help confirm or disprove findings and the identified countermeasures.

Keywords: Handover; construction management; project planning; commercial buildings; delays and defects
1. Introduction

This paper reports on a study initiated by the municipality of Trondheim, Norway, of the handover process of commercial buildings within the context of the Norwegian construction industry. More specifically, it analyses the causes of office building delays and defects identified in this process along with countermeasures to remediate these.

A construction project is typically characterized by being a one of a kind product, tailor made according to the specifications of a given client. It is generally seen as a unique set of coordinated and controlled activities constrained by time, cost and resources (British Standards Institution, 2000). These are undertaken to achieve specific requirements. Through various forms of contracts a project organization is established, often with conflicting environmental, personal or financial interests. Whyte et al. (2013) have identified the handover stage of construction projects to be particularly challenging. According to Statistics Norway, the start-up of Norwegian office buildings amounted to a total of 600 000 m² in 2014. The municipality of Trondheim has indicated that a complex building and process makes for a larger number of delays and defects than a straightforward building project.

1.1. The problem – causes and countermeasures

NS 8430 is the Norwegian standard for handover of buildings and civil engineering works (Norwegian standardisation organisation, 2008b). Handover is, according to the standard, to be conducted through an inspection of contract work and documents. In spite that the standard - apparently - clearly describes the handover process, the municipality of Trondheim has indicated the Norwegian handover process as being too costly and time consuming as well as inefficient due to excessive delays and defects. Likewise, the literature review conducted in the initial phase of this study indicated that the handover process presents a challenge internationally. Koski (2004) describes the Finnish handover process as implemented quite deficiently. Forcada et al. (2013) report on a significant number of defects in the handover of Spanish housing projects, and Josephson and Hammarlund (1999) have found a great number of defects in their study on causes and costs of defects in Swedish construction. Dvir (2005) found - after a study of defence projects - that final user preparations for operational use are highly correlated with customer benefits. Overall, however, little research seems to cover the issue. The ambition of the paper is to study challenges and potential countermeasures in the handover of commercial buildings specifically. We intend to address the following research questions:

1. What are the main causes for delays and defects in the handover process?
2. What countermeasures can be implemented to avoid these delays and defects?

The paper intends to address these by a case study following the principles of Yin (2014) on a Norwegian office building, going through final stages and handover.

2. Methodology

A literature review as well as a document study was carried out in addition to three general semi-structured pilot interviews and seven semi-structured, case specific interviews. The respondent group was composed of respondents from both contractor and client side. The office building is an environmentally certified, 11000 m² building in Oslo, Norway. This design-build (DB) project was chosen for its complexity, its handover date as well as the fact that the main author knew it through two consecutive summer internships and by a previous pilot study.

In accordance with the procedures outlined by Blumberg et al. (2014), a literature review was performed to understand handover processes in Norway from a theoretical point of view. The main sources of literature on the subject were databases available through the Norwegian University of Science and Technology libraries, as well as...
the libraries themselves. The databases used were \textit{Scopus (Elsevier)}, \textit{Compendex (EI Village)}, Civil Engineer Database (ASCE) and Science Direct (Elsevier). The reliability of the literature was sought preserved through thorough selection on the basis of sources, publishers and authors. Literature validity was sought achieved through a selection process based on the challenges defined in the introduction, securing data aimed at the research questions.

A project document study was performed, supporting subsequent interview findings. Yin (2014) argues that the most important use of documents is to corroborate and augment evidence from other sources. In accordance with this, our analysis aims at uncovering inefficient and/or failing practices. The document study was based on project documentation provided by the DB-contractor. The analysed documents consisted in a summary of handover inspection defects, contract excerpts and specification of work.

The pilot study interviewees were two experienced projects managers as well as a project director and the topic was challenges in the handover of construction projects. The interviewees in this case study were three developer and four contractor representatives. These were chosen in order to focus directly on the case study topics, as well as provide perceived causal inferences and explanations as recommended by Yin (2014). They were chosen on the basis of their experience in project management as well as their thorough understanding and knowledge of the case project. Having both contractor and developer respondents secures balance in the interview findings. The developer respondents were the project director, management director as well as a project manager from a contracted project management firm. The contractor respondents were the project economist, construction manager, project manager and service manager. All interviews were based on a common interview guide to ensure that the respondents answered the same questions. They were conducted in a semi-structured fashion to motivate free speech within the boundaries of the sessions. Each interview was conducted in the respondents’ workplace, lasting between thirty minutes and one hour. All interviews were taped to secure data from being lost. This will, according to Kvale (2007), yield a good result as it allows the interviewer to concentrate on the topic and the dynamics of the interview knowing the material is safely registered, thus being able to contribute to the fullest.

Schneider (2015) has the interview guide containing interview questions as an attachment.

3. Theoretical framework

Delays and defects in the contract work are defined in NS 8407 General conditions of contract for design and build contracts (Norwegian standardisation organisation, 2008a). In the standard, a delay is understood to be work not taken over in accordance with the deadlines. Such delays are typically subject to daily penalty charges. A defect is said to exist if, at the time of taking over, the contract work does not satisfy the requirements in the standards and this is due to circumstances for which the DB contractor is liable.

The standard NS8407 describes contract work handover to be carried out according to a set of taking over proceedings. According to the standard, the parties are obliged to attend these proceedings unless there are objective grounds for not attending. At the proceedings, the contractor is to submit a summary of final inspection defects, specifying which defects have been remedied. The parties are to jointly undertake a careful inspection of the contract work. Subsequently, the standard describes a handover protocol stating who is present, defects discovered and time limits for rectifications. Further, the client’s right to refuse taking over or to take over parts of the work is stated, as well as the effects occurring upon taking over. The standard NS6450 Operational testing of technical building installations, being developed at the time of writing, is intended to further the quality assurance in the project handover. The new standard is to be coordinated with current standards. It is to define operational testing, when this is to be performed, conditions for testing as well as input and output.
3.1. International practice and challenges – handover and commissioning

As a process, the British handover is described by Lester (2014) as involving an exchange of project completion documents, the project thus being accepted by the client. Signed acceptance certificates enable contractors to submit final payment certificates. As a part of the handover, a so-called close-out is carried out. This consists of closing out contracts and subcontracts, clearing the site of temporary installations as well as collating, indexing and binding all operating or maintenance manuals, drawings, test certificates and guarantees produced during the course of the project. Lester (2014) argues that the cost of preparing this documentation is often underestimated. Another part of the close-out Lester underlines as important, is the commissioning of project deliverables. The deliverables go through specified performance tests and operating trials in order to prove that they satisfy required performance criteria. In Norwegian standards (NS8407 and NS8430) such performance tests and operation trials seem, despite being mentioned, to be quite poorly described. In addition, the vocabulary in the English versions of the Norwegian standards are in some cases not in accordance with international terminology.

According to our literature review, commissioning has emerged as one of the more significant elements of the handover processes. The commissioning part of building handover has its origin in the ship building industry. Ágústsson and Jensen (2012) link the commissioning needs in ship building to the high risk involved in shipping as well as the high cost of recalling a completed vessel. Consequently, a need for quality assurance in production emerged. Building commissioning was adopted by the U.S. government as a consequence of an increased focus on energy consumption in the 1970s. Especially in the U.S., the accelerating technical development of the building industry has taken commissioning from being a tool for energy saving to an essential means of securing overall building performance. The Norwegian standard for handover of buildings and civil engineering work does not regulate such overall building performance. Commissioning is described solely as the isolated process of testing, tuning and coordinating technical systems, thereby assuring the best possible energy efficiency of a given system, as well as preventing system interface complications in building operations. In this paper, the term commissioning is used in accordance to the Norwegian standard.

Along with the heightened commissioning awareness, the need for specialist knowledge on the area has increased. According to Elzarka (2009), the pool of experienced commissioning providers has not increased at the same rate. To ensure building performance, it has internationally become customary to procure independent, third party commissioning agents. Educating owners in recommended best practices for procuring commissioning services offers significant opportunities. Elzarka maintains, however, that there are variances between best practices in commissioning procurement and todays’ practice. Many owners do not involve the commissioning agent early on in the conceptual design phase and the majority use cost as the only selection criteria. The handover in itself may be used as a natural point of assessing whether project goals have been reached, and Lock (2004) stresses the importance of handover success. More specifically, he underlines how the challenges of project phases increase according to increased size and complexity, furthering the importance of commissioning. He describes a prolonged or delayed construction process as somewhat unpopular among contractors. In many cases, they have moved their workforce to another project with more apparent value. A possible countermeasure is to assign a new task force. Lock (2004) suggests, for large projects, that the contractor might even open a new mini-project, complete with its own plans and budgets. According to the experience of the authors, procuring third party commissioning services and educating owners is not a common practice in the Norwegian construction industry.

Despite the seemingly crucial role of the handover process, the literature reports on a lack of control. Cheng et al. (2003) found that an increase in construction project scale and complexity induces project difficulties and Whyte et al. (2013) state that the handover stage can be particularly challenging as it is “not seen as the sexy end of the project”. Still, in recent years there has been a heightened status of the handover as a core process. The U.S. has, according to Ágústsson and Jensen (2012), a head start when it comes to commissioning. In parallel to governmental regulation, the increasing environmental focus of the international construction industry has made way for
economically and environmentally motivated certification systems. Systems like the U.S. Green Building councils LEED (Leadership in Energy and Environmental Design) and the Norwegian Green Building councils BREEAM Nor (Building Research Establishment Environment Assessment Method, Norway) have levels of environmental certification, according to the number of points collected throughout the project. A by-product of these strict regimes is thorough documentation and control in every part of the project. A concrete measure for establishing project control, as described by Barnes (1988), is a simple change of wording. By referring to the task of achieving key dates not as “planning”, but as “time-control”, the activities attain an active rather than a passive character. This applies equally to cost controlling. A focus on what remains to be done as opposed to what has been done counteracts complacency and clarifies future information flows. Lock (2004) clarifies the value of information and documentation in handover proceedings and the following start-up of operations. As-built documentation, drawings register, design calculations, purchase schedules, vendors’ drawings and other documentation is paramount for assuring handover control. Wu and Low (2010) state that it is especially important for the building to be commissioned if the client seeks green certification, as the client did in this paper’s case project.

More general aspects prove equally important for an adequate handover process, such as contract specifications, design quality, project team assembly and general communication challenges. Depending on the specific contract type, the client is to provide varying degrees of project design. In a DB contract the responsibility of designing as well as procuring and constructing falls on the chosen DB contractor. To ensure that the client’s objectives are met, a specification of work is made, describing the client’s requirements while leaving detailed design to the DB contractor (Difi, 2015). As stated by Xia et al. (2012), the degree of client or owner provided design going into a DB project can have a direct effect on project success as seen from both a client and a contractor perspective. The contract type allows for creative solutions while protecting the client’s objectives. Still, Xia et al. (2012) maintain that the client micro managing can be harmful to the process as the allocation of risk and responsibility between owners and design-builders is already determined. If the client does not accept contractor solutions, this may lead to excessive iterations in building design alongside ongoing construction, which in turn impedes progress and complicates the handover. Further, they maintain that a sufficiently developed request for proposal (RFP) in DB procurement makes for the best possible understanding of the project, while still preserving the prospects for innovation. In addition to an initial client briefing, Smith and Love (2004) refer to the client briefing as an ongoing process of eliciting and documenting client requirements at various design stages. According to the experience of the authors, this is relevant in current DB projects as the design process in many cases stretches out into construction. Barnes (1988) states that to ensure efficient decision-making during construction, the designed qualities should aspire to be adequate, but not unnecessarily sumptuous. He also states that all design stage information exchange should be referenced to the project performance objectives. This does not always mean pursuit of high quality, but appropriate quality. The latter may be achieved through anchoring quality descriptions in formal building standards agreed upon in advance, preventing disagreements down the line leading to delays or defects. DB contracts are increasingly used in the Norwegian construction industry, especially in commercial projects. In such contracts, the contractor normally allows for the design work to run alongside the structural work, making client briefing and decision making critical.

As the objective of most construction projects is to perform in the building operation phase, much can be learned through assessing user feedback. Goins and Moezzi (2013) have identified what they describe as quite a clear connection. They have found that when there is a mismatch between the conditions that building users expect or want and the conditions they experience in operation, they may complain. There is, however, according to Goins and Moezzi a tendency in commercial buildings for the otherwise informational benefits of complaints to be overshadowed by the reputation threat that complaints represent. The basic human and organizational reaction is in some cases to suppress them, thereby defeating their purpose. The interparty information flows, it seems, need to be in operation from project inception throughout the complaint period. Bubshait et al. (2014) have found existing construction processes to be frequently haunted by issues negatively impacting project completion; performance of
role players, involvement of other stakeholders and contractual relations are some of these. However, improving communication and coordination through relationship management has shown to mitigate delays.

Schultz et al. (2014) have studied the correlation between project characteristics and the extent of defects measured at handover in Denmark. The determining characteristics were found to be planning of budgetary conditions, time schedules and early, continuous quality control. There were also indications of stakeholder collaboration having a positive influence on defects at handover. Forcada et al. (2013) state that although there is legislation in place to protect customers, a significant number of defects can be found in newly built houses in Spain. The defects detected by customers are predominantly functional rather than technical, such as door misalignment, defective window joints and incorrect hinges. These functional defects should have been addressed prior to handover. The findings of Josephson and Hammarlund (1999) seem valid in today’s project environment. They found root causes of building defects to be instability in the client organisation, client lacking project control, late user involvement, time pressure, composition of the project organisation, cost pressure, lacking support to the site organisation and lacking motivation. Building defects and general complications not being addressed often culminate in project delays. Braimah (2013) claims project delays emanating from a multiplicity of sources combined with high uncertainty in cause-effect has created difficulties in apportioning delay responsibilities amongst contracting parties. Lack of adequate project records is found to be the top contributory reason for this, resulting in claims being dealt with long after project completion. The Norwegian standard NS8407 seems quite clear on ramifications of defects and delays, as well as on apportioning responsibilities. Still, the municipality of Trondheim along with the Norwegian industry in general report on excessive delays and defects, and Ingvaldsen (2008) found the cost of building defects after handover to make up 2-6 % of net production value.

4. Findings and Discussions

General cleaning and finish imperfections make up 77 % of the 97 registered inspection defects in floors 2 and 3 of the case office building, shown in the summary of handover inspection defects. This is a repeating trend throughout the building. The attention drawn to visual cleaning imperfections is most likely at the expense of more crucial building defects.

Contract excerpts concerning planning and reporting show an attention to decision making planning, preliminary design review as well as technical coordination. Routines for handling changes are also described in the contract and forms are provided in the form of attachments. The contract seems generally well drawn up and the specification of work seems quite comprehensive. Still, some aspects might be too vague to perform as specification of a DB project. Coupled with conflicting interpretations from client and contractor, this leads to excessive design iterations.

The pilot study interviews preceding the case study gave clear indications of the complex contract being a source of handover challenges. The DB contractor handed over the case building in one step, not several, and the intended customer of the project participated in the handover process. The project was organized as an own legal entity, where the intended customer took over all the stock at handover. The legal entity had a contract with the DB contractor and was during construction owned by a professional property developer, carrying out the project up to handover.

Interview findings showed the handover challenges to involve three main areas; differing expectations and interpretation of contracts and contract deliverables, poor execution and planning of handover related activities as well as challenges related to damaging, staining and chipping of completed surfaces, often caused by late fixes.

4.1. Conclusion - causes of project challenges and countermeasures found

The case study showed most of the process challenges to be related to differing expectations and interpretation of contracts and contract deliverables. This concerns both developer and contractor. As the contract was based on a
somewhat vague specification of work, the client had high expectations as to what was to be delivered. These ill-defined specifications in connection with the customer not understanding the contract form led to customer opinions contradicting the contractor’s room for manoeuvre in the DB-contract. The most mentioned remedy is a more detailed specification of work going into the contract work. Having more details as part of the procurement leaves less room for interpretation. A point not to be forgotten is that more details prior to procurement imposes a larger cost early on. Another way of avoiding dissention is to be clear as to what quality is to be delivered by using reference buildings and test offices. This reconciles expectations and provides a common understanding. A clever solution used by the contractor’s project manager was to commission an experienced surveyor for the inspections. The surveyor had in-depth knowledge of standards, requirements and tolerances in the Norwegian guidelines, making it possible to come to agreements on site. It was also suggested to make sure to be explicit when it comes to room for manoeuvre within the contract form and to be strict when it comes to decision making plans. Not accepting changes too late in the process is a big part of retaining control in closing stages. There was a clear impression among the respondents that the eagerness to be customer friendly in some cases did more harm than good. There were problems with the municipality’s Department of planning and building due to inconsistency concerning universal design and too much emphasis on being service minded. In being stricter with decision-making and planning, many of the revealed challenges could have been avoided. The respondents all seemed to be convinced that there are both positive and negative sides to service mindedness. A suggested solution is be stricter on requests concerning laws and regulations, being uncompromising in this area and rather be service minded when it comes to pure aesthetics.

Poor planning, or late changes inflicting on planned activities were also responsible for reported handover defects and delays. This may have been caused by excessive focus on being service minded, or poor control in beginning phases propagating throughout the process. Still, the respondents emphasised the advantages of being service minded to a certain extent, such as a positive work environment and further cooperation. The planning and expertise was described as inadequate, and the milestone called “mechanical complete” was delayed due to it not being ready upon inspection. The challenges regarding poor execution and planning of handover related activities can in many cases be solved by better activity planning. The interviews also revealed problems concerning the technical testing. According to both contractor and developer project managers, technical problems seem to appear no matter what. Stricter self-inspection regimes and multiple random inspections incite sub-contractors to deliver on schedule. Planning for adequate time buffers is also deemed important. By procuring a third-party commissioning agent with wide competence, some problems might very well be avoided. Still, successful use of the third-party agent is dependent on project control going into the process.

A more visible class of causes are those concerning visual building defects and damages during closing stages. Unsatisfactory surface finish upon final inspection was a concern shared by several of the respondents. Excessive focus drawn to surface finish presumably effected the quality of the rest of the inspection and took attention away from building performance. Damaging of finished surfaces is traced both to workers being careless and to poor activity planning. Workers being uninspired can be bettered by involving them and conveying the projects ideas and its use, as well as what kind of customer it is intended for. A feeling of ownership is beneficial no matter the project role. Planning of activity order as well as planning of surface protection reduces the chance of scratching and damaging. Using white gloves and quality shoe covers during final installations counters smudging and staining. As does setting up portable washing stations and hiring cleaning personnel prior to inspections.

Further studies on the subject, using the research results found will help confirm or disprove findings and countermeasures. These should be ranked in order to determine cause and countermeasure importance. Researching multiple case projects will give a clearer problem scope as well as give a basis for developing and implementing countermeasures. This can in turn improve performance and profitability in commercial buildings in Norway.
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