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High-performance building projects: how to build trust in the team

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ABSTRACT

Trust is a prerequisite in all endeavours concerning uncertainty and interdependencies. By studying the development of a sustainable, high performing building this paper report on such an endeavour. The client implemented a collaborative project delivery method where key actors were brought together to collaboratively develop the project in the design phase. For the participants to collaborate, and thus work as a high-performance team, there was a need for trust. Therefore, this study addresses the following research questions: what was perceived as the key elements for building trust in this project? and, how did the key elements impact the trust-building in this project? The study is based on observations of weekly design meetings (so-called Big-Room sessions), as well as secondary data from a document study, and a supplementary questionnaire. Trust was essential as the participants were able to rely on each other's expertise and work interdependently towards a common goal. The most prominent elements that affected trust were the start-up seminar, team composition, shared interest, support from management, joint problem solving, and the use of integrated concurrent engineering. These elements built and sustained trust due to their ability to create or positively impact the experiences, problem-solving, shared goals, reciprocity, and reasonable behaviour of the project team. The insight into how the collaborative project delivery method build trust may be valuable for practitioners and researchers alike.

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Trust; project delivery methods; collaborative project delivery; high-performance buildings; integrated team; building design management; integrated concurrent engineering

Introduction

The demand for so-called sustainable, high-performance buildings is increasing. Such buildings typically optimise a set of parameters beyond the typical cost, schedule, and quality parameters, and thus seeks to achieve goals that outreach typical construction projects (Fischer, Khanzode, Reed, & Ashcraft, 2017). But complex projects come with significant challenges as they involve numerous activities that depend on each other to accomplish the project's overall objective (Browning, 2014).

Consequently, concerns have arisen that traditional project delivery methods will not deliver satisfactory results. Traditional project delivery methods that emphases on detailed contractual specifications and close monitoring signal a climate of distrust that tends to induce opportunism and hinder collaborative interaction (Kadefors, 2004). Instead, the early involvement of the contractor as well as defining the level of integration in the project delivery process appears to be a key factor for

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successfully deliver high-performance building projects (Mollaoglu-Korkmaz, Swarup, & Riley, 2013). Therefore, a proposed solution is to use a project delivery method that seeks to integrate and align the project participants at an early stage (Fischer et al., 2017). However, integrating and aligning project participants in a way that supports interdisciplinary interaction is a challenging endeavour. Often, clients feel vulnerable in relation to contractors, and historically established and cultivated routines and habits prevent clients from selecting a project delivery method that emphasises collaboration (Hartmann & Bresnen, 2011; Lædre, Austeng, Haugen, & Klakegg, 2006).

As project teams are inter-organisational and temporary in nature, building and sustaining trust amongst the participants in the design phase has proven to be a critical success factor (Kadefors, 2004; Khalfan, McDermott, & Swan, 2007; Laan, Noorderhaven, Voordijk, & Dewulf, 2011; Lau & Rowlinson, 2009; Ng & Cai, 2007). In the absence of trust, project teams are prone to adversary behaviour and, thereby uses resources in a way that is not ideal for the project (Baiden, Price, & Dainty, 2006). Consequently, the ability of the team is greatly improved if there is a climate in which the participants are able to establish and maintain trust (Khalfan et al., 2007). Yet, trust in construction projects appears to be scarcely researched empirically and only limited research regarding project delivery of sustainable, high-performing buildings seems to exist (Lapinski, Horman, & Riley, 2006; Molenaar et al., 2009; Mollaoglu-Korkmaz et al., 2013).

This study reports on a sustainable, high-performing building, i.e. the so-called ZEB Living Lab in Trondheim, Norway (Engebø, Klakegg Ole, Lohne, & Lædre, 2020a; Time, Engebø, Christensen, Dalby, & Kvande, 2019). The client's main ambition is (1) to have a building that will produce a surplus of renewable energy during its lifetime (60years) and thus compensate for the greenhouse gas emissions from the construction, operation and, production (The ZEB Research Center, 2018); and (2) it should be a Living Lab, meaning that the behaviour of facility users and usage patterns are collected by researchers investigating the possibilities for merging new technologies with user-centred design (MIT Office of Sustainability, 2018).

The client had high expectations and set great demands on flexibility and innovative solutions regarding the building. The client saw it as desirable that the project was carried out with a collaborative project delivery method that optimised interdisciplinary interaction. The foremost principle was to bring on board the best possible team while, at the same time, minimising the use of intricate contractual arrangements. The solution was to involve the contractor as early as possible so that the contractor's competence in collaboration with the client's management and design team was utilised. The client implemented elements such as Integrated Concurrent Engineering (often referred to as Big-Room sessions or ICE-sessions by the practitioners as it is taking place in the 'Big-Room'), early contractor involvement (ECI), and co-location of the project team. Accordingly, the need for trust between the participants emerged as the process relied on relational aspects rather than contractual safeguarding. Therefore, this project was suitable for a study where one could look at how the relationship of trust developed through the phases of the project. Hence, the following research questions were addressed:

RQ1: What was perceived as the key elements for building trust in this project?

RQ2: How did the key elements impact the trust-building in this project?

Theoretical framework

The need for sustainable, high-performance buildings

The impact of the Architecture, Engineering, and Construction (AEC) industry on society and the environment is profound. The AEC-industry employs 7% of the workforce and generates 10% of the GDP worldwide. For Norway, the numbers are slightly lower, 6.5%, and 8.6% (Statistics Norway, 2017). Further, the AEC-industry consumes 17% of the freshwater (Herda & Autio, 2017), 30–40% of the energy (IEA, 2016), 50% of the materials, and 60% of the harvested land (UNEP-

SBCI, 2009). Thus, the AEC-industry should be a key industry for moving society towards sustainability through delivering buildings and infrastructure that meet the societal needs for more sustainability. For instance, the governing bodies want energy and resource-efficient buildings, the building clients want sustainable and cost-efficient buildings, and the users want safe buildings with high indoor quality. Consequently, we need sustainable, high-performance buildings with little embodied energy, little emissions of greenhouse gasses, and little or no in-use energy consumption. This study reports on a project that seeks to push the known conventional industry standard.

The need for new project delivery methods

The need for sustainable, high-performance buildings entails challenges at different analytic levels. First, there is a need for new thinking about how to deliver high-performing buildings. Second, as the construction industry has become highly fragmented. there is a need for integration in the project delivery. Collaborative project delivery methods are proposed as a potential solution for how to achieve the wanted integration and, thus, meeting the clients' ambitions of delivering sustainable, high-performing buildings (Fischer et al., 2017; Mollaoglu-Korkmaz et al., 2013; Walker & Lloyd-Walker, 2015).

A project delivery method, as defined by Miller, Garvin, Ibbs, and Mahoney (2000, p. 59), is 'a system for organising and financing design, construction, operations and maintenance activities that facilitates the delivery of a goods or service'. Traditional project delivery methods, such as design-bid-build (DBB), and construction management at risk (CMR), are often the preferred choice for the project client. However, construction projects continuously fail to meet the clients' ambitions. An alternative is to use a project delivery method that integrates and aligns the project participants at an early phase (Fischer et al., 2017). These delivery methods seek to provide a framework for integration and may, therefore, be labelled collaborative in nature (Engebø et al., 2020b). In this context, integration refers to project participants that are collaboratively working, coordinating closely in decisions, understanding each other's' requirements and constraints, and have confidence in everyone's commitment to achieving common goals (Austin, Newton, Steele, & Waskett, 2002). Foremost, this may be obtained by implementing a broader view of what constitutes the value of projects (Klakegg, 2017; Walker & Lloyd-Walker, 2015). In practice, the client has an extensive list of contractual, organisational, and cultural elements (often referred to as hard – and soft elements, or the more generic Partnering elements) ranging from early contractor involvement to integrated concurrent engineering to choose from (Engebø, Skatvedt, & Torp, 2019; Hosseini, Wondimu, Klakegg, Andersen, & Laedre, 2018; Larssen, Engebø, Lædre, & Klakegg, 2019; Simonsen, Skoglund, Engebø, Varegg, & Lædre, 2019; Wøien, Hosseini, Klakegg, Lædre, & Lohne, 2016).

The need for trust in the collaborative form of project delivery

The design phase of a sustainable, high-performance building project is typically characterised by both a high degree of uncertainty and a high degree of flexibility. It involves the design, organisation and management of people, knowledge-sharing, and manipulation of the flow of information to obtain specific project goals and objectives (Knotten, Lædre, & Hansen, 2017). The design is an iterative process consisting of many types of interdependencies that need to be addressed as the project advances. For example, prolonging iterative processes can be beneficial to the value, but ran too long without conclusion, they can negatively affect time and cost (Knotten, Svalestuen, Hansen, & Lædre, 2015).

For the design phase, the key for the collaborative project delivery method is to establish an integrated high-performance team selected on a best for the job basis; sharing risks with incentives to achieve performance in pre-aligned project objectives; within a framework characterised by trust, collaboration, innovation and mutual support (Hutchinson & Gallagher, 2003; Yeung, Chan, & Chan, 2007). A team is a set of individuals brought together to carry out a task of any type and for any duration (Cornick & Mather, 1999). By working in collaboration, teams seek to generate synergy through coordinated effort to generate performance beyond just the sum of individual contributions (Fischer et al., 2017). At the team level, the highest potential for improvement is by improving the team culture, organisational structure, and team competence (Ekström, Rempling, & Plos, 2019). For example, it is important to create a team culture that uses a shared language and improves personal relationships through trust, care, and openness (Sun, Fleming, Senaratne, Motawa, & Yeoh, 2006). Subsequently, collaborative working requires a change in the approach to the design, development, and implementation and investment in tackling 'soft issues', such as trust (Damodaran & Shelbourn, 2006). Integrated concurrent engineering represents an approach that encourages face-to-face relationships and interaction, and thereby improves the communication process and the coordinated effort toward common goals within a project's organisational system (Love, Gunasekaran, & Li, 1998). Successfully conducting integrated concurrent engineering requires that psychological factors such as trust are well managed and failure modes such as infighting, over-conservatism, defensiveness, and fatigue avoided (Chachere, Kunz, & Levitt, 2004). Shortfalls of integration in the aspects of people, processes and technologies may have significant impacts on subsequent phases and the entire project throughout its development and use (Prins & Owen, 2010).

Trust has been conceptualised as both *behaviour* and a *belief* (Shoda, Mischel, & Wright, 1994), as a *driver* (Mesa, Molenaar, & Alarcón, 2016), or in a more nuanced manner, as an *affective state*, *cognition*, and *intended behaviour* (Cummings & Bromily, 1996). The latter defines trust as a belief that another participant or group (a) makes a good-faith effort to behave by any commitments, both explicit and implicit, (b) is honest in the negotiations preceding such commitments, and (c) does not take excessive advantage of another, even when the opportunity is available (p.303). Consequently, trust is found at the centre of a whole web of concepts, such as reliability, predictability, expectation, cooperation, and goodwill (Hawley, 2012).

In the design phase, keeping commitments and demonstrating collaboration are the typical actions expected from trust (Lau & Rowlinson, 2009). However, as projects are time-limited and the teams are comprised of different people each time, trust does not have the same environment to develop as in other industries. Trust in such an environment can be prescribed as 'swift trust', a form of trust that tends to develop in short-term professional collaboration (Meyerson, Weick, & Kramer, 1996). Swift trust is a form of trust with less emphasis on feelings and interpersonal relations and more on cognition and action (one 'knows' engineers in general and, therefore, trusts this engineer to behave according to that norm.). However, there are aspects of the design process that move beyond swift trust. Bond-Barnard, Fletcher, and Steyn (2018) showed that the level of trust between the participants is also influenced by expectations, the exchange of knowledge that takes place, and imported trust.

According to Oakland and Marosszeky (2017), trust is key to good teamwork as the participants are enabled to feel, accept, and discharge responsibility through the elimination of fear. Trust implies positive expectations towards the behaviour and intentions of others in situations with possibilities of negative outcomes. As such, trust represents vulnerability and risk as well as the possibility of substantial gain (Schiefloe, 2015). Henderson, Stackman, and Lindekilde (2016) stated that effective communication norms might help establish and maintain interpersonal trust amongst team participants. In this perspective, trust shares essential qualities with the concept of a 'temporarily shared social reality', denoting a space of implicit understanding, such as communication norms, and other cues to how the utterances of the other should be interpreted (Rommetveit, 1974). Lack of shared understanding can lead to misunderstandings, which might be interpreted as differences in interest and lack of will to acknowledge the other's perspective (Carlile, 2004). Such mistrust may cause participants to hesitate to initiate interactions, remain constantly 'on guard', and default to follow safe routines (Sztompka, 1999).

We have identified that trust is a prerequisite in all endeavours where there exists uncertainty (risk) and interdependency i.e. complex projects such as the realisation of a sustainable, high-performance building. Traditionally, this trust is attained and supported by contracts and used to limit opportunities and incentives for opportunism, and getting participants to behave in a trustworthy manner (Woolthuis, Hillebrand, & Nooteboom, 2005). But a collaborative project delivery method goes beyond using the contract as a safeguarding measure and instead emphasises the contracting participants to collaborate to achieve mutual benefits (Bresnen & Marshall, 2000a, 2000b). The proposition is that the trusting relationship between participants may lead to better performance for all parties (Anderson & Polkinghorn, 2011). One of the arguments is that collaborations can help reduce uncertainties and provide access to resources one might not otherwise be able to obtain (Doz & Hamel, 1998). Trust, again, is well-established as a prerequisite to elevating the collaboration, relationships, teamwork, commitment, and communication between the participants (Chan, Chan, & Ho, 2003a, 2003b; Eriksson, 2010). Furthermore, teams spend more time on joint problem solving the higher the level of trust placed upon them (Sako, 2006). Yet, change tend to be followed by resistance, especially when seeking to shift from an environment governed by contracts to an environment governed by the trust within what is often a risk-shedding and distrusting industry (Owen et al., 2010).

Hence, a knowledge gap arises in identifying key elements and their impact on building trust in a project using a collaborative project delivery method. Trust-building is in this paper viewed as contractual, organisational, and cultural elements (mechanisms) used as a framework or an environment in which trust can develop. We will investigate how this development is promoted in practice and illustrate the impact in a specific case project.

Methodology

Research design

The empirical research is limited to a single case, the ZEB-Flexible Lab that is intended to be Norway's (Trondheim) most advanced sustainable high-performance building. The case is studied longitudinally through *stage one* of a *two-stage* process. Stage one included the concept developmental, which hereafter is referred to as the design phase. The contractor's team was paid by the number of spent hours. If stage one was successful, the client and contractor had the option – but not the obligation – to enter a Design-Build contract for the detailed design- and execution phase.

A qualitative orientation was chosen as it was deemed suitable for researching the 'what', 'how', and 'why', related to the phenomena of project delivery methods and trust (Yin, 2014). Trust is an abstract phenomenon, as it is both dynamic and has a wide array of nuances. In the context of projects, trust is important because projects include risks and dependencies (*no risk or dependencies, no need for trust*). Thus, trust (*or mistrust*) is something that is developed dynamically in a construction project and occurs because of human interactions over time. The best way to study human interactions and behaviour is by observing them in their 'natural habitat'. Therefore, the researcher observed so-called Big-Room sessions throughout the period from April until December. This period consisted of concept development, concept processing, optimising and design. The process ended with the project team handing a coherent concept over to the client, including a schematic design and specifications that should be followed. Then, the client had the option to contract the project team for the detailed design and construction. Conducting observations during this period gave depth and insights into this process that would be hard to capture through any other research method.

A literature review was conducted to create a theoretical anchoring between the management literature on project delivery methods and trust as a sought-after quality in collaborative project delivery. A knowledge gap was identified regarding how contractual- and organisational elements (hard elements) and cultural elements (soft) impacted trust and collaboration in the delivery process of the construction project.

Data collection and analysis

The data collection is based on (1) observations of the weekly Big-Room sessions. The data were supplemented with (2) a document study that included full access to project files, and (3) a survey was conducted in October 2018.

Primary data: observations

As we had access to a suitable project and resources to follow the process throughout, an observational study was an appropriate choice. The main author took the role of a non-participant, often referred to as a 'participant-as-observer' (Saunders, Lewis, & Thornhill, 2016). The topic and the purpose of the observations was revealed to the observed group in the first session. The observation method proved to be convenient for assessing whether the team developed and maintained trust and what elements contributed. Instead of asking the participants ad hoc, the researcher could observe the team development unfolding from week to week by listening and watching their experiences and actions.

This research mainly concerned the participant observation approach that emphasised discovering the meaning that people attach to their actions (Saunders et al., 2016). However, elements of a structured approach were also used to some extent. For example, the number of times the participants unnecessarily used their electronic devices were noted. In this case, 'unnecessary' means that it was noted when participants used devices in parts of the sessions where no devices were allowed according to the group agreement signed by the participants.

In total, the main author attended 16 full-day sessions, approaching approximately 80 h of observation and more than 175 pages of notes. The sessions were held every Tuesday, lasted the entire workday, and included both plenary sessions and thematic meetings. The physical location (referred to as the *Big-Room*) was a classroom furnished with desks located in a horseshoe around two SMART boards. As the observations were made over several months, the researcher gradually became more familiar with the setting. This familiarity gave depth to the observations, and the interpretations were transformed in a hermeneutical process, moving from pre-understanding, via observation and interpretation, to a new understanding, which again forms the starting point for the next observation and interpretation (Ulin, 2001).

To collect data from the observations, note-taking was selected as the preferred method (Bryman, 2015). This approach took the form of a researcher-diary, in which events, statements, and actions were documented. One could say the notetaking was descriptive, and mainly concerned describing the physical location, primary activities, and the process flow (the sequence of events). Additionally, to transform the raw observations into useful data reflection-notes and memos were written after every session (Fyhn, 2017). With some distance from the events, but while still having the impressions fresh in mind, the main author examined the notes and considered several interpretations of certain key incidents. These were more-or-less unstructured but aimed at capturing the general impression of the sessions and interpretations of key-incidents.

As for the analysis, the most prominent contractual, cultural, and organisational elements present in the project were analysed according to factors known to build trust. These factors, adopted from Khalfan et al. (2007), were as follows: experiences (How the group interacted), problem-solving (How the group approached and handled problems), shared goals (How the group understood their roles and the aims of the project), reciprocity (How the group supported and rewarded trusting behaviour), and reasonable behaviour (How the group behaved towards each other).

Secondary data: document study

A document study is a systematic procedure for reviewing or evaluating documents (Bowen, 2009). Secondary data in the form of documents were primarily used to provide context to the research and to verify findings from other sources. Through access to the project's web-hotel, a substantial record of written documents were made available. The documents scrutinised ranged from contracts, work descriptions, and meeting summaries, to written communications between the participants (such as e-mails). The documents were not analysed to generate data for the research, but they proved to be necessary tools for the researcher to understand the data collected from the observations. For example, these documents provided explanations for why and how the project team choose to organise the design session, provided the agenda for each session, and gave the researcher insight into how the project continuously evolved.

Supplementary data: questionnaire

Everything observed, regardless of familiarity, is open to more than one interpretation, but the repeated observations allowed the researcher to develop relevant and representative interpretations, as described by Gadamer (1960). To strengthen the study in this regard, the main author collected additional information through a survey as well as meeting-summaries and the contract documents to verify, modify or dismiss certain interpretations according to the recommendations of Saunders et al. (2016). Therefore, in the final session, a survey was distributed. The survey consisted of two parts. The first part asked the participants to select partnering elements from a defined list that they had experienced during the planning process. The second part asked the participants to rank the three most important elements for building trust. The purpose was to explore the attending participants' awareness, or knowledge, about contractual elements and their effect on trust (Fellows, Fellows, & Liu, 2015). Thus, these data were used to crosscheck the observational data collected throughout the process.

Findings

The client acknowledged that they needed a collaborative project delivery method as they assumed trust may lead to better collaboration and performance. After the tendering-process, the client commenced work with a contractor-led project team on a 'fee-for-service' basis for the period up to concept approval. The team involved in the ZEB-Flexible Lab project was observed from the start, i.e. from the concept development phase, through the phase of optimising the concept, until the concept was sufficiently developed so the contractor and client could sign a design-build contract for the execution. The project team included the main contractor, the architect, the sub-contractors, and the engineers, i.e. all participants bound to the main contractor through contracts. The participants are the individuals in the project team representing the different actors. The client is the organisation that had a single contract with the main contractor. Thus, client participants are individuals from the client.

The key elements for building trust in this project

While not being able to foresee how elements in the project delivery method directly affected trust, they recognised that a set of elements combined could provide the necessary trust to meet their high expectations. The first thing done in the project after signing the contract was to arrange a two-day start-up seminar. Using a start-up seminar to kick-off the project proved to be a key element for establishing a relationship between the participants. After the start-up seminar, the team met regularly using integrated concurrent engineering, often referred to as Big-Room sessions by practitioners. It meant that the project team met every Tuesday from 08.30 to around 14.00 for full-day sessions during the whole design phase. The sessions followed a standardised set-up, starting with the design manager going through the agenda, proceeded by a 'round around the table'. Then the tasks from the previous week were followed-up before the client had its 'client's quarter'. Then the team dispensed into smaller working groups (*Thematic meetings*). At mid-day, the participants ate lunch together before finishing the day with a summary meeting where they defined the tasks for the next week.

Figure 1 shows the seating pattern that emerged during the design stage. Even though project participants sometimes varied their positioning, the trend was evident. The engineers often sat at the right-hand side, sometimes joined by one or two brave individuals from the client. The contractor occupied the left-hand side, while the architects often positioned themselves between the contractor and the client. The client sat in the middle. The participants involved were as follows, from the upper

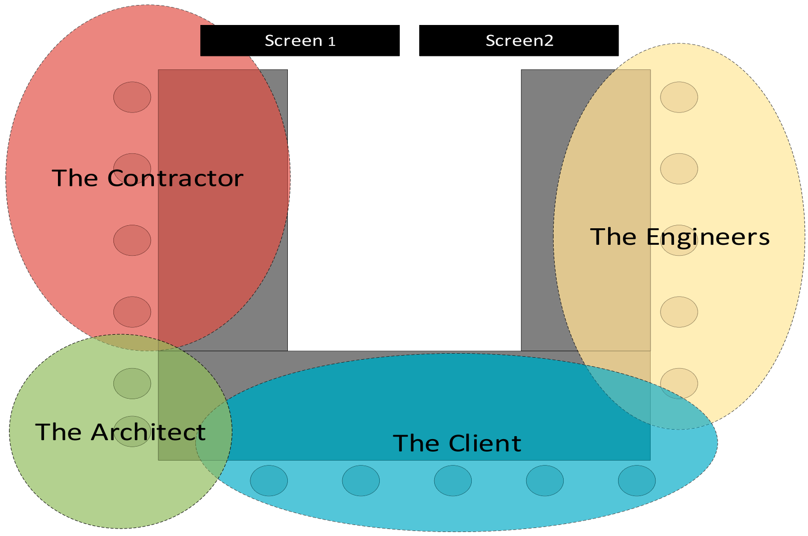

Figure 1. Seating pattern in the Big-Room.

left of Figure 1: the design manager (contractor), project manager (contractor), BIM-coordinator (contractor), project developer (contractor), architect, architect assistant (architect), project manager (client), building physics expert (client), laboratory design expert (client), sustainability expert (client), ventilation expert (client), engineer (structural), engineer (HVAC), engineer (electricity), engineer (automation), and the Integrated Technical Building (ITB)-coordinator.

Integrated concurrent engineering should help facilitate the creation of a high-performing team as it co-locates and 'forces' the participants to interact on more-or-less defined tasks. The co-location is often a pre-requisite, while the specific methods and technologies used in the sessions vary. The observations of seating indicate how the participants more-or-less unconsciously sought like-minded people. For example, even though they came from different organisations, the engineers shared similarities in terms of background, education, roles, and professional language. Such similarities might explain the observed seating in groups (see Figure 1).

The size of the project team seems to influence the participant's confidence and engagement. The observations showed that some were more inclined to raise their voices, give suggestions, criticise, and interact while others avoided weighing in on discussions in front of the whole team. This was most prominent in the plenary part as these participants tended to be more engaged in the smaller thematic meetings. Other signs of detachment such as arriving late, using phones, or the computer was also noted. There was a tendency that those showed such signs was also those who struggled the most reconcile with this way of working. It was also observed that not all participants integrated easily into the team. For example, one participant was removed as the participant did not seem to fully comprehend the project and displayed a lack of willingness to participate in the shared problem-solving. The behaviour may be attributed to a lack of trust in the competence of the rest of the project team (he was a senior-staff worker from the client).

In the last Big-Room session, the 11 attendees were asked which contractual elements that they perceived to be the most prominent for building and maintaining trust in the process they had been through. Table 1 shows the trust-building elements according to the project team.

The following three elements did not exist in the main contract: 'Inclusion of architect in the contract', 'Inclusion of sub-contractors in the contract' and 'Inclusion of consultant in the contract'. The formal contractual arrangement is only between the main contractor and the client. The main contractor then manages the individual contracts with the remaining participants. Related to the concept of trust, it is of interest that the participants felt included without being part of the formal agreement

Table 1. Trust building elements according to the project participants.

#	Elements perceived by the project team	Mentioned ($n = 11$)	Comment
1	Integrated Concurrent Engineering	11	
2	Inclusion of architect in the contract	11	Not 'technically' true, perceived to be the case
3	The use of BIM	11	
4	Start-up seminar	10	
5	Co-location of the group	10	
6	Early involvement of contractors	10	
7	Inclusion of sub-contractor in the contract	10	Not 'technically' true, perceived to be the case
8	Inclusion of consultant in the contract	10	Not 'technically' true, perceived to be the case

between the contractor and client (which also included a pain/gain mechanism). An explanation may be that trustworthy management enhanced the feeling of inclusion for all participants regardless of the formal agreement. The 11 participants were also asked about prominent cultural elements: Openness, communication, mutual understanding, ownership, clear deadlines for deliveries, knowledge about everybody in the team, emphasis on building relationships, time in 'shared' actions, shared objectives, collaborative working – with challenges, enthusiasm, creativity, and face-to-face meetings were all mentioned as important for the process.

Key elements' impact on the trust-building in this project

Start-up seminar: The arrangement of a two-day start-up seminar to kick-off the project provided an area for getting to know each other, and it was used to establish the initial partnership between the client and the project team. Contracting the contractor-led project team on their competence and ability to deliver has also proven decisive. Using team-composition as an evaluation criterion is a way of ensuring the right team composition.

Integrated Concurrent Engineering: Inter-organisational collaboration over a substantial time-period may be constrained by intra-organisational commitments such as being assigned to different projects simultaneously. As expected, some participants were not able to commit to seeing the project through and replacements within the team were observed. For example, the ITB-coordinator was replaced due to parental leave, and the new ITB-coordinator was not able to integrate well into the project group. Another observed difficulty was when the system-integrator engineer had difficulties communicating the technical aspects surrounding his field in a language the rest could grasp. The consequence is that the client failed to recognise the value of the solutions provided and it strained the common language within the team. Eventually, the client initiated a string of one-to-one meetings which solved the situation.

Shared interests: Unlike in traditional design, one of the premises set by the client was that the project participants should seek solutions going beyond pre-accepted technical solutions and the client trusted the team's ability to do so. However, during the initial stages, it was observed some hesitance from the participants as this deviated from contemporary industry practice. The client expressed frustration over the participants' missing willingness to do just so. Eventually, due to continuous interactions through the integrated concurrent engineering sessions, the team started to move beyond proven trade standards. For example, when deciding on the preferred HVAC-concept, the project team was willing to take risks concerning design solutions, project scope, and budget, at a level not typical for such processes.

It was also observed that the participants were also reasonably fair towards each other when expectations were not met (for example when prerequisite tasks before Big-Room sessions were not finished). The most challenging interface was between the architect and the contractor, as the contractor often had to scrap suggestions due to costs (the architect felt they were being dragged from pillar to post). Such straining iterations might inhibit trust, but the architect acknowledged the commercial realities and the contractor-client, on the other hand, went out of their way to give the architect other means of expression.

Support from management: The design manager primarily facilitated a structured and standardised process on behalf of the management. The temporary organisation had a design manager, a project manager from the contractor, and a project manager from the client. The client project manager acted as the intermediary between the project and the client organisation, the project manager from the contractor had the overall responsibility for the supply chain, and the design manager had the responsibility for the technical coordination. However, being accustomed to a hierarchical decision-making structure, it was observed that the participant, at least initially, struggled to habituate this reality. It may be ascribed to mixed signals from the management. For example, while the design manager might be described as having a supportive leadership style, others used authority and enjoyed a charisma that enabled the occupation of space and attention when needed.

The participant with charisma was concerned about costs and always encouraged the project group to think in terms of cost–benefit and progress and interactions tended to be interpreted as direct orders instead of discussable tasks. A concrete example was one time the team was urged, from then, to prioritise the CO2-budget (client goal) and workhours in production (contractor goal). It was stressed that all participants had to think twice before suggesting changes, as all changes at that point delay progress. While nobody contradicted at the time, one participant eventually spoke up in the following thematic meeting. This resulted in a discussion where this participant stated that the priority of just CO2-budget and workhours would impair the building's flexibility (also a core-ambition of the client). The participant showed an understanding of the shared goal of the project and dared to speak up for the best of the project. The incident marks that point where trust had risen to such levels that the team started to act as a well-integrated team.

Discussion

We used the elements of a project delivery method to explain how trust has been developed and maintained by highlighting key elements perceived to be important for trust. Trust is not easily measured but is easily observed when it is lacking because then it materialises in how participants communicate, act, and collaborate. In such instances, the participants will seek to transfer risk and operate with secret agendas instead of working with shared interests in mind. Such behaviour was not observed, but secret agendas are – as the word implies – difficult to observe. Interestingly, this reveals a methodical limitation when using observations as data collection. Reliability and validity are first built when observing over an extensive period.

The key elements for building trust in the delivery of a high-performance building

A Start-up seminar may at first glance seem like a trivial, even time-wasting, activity. However, as described by Kadefors (2004), team-building in the early phases have a positive influence on behaviour and project knowledge. The team composition is, as argued, important for such projects as all involved individuals will be working together for a substantial period solving a complex task. The client must have professional trust in the competence of the project team to benefit from their greater expertise (Frowe, 2005). This is the trust that those not professional in a domain projecting onto those who are. In other words, the client must be confident that the project team has the proper technical skills to solve the given tasks, resembling what Meyerson et al. (1996) called 'swift trust', which tends to develop in these short-term professional collaborations. A weakness addressed is that only formal attributes are weighted, and relational attributes such as teamwork and collaborative skills not (*maybe because they are elusive and hard to assess*). For example, an engineer with a bachelor's degree and excellent teamwork skills can outperform an engineer with a master's degree that lacks the latter. As such, having a highly educated team does not automatically mean that the team will perform well, especially not if the participants cannot collaborate or are not given the right *modus operandi*.

The right *modus operandi* is achieved when the client is integrated with the contractor-led team. Therefore, the contractor-led team must be compatible with the client participants. In this case, the outcome was a highly motivated, competent, and committed team with self-reinforcing trusting behaviour as the participants behaved reasonably towards each other. This materialised during design iterations when the participants were willing to take on more risks regarding their delivery, because it served for the best of the project. These actions could affect their work negatively by, for example, making their work in the execution phase more complex or involving implementing technical solutions not currently described in technical standards. This is, as Schiefloe (2015) described, trust manifested as positive expectations towards the behaviour and intentions of others in situations difficult to control and with possibilities of negative outcomes, but with the possibility of substantial gain for the team as a whole.

Integrated Concurrent Engineering enabled a trusting environment in which the participants expected positive behaviours from the others. The participants behaved as an integrated project team with little emphasis on their organisational belonging (i.e. barriers to building trust). This finding is supported by for example den Otter and Emmitt (2008), who state that such integration enables understanding, stimulates the sharing of knowledge, and encourages team building. Integrated concurrent engineering resulted in an environment that enabled the participants to work with a holistic point-of-view on the project objectives.

Key cultural elements for building trust were shared interest and support from management. We emphasise the cultural aspects of management support (leadership, attitudes, human relations, etc.), but acknowledge its organisational aspects (roles, access to resources, etc.). When it comes to the cultural aspects, each participant received the power to make decisions within his or her assigned role. This enabled a form of – formal and informal – interactions to unfold that made the participants from the client and the project team trust each other. Within the project, the participants enjoyed autonomy to make decisions and engage in problem-solving without having a confer with their respective organisations. As the participants became more familiar with each other and more experienced, this way of working became self-reinforcing, corresponding well with Carlile (2004) statements that trust demands shared understanding, and shared understanding demands trust.

Therefore, the key elements building trust in this project has been recognised to be the use of a start-up seminar and an emphasis on team composition. The client established a small team, where the participants were integrated using integrated concurrent engineering. Lastly, the cultural elements shared interest and support from management were important to build trust. All things considered, the findings suggest that a combination of contractual-, organisational- and cultural elements are intertwined with the development of trust.

The key elements' impact on trust in the delivery of a high-performance building

In the following, the key contractual, organisational and cultural elements' effect on trust in the delivery of high-performance buildings is analysed in the light of factors known to build trust, adopted from Khalfan et al. (2007). Table 2 shows how the key elements contributed to developing and maintaining trust through the ups-and-downs in the design phase through:

Table 2. The key trust-building elements' coupled with factors known to build trust according to Khalfan et al. (2007).

Factors known to build trust	Integrated Concurrent Engineering	Team composition	Shared Interest	Support from Management	Start-Up Seminar
Experience	✓				✓
Problem solving	✓	✓	✓	✓	
Shared goals	✓	✓	✓	✓	✓
Reciprocity	✓	✓	✓	✓	
Reasonable behaviour	✓	✓	✓	✓	✓

- how the group interacted (experiences),
- how the group approached and handled problems (problem-solving),
- how the group understood their roles and the aims of the project (shared goals),
- how the group supported and rewarded trusting behaviour (reciprocity), and
- how the group behaved towards each other (reasonable behaviour).

The use of Integrated concurrent engineering enabled the participants to take a more holistic point-of-view of the project. The element encourages face-to-face relationships and interaction and improves the communication process (Love et al., 1998). The project participants were all highly specialised experts put in an unfamiliar environment and the sitting pattern illustrated in Figure 1 may, thus, be attributed to already established organisational relations, and what Rommetveit (1974) named a 'temporarily shared social reality' such as communication norms surrounding particular professions. Initially, the participants spoke different professional languages, but over time the team showed a collaborative effort towards being patient, trusting, and respecting each other's contribution. As seen with the automation engineer, some had challenges with understanding 'for the best of the project' thinking and struggled with communicating in a language understood by all participants. Instead of inaugurating conflict, the other participants showed reciprocity by being patient and cooperative until the participant was on board with the rest of the team's mindset. Eventually, they came across as a team that communicated effectively across disciplines as they participated in joint problem-solving beyond expectations.

Foremost, the participants were able to build and maintain trust because they were given time to work together. This is important in all settings, as some adapt quickly and others not. By working for a full day on a week-to-week basis, they established shared experiences as well as a commitment. The strength of shared problem-solving was evident as challenges that normally could have taken weeks (often through lengthy email conversations) was solved challenges on-the-go. The participants experienced progression during the process as they supported and rewarded each other for showing trusting behaviour. The aphorism 'a rising tide lifts all boats' describes this observation well, as the Big-Room sessions benefitted all participants. This was particularly evident through how ideas flowed freely as everyone both were encouraged and eventually felt free to weigh in on matters presented. In a distrusting environment, the participants would have been reluctant to comment or discuss subjects outside his primary sphere of competence.

Shared interest facilitated shared experiences, problem-solving, and reasonable behaviour among all involved and, thus, a coordinated effort toward common goals. It is both a condition and understanding by all that the behaviour, actions, and intentions of others are conducted with gain for the team in mind. Complex projects are prone to design errors and delays and the actors responsible are conditioned to 'playing it safe' by using pre-accepted technical solutions following proven trade standards. The motivation for the client to implement Integrated concurrent engineering was, thus, to be able to work collaboratively with the team, providing them with incentives to push beyond. Open communication enhanced collaboration. Hence, a trusting environment was generated as the team did not hesitate to initiate interactions, which can happen in projects with mistrust (Sztompka, 1999). By going beyond proven trade standards, the participants took risks perceived to be against the risk-averse policies they usually operate within.

Support from management. In a traditional design phase, participants encounter each other infrequently, which is a barrier to build trust. To start with, the participants struggled to familiarise themselves with a less hierarchical decision-making structure. It might have been because the management structure was unclear as managers from different organisations were present. As participants became accustomed to the new way of working, the interactions started to resemble that expected of an intra-organisational team. Working in the integrated concurrent engineering set-up was less hierarchical and the participants were given the freedom and decision power within their

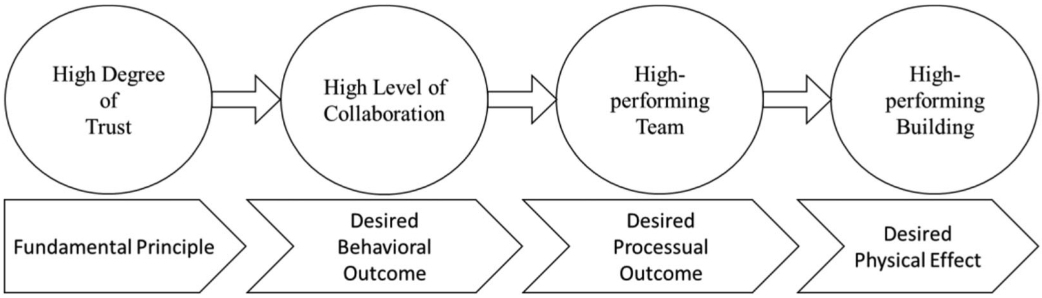

Figure 2. Trust in the context of delivering high-performance buildings.

sphere of competence. This implies that management should facilitate the feeling of being *one* organisation to build trust.

The case project offers advice on how to develop and maintain trust within temporary teams. As argued by Khalfan et al. (2007), trust is built when participants solve problems together, rather than referring to their superiors or the contract. High-performing buildings – such as the case project – are optimised beyond the typical cost, schedule, and quality parameters, which makes them complex. Such projects are risky endeavours and involve specialists whose performance depends upon each other. Therefore, trust is important when delivering sustainable, high-performing buildings. Trust facilitates the desired collaboration needed for designing a sustainable, high-performing building. Figure 2 conceptualises that trust is needed when delivering high-performing buildings.

Conclusion

Using the construction of an advanced sustainable high-performance building, this study improves the understanding of the relationship between trust and project delivery methods by exploring (1) key elements used for building trust and (2) how they impacted the development of trust. The five key elements for building trust were start-up seminar, team composition, integrated concurrent engineering, shared interest, and support from management. They impacted the development of trust through their ability to form experiences, joint problem-solving, shared goals, reciprocity, and reasonable behaviour within the team, which are trust-building factors outlined by Khalfan et al. (2007).

We propose that trust reduces the risk for all parties involved, as it moves the attention away from adversarial behaviour and contractual safeguarding towards problem-solving with mutually beneficial outcomes for all involved. Useful insights into elements to employ to build trust are:

- A start-up seminar is a vital first step towards creating shared experiences and definitions of common goals – which are essential for establishing trust and team composition impacted problem-solving, shared goals, reciprocity, and reasonable behaviour. For that matter, other contractual elements as well should integrate the client in the contractor-led team and ensure that individuals with the necessary authorisation are dedicated to the project.
- Integrated concurrent engineering provides a less hierarchical way of working and imposes freedom and decision power to those who possess insight and competence. This element impacted experience, problem-solving, shared goals, reciprocity, and reasonable behaviour and was integral for how the group interacted, handled problems, understood their roles and the aims of the project, rewarded and supported trusting behaviour, and behaved reasonably towards each other.
- Support from management (Impacted problem solving, goals, reciprocity, and reasonable behaviour) was also crucial, and the managers understood that their role went beyond facilitating the

process. Support from management is key to trust as it promotes autonomy to handle and make independent decisions. This enabled participants to proportionally commit to shared problem-solving and to cooperate as a team, both formally and informally.
- Shared interests are possibly the most important trust factor at such a stage. Continuous interactions coupled with a team that has realised that they are bound together through shared interests may prove to be a powerful force driving the establishment and maintenance of trust (Impacted problem-solving, goals, reciprocity, and reasonable behaviour).

Our findings have some implications for practitioners involved in the delivery of sustainable high-performance buildings. First, delivering a complex project requires all actors to trust each other as the process is characterised by uncertainty and interdependence. Therefore, the relationship between the client and the supplier should be arranged through acquiring the delivery team on a basis than other than price (team composition) and the trust-building should start immediately after contract-signing using team-building activities such as a start-up seminar. Second, the process should be arranged in an environment that resembled that of a unified organisation (using an element such as integrated concurrent engineering). Finally, building trust through support from management and shared interests may benefit as knowing that the other actors are acting in your – and the project's – best interests free up time, capacity, and resources to do what matters – value creation.

The study is limited to a single case study of the design phase of a construction project with a collaborative project delivery method. Thus, the results are limited to *observations* of *how* key elements *affect* trust-building in this project. To increase the scientific and practical understanding of how to build trust, more research regarding contractual, cultural, and organisational elements in collaborative project delivery methods is encouraged. Furthermore, the established conceptual cause–effect relationship between high-performing teams and high-performance buildings needs empirical research.

Disclosure statement

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