

# IMPROVING DESIGN MANAGEMENT WITH MUTUAL ASSESSMENT

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## ABSTRACT

The Architecture, Engineering and Construction (AEC) industry recognizes the understanding of the design process as a key to successful projects. With the background of Lean Construction efforts such as the Last Planner, Collaborative Planning in Design etc. the planning of the design process has improved significantly. A key part of Lean Construction is to involve the team in the planning and use metrics to check the results. Metrics and measurements in the AEC industry have traditionally focused on the performance of the project and not so much on the interpersonal relations of in the design team itself.

In this paper, we elaborate on how the Mutual Assessment (MA) can help to improve the design process, by aligning the MA with experience and current relevant literature.

Mutual Assessment (MA) is an approach for continuous improvement of the design team in a pre-planned setting. MA was developed by a Scandinavian contractor in order to improve client satisfaction. Through the use of a survey the design team evaluate each other, creating a common understanding of needed improvements. MA gives all major participants a chance to systematically assess the team, and creates room for dialogue and improvement. Improving the design teams helps align design and construction, and thereby to achieve success.

The methodical approach of the research is a single case study, based on studied documents and semi-structured interviews with a large Scandinavian contractor. In addition, a literature review of metrics, design management and teams was carried out. The research is a qualitative study focusing on MA as an important tool for continuous improvement of the design team.

The experiences from the case show that MA is an easy and accessible method to systematically improve the design team thus improving the design management process.

## KEYWORDS

Lean construction, continuous improvement, collaboration, mutual assessment

## INTRODUCTION

The Architectural Engineering and Construction (AEC) has a potential to increase its productivity and to increase the value of its projects (Bråthen, 2015; El. Reifi &

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Emmitt, 2013; Mejlænder-Larsen, 2015). The industry recognizes the understanding of the design process as a key to successful projects (Aquino & Melhado, 2002). With the background of Lean Construction efforts such as the Last Planner, Collaborative Planning in Design etc. the planning of the design process has improved significantly (Fundli & Drevland, 2014; Hamzeh et al., 2009). A key part of Lean Construction is to involve the team in the planning and use metrics to check the results. Metrics and measurements in the AEC industry have traditionally focused on the performance of the project and not so much on the interpersonal relations of the design team itself.

The design team or the people doing the design are important for the result. Dainty et al. (2007) points out the industry's ability to improve are limited by how the people are managed. "Buildings require the combined efforts of many individuals, working and designing collaboratively to provide value to their clients" (Emmitt & Ruikar, 2013). Boyle (2003) states that a key factor for achieving success in AEC projects is directly linked with the personnel involved, i.e. the team.

Mutual Assessment (MA) is an approach for continuous improvement of the design team in a pre-planned setting. MA is an experience-based approach developed by a Scandinavian Contractor in order to increase the client satisfaction in projects. Through the use of a survey the design team evaluate each other, creating a common understanding of what issues that needs to be improved. MA gives all major participants a chance to assess the team in a systematic manor, creating a room for dialogue and improvement. Improving the design teams helps to close the gap of misalignment between design and construction, and helps to achieve success.

The Lean Project Delivery System (LPDS) have implemented a learning loop that runs thru all the phases of a building project, from start to finish and back to start again on a new project. This implicates that there is a need for a planned learning thru the whole lifecycle of a building project. The authors did not find a consistent description of how this is executed, but we believe that MA could contribute to this.

In this paper, we elaborate on how Mutual Assessment (MA) can help to improve the design process, by aligning MA with experience and current relevant literature.

The paper is organized by first presenting a relevant theoretical framework, then in the findings chapter presenting how MA is carried out, and at last a discussion and conclusion chapter linking MA to the theoretical framework.

## **METHODS**

The method of this research has the approach of a qualitative case study. A case study does not need to control behavioural events and the focus is on contemporary events (Yin, 2014). The research consisted of a review of relevant literature linked to the main parts of MA, based on the recommendations of Creswell (2003). The literature is presented in the theoretical framework chapter and its link to MA is presented in the discussion and conclusion chapter. The literature on MA seemed to be quite limited, so the authors selected to expand the scope to also include for example Balanced Scorecard and Lean Project Delivery System. The case studied is from a Scandinavian contractor chosen of their experience with MA. The study consisted of two open-ended interviews and a document study concentrating on internal descriptions of MA.

## **THEORETICAL FRAMEWORK**

Success can be defined in many contexts but Oxford dictionary of English simply states, “Success is the accomplishment of an aim or purpose” and failure as “lack of success”. Samset (2010) states “Projects are initiated to solve problems or satisfy needs”. Thus we can assume that a project success is actually connected to its ability to solve those problems or needs. From the same definition it is apparent that we need an aim or purpose to be successful, i.e. we need a goal. So how do we know that we have reached our goal? We need a way to assess that the goals are achieved. The next question is of course when do we assess? The time of the assessment is linked to the goal we have set. If a goal is linked to the total time or economy of a project, a post-project evaluation is ok (Samset, 2010). On the other hand if you want to assess goals concerning the process of the project then an interim evaluation is more suitable. The timing of the assessment is closely linked to the learning potential, if you want to change the process then the assessment must be made so its possible to try out the changes. Jerrard and Hands (2008) point out problems in trying to create design audits vs. traditional metrics. The design audits should consist of both quantitative and qualitative data, and view both social and economic measures, while traditional project metrics consist of quantitative economic measures.

Even though a failure can be explained as the lack of success Meland (2000) points out important failure predictors in the design process of AEC projects. Important predictors were lack of support from the client, but also design manager’s lack of managerial skills, especially regarding communication, goal setting and planning.

The learning potential of the AEC industry has been debated by several authors and also in the Lean community (e.g. (Christensen & Christensen, 2010; Lantelme & Formoso, 2000; Skinnarland & Yndesdal, 2014). Learning barriers has been mentioned as a challenge for change. Skinnarland and Yndesdal (2014) points out problems with unlearning, organizational structures and norms as barriers of learning. Christensen and Christensen (2010) raise the question of the difficulties of learning because of syntax, semantics and motivation between the trades in AEC projects. Addressing these barriers is important to achieve learning and improvement of the industry.

The AEC industry is a fragmented industry relying on many different actors from the start to finish of the project, creating challenges with communication and teamwork within the AEC projects (Kerosuo, 2015). Bølviken (2012) characterizes the industry’s production as a project production of unique products and temporary organizations. “Temporary teams function under constraints off high uncertainty and interdependence during a limited time. The functionality of the teams is dependent on their members’ sets of diversely skills and knowledge sets”(Kerosuo, 2015). Emmitt and Ruikar (2013) states “Building design is rarely the product of one persons thinking process; rather it is the result of many different disciplines collective knowledge.” The performance of the design team is thus dependent on the group members’ skills and knowledge, and their ability to work as a team. Svalestuen et al. (2015) list 12 key elements that influence the performance of a building design team. As table 1 shows, the survey indicates that trust between team members and commitment to the project is the most important element for an effective team. However, a team is not build on trust and commitment alone. The other elements are also important in order to create an efficient building design team. Having a team building exercise is important in the design phase were team members are unfamiliar with each other, and even a short exercise to commit

them to the goal is always a good investment. Furthermore, focus on team development throughout the process is important as it takes time to form a team (Svalestuen et al., 2015).

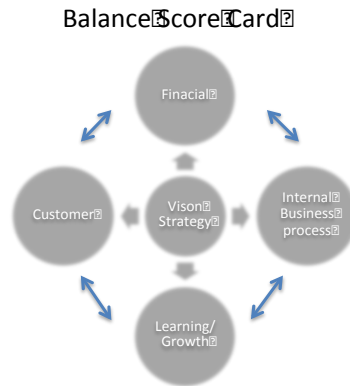
*Table 1: Key elements of a good design team (Svalestuen et. al., 2015)*

<b>Elements</b>	<b>Average score</b>	<b>Short explanation</b>
Trust between the team members	1.34	Honesty, transparency, consistency and respect
Commitment to the project	1.34	Involving team members in planning
Involvement in the goal setting process	1.56	Commits the members to the goal
Good collaboration between all project leaders	1.56	Increase collaboration in the whole project
Cohesion	1.72	Commitment to the team
Contract models	1.78	Needs to encourage collaboration
Elite feeling	1.88	Create a unique and challenging project
Team building	1.94	Getting to know each other and the project
Former relation between team members	2.03	Speed up the team building process
Identifying the design team members' roles	2.06	Team composition
Focus on team development	2.22	Takes time and effort to form a team
How difficult the goal is to reach	2.66	Effects the elite feeling

Managing the design process is challenging due to the nature of design (Knotten et al., 2015). The design management can be divided in two parts, the management of the process and leading the design. The management is trying to keep the process on time, at budget and with the right quality. The design leader is trying to get the most of knowledge and creativity of the team. The high flow of information, and the need of decisions call for a strong collaborative environment. There have been some efforts to describe ways of collaborative design management (e.g. (Emmitt & Ruikar, 2013; Fundli & Drevland, 2014)). Fundli and Drevland (2014) highlighted the importance of a start-up meeting in the project. A start-up meeting with the project team had positive effect on cooperation, communication and commitment of the team members.

The Balanced Scorecard (BSC) is a common method to align strategic, operational and tactical goals. “The BSC should translate a business units mission strategy into tangible objectives and measures” (Kaplan & Norton, 1996). There are four focus areas in the BSC approach, the financial focus, the customer focus, the internal business processes focus and the learning and growth focus. “The measures are balanced between the outcome measures – the results from past efforts and the measures that drive future performance”(Kaplan & Norton, 1996). The BSC looks at measurements of what has been e.g cost, time, but also at what to come. It also balances between external and internal focus (see Figure 1). The BSC can also be use to set the strategic goals. The focus here is; Clarifying and translating the vision and strategy. Next is

communicating and linking these. After that planning and setting the targets, and finally giving strategic feedback and learning.



*Figure 7: Balanced Score Card*

Construction industry has developed a large number of KPI's (Key performance indicators) and despite the claims about their usefulness they received a fair amount of criticism from many researcher (e.g.(Beatham et al., 2004; El-Mashaleh et al., 2007)). The KPI's are designed not to give insight into the means of improving performance and therefore have limited use for internal management decision-making (Bassioni et al., 2004). KPI's are `lagging` measures (Haponava & Al-Jibouri, 2012). They are used for review purposes after a completion of the project and do not provide the opportunity during the project development and execution stages.

## **FINDINGS**

When introducing Mutual Assessment (MA), the contractor primarily aimed to increase the client satisfaction of projects by addressing issues raised by the client (and others) during the project instead of post project evaluations. This works because if the client does not raise any issues during the project, how can the client then raise issues at the end of the project. Hereby, the contractor can avoid client dissatisfaction.

MA consists of two major parts, the planning of MA and the execution of MA. The planning of MA needs a consensus from the team members and the client to use this method. The planning is done collaborative in a start up session. In the planning one needs to agree on the use of metrics, how often to asses, who will evaluate on behalf of who, and of course to agree on the common goals of the project. The start-up session has many agendas to cover, but in regard of MA the most important is to agree on when the team wants to carry out an assessment session, who will answer on behalf of who, and agree and what goals are important for our project. The start-up session has two outputs, an assessment plan and the assessment goals. (See Figure 2)

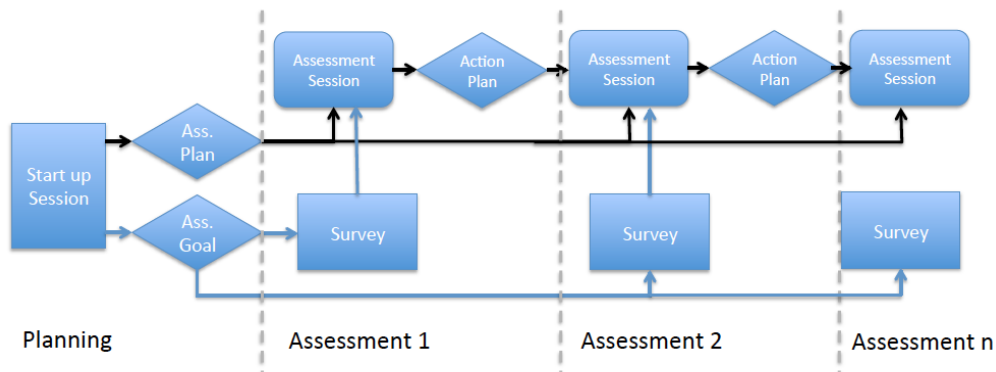


Figure 8: Mutual assessment

The assessment plan consists of two major parts. The first part is to decide who of the team is answering and participating in the survey and the second part is to plan when the assessments should take place. One of the key points of MA is that all of the main parties are to be heard in the assessments. There will of course be a limitation to how many of the involved parties (consultants, suppliers, sub-contractors etc.) should be included, but a rule of thumb here could be to ask yourself how dependent you are of these parties. If a party could be the success or failure of the project, then they should be involved. Together the project should agree on who are the parties to assess each other and who of the projects members should the represent their party. For instance this could mean that the main contractor would point out who of his team would assess the other. The same would apply for the client, architect and the other consultants. A key here is to make a representative voice. For the purpose of not letting the project history cloud the teamwork, it is important that the facilitator of the MA- process have no direct connection to the project. The facilitator leads the start-up session and runs the assessments sessions.

The second part of the assessment plan is to decide when the assessments should take place. Consequently, creating fixed interval between each assessments and assuring that the team members actually reserve time in their busy schedule to improve during the process. This could be a milestone or just fixed intervals in the design phases.

*Figure 9* shows an example of a plan for a project. The red lines show the planned assessments sessions. The sessions are placed so the team can benefit from the session and prepare for the next phase. The number of assessment sessions will vary according to what is decided in the assessment plan.

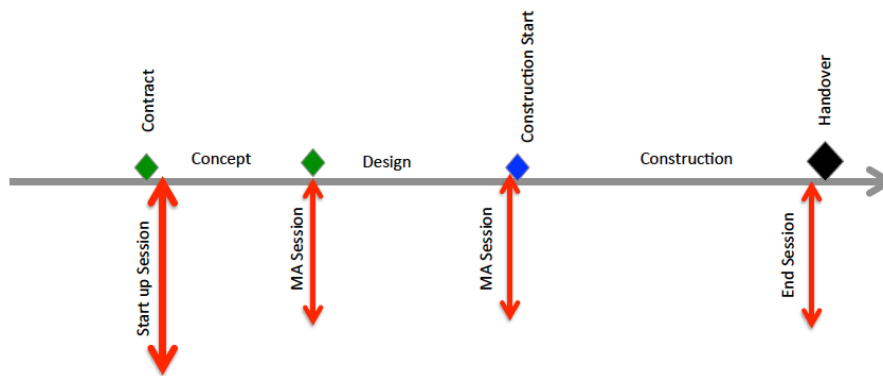


Figure 9: Assessments sessions

The assessment goals are worked out together through the start-up session. The goals are set by the team in collaboration, and are important for this project and this team. The goals will typically be related to cost, time and quality, but also to cooperation, client satisfaction etc. The goals will then be formulated so they can be assessed in a survey. *Figure 10* shows an example of goals from a project, translated into questions. In the survey the questions will be answered as e.g. “how is company N.N. helping to keep the project on plan?”

Questions:

<p>Is the project on plan?</p> <p>Is the project on cost?</p> <p>Is the quality as ordered?</p> <p>Are flaws and errors taken care of?</p> <p>Are the responsibilities in the team clear and accepted?</p> <p>Is the cooperation based on honesty and openness?</p> <p>Is the communication open and constructive?</p> <p>Is the cooperation positive and focused on results?</p>
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Figure 10: Example of Survey questions

The second part of MA is the execution of the assessment sessions. The execution should be according to what the team members planned in the start-up session (see figure 2). First, the team members representing the project receive the survey with the pre-agreed questions. The team members will rank the other team members after their ability to fulfil the goals. A low score on several of the survey questions from many team members indicates that there is an issue that deserves attention from the team. Second, the appointed facilitator will go through these surveys and pick the topics that need attention from the team. In the assessment session all the team members should be present, including the client. The facilitator runs through the topics, creating a dialogue for the best way to improve the team. The result of the session is a unified action plan that describes who is responsible for what action and when it should be done.

At the next session the completion of last session's action plan is addressed, and the next MA starts. In the end of the project, the actors arrange an end assessment session that sums up the project.

## **DISCUSSION AND CONCLUSION**

Mutual assessment (MA) is an experienced based approach developed by a Scandinavian contractor in order to improve the client satisfaction with project execution. The contractor works primarily with negotiated contracts and have a yearly turnover of approximately USD 204 million. By increasing the client satisfaction one can assume that the client gets a better product. This is done by focusing on the team and letting the key team members assess each other with interim evaluations throughout the project.

The contractor's experiences from using MA are very good. Since they started using MA, all their projects had a positive financial outcome. They also reported of no conflicts with clients or other cooperating parties.

MA addresses several challenges in the AEC industry. First it addresses the challenge of a fragmented industry working with unique products and temporary workers, by collaboratively making a design team. The collaborative setting – ,established through the start-up session, the planning of common goals and execution – makes the grounds for continuous improvement. All this helps to achieve good design teams(Svalestuen et al., 2015). Second, MA addresses the performance and improves the performance through a collaborative dialogue, which can replace KPIs. Third, MA creates an opportunity for learning during the project, instead hoping that something is learned when the project is finished. By agreeing on MA the actors remove an organizational barrier of learning (Skinnarland & Yndesdal, 2014), and by letting all key team members set goals and evaluate them one removes the barriers between the trades (Christensen & Christensen, 2010).

Involving the team participants is important (see table 1), and the team participants get involved when practicing MA. Tillmann et al. (2014) highlights the importance of a collaborative environment when creating a learning team. This together with a collaborative design management (Emmitt & Ruikar, 2013) or collaborative planning in design (Fundli & Drevland, 2014; Veidekke, 2013), the management of the process is helped.

Lantelme and Formoso (2000) state that one of the most cited approaches to measurement is the Balanced Scorecard Method, introduced by Kaplan and Norton (1996). The MA has some similarities with the BSC, by looking at important goals, both hard and tangible goals, and also to look at more soft measurements of team evolvment and cooperation. By using BSC as a frame for goals and measurement it is easier to make this transparent for everyone.

Even though the BSC was developed for corporate structures, BSC could be aligned to AEC projects (See figure 1). Clarifying and translating the vision and strategy for the project should be done by the key stakeholders, representing goals for the project and how this affects the corporates strategies. Communicating and linking is ensuring that all project members are aware of the common goals of the project. Planning and setting target are the goals the project wants to achieve, made tangible so one can assess them. The goals should represent all the four focus areas of finance, customer (time, cost, quality), the working processes of the project and learning processes of the



projects members. This should finally be organized in such a way that the feedback from the process could be assessed and aligned with the strategy. The goals of the projects could be e.g. project finance, the client focus, team process, and learning / development. Kaplan and Norton (1996) highlight the important of linking the goals both in the organizations and at the companies CEO level.

MA fills a gap in design management by letting the whole team assess how they work together, thus contributing to a more thorough continuous improvement of the design team. Getting a good team needs collaboration and good assessment. MA is a versatile approach, which can adapt to different project executions and sizes as long as there is a mutual agreement on the need of assessment.

MA is based on the fact that the project participants are truthfully in the survey and in the assessment sessions. There is a need of trust to make MA work. In small projects with a low number of team participants it might be transparent on a personal level who is assessing who, risking to shift the focus away from the continuous improvement process.

MA was primarily set up to increase client satisfaction and the authors see some room of improvements. By structuring the goals of the project through a framework based on BSC one can better align project goals with the team. Because of the fragmented nature of the AEC industry, MA is an important tool of continues improvement of teams, even if a client does not want to be a part of MA.

The involvement, collaboration and the aid of process control makes MA an approach well suited for Lean Construction approaches, and the learning loop of LPDS.

For the contractor MA has proved to work well in the design phase. The authors believe that the approach could work equally well in all the phases of an AEC project, and in fast track projects in particular. Further research would be to test the MA approach in more projects, and also to expand on the number of interviewees. It would also be interesting to map other construction companies' experiences from using MA approach.

## REFERENCES

- Aquino, J. P. R. d., & Melhado, S. B. (2002). *The importance of the design for production in the design process management in building construction*. Paper presented at the 10th Annual Conference of the International Group for Lean Construction, Gramado, Brazil.
- Bassioni, H. A., Price, A. D. F., & Hassan, T. M. (2004). Performance measurement in construction. *Journal of Management in Engineering*, 20(2), 42-50.
- Beatham, S. M., Anumba, C. J., Thorpe, A., & Hedges, I. W. (2004). KPIs- a critical appraisal of their use in construction. *Benchmarking: An international Journal*, 11(1), 93-117.
- Boyle, G. (2003). *Design project management*. Aldershot: Ashgate.
- Bråthen, K. (2015). Collaboration with BIM - Learning from the Front Runners in the Norwegian Industry. *8th Nordic Conference on Construction Economics and Organization*, 21, 439-445.
- Bølviken, T. (2012). *On the Categorization of Production: The Organization-Product Matrix*. Paper presented at the 20th Annual Conference of the International Group for Lean Construction, 18-20 Jul 2012, San Diego, USA.
- Christensen, R. M., & Christensen, T. N. (2010). *Lean Construction Facilitates Learning on All Organisational Levels?* Paper presented at the 18th Annual Conference of the International Group for Lean Construction, 14-16 Jul 2010, Haifa, Israel.
- Creswell, J. W. (2003). *Research design: qualitative, quantitative, and mixed methods approaches*. Thousand Oaks, Calif.: Sage Publications.

- Dainty, A., Green, S., & Bagilhole, B. (2007). *People and culture in construction: a reader*. Abingdon, Oxon: Taylor & Francis.
- El-Mashaleh, M. S., Edward Minchin Jr, R., & O'Brien, W. J. (2007). Management of construction firm performance using benchmarking. *Journal of Management in Engineering*, 23(1), 10-17.
- El. Reifi, M. H., & Emmitt, S. (2013). Perceptions of lean design management. *Architectural Engineering and Design Management*, 9(3), 195-208.
- Emmitt, S., & Ruikar, K. (2013). *Collaborative design management*. London: Routledge.
- Fundli, I. S., & Drevland, F. (2014). *Collaborative Design Management – A Case Study Paper* presented at the IGLC-22Oslo, Norway, 25-27 Jun 2014.
- Hamzeh, F. R., Ballard, G., & Tommelein, I. D. (2009). *Is the Last Planner System applicable to design ? A case study*. Paper presented at the IGLC-17, 2009Taipei, Taiwan.
- Haponava, T., & Al-Jibouri, S. (2012). Proposed System for Measuring Project Performance Using Process-Based Key Performance Indicators. *Journal of Management in Engineering*, 28(2), 140-149.
- Jerrard, B., & Hands, D. (2008). *Design management: exploring fieldwork and applications*. London: Routledge.
- Kaplan, R. S., & Norton, D. P. (1996). *The Balanced Scorecard : translating strategy into action*: Harvard business school press.
- Kerosuo, H. (2015). BIM-based Collaboration Across Organizational and Disciplinary Boundaries Through Knotworking. *8th Nordic Conference on Construction Economics and Organization*, 21, 201-208.
- Knotten, V., Svalestuen, F., Hansen, G. K., & Lædre, O. (2015). Design Management in the Building Process - A Review of Current Literature. *8th Nordic Conference on Construction Economics and Organization*, 21(0), 120-127.
- Lantelme, E., & Formoso, C. T. (2000). *Improving Performance Through Measurement: The Application of Lean Production and Organisational Learning Principles*. Paper presented at the 8th Annual Conference of the International Group for Lean Construction, 17-19 Jul 2000, Brighton, UK.
- Mejlænder-Larsen, Ø. (2015). Generalising via the Case Studies and Adapting the Oil and Gas Industry's Project Execution Concepts to the Construction Industry. *8th Nordic Conference on Construction Economics and Organization*, 21, 271-278.
- Meland, Ø. (2000). *Prosjekteringsledelse i byggeprosessen: suksesspåvirker eller andres alibi for fiasko?* (Vol. 2000:116). Trondheim: [Tapir].
- Samset, K. (2010). *Early project appraisal: making the initial choices*. New York: Palgrave Macmillan.
- Skinnarland, S., & Yndesdal, S. (2014). *Barriers to a Continuous Learning Process in Construction*. Paper presented at the 22nd Annual Conference of the International Group for Lean Construction, 25-27 Jun 2014, Oslo, Norway.
- Svalestuen, F., Frøystad, K., Drevland, F., Ahmad, S., Lohne, J., & Lædre, O. (2015). Key Elements to an Effective Building Design Team. *Conference on ENTERprise Information Systems/International Conference on Project MANagement/Conference on Health and Social Care Information Systems and Technologies, CENTERIS/ProjMAN / HCist 2015 October 7-9, 2015*, 64, 838-843.
- Tillmann, P., Ballard, G., & Tommelein, I. (2014). *A Mentoring Approach to Implement Lean Construction*. Paper presented at the 22nd Annual Conference of the International Group for Lean Construction, 25-27 Jun 2014, Oslo, Norway.
- Veidekke. (2013). *Collaborative planning in design - A guide to* (pp. 20).
- Yin, R. K. (2014). *Case study research: design and methods*. Los Angeles, Calif.: SAGE.