



SBE16 Tallinn and Helsinki Conference; Build Green and Renovate Deep, 5-7 October 2016,  
Tallinn and Helsinki

## Integration of BREEAM-NOR in construction projects: Utilizing the Last Planner System

Åse I. Nesteby<sup>a\*</sup>, Marie E. Aarrestad<sup>a</sup>, Jardar Lohne<sup>a</sup>, Rolf A. Bohne<sup>a</sup>

<sup>a</sup>NTNU, 7491 Trondheim, Norway

### Abstract

According to the general literature, maximizing the potential of BREEAM-NOR could significantly contribute to create a greener and more sustainable construction industry. Lean Construction techniques promise to eliminate waste in the production process and consequently maximize the customer value of the final result. According to literature, these are traits where many Norwegian construction projects that strive to meet the requirements of a BREEAM-NOR certification seem to fall short. BREEAM is the most widely used environmental assessment method for buildings today, with the main objective to secure more sustainable construction practices. The purpose of this paper is to examine how the documented pull-effect created by the Last Planner System (LPS) can be utilized in reducing challenges that arise from a managerial push-strategy. The context of the analysis is certifying construction projects in accordance to BREEAM-NOR. A case study of the projects was conducted in a Norwegian construction company. Twelve in-depth interviews were conducted with key actors in the projects, consisting of project managers, construction supervisors, Accredited Professionals, trainees, foremen and squad bosses. In addition, weekly squad meetings as well as regular lookahead planning sessions were observed. All of the projects were design and build and two of them aimed for the BREEAM-certification class Excellent. A preliminary literature study that identified common challenges related to the requirements of BREEAM-NOR and discussed how they could be resolved, served as a basis for this research. A majority of the observed challenges when introducing BREEAM-NOR requirements to construction projects seemed to stem from a managerial push-strategy within the project organization. Positive effects of implementing the pull-strategy of LPS proved a plausible measure to reduce these challenges, by introducing a shift in strategy from push to pull. Furthermore, a planning strategy was suggested based on findings from the case study. The strategy intended to optimize the integration of BREEAM-NOR in the LPS-system in order to ease the process of integrating BREEAM-NOR requirements, thus creating more sustainable projects. This paper uncovered the possibility of a reduction in incremental costs related to the requirements of BREEAM-NOR. Through reducing waste and improving workflow, value can be increased for all stakeholders involved including owner, contractor, customer and the society at large.

© 2016 Published by Elsevier Ltd. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Peer-review under responsibility of the organizing committee of the SBE16 Tallinn and Helsinki Conference.

\* Corresponding author. Tel.: +47-992 99 779.  
E-mail address: [aseingri@stud.ntnu.no](mailto:aseingri@stud.ntnu.no)

*Keywords:* Building Green; BREEAM-NOR; Lean Construction; The Last Planner System; planning methodology; construction projects

---

## 1. Introduction

The increased knowledge of climate change impacts has resulted in extensive responses from governments, businesses and civil society [1]. Today there is a 90-100 % consensus amongst climate experts that recent changes in climate conditions are human-caused [2], [3], and nine out of ten Europeans now think that climate change is a serious problem [4]. According to the UN's International Panel on Climate Change, the dangers of climate change is increasing and there is an urgency to find sustainable solutions to prevent further impact on human and natural systems. [5]. The latest breakthrough came in 2015, when over 190 countries of the world met in Paris, and agreed upon a global agreement on climate change. All countries present pledged their individual goals for carbon emission reduction [1]. The building sector is proven to be responsible for 40% of the world's energy consumption and contributes 30% of global annual greenhouse gas emissions, this through its production and operation of buildings. [6]. With the ever present focus on climate change, the pressure is therefore high on the construction industry to reduce its environmental impact [7].

In the effort to mitigate the industry's environmental impact, many different tools and programs have been developed. Among them the Building Research Establishment's Environmental Assessment Method (BREEAM), which is an assessment system for construction and real estate [8]. According to the Building Research Establishment (BRE), it sets the standard for best practice in sustainable design and has become the de facto measure used to describe buildings' environmental performance. Currently, BREEAM is the world's leading and most widely used environmental assessment method for buildings [8], [9]. The subject of this paper will be the Norwegian adaptation of the method, namely BREEAM-NOR, which is adapted to national relevant standards, rules and practices in the environmental and energy areas [8].

Although BREEAM-NOR is growing and is becoming more sought after, it is still fairly new to the Norwegian construction industry [10], [11]. A preliminary literature study conducted prior to this paper uncovered that when certifying in accordance with BREEAM-NOR, many construction projects encountered several complicating challenges [12]. The conclusion of this study was that most of the identified challenges could be traced back to a push-mentality in project management. Moreover, it concluded that such a mentality needs to be altered in order to maximize the potential of BREEAM-NOR as a method. If not, its intended objective of improving the sustainable practice of the construction industry may be unattainable.

The intention of this paper is to present a change in planning strategy to adjust the aforementioned push-mentality. To develop this strategy, a case study was conducted in a Norwegian construction company in order to answer the following research questions:

- Does the LPS-practice create the desired pull-effect in the observed projects?
- What are the most prominent challenges that arise due to the extended requirements of BREEAM-NOR in the projects?
- Do the potential challenges coincide with those identified in the preliminary study?
- How can the process of BREEAM-NOR certification be expediently integrated in the LPS-system in order to reduce the potential challenges?

The first two research questions are answered through the presented findings and the third question is answered through the following discussion. Lastly the fourth question is discussed in the findings and then summarized in the final conclusion.

<b>Nomenclature</b>	
AP	Accredited Professional; An internal project support in BREEAM projects
BREEAM	A sustainability assessment method for master planning projects and buildings
BREEAM-NOR	The Norwegian adaptation of BREEAM
Construction Supervisor	A member of the project team on the construction site
Foreman	The link between the project team and the site workers
Lean Construction	A production-management based approach to project management
Lookahead meeting	A planning meeting in the LPS system, planning 6-8 weeks ahead
LPS	A production planning system developed for Lean Construction
Phase planning	A planning meeting in the LPS system, planning larger phases of the project
Pull	Introducing activities in projects based on when the activities are confirmed feasible
Push	Introducing activities in projects based on a completion date
Squad boss	Responsible for organizing of his/her squad on site
Squad meeting	A planning meeting in the LPS system, planning 1-2 weeks ahead
The last planner	The squad boss in LPS terminology

## 2. Theoretical framework

BREEAM is a renowned assessment method for construction and real estate that documents differences in the effects on the environment and human health. Some of the main objectives of BREEAM is to mitigate the impacts of buildings on the environment, provide market recognition, low environmental impact buildings and to ensure best environmental practices are incorporated in buildings [8]. A certification in accordance with the standards of BREEAM is based on a so-called “credit list”, where points can be obtained by meeting set technical requirements in ten different categories. Points that can be attained will vary between different types of buildings, and the total amount of points obtained will decide the project's certification class [8]. All of this is specified in further detail in the technical manual of BREEAM.

Because BREEAM-NOR is a new method of assessment in the Norwegian building sector the number of conducted studies concerning its challenges and impact are limited. The research that has been carried out consists of unpublished works such as master theses. Flo and Wehmer [13] studied the challenges that arise implementing BREEAM-NOR in construction projects. Meling [14] assessed the experiences regarding BREEAM-NORs usability shortly after its introduction to the Norwegian building sector, and Morken [15] examined the effect of implementing BREEAM-NOR in a specific supply company. Also, Nesteby and Aarrestad conducted a literature study summarizing the findings of the existing studies [12]. Though these studies all confirm the presence of the same challenges, none of them describe a specific solution to mitigate them. To some extent they all touch on possible measures of improvement, but there is to the authors knowledge no study in Norway today that proposes a tangible solution.

The Last Planner System is a production planning system part of Lean Construction [16], which is a production management-based approach to project delivery [17]. LPS's purpose is to produce a predictable workflow, and it is based on two components: product unit control and workflow control [18]. Respectively, they aim to improve the actual work tasks that are to be executed through continuous improvement and learning, as well as improve the workflow across units in the project organization. That is, to create “healthy” work activities that not only SHOULD be done, but also CAN be done [18]. This contributes to the goal of Lean Construction to improve the project's overall performance, by maximizing value and minimizing waste [17]. The term waste refers to unnecessary use of project resources.

	Temporal aspect	Documentation process	Teamwork and communication	Attitude	Incremental costs	The BREEAM-NOR certification system
Phase scheduling						
Look ahead planning						
Squad meetings						
Eliminating waste through the implementation of LPS						
Optimizing workflow through the implementation of LPS						

Figure 1 Illustration of which components of LPS that can potentially reduce BREEAM-NOR related challenges, and to what extent [12].

By improving workflow and creating “healthy” work tasks, LPS introduces what is known as a “pull-effect”. Ballard defines “pulling” as a way of introducing new information and/or materials into a building process [18]. “Pushing” stands in contrast to pulling, as it pushes information on what should be done through the system regardless of the project’s status quo. Whereas a pulling technique pulls information on what actually can be done in the projects, based on current conditions. Assuring the quality of a work task’s feasibility through phase planning, look ahead planning, constraint analysis and squad meetings are all considered pulling techniques. Therefore, LPS is categorized as a pull-system.

Lean Construction is an increasingly utilized planning approach in the Norwegian building sector. Numerous actors in the industry promote their use of Lean Construction [19]–[21] and journals also reports of an increasing presence of Lean-practices [22]–[24]. Coupled with the fact that several of the largest companies in the Norwegian building sector are a part of the network *Lean Construction NO* [25], this supports the notion that it is a recognized planning tool. Several studies document positive effects when implementing the Lean Construction methodology in Norwegian construction projects [26]–[30], but studies on the effect of Lean Construction in BREEAM-NOR projects have however not been published to the authors knowledge.

Figure 1 is taken from the preliminary study and illustrates in which areas LPS (left column) could help reduce BREEAM-NOR related challenges (top row) in projects, and to what extent. On the basis of this, integrating BREEAM-NOR in the LPS-system was chosen as a possible solution. Because this was the chosen system for improvement in the preliminary literature study, the focus of this paper will be to develop a solution within the scope of LPS.

### 3. Method

The preliminary study was conducted as a literary review, and its structure was based on recommendations from Aveyard [31]. This consisted of concise research questions, a clear search strategy with logical and relevant search terms as well as an unambiguous and repeatable review of the collected literature.

The research for this article was conducted as a multiple-case study in collaboration with a Norwegian construction company, examining three of their projects. Yins [32] principles for case studies served as a foundation for the research approach. In the case study interviews, observations and a document study was utilized as means of gathering necessary data.

In total 12 in-depth interviews were conducted, in accordance with the guidelines of Dalland [33] and the interview subjects consisted of members of the project organization, including project managers, construction supervisors, foremen, trainees, AP's and squad bosses. Interview subjects were chosen to attain a diverse specter of informants, and to represent all levels of the project organization due to LPS's requirement for all tiers to be involved in the planning process. A loosely structured interview guide was used in all interviews to encourage a guided conversation within the desired topics.

According to Yin [32], direct observation can be a useful tool in providing additional information of the topic being studied. Being two authors in this case study strengthened the reliability of the observations, making it a suitable choice of method. The authors observed in total 8 meetings, all from the LPS-system. Three of these were squad meetings, where squad bosses and foremen planned the following two weeks of production, the other five meetings were lookahead meetings. Here project managers from the different technical disciplines met to plan the future 3-8 weeks of production.

Yin also pointed out that documents play an explicit role in any data collection when doing case study research [32]. Therefore, a document study was performed to obtain a necessary knowledge base of the company policy on BREEAM-NOR and LPS. Document such as LPS models, BREEAM-NOR course material and internal project policies were scrutinized. Specific knowledge concerning the three projects was also collected, including information such as which BREEAM-NOR points the projects aimed to achieve.

Table 1 presents the three projects in the case study and provides an overview of their features.

Table 1 Overview of BREEAM-NOR and LPS in the projects

Project	Phase	Contract structure	BREEAM-NOR	Certification level	Squad meeting	Lookahead meeting	Phase planning	Zones
1	Early	Design and build	X	Excellent	X	X	X	X
2	Mid	Design and build		-	X	X		X
3	End	Design and build	X	Excellent	X	X	X	X

#### 4. Findings and discussion

The objective of the case study was to confirm the presence of challenges identified in the preliminary study. To do this the most prominent challenges in the studied BREEAM-NOR-projects were identified. Further it was investigated whether the LPS-practice in the projects created the desired pull-effect, in order to eliminate any push-mentality. In the following chapter the findings are analyzed and discussed to answer these questions. Through this analysis a strategy on how to expediently integrate BREEAM-NOR in the LPS-system is developed. This is presented in further detail in the conclusion.

##### 4.1. Parallel processes

Interviews and observations confirmed the preconceived notion that BREEAM-NOR and LPS were running as two parallel processes in the projects. One targeted BREEAM-NOR certification while the other focused on planning and executing the project in accordance with the LPS system. Besides quotes from some informants, the lack of BREEAM-NOR on the meeting agendas was the strongest proof of the parallel policy. BREEAM-NOR was addressed as part of lookahead meetings in one of the projects, but only because of the AP's participation. The AP in this project commented that otherwise it would probably not have been taken into account in the lookahead process.

This way of administering the project could contribute to alienate the BREEAM-NOR certification process to the involved actors. It seems that a stronger correlation would be beneficial. An easy way to regularly include BREEAM-NOR in the project could be to include it in the meeting-templates of both the lookahead meetings and the squad meetings. This could create a greater awareness of the project being a BREEAM-NOR project on a continuous basis and contribute in reducing the number of do-overs caused by misunderstandings regarding the BREEAM-NOR requirements. It could also strengthen the involved parties' ownership feeling towards the project

through showing the benefits and strengths of construction in accordance with BREEAM-NOR. One way BREEAM-NOR did get included in project planning and execution was through the regular safety inspection rounds. This is not a LPS-tool, but this way of including BREEAM-NOR in the project seemed to be a success. The safety inspection round was mentioned by all informants when asked how BREEAM-NOR influenced the project routines.

#### 4.2. Distribution of BREEAM-NOR responsibilities

Another finding from the case study was that BREEAM-NOR related issues generally seem to solely be the AP's responsibility. Every actor interviewed in the BREEAM-NOR projects confirmed that it was the responsibility of, and mainly concerned, the AP. Some may have been included in the process through attending safety inspection rounds or providing documentation, but all BREEAM-NOR related assignments were only conducted due to requests by the AP. It was also noted that even though the AP was largely in charge of the whole BREEAM-NOR process, the only responsibility featured in the different LPS meetings was the demand for required documentation. Involvement of the different actors in BREEAM-NOR- and LPS-processes is illustrated in Figure 2.

This hierarchy of BREEAM-NOR responsibility is another factor contributing to the estrangement of BREEAM-NOR in the projects. As an example, it was only in the LPS-meetings where an AP was present that BREEAM-NOR was brought up. This strong constriction of responsibility contributes to degrade the ownership culture towards BREEAM-NOR, preventing the other involved actors from having to take action. Additional delegation of tasks could help create a greater sense of ownership amongst different project members. Further it can easily become an element of irritation for squad bosses and contractors when BREEAM-NOR is only brought up in meetings as the AP requesting documentation. Possibly resulting in a more negative attitude towards BREEAM-NOR.

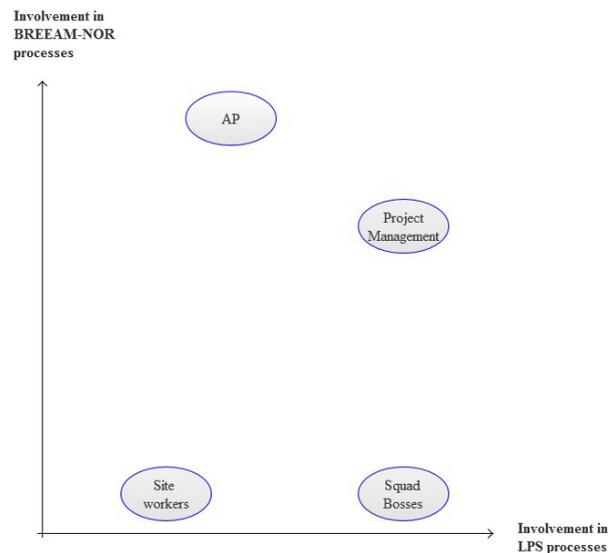


Figure 2. The influence of BREEAM-NOR and LPS on different roles in the project

#### 4.3. Level of education

A gap in knowledge between project management and site workers was uncovered through interviews. It was evident that squad bosses and site workers did not have the same knowledge of the purpose of BREEAM-NOR and LPS. Project management members expressed a positive attitude towards the matters, while site workers typically were more indifferent, some bordering on the negative. Project management displayed reflectiveness on the possible

advantages of the tools, and had a greater understanding of what the project could gain if they could utilize their potential.

This difference in attitude could possibly be traced back to the finding that project management has a higher level of education within the two fields, which allows them to see a bigger picture. It is policy in the company that all project management team members receive at least basic training in BREEAM-NOR and LPS from certified trainers. For squad bosses and site workers the required level of education is an introduction on site. Nevertheless, all informants expressed that LPS had eased project planning, and no exclusively negative attitude was detected.

Regarding attitude among squad bosses, age proved a significant factor. Younger people were more willing to adapt to new practices, while the age group 40-50 showed more reluctance. The latter mainly considered LPS and BREEAM-NOR fancy words rather than something that could improve their daily work.

#### 4.4. Perceptions on education level

Interviews revealed a difference in understanding on what training the site workers had received. Both the APs mentioned that there had been conducted trainings for the site personnel, which included a brief introduction given in the startup meetings for the projects, and a course on the influence of BREEAM-NOR in the workday. Both of which were developed by the company. However, the squad bosses did not share this opinion. They did mention a general introduction in the startup meeting, but besides that no specific training was reported.

Another opinion expressed by squad bosses were that both they and their squads did not have any particular need for training as BREEAM-NOR was just something management had told them needed to be implemented. This is to the authors a clear indication that BREEAM-NOR is introduced in the project using a push-strategy where management makes decisions without including *the last planner*.

When interviewing the squad bosses, all stated that squad meetings was a somewhat a useful way of planning. However, the project managers and foremen seemed to ascribe the meetings a greater benefit for the squad bosses than they did themselves, indicating that management sees a higher benefit than there actually is.

#### 4.5. BREEAM-NOR in the construction phase

Informants expressed that BREEAM-NOR was a concern mainly in the design phase and after completion of the project. This because the groundwork to obtain many of the points is done in the design phase, as well as the fact that verification of the points and the actual certification is done after completion. The temporary certification given after the design phase also supports this.

To the authors, this standpoint is considered one of the main reasons for the challenges arising in BREEAM-NOR projects. By pushing what concerns BREEAM-NOR to the other project phases, rather than keeping the focus throughout the whole process, the project team cannot fully be prepared to handle challenges that will arise in the construction phase. In addition, this attitude substantiates the push-mentality of BREEAM-NOR projects by saying that it does not concern *the last planners*. Keeping BREEAM-NOR on the agenda continuously will increase the project team's ability to detect problems before they arise. This will prevent situations where the squad bosses will have to come up with solutions "on the spot" due to extended requirements and do-overs because of misunderstandings regarding these requirements. A strong focus on how BREEAM-NOR is present through the whole project can increase the feeling of ownership for site workers. Visualizing the process of gaining points, and highlighting the necessary contribution from the squad could help create the feeling that BREEAM-NOR is something everyone needs to contribute to. Thus increasing the pull-mentality.

#### 4.6. Meeting structure

Observations of the lookahead meetings and squad meetings in the case study gave a clear impression that all of them lacked a firm chairperson and consistent structure. This resulted in the meetings deviating from the set agenda. The meetings with the greatest lack of structure were also the ones deviating the most from the set agenda. As one of the squad bosses commented; "We don't make money sitting in meetings. We make money out there on the site", which reaffirms the notion that the squad bosses also appreciate a clearer structure and less time spent in meetings.

Through observation, it became clear that all parties could benefit from a firmer structure of the meetings in the LPS system, which applies to all the projects. A clear chairperson is needed to maintain progress and keep within a designated timeframe. Further, there is a need to retain the amount of deviation from the agenda as much as possible. In almost every observed meeting, it was a reoccurring problem that participants asked unrelated questions to the activity at hand and discussions on completely different matters would flourish. The chairperson should be responsible for blocking such digressions to keep to the timeframe as well as the time perspective of the meeting, whether it is a squad meeting or lookahead meeting. This way they can be more efficient, which is the essence of the Lean methodology and is necessary to let LPS achieve its purpose.

An argument to exclude BREEAM-NOR from the LPS-structure was that it would just add to already long meetings and ultimately can result in increased incremental costs. Implementing the suggested measures could make it possible to put BREEAM-NOR on the agenda without prolonging the meetings significantly. A prerequisite in order to achieve this is that all participants will have to come prepared to the meetings, project management and site workers alike. The planning process will be the most efficient if all parties are on top of the work planned for the relevant timeframe as well as the work status of their own fields. LPS seeks out to involve site workers in planning their work, but without the needed structure, it might only lead to an increase in incremental costs.

#### *4.7. Incremental costs*

Long meetings, do-overs and restricted access to materials were mentioned as causes for incremental costs. It was pointed out that because BREEAM-NOR restricts the use of certain materials that are familiar to the site workers it forces them to use BREEAM-NOR approved substitutes. These materials are often unknown or harder to work with and therefore leads to a longer execution time. Because the site workers very often do piecework, this creates a conflict between earning money and achieving the required quality to obtain points for certification. As commented by squad bosses, they mostly do not know why they are not allowed to use certain materials other than “because of BREEAM-NOR”. If the previously mentioned gap in knowledge had been smaller or non-existent, and the feeling of ownership towards BREEAM-NOR was more present, a better understanding of “why” could have been created. Subsequently a lot of resistance could be avoided, as the requirements of BREEAM-NOR would possibly feel less forced from above by project management.

To aid the prevention of do-overs, the aforementioned measure of including BREEAM-NOR in the meeting-templates can contribute greatly in reducing incremental cost. An example of a measure that has been introduced with success on sites through BREEAM-NOR and LPS, is the concept of “clean and dry building process”. This is a requirement in BREEAM-NOR-projects and a consequence of the LPS-system. Both managers and site workers pointed out the advantages of this in most interviews. One of the squad bosses said that by having a tidy and clean work site at all times, it had naturally made it a lot easier to do their job. This statement supports the premise that measures like a clean and dry building process can contribute in reducing incremental costs.

#### *4.8. The documentation process*

In the preliminary literature study, the documentation process of BREEAM-NOR was mentioned as one of the greatest challenges, which was confirmed in the case study. However, both AP’s in the two BREEAM-NOR-projects expressed that documentation had become a lot easier after the introduction of the Product Exchange platform. The platform is designed to gather necessary documents in a construction process and thus ease the APs responsibilities.

In one of the projects, the AP participated in lookahead sessions and directly asked the contractors present to submit documentation. This observation illustrates an advantage in including BREEAM-NOR in the LPS structure. The AP can keep continuous awareness on BREEAM-NOR requirements to avoid do-overs and additionally evade pile-ups of documentation that needs to be collected at completion. Both of which was identified as part of the documentation challenge. Moreover, this can contribute in the reduction of incremental costs.

By having the AP continuously follow up on documentation in the project, there is a possibility for the squad bosses to contribute in gaining additional BREEAM-NOR points. For instance, through better choices of materials than suggested in the design phase. If this is to be a realistic possibility the previously mentioned measures of

education and involvement is a prerequisite. To promote this spirit of constant improvement in the project and build up under the sense of ownership as well, incentives can be used as an encouraging measure.

#### *4.9. Early involvement of BREEAM-NOR*

Confirming findings from the preliminary study, early involvement was emphasized as a key necessity for success by informants with management positions. Comments suggested that BREEAM-NOR should be integrated into the project from the get go, primarily to avoid losing points and be able to plan and design to obtain all the points needed. This is also an instance where LPS can benefit BREEAM-NOR projects greatly, because of its structure as a planning tool. The phase planning and start-up sessions utilized by the company is a suitable arena for clarification of expectations. Here education could be emphasized, and thus the gap in knowledge could be reduced. Of course, BREEAM-NOR requirements are also included in the contract specifications and should imply that the tendering contractors have some experience with BREEAM-NOR. However, the impression that came across is that this is not always the case because BREEAM-NOR is relatively new in the Norwegian construction industry.

Introducing BREEAM-NOR as early on as possible with a clarification of expectations and ambitions, as well as education on the matter, can provide a much more positive regard towards it in the execution phase. By including all actors from the start a stronger basis for team spirit can be built. Perhaps even an atmosphere can be created, where there is a sense of achievement throughout the entire project organization when points are obtained and ambitious goals are met.

Interviews with the squad bosses revealed that they did not feel like working on a BREEAM-NOR project extensively separated itself from any other construction project. The impression that came across was that BREEAM-NOR served as yet another requirement from the project management specified in the contract, and did not impact their daily activities severely. Whereas LPS had a more direct impact on their day-to-day work. On the contrary, APs and project managers presented BREEAM-NOR as a useful and important tool to construct high quality, sustainable buildings, making it an important part of their daily work.

This attitude displayed among the squad bosses convey a lack of ownership that possibly can be traced back to the previously mentioned push-strategy in the projects. Such a lack of ownership might be prevented by including both the squad bosses and BREEAM-NOR from the very first phase scheduling. Involving the squad bosses earlier in the planning process creates the opportunity for them to contribute with simple and effective solutions. Early involvement can also contribute to them focusing on BREEAM-NOR solutions throughout the construction phase, making it a natural part of their day.

Figure 3 illustrates the possible effect of introducing BREEAM-NOR in the project organization with a push-strategy vs. a pull-strategy.

## PUSH

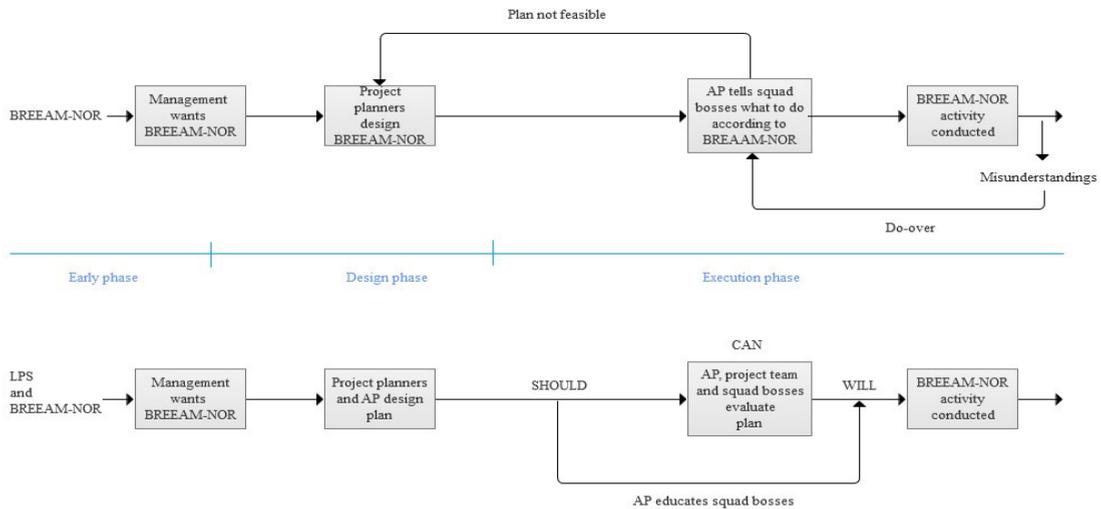


Figure 3. Illustration of push- vs pull-strategy in BREEAM-NOR certification processes

## PULL

### 5. Conclusion

The presence of the challenges relating to BREEAM-NOR in projects identified in the preliminary literature study were confirmed in the case study. Furthermore, the overall findings from the same study are also consistent with the performed research.

Statements from conducted interviews in the BREEAM-NOR projects support the theory that they are governed by a push-strategy from management. They also showed that BREEAM-NOR and LPS run as two parallel components in the project. Based on the research in this article, the conclusion is drawn that BREEAM-NOR should without further complications be possible to integrate into the LPS-system of a project. This will help turn the push-strategy towards pull-strategy. A prerequisite is that the LPS-structure applied in the project is optimized, which is not the current situation in the studied projects.

Even though today's situation does not portray an optimal implementation of LPS, it has been confirmed through interviews that LPS has had a positive effect on the projects. It was deemed a useful planning tool and had increased involvement of all squad bosses. This substantiates the preliminary study's conclusion and strengthens the notion that the positive pull-effects of LPS can reduce the push-related challenges of BREEAM-NOR projects.

#### 5.1. Proposed strategy

Based on observations and interviews, the following strategy is proposed:

##### Main goal:

- Implement BREEAM-NOR in project planning, utilizing the system of LPS.

##### Means of achieving set goal:

- Higher level of education for the involved parties
- Visualization of the points in the construction process
- Rewarding the involved actors when points are gained
- Contract incentives to stimulate even higher performance than obligated
- Delegate the responsibilities of BREEAM-NOR to additional roles

- Clearly integrate BREEAM-NOR in planning meetings through agenda and templates
- Earlier involvement of BREEAM-NOR for all involved actors
- Clearer and stronger structure of LPS planning sessions
- Continue current practice of including BREEAM-NOR in the safety inspection rounds

By applying the proposed strategy, a number of desired benefits can be achieved. Inclusion of all parties from the beginning can create a stronger sense of teamwork as well as a stronger sense of ownership. This can also come from a visualization of BREEAM-NOR in the daily work. Continuous awareness of BREEAM-NOR and its requirements can lead to better communication and thereby less misunderstandings and do overs, resulting in a better workflow. Better workflow with less waste will in turn add value and contribute to more sustainable projects.

For some aspects of the previous discussion as well as the proposed strategy it is important to consider their feasibility. It is necessary to consider whether suggested measures are realistic, based on the dynamics in today's construction projects, and the strategy can be customized to individual projects based on their circumstances.

## 5.2. Sustainability and over-all performance

Based on the discussion, it can be argued that this coalition of BREEAM-NOR and LPS can lead to more sustainable practices and products. This is true for all three projects in the case study as well as from a larger perspective. First of all, BREEAM-NOR requires a higher standard than TEK10, the Norwegian regulation of technical requirements for construction. Further, it aims to optimize the building for future use as well as during construction, providing a stamp of quality making it more valuable over time. BREEAM-NOR takes the whole process into account, ensuring a sustainable product through its entire lifecycle. This by ensuring sustainable materials through its demand for documentation, as well as energy-efficient and environmentally sound solutions through all its requirements. When executed right LPS will generate an efficient workflow with minimal waste, ensuring high performance during the construction phase. BREEAM-NORs effects on the project's over-all performance can be amplified further through the utilization of LPS, ensuring that the high quality measures are delivered in a cost and time efficient manner.

BREEAM-NOR desires to simulate the demand for sustainable buildings in the market. Combined with LPS's goal of maximizing customer value this is a step towards creating sustainable constructions with a higher over-all performance.

## Acknowledgements

The authors would like to thank the informants for their time and willingness to share their experiences. Also the project teams deserve a thank you for their cooperation and for allowing the authors to observe their meetings. A thank you is also owed to the supervisor from the construction company for contributing with all her knowledge, time and encouragement.

## References

- [1] R. Willis, M. Spencer, F. Metternich, K. Crane, M. Jacobs, G. Morgan, H. Huyton, T. Viita, R. Davis, A. Doig, J. Lanchbery, C. Born, B. Stafford, R. Dickinson, B. Johnston, P. Evans, H. Dennis, M. Birt, D. White, L. James, B. Fischler, G. Harrison, E. Perez, B. Huckstein, T. Carty, L. Hickman, M. Adow, R. Garthwaite, and K. Pumphrey, "Paris 2015 Getting a global agreement on climate change," pp. 1–24, 2014.
- [2] J. Cook, D. Nuccitelli, S. A. Green, M. Richardson, B. Winkler, R. Painting, R. Way, P. Jacobs, and A. Skuce, "Quantifying the consensus on anthropogenic global warming in the scientific literature," *Environ. Res. Lett.*, vol. 8, no. 2, p. 7, 2013.
- [3] J. Cook, N. Oreskes, P. T. Doran, W. R. L. Anderegg, B. Verheggen, E. W. Maibach, J. S. Carlton, S. Lewandowsky, A. G. Skuce, and A. Sarah, "Consensus on consensus : a synthesis of consensus estimates on human - caused global warming," *Environ. Res. Lett.*, vol. 11, no. 2016, pp. 1–24.
- [4] Special Eurobarometer, "Climate change," *Eur. Comm.*, 2014.
- [5] United Nations, "Promote Sustainable Development | United Nations." [Online]. Available: <http://www.un.org/en/sections/what-we->

- do/promote-sustainable-development/index.html. [Accessed: 13-Apr-2016].
- [6] S. Lemmet, "Buildings and Climate Change," *Unep*, 2013.
- [7] World Commission on Environment and Development, "Report of the World Commission on Environment and Development: Our Common Future (The Brundtland Report)," *Med. Confl. Surviv.*, vol. 4, no. 1, p. 300, 1987.
- [8] NGBC - Norwegian Green Building Council, *Technical Manual BREEAM-NOR*, 2012.
- [9] BRE, "The world's foremost environmental assessment method and rating system for buildings," p. 562, 2011.
- [10] DiBk - Direktoratet for Byggkvalitet, "BREEAM-NOR: Nytt verktøy får bransjen til å strekke seg - Direktoratet for byggkvalitet," 2012. [Online]. Available: <https://www.dibk.no/no/Tema/Miljo/Nyheter-miljo/BREEAM-NOR-Nytt-verktoy-far-bransjen-til-a-strekke-seg/>. [Accessed: 11-Apr-2016].
- [11] BRE, "BREEAM enters Norway." [Online]. Available: <http://www.bre.co.uk/news/BREEAM-enters-Norway-660.html>. [Accessed: 11-Apr-2016].
- [12] I. Nesteby and M. E. Aarrestad, "LPS som verktøy for å redusere påvirkningene av push-strategi i BREEAM-prosjekter," project paper, Department of Civil and Transport Engineering, NTNU, Trondheim, Norway, 2015.
- [13] E. C. Flo and A. Wehmer, "Utfordringene ved BREEAM og implementeringsprosessen i byggeprosjekter," MS thesis, Department of Mathematical Sciences and Technology, NMBU, Ås, Norway 2015, <https://brage.bibsys.no/xmlui/bitstream/handle/11250/294542/Wehmer%20og%20Flo%202015.pdf?sequence=1>.
- [14] J. Meling, "BREEAM i Norge - Vudering av BREEAM NOR i praksis," MS thesis, Department of Civil and Transport Engineering, NTNU, Trondheim, Norway, NTNU, 2013, <http://www.diva-portal.org/smash/get/diva2:637811/FULLTEXT01.pdf>.
- [15] D. Morken, "Implementeringen av BREEAM hos YIT i Stavanger," MS thesis, Department of Industrial Economics, Risk Management and Planning, UiS, Stavanger, Norway 2013, <https://brage.bibsys.no/xmlui/bitstream/handle/11250/182209/Morken%20Daniel.pdf?sequence=5>.
- [16] LCI - Lean Construction Institute, "The Last Planner (R)," 2016. [Online]. Available: <http://www.leanconstruction.org/training/the-last-planner/>. [Accessed: 11-Apr-2016].
- [17] LCI - Lean Construction Institute, "What is Lean Design & Construction," 2008. [Online]. Available: <http://www.leanconstruction.org/about-us/what-is-lean-construction/>. [Accessed: 25-Oct-2015].
- [18] G. Ballard, "The Last Planner System of Production Control," Ph.D dissertation, School of Civil Engineering, University of Birmingham, United Kingdom, 2000, <http://theses.bham.ac.uk/4789/1/Ballard00PhD.pdf>.
- [19] Kruse Smith, "LEAN construction - Kruse Smith," 2015. [Online]. Available: <http://www.kruse-smith.no/om-kruse-smith/forskning-og-utvikling/lean-construction/>. [Accessed: 26-Nov-2015].
- [20] A. O. Hønsvik, "Bergtatt av miljøløsninger," *Relasjon - Skanska*, 2009.
- [21] H. V. Nikolaisen and L. Hoberg, "« Lean in Statsbygg - Experience and Potential »,," in *Productivity in Construction*, 2014.
- [22] J. Tøien, "Bransjen mangler Lean Construction-kompetanse," *Byggenæringen*, 2014.
- [23] T. Lien, "Byggebransjen trenger en miljødugnad : Bygg.no - Byggeindustrien," *Byggenæringen*, 2015.
- [24] M. G. Garathun, "LEAN CONSTRUCTION - Statsbygg henter inspirasjon fra Porsche til ny kunsthøyskole," *Teknisk Ukeblad*, 2014.
- [25] Lean Construction NO, "Lean Construction nettverk," 2015. [Online]. Available: <http://samforsk.no/lc/Sider/Lean-Construction-nettverk.aspx>. [Accessed: 26-Nov-2015].
- [26] M. Lie, "Innføring av Lean Constructions hos YIT i Stavanger," MS thesis, Department of Industrial Economics, Risk Management and Planning, UiS, Stavanger, Norway 2012, <https://brage.bibsys.no/xmlui/bitstream/handle/11250/182106/Lie%2c%20Morten.pdf?sequence=1&isAllowed=y>.
- [27] K. S. Olsen, Eline og Gjertsen, "Byggherrens interesse av Lean Construction med hovedfokus på produksjonsfasen og bruk av Last Planner System," MS thesis, Department of Engineering Sciences, UiA, Grimstad, Norway, 2010 [http://brage.bibsys.no/xmlui/bitstream/handle/11250/138356/Olsen\\_Gjertsen.pdf?sequence=1&isAllowed=y](http://brage.bibsys.no/xmlui/bitstream/handle/11250/138356/Olsen_Gjertsen.pdf?sequence=1&isAllowed=y).
- [28] F. Roalsø, "Implementeringen av Lean Construction i det norske entreprenørselskapet Kruse Smith AS," MS thesis, Department of Engineering and Chemical Sciences, Karlstad Universitet, Karlstad, Sweden, 2012, <http://kau.diva-portal.org/smash/get/diva2:534872/FULLTEXT01.pdf>.
- [29] S. Skinnarland, *Lean Construction i Kruse Smith - Samhandling for økt effektivitet og bedret produksjonsflyt*. Oslo: FaFo, 2010.
- [30] S. Skinnarland and S. E. Moen, *Mot en mer inkluderende byggeplassproduksjon i Kruse Smith*. Oslo: FaFo, 2010.
- [31] H. Aveyard, *Doing a Literature Review in Health and Social Care : A Practical Guide*, 2nd ed. Berkshire: Open University press, 2010.
- [32] R. K. Yin, *Case Study Research : Design and Methods*, 5th ed. Los Angeles: SAGE, 2014.
- [33] O. Dalland, *Metode og Oppgaveskriving for Studenter*, 5th ed. Oslo: Gyldendal skademisk, 2012.