Popularizing DGNB in the Danish construction industry: A field study of the industry via a qualitative comparative analysis

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Abstract
DGNB-certifying a construction project helps to regulate and improve the construction industry. Further popularizing it in Denmark accelerates change to a more sustainable future. This paper presents the first results of a field research study of the Danish construction industry, to identify possible market opportunities towards further popularizing DGNB certification in Denmark. The study adopts a qualitative comparative study through triangulating knowledge obtained from (a) literature review, (b) reviewing the result of four actual studied cases, besides (c) conducting 20 semi-structured interviews with professionals, sharing their experiences. It is concluded that the DGNB contributes to introducing the benefits of a green-certified building to the end-users, and helping project owners understand the potential benefits of such projects. For popularizing it further in the Danish construction industry, more effort should take place on (i) spreading the knowledge of the system to the relevant stakeholders, (ii) studying the actual added-value from DGNB certifying a project, and (iii) adapting DGNB for smaller buildings (DGNB-DK "lite").

Keywords: Sustainability, DGNB, DGNB-DK, popularizing sustainability, field study

1 Introduction

The construction sector is responsible for a sizeable portion of global carbon emissions. For the construction industry to become more sustainable, rethinking standard approaches adopted by construction companies becomes crucial. However, in order for construction companies to make the drastic changes required, they need to understand, and be convinced by, what can be gained when deviating from their usual approach towards a more sustainable one (Kotter 1996).

The concept of sustainable design was introduced to the construction sector via a set of standards in the form of *certification systems*. One such certification system, DGNB, was introduced to the Danish market in 2012 (DK-GBC 2014), and has experienced a slow but gradually increasing uptake: 56 submitted certifications and 54 submitted for precertification in 2020, up from 24 and 15 submissions, respectively, in 2019. DGNB is the preferred certification tool in Denmark, and ranks buildings for social, economic, environmental, technical, process, and site qualities. Thus, a DGNB certified building is expected to be sustainable in a *holistic* sense by balancing multiple dimensions (DK-GBC 2016a).

However, compared to the total amount of newly started construction projects each year, the number of DGNB-certified projects is still low, at less than 1% since 2019. One barrier is that DGNB certification primarily attracts the more expensive and larger construction projects, which

comprise less than 5% of all new construction projects in Denmark. Even within this category of large scale projects (i.e. those priced at more than 30 million DKK), DGNB uptake is low: an estimation was made that only 16% of all newly started large scale construction projects in Denmark in 2019 were expected to be DGNB certified (DK-GBC 2019a).

This paper presents first results of a field research study of the Danish construction industry, that seeks to identify possible market opportunities for accelerating the adoption of DGNB certification in Denmark. The paper presents a qualitative comparative study (Ragin et al 1987) triangulating knowledge obtained from (a) literature research on the status of the current market, (b) reviewing four real studied cases, and (c) 20 semi-structured interviews with professionals from the Danish construction industry sharing their experiences, conducted by the authors.

1.1 Methodology

We use the Qualitative Comparative Analysis method (QCA, methodological triangulation) (Ragin et al 1987) consisting of the 20 semi-structured interviews with industry professionals from 20 construction originations and the review of 4 actual case-based studies in Section 3. The use of QCA through the triangulation technique involves using multiple data collection methods and analysis that increase the validity of this study. QCA method is, however, limits its potential to be time-consuming, and a lot depends on the selection of the collecting data sources and especially interviewees, and to what degree they are willing to share their opinion independent as the company they are representing, besides researchers' understanding and perceiving the context.

2 Background: DGNB-DK and Green Building Certification in Denmark

The Green Building Council Denmark (DK-GBC) was founded in 2010, and they established the Ger-man certification **Deutsche Gesellschaft für Nachltiges Bauen (German Society for Sustainable Buildings, DGNB)** in Denmark in 2012. The Danish version DGNB-DK was created to obtain a standard definition for addressing sustainability in broader perspectives (Kamari et al 2017) and to make it more measurable (DK-GBC 2014).

The DGNB System is based on three key paradigms: Life cycle assessment, Holism, Performance orientation. Within the certification process, the entire life cycle of a project is consistently taken into account and, instead of individual measures, the overall performance of a project is evaluated, marking a departure from other green certification standards such as BREEAM, LEED, HQE, WELL, LBC, and Active House. In its evaluation, DGNB equally weights three central sustainability areas of ecology, economy, and sociocultural issues. Performance with respect to location, technical and procedural quality are evaluated by means of certification criteria, which are individually tailored to different types of use and can be applied to new buildings, existing buildings, refurbishments, and buildings in use.

DGNB measures five qualities of the construction, as illustrated in Figure 1. They cover the score of the final project. Process quality (10 %), environmental quality (22.5 %), economic quality (22.5 %), social/sociocultural and functional quality (22.5 %) and technical quality (22.5 %). Site quality is the sixth quality, but it does not count for a percentage of the overall score but is still necessary to get the certificate.

Figure 1. DGNB's 5 part qualities plus one (DK-GBC 2020a)

2.1 DGNB certified buildings

Table 1 presents the current total number of DGNB pre-certified and certified projects in Denmark (DK-GBC 2020b). The numbers seem low, but for 2020 alone, 56 DGNB certified and 54 DGNB pre-certified buildings have been registered.

Table 1. DGNB certified construction Denmark (DK-GBC 2020b)

Building type	Pre-certified	Certified
Office and administration	7	39
Apartment block and terraced	27	23
FLEX	4	3
Hospital	4	3
Education and institutions	2	7
Conference and hotel	1	2
Building renovation	0	15
City space	10	0

2.2 Evaluation process

Any construction project can try to get a certificate, but the indications point that certification is most popular in the more expensive building projects (DK-GBC 2019a). Getting a project certified begins by registering the project to DK-GBC. Then, the owner hires a consultant or auditor certified in DGNB, and the goals of the certification level are agreed upon. The consultant/auditor sends a document for the project, and the owner will then receive a pre-certificate for the project. The last step is the final certificate documentation after 75% completion of the project (DK-GBC 2016a).

2.2.1 Prerequisites for DGNB certification

In order to be able to get a pre-certification or certification for DGNB, a series of steps are needed:

1. It must be a construction of a new building or an extensive renovation.
2. It must be an individual building.
3. To archive a certification, it must happen before a 3-year period of the stated use of the building or its completion.
4. It is the building and its connected open areas, which gets certified unless other is specified in the individual criteria.
5. The building must mainly be used as the type, which it is certified for. Except for the parking facilities, maximum of 20% of the build area can be used for another purpose.
6. If 5 is not the case:
    a. A mixed certificate with separate processes for different types of buildings is possible if the separations are clear and easy to see and must have different addresses.
    b. Smaller buildings like family houses can only get certified if they get certified together in a large group with identical houses.

3 Review of four previously studied cases in Denmark

This section contains our review of four previously studied cases in light of our research questions on steps towards popularizing DGNB-DK in Denmark.

3.1 Case study 1 - Is it expensive to build sustainably?

A report by Buus Consult (2020), published by DK-GBC, seeks the answer to the question: Is it expensive to build sustainably? Their approach is based on a statistical analysis of the price per square meter of DGNB certified building from 37 different DGNB certified buildings (3 platinum, 27 gold, and seven silver graded projects). It investigates the stored data from DK-GBC on the 37 buildings to analyze and potentially find relevant connections. The focus here to identify any possible relationship to the DGNB score. The report seeks to rationalize sustainability, which deviates from the subjective approach of *defining* sustainability, and how it is associated with an aspect of planning that is confusing and expensive.

The report argues that there are no clear tendencies to be more expensive and sustainable, and therefore a higher DGNB score does not imply a higher construction expense. It also shows that it is still possible to get a higher grade and pay less per square meter. No tendencies were found between the climate impact and construction expenses. It is concluded that there must also be other parameters that influence various projects' economics (Buus Consult 2020).

3.2 Case study 2 - Office building location, branding sustainability

Through an extensive analysis of the Danish office market, Epinion's (2016) report analyses the office domicile choice of 201 companies and how much focus they have on sustainability. The report covers what Danish companies generally focus on when seeking a new office. The hypothesis is that sustainability is not directly sought after, but has an influence when the factors that impact sustainability are specified. The investigation also covers the company's perception of the term "sustainability". The companies included in the study are consulting firms, IT, and creative professions. The distribution of company size in the study was 61% small companies (10-49 employees), 23 % medium (50-149 employees), and 16 % large (above 149 employees). The participants had to rank a series of points by subjective importance, and explain what they meant to that company.

When asked to specify their highest priority concern, only 2% of responds selected *environmental quality*. The ranking of other highest-priority concerns was: *location* (56%), *economics and operation* (19%); *wellbeing and indoor climate* (17%); *strategy and branding* (5%).

3.3 Case study 3 - Market research on the topic of sustainable buildings

A report by DK-GBC (2016b) explores market research on the topic of sustainable buildings in the Danish construction industry. The report is built on data sent to 55 people from 45 companies, both from members and non-members of the green building council in 2016. The data is collected from a survey sent to people on e-mail or social media. The survey was done in collaboration with Rambøll. 25% of the participants originate from a company of 1-20 employees, 11% from a company of 21-50 employees, 33% from a company of 51-500 employees, 11% from a company of 501-5000 employees, and 20% from a company of >5000 employees. The construction of the survey began by identifying the professional background of the participants. After which, the general opinion of sustainability is placed and their view of the market status. The survey also includes the participants' opinions towards sustainability certificates.

The main relevant conclusions in the report are that:

- 80% believe that there will be an increased demand for sustainable buildings, and no one believed in a decreased demand.
- 48% see a better economy as a defining argument to build sustainability.
- 85% expect that the ambitions will increase on the topic of sustainable buildings.
- 75% believe that further development is connected to the demand from the end-user.
- 90% expect that the value increases by certifying the building.
- A way to popularize sustainability in the building industry is to spread the knowledge to the given stakeholders.

3.4 Case study 4 - Use of DGNB for increasing the value of properties

Throughout history, organizations have attempted to merge social, environmental, and economic considerations into their business models and create shared value for society and the individual corporation at the same time. However, this has proved to be a complicated process, especially making the environmental and social benefits profitable and incorporate them at the heart of the business model (Olsen 2018). This issue is the core of the objective of the report by Rasmus Grosen Olsen in 2018, on 'How can Co-Branding create increased value for Pension Danmark and DGNB.' It is performed through 11 qualitative interviews and an empirical basis from qualitative data from a market survey. The researcher acknowledges a need for critical thinking when handling his qualitative data.

The key findings include the opportunity of increasing Pension Danmark's Corporate Social Responsibility (CSR) by using DGNB, there is a lack of documentation on the effects of the

certification, there is insufficient knowledge among DGNB stakeholders, and there is a lack of brand awareness of DGNB, especially outside of professionals in the construction industry.

The use of DGNB on Pension Danmark's properties is expected to increase their value due to the expected growth of awareness on the topic of sustainability and certification, providing a competitive advantage over other non-certified buildings in the future. This lack of awareness and understanding amongst key stakeholders is expected to undermine efforts of actively choosing the certification (Olsen 2018).

4 Semi-structured interview of engineering consultants, engineering contractors and project owner in Denmark

To verify or discharge the afore-stated hypotheses, data was collected in the form of semi-structured interviews with key professionals. As DGNB has only been in Denmark for certification since 2012, only a small subset of the industry has qualified experience with DGNB certification. Thus, due to the small set of experts and the relatively new topic in the Danish context, the interview consists of open and explorative questions in a semi-structured format, similar to other research efforts in sustainability and building energy (Galvin 2015).

The specific aim of the interviews was to (1) investigate the topic of DGNB-DK, (2) to identify the attitude towards DGNB-DK certification, and (3) to gather opinions on how to popularize the use of DGNB in Denmark. The questions were designed to encourage the interviewees to speak openly and freely from their perspectives in order to increase honesty in statements and to result in a broader data set. The interviews were conducted between September 2020 and November 2020. Interviews were carried out remotely, by skype or phone call (due to Covid-19 restrictions). The interviews were divided into three parts. The first part was formal, and sought the interviewee's professional status, background, experience, and role connected to DGNB projects. The intention was to ease interviewees into the interview, establish basic rapport between interviewee and interviewer, and make the interviewee generally more comfortable. The second part focused on their perspectives on some of the questions, making room for a broader view and some follow-up questions, which supported them in specifying their reason for their standpoint. Finally, the third part was addressed any skipped questions, and contained questions that sought their opinion on how to make DGNB-DK more widely used in Denmark.

4.1 Diversity of interviewees

The interviewees all have working experience with DGNB-DK, have worked in connection with DGNB certified construction projects, their professional backgrounds are connected to the Danish construction industry. In order to gather a broad, diverse set of responses, the pool of interviewed professionals covers different: age groups, genders, educational backgrounds, graduation periods, company sizes, working positions, sectors (public, private), levels of experience with DGNB (newly introduced, and veterans with years of DGNB experience). The companies were all selected from the Aarhus area, in Aarhus city, Denmark.

Specifically, we interviewed 20 participants. Participants were employed in one of three **types of companies** ("*" indicates that the company is also a project owner):

- engineering consultants (NCC*, ZÜBLIN, Enggaard*, MT Højgaard, Jorton)
- engineering contractors (LB Consult, Newsec, Niras, Viggo Madsen, Etos
- ingeniører, AFRY*, Rambøll)
- project owners (Pension Danmark, Topdanrmak Ejendom A/S, Boligkontoret Aarhus, AAB Aarhus, Kilden & Hindby, Danica Ejendomme, Bygnings-styrelsen)

The diverse set of **job positions** of participants are: sustainability consultant, sustainability specialist, director and technical business unit manager, head of the department, technical director, technical consultant, head of bids, head of sustainability, HVAC engineer, project leader, project director, project employee, partner, CEO, member of construction and innovation.

Participants graduated between the years 1984 and 2020 with the following **educational qualifications**:

- Bachelor and Master of civil engineering
- Master of Architectural and Civil Engineering

- Masters in Geography and Political Science
- Bachelor of Architectural Technology and Construction Management
- Bachelor's in technology Mgt. and Marine Eng.
- Environmental Accountant
- Architect
- Construction Architect
- Construction Economist
- DGNB consultant
- Energy consultant

4.2 Interview guide

The interview guide used to conduct interviews in this study consists of the following questions:

- Would it be acceptable to use your name and company in this project?
- What is your professional background?
- How many DGNB certified projects have your company taken part in?
- What is your connection to DGNB certification?
- Which project types could benefit from DGNB certification?
- Why does your company work with DGNB?
- How do you reckon this could have been avoided?
- Have you experienced/heard of some difficulties from constructing a DGNB certified project?
- Who is responsible for DGNB certifying a building?
- Do you believe something makes companies/people less interested in working on DGNB projects? If yes, what?
- How do you think DGNB could become more popular?

4.3 Data analysis

The interview transcripts were analyzed in an iterative process, investigating emerging concepts or agreements/disagreements. We first coded the data[1] in line with standard practice in qualitative research (Coffey et al 1996). The QSR Internationals program NVivo was used (Gibbs 2002) to manage, sort, categorize and search through the coded transcriptions.

5 Analysis and Findings

The following subsections present the key findings from the interviews cross-tabulated with the case studies' information and the empirical data derived from the literature research.

5.1 Which types of building projects can benefit from DGNB certification?

When choosing to certify a building, 50 % of the interviewees independently agreed that all buildings are suitable for certification. The second most common opinion showed that 30 % of the participants expressed every building, except for the smallest ones, could benefit from DGNB certification, e.g.:*"I see that it is more suited for the larger projects than the small ones, due to the sheer amount of work in a DGNB certification, and the added workload. Thus, I believe that it makes more sense in the larger projects where there is a larger budget."* This follows the current market trend where the certified projects have a budget above 30 million DKK (DK-GBC 2019a).

There is an added expense besides the mandatory fee from DK-GBC regulated by the area of the building (DK-GBC 2019b). Two participants mentioned that the costs are approximately 1 million DKK when adding up all the extra person-hours from the consultants and auditors.

Four out of 5 interviewees, who each had more than five years of experience using sustainability tools, supported the opinion that every project can benefit from certification. The same is pointed out by 6 out of the 10 project owners.

One participant said: *"I believe that all projects can benefit from it. I am working on every type of project right now. From the large industrial buildings to office buildings to kindergartens and a*

[1] Coding is the act of classifying parts of texts into categories to be later able to compare the statements.

common house project. Especially the DGNB system can be used in a variety of different ways." In this regard, case study 3 (Section 3.3) also showed that 48% of the participants had wished for a better economy in the building when certifying a building, 90% expected that the value would increase by certifying the building, and 24% believed that certification could increase the buildings rental or sales value (DK-GBC 2016b). This could make up for the added cost of a project. Likewise, case study 4 concluded that certifying a building could benefit the companies Corporate Social Responsibility and create value (Olsen 2018).

5.2 Who is responsible for DGNB certification of a building?

65 % of participants agreed that the project owner should be responsible for DGNB certification. However, a majority of the 65 % also indicated that other project participants have a significant influence on achieving certification. Only 20 % said that all participants carry the responsibility together.

Only 1 out of 10 project owners agreed that all stakeholders should carry the responsibility. In contrast, the remaining 9 project owners said that it is the project owner alone who is responsible. However, it was agreed that others could influence the project owner, e.g.: *"From the very beginning, it is exclusively the project owner who needs to have the interest. If there is no interest in certifying, then it will never be because it is not something we choose ourselves."*. Another participant added: *"It is, of course, the project owner who chooses if [they want] it, considering the cost. But then the consultant can recommend certain procedures like DGNB."*. The participant continued by supporting the idea that the DK-GBC process of certifying a building should start at the project owner (according to DK-GBC 2016a).

Three participants stated examples where the project owner chose to certify based on other participants' recommendations. Another participant added: *"We are all responsible as an actor in the project. You cannot complete a DGNB certification if not everyone is on the same page because everyone needs to hand in the documentation. The project owner, architect, landscaper, engineers, auditor, and contractors should make certification possible. If an actor does not document their part, it will become a lot harder."* This emphasizes how the project owner cannot conduct the certification alone.

5.3 Cases of stakeholders lacking interest in working with DGNB

Out of the 20 participants, 85 % had experience with people acting negatively towards the idea of working with DGNB. However, 10 individuals expressed that this tendency is dissipating from the industry. Only 15 % never had any negative encounters. Those three individuals all finished their education recently relative to the other participants, between 2010 and 2020. The 10 participants stated that this points towards the same conclusion. Likewise, in case study 3 (Section 4.3), namely that 80 % of the participants believe that there will be an increased demand for sustainable buildings, and no one believed in a decreased demand (DK-GBC 2016b).

One participant said: *"Well, it is a very conservative industry, you know, the building industry. It will take some time before people see the meaning in the new, but I see that people are more and more open towards it. This includes both the large engineering contractors but also the construction workers. Overall, I feel like I have many positive experiences in that matter. It could also just simply be because I am lucky. There will always be someone who thinks change is bad. Why not just do as we are used to? That is how I experience this industry."*

Concerning the older and more experienced employees who had shown general negativity towards the new employees, one participant stated: *"you try to take a walk down the hall here and ask the project directors and managers what they think of DGNB. They will most likely call it something for hippies. When I started as a DGNB consultant, they thought I should take the bike to work because I was sustainable now. This shows that if you have this attitude towards it, and when you get a new project where they need to DGNB certify it, then their focus is all wrong."*

Both statements point negativity towards DGNB, while 50 % of the interviewees pointed towards the fact that the negative viewpoint is outdated. Likewise, case study 3 also identified that 61.5 % would build a certified building if the market demand increased (DK-GBC 2016b). This participant also mentioned that as junior employees would subsequently replace the older

generation, their negative opinion of DGNB would probably also retire. Moreover, their opinions are most likely formed due to having observed many new trends emerge during the career, which never became an industry standard.

5.4 Problems connected to working with DGNB

Out of the 20 interviewees, 70 % argue that there are problems connected to working with DGNB. Only 10 % stated that they could not identify any issues at the time, while 40 % stated that there is a problem related to the added expenses when DGNB-certifying a building. As previously mentioned, two participants believed that certification for a building would cost approximately 1 million DKK.

5 out of the 8 participants who had acknowledged added expenses as a problem were project owners. This indicates that project owners, as the stakeholders that must pay for it, ultimately decide to certify or not, as discussed above. Looking at the representatives from the companies with less than five certified buildings in their portfolios, 6 out of the 8 within their group agree that the expenses are a problem. This indicates that the more experience a company has constructing DGNB certified projects, the less of an obstacle the expenses seem to be. One participant mentioned that in some cases, they construct a building capable of certification without submitting it for DK-GBC. This shows that the added expenses from the costs to DK-GBC and the auditor are the only factor keeping them from registering for certification.

Additionally, the added expenses were a crucial factor that kept three interviewees from recommending certifying the smaller buildings. This was emphasized in section 5.1, as well. While stakeholders expect that certifying a building will add value, there is no strong evidence of this in the market today. Six interviewees perceive this as an action point for popularizing DGNB. E.g. two participants expect that a future market could be influenced by the current sustainability trend making a non-certified building is harder to sell. Another participant expects the market to change to result in some buildings losing value if they are *not* certified. It was further pointed out how the added expenses may serve as insurance for the building to prevent it from losing value.

Two participants argued that parts of the added expenses are the extra work that comes along with certifying a building. 35% of the interviewees think that the focus of the certification process documentation is too high, e.g.: *"the documentation becomes more important than the actual product. I got an issue with it because I have seen so much polished documentation, which tells how great and impressive a house is. It got everything. However, when we look at it, it is actually 'shitty.' The construction lacks effort from the contractors and the consultants' missing follow-up. Nevertheless, the documentation tells another story. That is the wrong direction to take. The focus should be to build high quality."*

In contrast, another participant said: *"I experience more frequently, especially the contractors saying: 'Well is that all we need to do? That is not so different from what we use to do.' It is just a few extra steps, and they understand the added benefit."* This shows that not every stakeholder shares that opinion. Four participants stated that adding DGNB to a project can be very easy, but it depends on the project. If the project owner wants to sell off the building and make a quick profit, then the addition of DGNB could be expensive, partly due to the added documentation.

The added load of documentation is problematic in some cases, but 30% of the interviewees expressed scenarios where the focus of stakeholders shifts to taking an easy way out. Still wanting the DGNB certification while wishing to reduce the added workload, they seek out *"the easy points,"* as two participants indicated. The job of one of these participants indeed includes finding easy DGNB points to add to the project, thereby gaining a higher DGNB score without focusing on improving the project. To counteract this, they recommended changes to the standard: *"…to increase the weight of scores which are harder/more expensive to get such as a green façade."* Another participant mentioned the example of: *"having 200 biking spots where no one bikes to work due to its location."*

The problems identified by the interviewees were not significant enough for them to avoid the system in general. The interviewees presented the issues as elements of possible improvement. Only a few stated the problems as issues that a company had experienced concerning the system's use. However, as case study 3 concluded: 61.5 % would certify if the

market demand increased (DK-GBC 2016b), and one participant further added: *"they do not want to be left at the station"* when explaining why more people use the system. Thus, these problems appear to be relatively minor.

5.5 How to popularize DGNB in Denmark?

When asked how to make DGNB more popular in the Danish construction industry, 65% of the initial statements were that it would become popular by itself or it already was popular. The statistics from 2019 show that only 16 % of the buildings worth more than 30 million DKK would be certified (DK-GBC 2019a). When interviewees were presented with this statistic, which contradicts the view that DGNB is already popular, they further specified their standpoints.

35% of the interviewees envisioned that DGNB is becoming popular due to a more straightforward project operation when a larger portion of the industry joins. This would make every stage in the process of construction better suited to the DGNB system, from raw material production to the final building elements.

60% of the participants agreed that dissemination of knowledge was the most effective way to popularize the system, e.g. one participant answered *"lack of knowledge"* when asked why projects were not certified. That standpoint is also presented in Case study 4 and Case study 3, where it is stated that: *"A way to popularize sustainability in the building industry is to spread the knowledge to the given stakeholders"* (DK-GBC 2016b).

5.5.1 Increasing uptake via increasing stakeholder knowledge

The interviewees mentioned various project stakeholders that the knowledge could be spread to further. One participant discussed the end-user who needs to gain a better understanding of the benefit of a DGNB certified building compared to a non-certified building, and stated that they should be able to seek that information out: *"I see students choosing to build because they are more sustainable."* This shows that people want to gain the benefits of living in a DGNB certified building, however, they currently do not necessarily know what DGNB stands for or the potential value it may have for them.

Another participant indicated an increasing need for end-users to become more educated on the matter: *"there is a tendency that the people who will rent the apartments are becoming more critical. What kind of materials is used in the building, how is the ventilation, is it low energy, are there any chemical vapor from paint."* Later in the interview, they also pointed towards DGNB being a term for the professionals and further argued that the common citizen does not know the meaning of it. Understandably, if there is a lack of knowledge, the end-user will not know to ask for it nor seek it out, as they are unaware of the benefits connected to DGNB.

Two participants mentioned cases where professionals in the industry do not know enough about DGNB and are consequently skeptical. Furthermore, as raised by three participants, most project owners could not manage the process on a DGNB project without a qualified consultant to guide them through the process.

5.5.2 Increasing uptake via new national regulations and laws

The Danish building code for energy demand (DBR) has become increasingly strict over the years by reducing the allowable average energy usage per m^2 for the entire building mass (Danish Energy Agency 2015). In this context, 40% of the participants argued for using regulation or laws to drive DGNB uptake. Case study 2 also echoed that 70% of the companies did not have any sustainability demand for their office building (Epinion 2016), indicating that a majority of companies will not actively seek out the construction of a sustainable building. Governmental regulations demanding more sustainable buildings are predicted to increase DGNB's market coverage, as it is deemed sustainable (Green Building Council Germany 2020).

One participant argued: *"That is what we need. If regulations require it, then will the remaining buildings follow if the government said so?"*, and *"Everyone expects it. Suppose they must live up to their 2030 plan. Then they need to change the regulation to suit it. We believe it will change. The coming years will DBR be stricter; otherwise, they will only be 30% there."* Regulations cannot explicitly demand DGNB as it violates the Danish Public Procurement Act §2 (Poulsen 2015). Thus, other certifications will possibly also benefit from it. Five of the interviewees further pointed towards the voluntary sustainability class in DBR as the leading competitor.

5.5.3 Increasing uptake via new evidence of added economic value

30% of the interviewees opined that evidence of the economic gains when certifying a building could increase the system's popularity. However, none of those participants with that view are contractors, indicating that contractors usually do not convince anyone to use DGNB and do not gain anything compared to a non-certified building. This follows the expected trend where the project owners or consultants pull towards DGNB, as participants stated above.

Likewise, a participant stated: *"Doing the DGNB consultant education, many people asked if there was any evidence of added value… I sometimes miss the evidence that I can show to a client and why they should invest in DGNB. Because to them, it just looks like an added expense."* Thus, the project owner's added economic benefit when choosing to certify a building project may not be precise enough. Identifying the economic gains or proof thereof is missing at this stage.

Case study 1, published by DK-GBC (Buus Consult 2020), attempts to counter the view that it is expensive to be sustainable via DGNB certification. However, the only conclusion is that they did not find any clear evidence that the higher graded DGNB project (platinum/gold) is more expensive than, the lower graded (silver/gold) as the study did not include non-certified buildings (Buus Consult 2020). Case study 3 concluded that 90 % of the participants believed that the use of DGNB would increase its value, and 38.5 % would certify if the effect of the certification is better documented (DK-GBC 2016b). Case study 4 builds on Pension Danmark's statements that they expect DGNB to be an economic gain (Olsen 2018). This is in alignment with their business plan; however, it is limited to being speculation and lacks evidence.

5.5.4 Increasing uptake via "lite" versions of DGNB

25% of the interviewees suggested an improvement to DGNB's portfolio by adding a lite version. This version should make it easier to estimate what the DGNB process would cost and how the lite version could apply to smaller buildings. One participant stated: *"I believe that if you could work with a lite model for the smaller projects, then it would be more accessible. I think that it should be scaled down. When working with small tranced houses and family houses, then some of the criteria becomes irrelevant. Like the longest distance to a bike parking space. I believe that it is some different things that show if a small house is sustainable."*

However, it was pointed out by another participant that: *"the problem is when you use the system on a smaller project the repetitions decrease, which means that every process needs to be documented in the smaller projects; where a large project repeats itself. Making the small building have the same number of documentations as a building 100 times its size."*

Both statements above indicate problems when using the current system on smaller-scale buildings. One solution could be to create a lite version that is better suited for those projects. One participant mentioned that the voluntary sustainability class might be even a better idea. The argument for including the smallest buildings is that 95.13 % of the Danish buildings are under 500 m^2 (Danmarks Statistik 2020). Therefore, they account for most in Denmark (2020).

5.6 Why work with DGNB?

45% of the interviewees believe that an argument in favor of working with DGNB is to ensure sustainable development, e.g.: *"There is no doubt that DGNB is equal to sustainability.", "We do not see sustainability as a cost for the projects. We see it as a win for both the project owner and society.",* and *"Use it in a way to make a difference."* In Case study 2, 25% of the reviewed companies had a strategy for sustainability; DGNB certification is one approach that could fulfill this role for the Danish building industry.

Another argument in favor of working with DGNB is the potential economic benefit. 75 % of participants expressed that DGNB certification of a building could give the project owner economic gain. This aligns with conclusions from Case study 3, where 90 % of participants believed that certification could increase the building's value (DK-GBC 2016b). Implementing the DGNB system in an organization's strategy may theoretically improve it from an economic point of view, similar to Pension Danmark in Case study 4 (Olsen 2018). The types of potential economic gains are identified as added sales or rental value, insurances that the building is attractive in a future market and the economic gains from an improved Corporate Social Responsibility;

although this remains speculative with a lack of strong evidence that all projects will experience added economic value from DGNB certification (Section 5.4).

6 Conclusion

This paper presented the first results of a field research study of the Danish construction industry, to identify possible market opportunities on how DGNB certification can popularize further in Denmark. Key conclusions of this study are:

1 : There is a general agreement from the interviewees that DGNB would become popular by itself. No drastic measures are necessary to change to a more sustainable orientated industry, as the industry seems to do this gradually on its own. The tendency of the industry also pointed toward, that a market trend like sustainability seems to make a permanent stay in the industry, lead to the phenomenon of the "fear of missing out" if a company were not to join in on the trend. Therefore, the industry actively seeks out sustainable measures itself.

2 : Knowledge about DGNB should be extended to a broader class of stakeholders, including the entire construction sector as well as the end-users. Knowing what DGNB is and what it will be beneficial for its widespread use. The knowledge should be extended to project owners, as they are the ones having to pay for the fee. Further, participants argued that stakeholders also need to understand what DGNB certification means in a simplified form. Extending knowledge of the benefits for the end-user will enable them to seek out more sustainable buildings as they currently live a better energy-efficient lifestyle.

3 : The reason for DGNB not being more popular was partially argued to be the conservative attitude from the Danish construction industry, but the market share was expected to increase in the coming years. A few issues connected to DGNB were introduced. The expenses would still be upsetting for some stakeholders, but it was expected that it could be worth a little extra as the output makes up for it. The high focus on documentation throughout the DGNB process could be frightening for some newcomers, but both EN and RA explained that when the contractors try it out, the process is not too farfetched to them.

4 : DK-GBC strives to keep DGNB relevant and will do so by adapting and changing to best fit into the industry. Improvements will continuously be made, which is anticipated to support becoming an industry standard.

5 : The vast majority of buildings could benefit from green building certification, both in terms of the quality of the project and in terms of economic benefits for the project owner. However, it is required to estimate what the DGNB process would cost or how a "lite" version could suit smaller buildings.

Future research studies can, therefore, focus on (a) spreading the knowledge of the system to the relevant stakeholders, (b) studying the actual added-value from DGNB certifying a project, and (c) adapting DGNB for smaller buildings (DGNB-DK “lite”). This can be through developing a new rigorous framework for formalizing and implementing its features into a decision support software system, which can be complied with Building Information Modelling – BIM (Kamari et al 2018a,b; 2019a,b; 2021a,b).

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