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Drivers, barriers and development needs for LCA in the Nordic building sector – a survey among professionals

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Abstract. *Introduction:* Design practitioners' knowledge and understanding of LCA is crucial for the necessary transition to decarbonisation of the built environment, as well as for lowering other environmental impacts. Recently, the Nordic councils of ministers suggested enhancing cooperation and harmonization within the use of LCA in the built environment in order to accelerate climate change mitigation in the building sector. To this end, it is important to identify in which areas harmonization and cooperation is especially needed. This paper presents the results of a survey on the LCA practice among Nordic design professionals in Norway, Sweden, Finland and Denmark. The aim is to analyse the survey results, and to reflect on the implications for further harmonization of method and industry practice within the Nordic region. *Method:* Survey results for the Nordic countries represent a subset of a larger survey conducted as part of the IEA Annex 72 project about assessing life cycle related environmental impacts caused by buildings. The web-based survey, targeting design practitioners, was carried out from late 2018 to late 2019 within 24 participating countries. From the Nordic countries, 223 respondents accessed the survey and answered one or more questions. *Results and conclusions:* The survey shows that Nordic building designers, in general, feel personally or professionally committed to applying LCA. However, a main barrier for including LCA in the building design is the perceived lack of incentive as well as a lack of sufficient data and information. Respondents perceive a moderate drive from the public sector and property developers/investors for integrating assessments of environmental performance. Concerning development needs, respondents point towards harmonization efforts within LCA for use within BIM. Results of this survey furthermore reveal the dilemma for the designers between, on the one hand, needing to know all the details of the environmental assessment to learn what drives and controls the results of a project, and on the other hand, needing to convert the results of a project into easily communicable information for the client. This 'translation' of results is an additional area of potential harmonization within the Nordic region.

1. Introduction

Life cycle assessment has become a key tool for evaluating the significant environmental burden of the building sector. By evaluating materials, products and whole buildings in a life cycle perspective, building designers may use the information provided by LCA to make informed choices about environmentally sound building designs. On a methodological level, there is a movement towards a harmonization of LCA method and practice, for instance via the IEA EBC Annex 57 and 72 projects [1,2]. On a European level, the harmonization is largely founded on the CEN/TC 350 standards from 2012, introducing a common framework for, for instance, terminology, scope and indicators concerning the LCA of buildings [3]. Other systems of relevance for the ongoing harmonization include the Product Environmental Footprint and the Level(s) reporting scheme.



Harmonization of LCA as a method is but one precondition for successfully lowering the environmental impacts of buildings and constructions. A second precondition of vital importance is the actual LCA practice employed by the building sector. There is an increasing focus on making LCA method and tools available for design professionals in the building sector [4,5]. A coordinated effort is needed to ensure comparability and consistency across the sector. However, large differences in construction, as well as environmental assessment practice, may complicate this harmonization.

Recently, the Nordic councils of ministers suggested enhancing cooperation and harmonization within the use of LCA in the built environment in order to accelerate climate change mitigation in the building sector. The topic of harmonization within the Nordic building sector has been receiving considerable interest based on the fact that several construction and consulting companies bid and work on projects across the Nordic countries. Furthermore, building authorities in Norway, Sweden, Finland and Denmark have all developed, or are in the process of developing, national guidelines and regulation for building-LCA. Hence, method and practice is well on the way in the Nordic region. To support this development, it is important to identify in which areas harmonization and cooperation is especially needed.

This paper presents the results of a survey on the LCA practice among Nordic design professionals. The survey was conducted as part of the Annex 72, an international research project under the auspices of the International Energy Agency's Energy in Buildings and Communities programme. The survey aimed at illuminating the LCA experiences of building designers in Norway, Sweden, Finland and Denmark. A specific focus on identifying the drivers and barriers towards increased use of LCA in the design process was chosen. The aim of this paper is to analyse the survey results in light of the ongoing development of LCA requirements in the Nordic countries, and to reflect on the implications for further harmonization of method and industry practice within the Nordic region.

2. Methods

The survey results of the current study was generated from a larger pool of responses to an international survey. This original, international survey was carried out under the auspices of the international IEA EBC Annex 72 Subtask 1 dealing with LCA method development and harmonization. The international survey aimed to map a broad range of LCA-related practices among building designers, e.g. the use of building information modelling, and the barriers perceived for using LCA. The survey was prepared by the coordinating group of LCA research experts in the Annex 72, and the survey was subsequently qualified through the inputs provided by the more than 50 international experts of the whole Annex 72. The survey was conducted as a web-based questionnaire, and was distributed by the Annex 72 experts in their respective countries via social media and, in some case, via national organisations, e.g. national association of architects. Responses were received throughout 2019. The full list of questions of this original survey can be found in Deliverable 2 of the Annex 72 publications (in progress), in which international, as well as national and regional, responses are displayed. The results generated by Nordic respondents to this Annex 72 survey constitute the core of the current study.

223 informants from Norway, Sweden, Finland and Denmark accessed the survey and made one or more responses. Having accessed the questionnaire, the respondent had the choice to skip questions and to quit the questionnaire at any time. Hence, each question was not answered by the full number of informants. Responses were extracted and data was prepared in graphs and figures. For the focus of the current paper, a selection of questions and responses were made to illustrate the background of the respondents, the drivers identified for using LCA and the barriers and development needs identified for building-LCA in Nordic industry practices.

3. Results

3.1. Respondents' background

Figure 1 illustrates the professional background of the respondents. The figure indicates that the vast majority of respondents, 81% in total, are found within the categories of civil engineers and architects.

Figure 1. Professional occupation of respondents. Based on 68 responses.

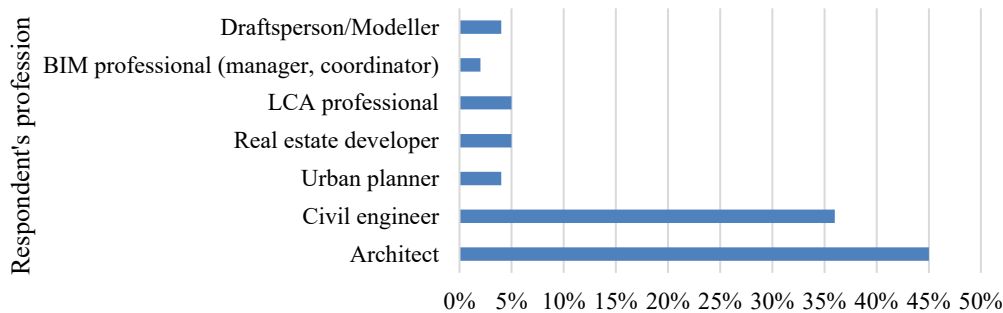


Figure 2 illustrates the company size of the respondents. There is a notable amount of respondents, 35%, belonging to the category of large companies with 250+ employees.

Figure 2. Number of employees in company of the respondent. Based on 62 responses.

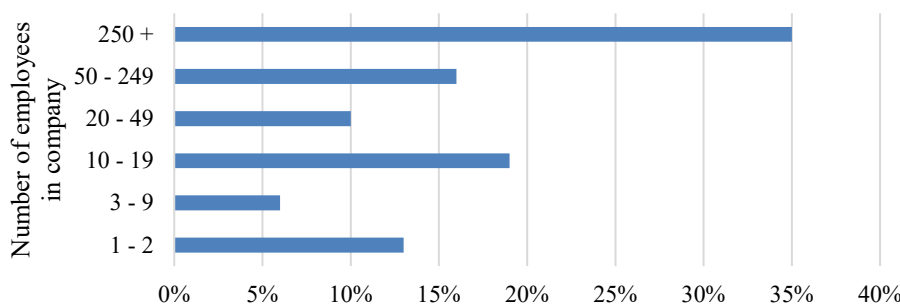
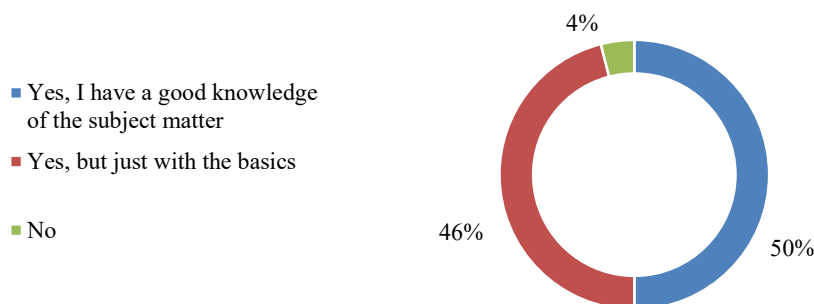


Figure 3 illustrates the self-declared competencies with LCA of construction products and building. Only 4% declare not having any knowledge on the subject. For the remaining part, approximately half the number feel confident with only the basics of LCA and the other half report having a good knowledge on the subject. The figure can be interpreted as an indication of mainly LCA-knowledgeable respondents being attracted to answering the questionnaire and this question in particular. The level of LCA knowledge indicated here is, thus, most likely biased, meaning that it does not represent the level of knowledge among all Nordic building designers in general, but only for the respondents of this questionnaire.

Figure 3. Responses to the question: Are you familiar with environmental LCA of construction products and buildings? Based on 70 responses.



3.2. Drivers for using LCA

Figure 4 displays the responses to a question about what motivates to use environmental assessments in projects. Note that the focus of this question is broader than just LCA as it encompasses the general focus on environmental assessments. The responses to this question are displayed for each country and as a Nordic average. A notable amount of respondents, 29%, and up to half the Finnish responses, indicate that their motivation to include the aspect in projects is based on personal conviction. Other, highly profiled motivational factors concern company policy and requirements by clients. Few respondents, 9% in total, point to regulation or expected regulation to drive the application of environmental assessments in projects. This low number is somewhat surprising, considering the fact that all four countries are preparing some kind of regulation concerning LCA. Apparently, this preparatory process for regulation has not influenced the respondents of this survey.

Figure 4. Based on 63 responses to the question: What motivates you to use environmental assessments in projects? Note: Respondents had the opportunity to select more than one answer.

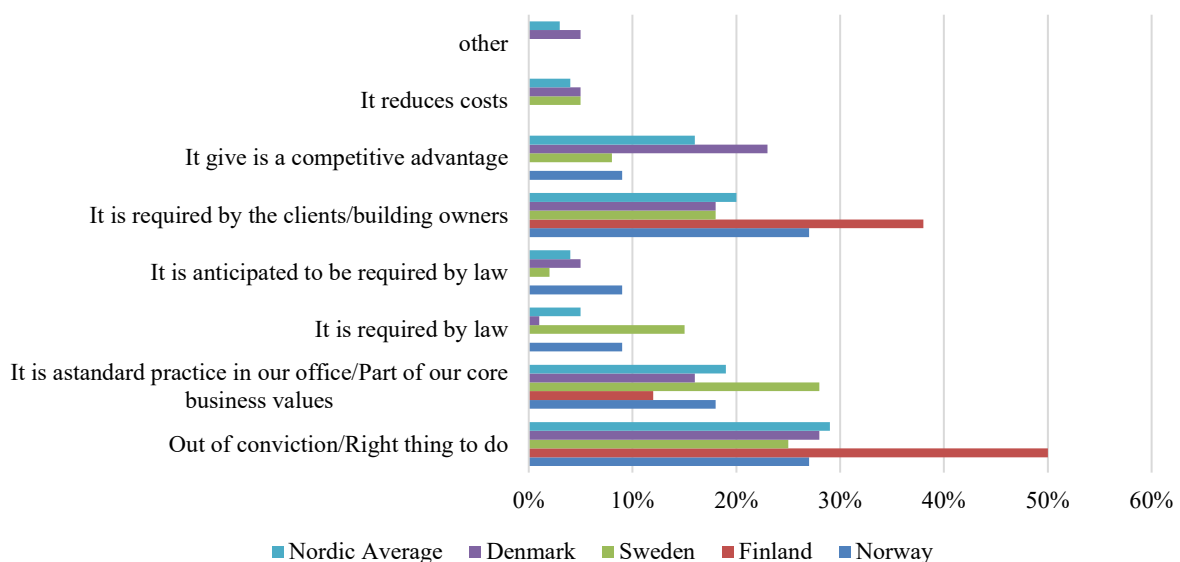
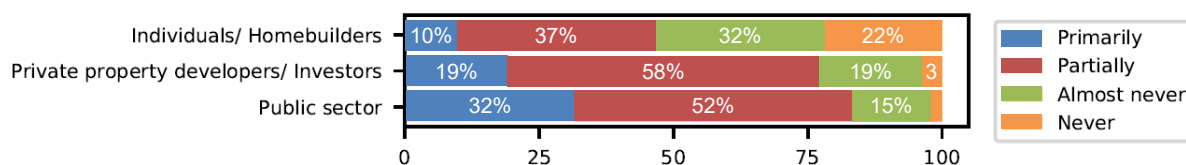


Figure 5 illustrates the indications from respondents about which type of clients usually demand services concerning environmental performance assessments. The numbers show how the public sector and the private property developers and investors seem to drive the demand by primarily or partially requiring environmental assessments in 77-84% of cases, whereas the corresponding number for individuals and homebuilders is at only 47%.

Figure 5. The clients asking for services concerning environmental performance assessments.



3.3. Barriers and development needs

Figure 6 displays the perceived barriers for environmental performance assessments as stated by the respondents. The figure shows how a general lack of incentives (lack of regulation / clients not requiring it) is perceived by respondents as an important barrier for further uptake. Additionally, the lack of information and data is perceived as the major barrier. Resources in terms of time and costs are, viewed together also seen as important barriers from the viewpoint of the building designers. Further, a general

lack of expertise and training opportunities can be viewed together as an indication of the level of knowledge being perceived as too low, currently.

These responses are similar to the ones from a previous 2015 LCA survey in the Nordic countries, performed as part of the NORNET LCA network project. In a publication by Schlanbusch et al. [6] on this previous survey, time/cost and lack of data was also listed as top issues concerning application of LCA in the building sector, further specifying how comparability of results and lack of transparency was seen to inhibit the use of LCA.

To this end, a harmonized approach to defining LCA method and background data within the Nordic region may act as a lever for more wide-spread use in the building design. Further, incentives are needed to boost the demand from clients. This could be in the form of regulation, but it could also be in the format of rewards for applying LCA. For instance, within several, larger urban developments, there are examples of sector-based networks promoting front-running, environmental building projects, publishing learnings, and facilitating knowledge-exchange [7,8]. Lastly, training of building designers in applying and understanding LCA would likely benefit the industry in terms of saved time and cost. Improved training concerns knowledge building at education level, but also concerns the effective communication of LCA to professionals in practice via targeted publications and courses.

Figure 6: Number of responses concerning the perceived barriers for building environmental performance assessments in the Nordic countries. Note: Based on 48 respondents, all having the opportunity to select more than one answer.

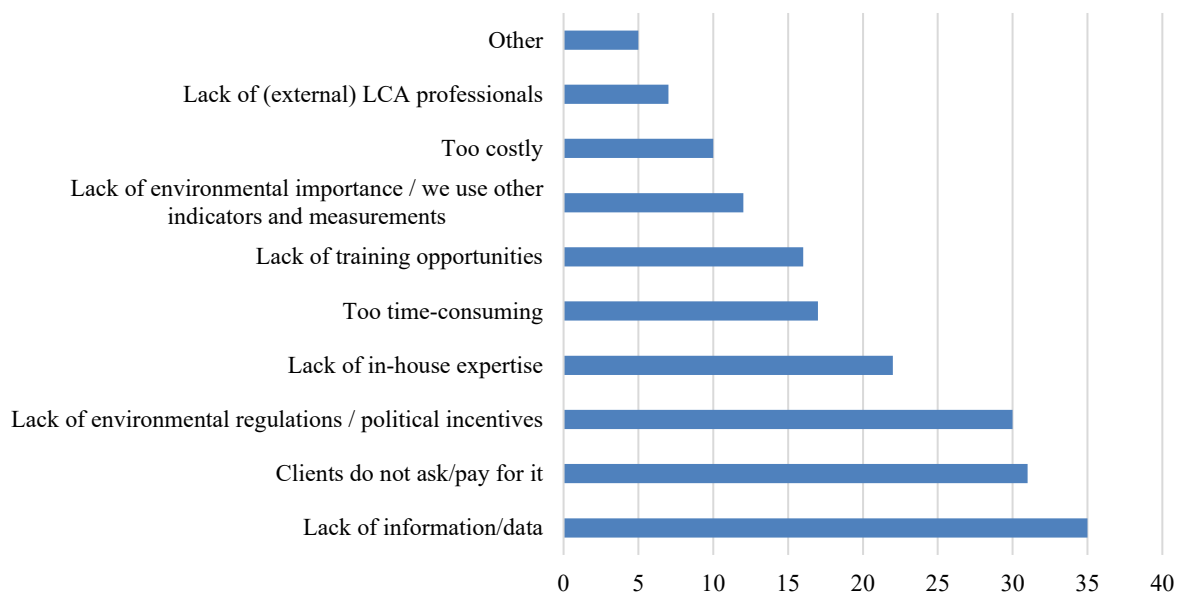


Figure 7 represents two different questions concerning the communication formats preferred by designers and clients. As seen from the figure, there is an almost inverse relationship in the preferences; the designers preferring most the detailed information and less the simple type of single-indicators and labels, in contrast to the clients preferring most a label format and least a comprehensive list of indicators.

These responses point to the important role of the building designers as interpreters of the detailed information into a more simplified format. Optimally, designers need aiding tools that allow for in-depth understanding of projects in order to generate the knowledge needed for later projects [9]. However, the designers also need to be able to condense results into the simplified format required by clients. Further work on this topic could target the harmonized development of tools and formats (e.g. for single-score indicators) that stimulates an increased demand for LCA from clients.

Figure 7. Preferred communication formats of designers (red – based on 66 responses) and clients (blue – based on 65 responses).

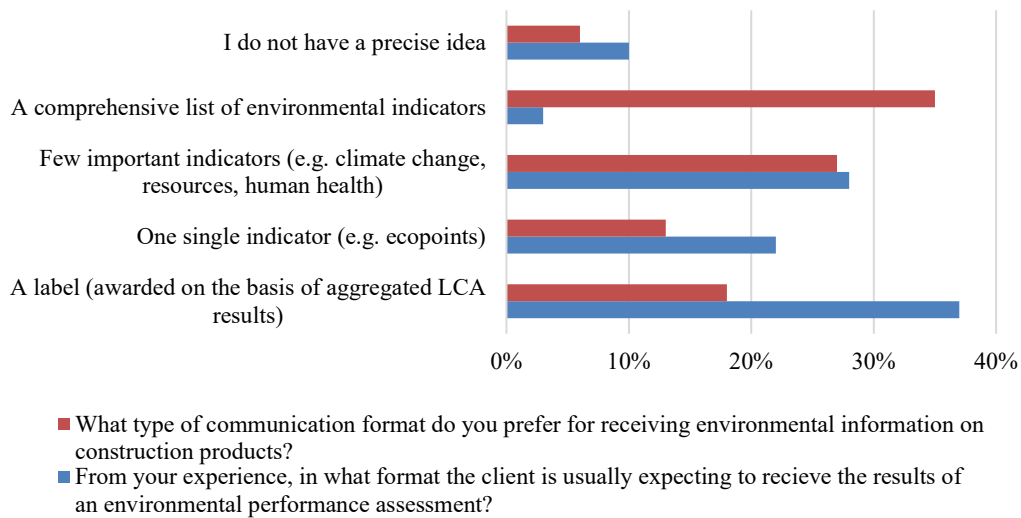
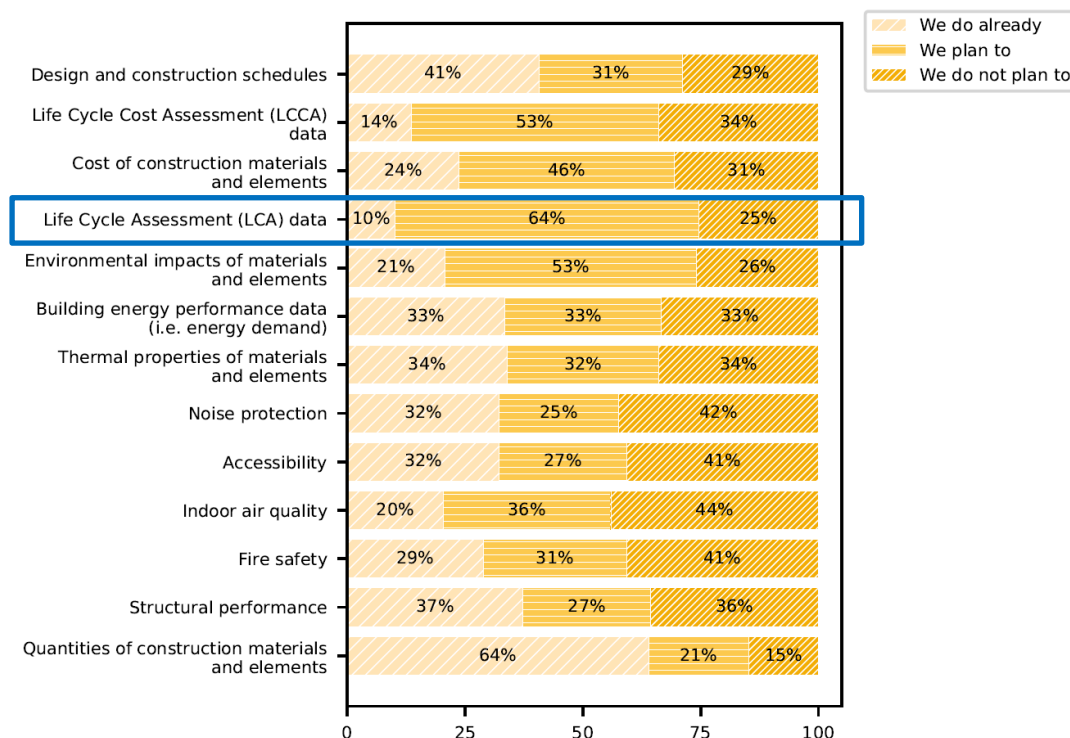


Figure 8 shows how future development and harmonization within the Nordic region may be rightfully focused on streamlining the procedure and structure for integrating LCA aspects into building information models (BIM) used by the building industry. Currently, only 10% use BIM in relation to LCA. However, an astonishingly 64% of the respondents plan to use BIM in relation to LCA. This request confirm how companies sees the integration of BIM and LCA as an important development need, preferably along some common, harmonized structure [6,10]. It should be noted that integration of LCA with tools for the early design stages also need development, since this is where the fundamental choices are taken about design idea and composition [11].

Figure 8. Responses to the question: Do you use BIM model’s capability to integrate information on the following aspects? Based on 61 responses.



4. Conclusions

This paper analysed the results of a survey carried out, as part of the IEA EBC Annex 72 project, among the building sector in the Nordic countries. The results conveyed in this paper focus on the identification of drivers and barriers towards an increased use of LCA in the building design process. Through the responses provided by the 223 persons who accessed the survey, some general remarks about potential future harmonization effort within the Nordic countries can be concluded. The background of the respondents disclose a potential bias, in the sense that half of the respondents declare ‘good knowledge’ of the subject of LCA. However, the predominance of this type of respondents may be seen as a strength in identifying the most pressing barriers and development needs.

The survey shows that the main barriers to including LCA in the building design revolve around a perceived lack of incentive as well as a lack of sufficient data and information. This is in line with a previous survey made in the Nordic region in 2015. However, the current survey also points to a notable commitment from design professionals in applying the LCA anyway, and several companies seem to integrate environmental responsible design as a core value for their business. Further, there is a moderate drive from the public sector and property developers/investors for integrating assessments of environmental performance. Concerning development needs, respondents point towards harmonization efforts within LCA for use within BIM. This effort could be fruitfully supplemented by common standards for LCA-based tools for the early design stages. Responses concerning communication formats furthermore reveal the dilemma for the building designer between, on the one hand, needing to know all the details of the environmental assessment to learn what drives and controls the results of a project, and on the other hand, needing to convert the results of a project into easily communicable information for the client. This ‘translation’ of results is an additional area of potential harmonization within the Nordic region.

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