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Implementing sustainable sourcing in construction: Results of a current analysis of the Austrian market

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Abstract. Achieving the UN sustainable development goals, construction industry shows a great potential. Since 50% of the total resource consumption and 40% of the entire energy demand in the European Union are caused by the construction sector, procurement processes indicate a crucial starting point improving sustainable construction. Currently, organizations struggle with implementing sustainable procurement processes. Missing information on sustainability issues can be stated as an important problem in the sourcing procedure. Consequently, interactions of planning processes and sustainable procurement represent a fundamental topic. To investigate the current situation on procurement especially in Austria, an expert survey has been carried out. Therefore, a set of three central research questions has been elaborated that could be evaluated by a detailed survey. Based on the detection of relevant stakeholders, by means of a standardized online-questionnaire the implementation of life cycle-oriented sustainability issues has been surveyed. The contribution is going to illustrate the current situation of lifecycle-oriented planning, awarding and tendering of construction works in Austria. Furthermore, deductions were made based on the results of the survey, indicating action areas and presenting future potential of the application of building information modelling.

1. Introduction

Fighting climate change is one of our main contemporary tasks. The United Nations stated 17 sustainable development goals to adopt ‘The 2030 Agenda for Sustainable Development’ [1]. Several of these goals emphasize the importance of construction and building industry in this context. For instance, goal number 7 ‘affordable and clean energy’, number 9 ‘industry innovation and infrastructure’ along with goal number 11 ‘sustainable cities and communities’ and the overall target of goal number 13 on ‘climate action’ are further linked to construction activities. Approximately 40% of the global energy use is related to buildings as well as 50% of the resource consumption can be linked to construction activities [2].

1.1. Sustainable procurement and sourcing

After determining the requirements for a future building and stating the demands based on its usage, the procurement stage begins on how the conceptual design should be developed further in what specific contractual arrangement. Procurement sets up legal boundaries, based on the specific conditions within a project is going to be developed. Thus, the procurement process represents an important starting point for implementing sustainability issues. Therefore, over the last few years several initiatives on European



and national level targeting public responsibility have been published; cf. COM 96 (583) final and COM 98 (143) final. Focussing on the integrations of environmental aspects in public procurement the European directive 2004/18/EC supports the awarding of contracts based on the most economically advantageous tender. Following this approach, specific criteria have to be provided, supporting the decision-making process during the awarding stage, to reach the goals of a sustainable development focusing on a life-cycle performance. Supporting sustainable sourcing, the European directive 2014/24/EU enables such a procedure by empowering a more life-cycle orientated perspective in terms of highlighting specific awarding criteria.

1.2. Role of public authorities

Public procurement especially indicates a main driver for implementing sustainability aspects into the sourcing processes of construction services. Due to market size and the potential related to public contractors, the public sector should lead the market and influence the private sector towards a more sustainable building supply chain. But focusing the practical implementation a different view arises. The current procurement process within harsh and competitive market conditions is characterized by a strong focus on emphasizing financial issues.

2. Methodology

Investigating the current situation and getting a better understanding of the challenges on public procurement, sustainable sourcing in construction and building industry an expert survey has been carried out, focusing the current situation in Austria. Therefore, a set of three main research questions has been elaborated:

- What's the situation of sustainable procurement and sourcing of construction works in Austria?
- What are the main requirements, to facilitate sustainable sourcing in the construction and building sector?
- How can data-information management tools like building information modelling support sustainable sourcing in construction industry?

To investigate and evaluate these main research questions an online-questionnaire has been developed. The aim of the expert survey was to use an empirical primary data collection, for generating valid data to understand the relationships of planning, tendering and awarding processes regarding the consideration of sustainability aspects.

2.1. Research design and questionnaire development

The questionnaire was developed based on previous explorative studies [3] [4] serving as an extensive question pool for the current survey. Additionally, a comprehensive literature review on sustainable public procurement has been conducted [5]. These measures have been part of a major research project at Graz University of Technology on sustainable design processes and integrated facades [6].

The questionnaire comprised five parts as shown in Fig. 1. General questions are covered in part 1. Part 2 focused on notions and concepts of sustainable and life-cycle orientated buildings. Part 3 targeted the design process. Part 4 concentrated on tendering and awarding aspects. Finally, part 5 considered the implementation of building information modelling in the context of sustainable building.

According to the classification of experts, the questionnaire was structured into three different paths (clients and planners, researchers and legal experts), allowing the participants to answer only questions related to their field of expertise and professional activity.

#	Structure of the survey	Number of questions	Clients and design experts	Research	Legal experts
1	General questions	5	5/5	2/5	2/5
2	Notions and Concepts	3	3/3	3/3	3/3
3	Design process	9	9/9	8/9	1/9
4	Tendering and awarding	8	8/8	8/8	8/8
5	Implementation (BIM)	8	8/8	2/8	2/8
		total	Σ 33	Σ 23	Σ 16

Figure 1. Structure of the questionnaire.

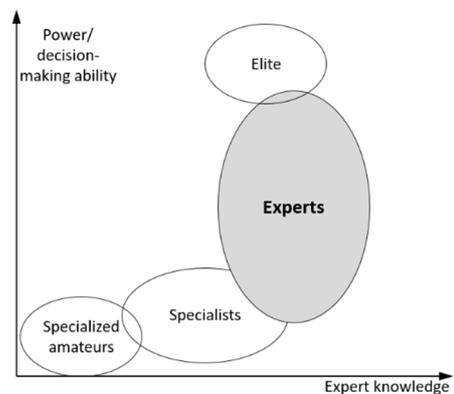


Figure 2. Definition of experts.

2.2. Selection of participants

Conducting an expert survey, it is crucial to identify appropriate participants by answering the following questions: Who is an expert for the specific subject area? Who got relevant information? Who is able and ready to provide and share this information? Experts can be characterized with many years of experience in a responsible and senior position related to subject-specific knowledge of the implementation of sustainable construction. Furthermore, experts are people with special knowledge, insights and information as well as contributing significantly to the decision-making process; illustrated in Fig.2 [7]. The chosen experts have been associated to the sphere of the client, representing the view of the contracting authorities and their agents.

The survey was conducted in April and May 2017. Overall 320 experts have been invited and 96 participated (in terms of complete replies to the questionnaire). The demographic information revealed that respondents could be classified into the following groups: public clients (30%), project controlling and management by clients (17%), designers (21%), researchers (10%), consultants and experts (12%), legal experts (5%), and the remaining 5% could not be assigned further. The respondents possessed 21 years of work experience in average. They majority of them is in an executive position (managing director, head of department, project manager) and all of them are involved in implementing sustainable construction.

3. Results

In the following section selected results from the survey are shown. Starting with general statements about the situation of sustainable procurement in Austria, followed by a closer examination of planning processes. Also, the level of implementation and the role of building information modelling is presented.

3.1. General statements on sustainable procurement in Austria

Despite the fact, that public authorities are addressing sustainability through a wide range of strategies and initiatives, the survey illustrated that implementing sustainable sourcing seems to be limited to individual aspects (e.g. energy efficiency) - an integrated holistic concept is often missing. That's because of insufficient consideration and implementation of sustainability aspects in early design stages. Referring to this, the survey showed, a prevalent application of sequential planning processes. Which means, each planner only focuses on his area of expertise, without taking contributions from others into account and not valuing possible interactions to improve a common project goal. As a result, only limited quantifiable issues and methods being used for sustainable sourcing. Establishing a sustainable sourcing process, awarding and selection criteria are key elements for sustainable procurement justifying the tendering decision, therefore the planning stages are crucial to identify such issues.

The current practical situation on sustainable sourcing can be characterized by considering sustainability issues mainly as individual ones without a common implementation and reference to the whole building performance.

3.2. Importance of the design process

Furthermore, the results of the survey showed, that the design process is very crucial for setting up the procurement process and providing evaluation and awarding criteria for sustainable sourcing. Based on various groups of experts, there is a different level of awareness, at which project stage sustainability issues should be considered. Planners need requirements and certain target values to consider these aspects during their design process. Clients have another perception, they seem less focused on sustainability aspects in early project stages, but when it comes down to the point of construction completion and commissioning, they are getting more aware of the future operational performance of the building including the life-cycle perspective [8]. However, the client is usually in charge of providing adequate information to define the specific qualities and quantities especially targeting the life-cycle performance of a building. Because without this input it is hardly possible for the design team to reach a certain quality level, when relevant information is missing.

3.3. Level of implementation of sustainability aspects

Trying to answer the question on what level sustainability aspects should be implemented, different views arise from the surveyed experts. As shown in Fig. 3, especially the planners would recommend implementing these aspects on material level. Using a building certification system is seen as a suitable approach by the group of clients and researchers. Building certification schemes as a comprehensive assessment method with a straightforward illustration on performance achievement (levels of certification depending on the respective organization range from bronze, to silver, gold and platinum) can support the communication of sustainable qualities easier compared to sustainability aspects on building level. This seems comprehensibly, especially according to the perspective of decision makers with limited knowledge on life-cycle orientated buildings.

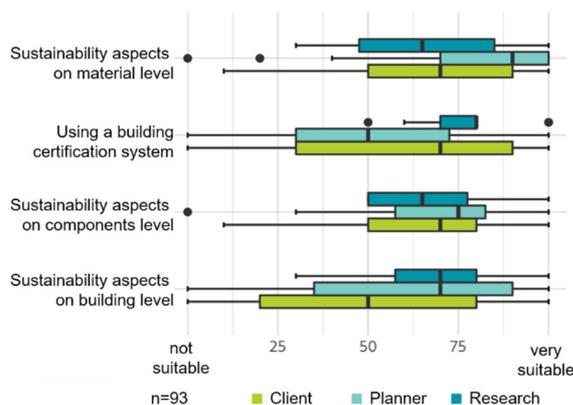


Figure 3. Implementing sustainability aspects.

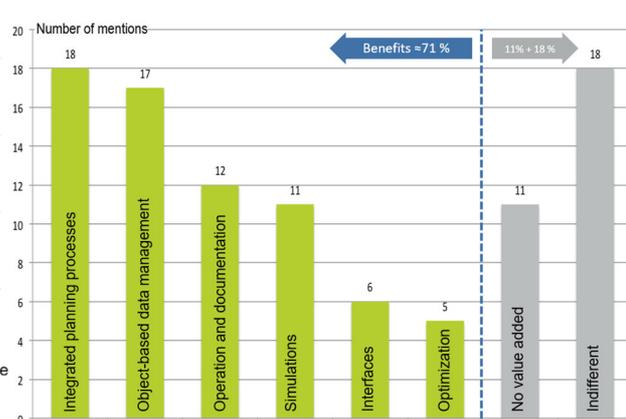


Figure 4. Benefits of using BIM.

3.4. Benefits of using building information modelling

Focusing on possible benefits of using building information modelling as a project management tool, the participants reported their expectations on improved integrated planning processes and a better object-based data management. Also, simulations and detailed coordination of interfaces are expected as benefits of using BIM as illustrated in Fig. 4. However, there are still a lot of responses reporting no real additional value or have indifferent opinions on using building information modelling.

4. Fields of action

Based on the results of the survey, specific fields of actions have been identified. In the following section three action areas have been selected and described in more detail:

- Information flow (interactions of planning and sourcing)
- Process-thinking and design
- Process support using data information management tools

4.1. Information flow

Missing sustainability aspects in sourcing of construction services are often caused by incomplete information flows between the planning and procurement stage. Improving consistency and enabling such interactions, it is crucial for the sourcing unit to understand not only the single requirements in terms of a specific label or evidence, but also the intended overall performance of the building with its elements.

The results of the study explored aspects on how procurement processes should be structured and suggested starting with the definition of requirement as a basis for the call for tender in earlier project stages to include the knowledge of different experts from the integral planning team. Applying systems thinking in such a context with consistent information flows, not only single improvements are possible but also a holistic approach can be targeted. Therefore, conventional sequential planning processes need to be considered in detail how to improve and structure interfaces for better information workflows [9]. This would enable a progressive value creating achievement as well as reducing additional expenses. Having a comprehensive knowledge on the targeted performance, improvements are possible when examining design alternatives. Collaboration in general is associated with a higher intensity of innovation.

Therefore, transparent information flows are required, which make it feasible to recognize the overall value and single contribution of each task. This helps to overcome insufficient information sharing between designers, contractors and suppliers. Doing so, process thinking becomes more significant.

4.2. Process thinking and design

Due to increasing complexity and interdisciplinarity of construction projects, especially if targeting and improving the life-cycle performance of buildings, the need arises to focus more on processes. Taking the building life-cycle performance into account, it is crucial, implementing user and operational requirements into early design stages, to allow the planners to consider these issues for a better building design.

Facilitating a holistic approach, various interfaces between the contributing disciplines and experts need to be arranged in a certain way, to maintain a value creating workflow. Therefore, several initiatives and research activities are performed to implement and improve process thinking, c.f. [10]. Additionally, over the last few years lean management principles from the production sector influenced the construction workflows. Starting at the construction site from operations planning and scheduling but focussing more and more on the detailed design and execution planning processes [11].

Lean philosophy concentrates on the elimination of all waste from a process, while targeting the maximum user value. From this point of view lean philosophy could be used as a control system to be implemented in sustainable building projects, improving the life-cycle performance of buildings. Both approaches (lean construction and sustainable building) are targeting the reduction of environmental impacts. Doing so, process thinking is necessary to focus on the value and further contribution to the overall performance. Especially if specific criteria are needed for the sourcing procedure awarding the contract.

Other helpful tools are building certification systems (e.g. BREEAM, LEED or DGNB/ÖGNI). They can provide guidance through the project workflow supporting the stakeholders to keep the overall performance in mind. Overall a collaborative workflow is determinant of the successful adoption of sustainable building.

4.3. *Process modelling and visualisation (BIM)*

Over the past few years digitalisation gained importance in the construction and building industry in terms of implementing building information modelling. Using BIM is expected to solve or at least reduce various problems like e.g. insufficient or missing information and poor collaboration. Still there are technical boundaries like missing connectivity and interchangeability of data and information. Based on the results of the survey, integrated planning processes and an object-based data management are expected benefits of using BIM. But to unlock these potentials, a common baseline of understanding the requirements and workflow is necessary.

Standardisation is necessary to communicate attributes and properties of building elements. There is the need of interchanging data and information on sustainable buildings, without any losses between the various stakeholders. Additionally, the properties should be interchangeable with possible suppliers fitting future requirements on e-procurement in the context of building information modelling.

Focusing on public clients, BIM should be encouraged by the government and industry to act as an information data management tool. Furthermore, transparency would be increased, supporting the information flows e.g. on building material properties, starting from the early drafts to contractors and suppliers. This would help to provide the right information to each project partner at the respective project stage.

5. **Conclusion and outlook**

Based on their market share and responsibility, public clients can act as a role model for several action areas on implementing strategies fighting climate change focusing the building sector. Thus, several strategies on procurement solutions are available, but their practical implementation seems to lag. Therefore, sustainable sourcing can be identified as a major issue to deal with the complex situation of supplying and purchasing in the building and construction industry, due to the various suppliers and trades involved.

Focusing on the current situation in Austria, an empirical study has been conducted. Experts in the field of sustainable construction have been queried with a standardized online-questionnaire comprised of five thematic categories: general data, notions and concepts of sustainable and life-cycle orientated buildings, design process, tendering and awarding procedures and the implementation of building information modelling.

The findings illustrate, that sustainable sourcing is currently based on single criteria or the use of building certification systems. Inconsistent information flows during the planning stages can be seen as a major reason for missing a holistic approach. A lack of incentives to adopt sustainable procurement in construction has been reported by previous studies [12].

Another result from the conducted study highlighted the importance of green procurement policies. Additionally, the need to open up the ‘golden triangle’ of cost, time and quality to more comprehensive aspects and also targeting the life cycle perspective, taking into account the usage stages - not only focusing on the construction phase of the building.

This paper emphasized the relevance of interactions on sourcing and life-cycle orientated planning processes. Therefore, not only product/object-related aspects of construction works are important to focus, also process-orientated aspects need to be considered in more detail. Consequently, the design process needs to be targeted and arranged towards a better information flow. The main requirements are stated by the client in early design stages and the implementation of sustainability into the sourcing process is still limited to the willingness and capability of the client and how comprehensive his requirements are described in early planning stages [13].

Additionally, the responsibility of the involved stakeholder needs to be improved for stronger collaboration on the sustainability performance of a building. Facilitating such a performance-based approach, focusing the practical implementation of data-information management tools can be helpful. Therefore, BIM is just a tool, not bettering projects itself. In this context the clarification of a crucial baseline (definition of sustainable properties) and common project standards are necessary. Performance

requirements can be communicated using standardized information with potential suppliers allowing them to adapt their solutions to the project specific requirements.

Further research is required on how e-procurement in context with building information modelling can support a more sustainable sourcing process [14]. But without a clear and structured workflow and a specific definition of the expected building performance at the beginning, their application doesn't seem effective. [15] Implementing sustainability starts with the know-how of all project members and a high level of collaboration.

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