Resilient Structures and Sustainable Construction
*Edited by* Pellicer, E., Adam, J. M., Yepes, V., Singh, A., and Yazdani, S.

ISBN: 978-0-9960437-4-8

# BUSINESS PROCESS THROUGH THE BUILDING LIFECYCLE USING BIM

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BIM (building information modeling) describes a method to integrate and connect all relevant, building related data into a virtual data model over the whole lifecycle. The superior goal of all BIM-related research projects at the Chair of Construction Management and Economics is therefore to advance the efforts of data model standardization and the corresponding flow of information between all participants involved in a building project. To identify all relevant data, the focus of each project is hence directed to the question who needs which information from whom, how, when and what for. In this context the research project "Development of an ideal chain of process for using the BIM-method during the lifecycle of real estate" aims to develop and define a standardized and idealistic virtual chain of process using BIM. Therefore, the actual process structure (without BIM) will to be analyzed and defined in consideration of relevant regulations, interviews of experts etc. In this respect, the performance spectrum of each participant and the communication as well as information interface will be taken into account. Up from this point the process can be enriched with BIM-content to create an ideal BIM-process-chain. It will be important to develop a most general-purpose to include different variations of project organizations and market players. By doing so, it will be possible to transfer the BIM-method to all real estate and civil construction participants.

*Keywords*: Building Information Modeling, Digitalization real estate lifecycle, Information delivery, Process-orientated method, ISO 19650, Implementation guideline.

## 1 OBJECTIVES

The digitization of the economy has been progressing steadily for several years, also in Germany. With regard to the building sector, the main focus is on the method of building information modeling. Compared to other countries, the implementation of the method has not been applied so far in Germany. Against the background of optimizing the effectiveness and efficiency and strengthening the competitiveness of the associated construction and real estate industry of Germany - even in international comparison - the implementation of the BIM method is also essential during the entire real estate lifecycle. (Bauindustrie NRW 2014) More and more information is being generated and stored digitally to improve the processes in the respective work steps. (Helmus *et al.* 2014) However, they are often not designed for further use in downstream phases. In practice, companies have to put the information into their systems and adapt it to their needs. The development of standards for the BIM-based processing of projects is

necessary to ensure that the methodology can also be used across the board. (ARGE BIM-Leitfaden 2013)

The research project "Development of an ideal chain of process for using the BIM-method during the lifecycle of real estate" is part of a longer-term overall concept to be set up. The aim is to promote the standardization efforts of building data models with regard to processes and the associated flow of information between the project participants in all lifecycle phases. At the same time, this will help to create transparency with regard to the BIM method for those involved in construction and real estate management. (International Organization for Standardization 2016)

## 2 RESEARCH DESIGN AND METHODS

According to the definition of the University of Wuppertal (BUW), the lifecycle of a real estate consists of five phases: development, design, realization, operation & maintenance and demolition. Within these phases, new information is generated from various roles from various information sources.

The extensive consideration of all these phases is not feasible in a single research project. For this reason, the BUW has decided to subdivide the lifecycle of a real estate in a structured manner and to develop the respective sub-areas in independent research projects which are always interlinked. Through the close networking, synergies can be used as best as possible and a broad knowledge foundation can be established. This enables the chair of Construction Management & Economics at the BUW to publish the gained findings in a targeted way in the general public, thereby continuing promoting the digitization of the real estate value chain.

In the following, the above-described linkage of the research projects is presented and explained for the currently running projects in each case. The division takes place on the one hand after separation in the sequence of phases or activities (horizontal axis). On the other hand by means of the classification of the process detailing levels - subdivision of a process in subprocesses (vertical axis).

- **BIM - Processes - Lifecycle** covers the overlapping frame over all phases of the lifecycle. The processes are viewed in coarser detail levels primarily from the point of view of the overall role of the building owner / operator.
- **BIM - Processes - Realization** considers the phase of the realization and the resulting requirements for the upstream and downstream phases of the real estate lifecycle. The processes are viewed in deeper detail from the perspective of the execution companies.
- **BIM - Processes - Work Planning** considers the step of the work planning of small and medium-sized enterprises (SMEs) in the implementation phase.
- **BIM - Processes - Health and Safety** considers the planning, realization and operation phases from the specific point of view of occupational health and safety. The processes are viewed over all process levels and integrated into the overall landscape.
- **BIM - Processes - Demolition** considers the phase of demolition and the resulting requirements in terms of the material cycle. The processes are viewed in deeper detail from the point of view of the demolition and recycling companies.

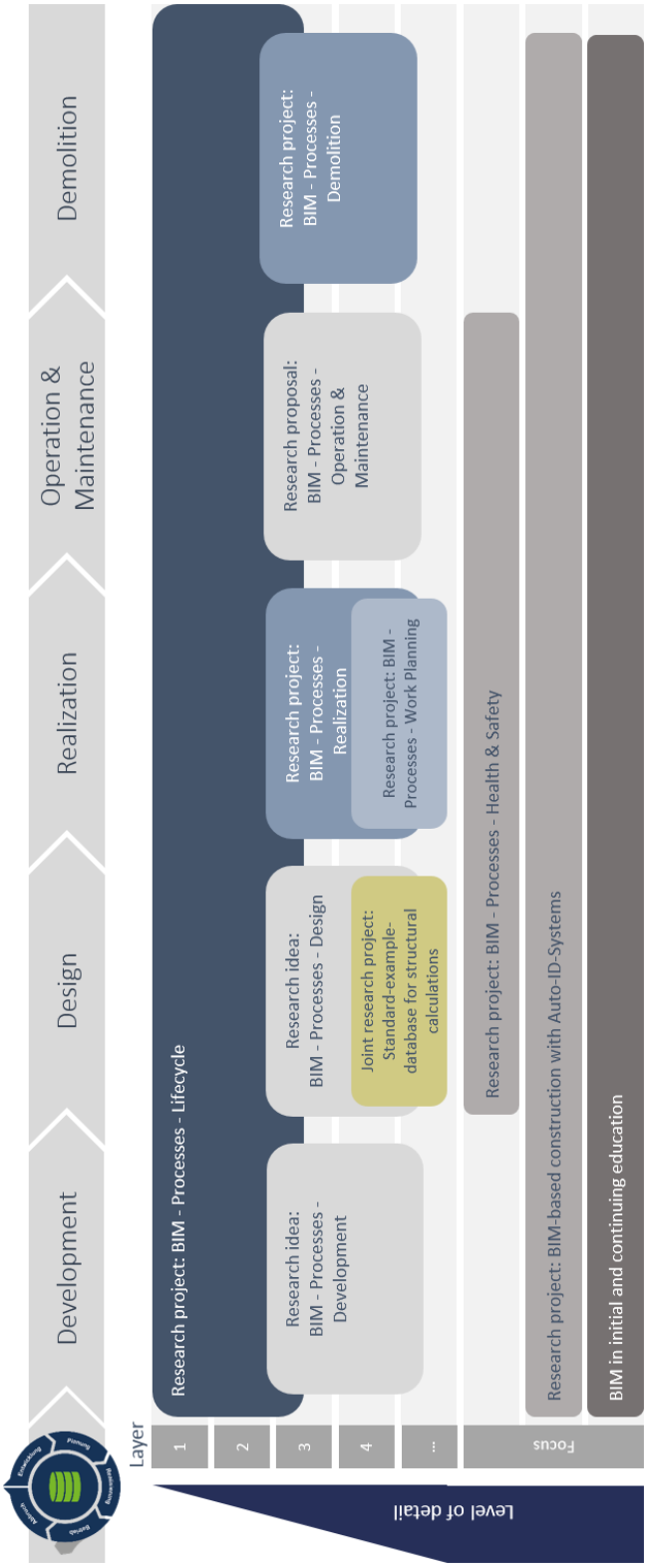


Figure 1. Integration of the BUW research projects in the real estate lifecycle.

On the basis of initial literature research and subsequent expert interviews, the respective research projects have brought together information from which basic principles have been developed. Based on this, the project teams use the information in a database-based BPM software. It enables a central collection of the entire knowledge and thus ensures that the described overall concept can be implemented. Finally, the gained and implemented findings are verified by the practice partners.

## 3 RESULTS

On the basis of the defined real estate lifecycle phases, processes from specific points of view were standardized and displayed in the common process map. This was used to investigate the extent to which the processes change by implementing the BIM method.

Even with the actual processes, a consistent, continuous flow of information can be generated. This allows the required information to be linked to an associated process as input and the condition that each process produces exactly one output. Thus, the processes recorded so far represent a human process flow (independent of auxiliaries), which cannot be changed in principle for the introduction of BIM. Through the digitization, only parts of it are supported or carried out with the help of the IT, thus supplemented by a technical process and requirements.

The IT-supported or semi-automated handling of processes requires more stringent regulations on storing information etc. This is because the automatisms are based on pre-programmed queries, which can only cope with the situations that were taken into account during programming. This increases the complexity with regard to the planning of the information flow. In terms of construction, this is described by the so-called BIM information management process. It describes aspects which have to be clarified for a smooth flow of information in advance. In order to transfer the actual processes into the BIM target process, it is therefore necessary to identify the locations in the existing process map that are used to clarify the aspects taken up in the information management process and to insert the respective sub processes of the information management process into the process map. The BUW BIM information management process is validity gained by different workshops with various national parties of the real estate lifecycle. The frame of the BUW information management process is also in accordance with the still not published international BIM information management process ISO 19650.

To clarify the questions in the information management process, the project participants must initially set up their requirements for both the human and the technical process. The collaborative process landscape of the BUW considers this with BIM targets, BIM uses and BIM requirements, which together result in the so-called BIM application container. The information to be entered there from the relevant viewpoints is used for the corresponding research projects, as described in Chapter 2. Based on this, lists can be derived as a basis for the establishment of the information management process and various other information for the most diverse tasks.

The project **BIM - Processes - Lifecycle** investigates the business process along the building lifecycle and environment of information management and production to achieve beneficial business outcomes to asset owners, operators and the project management. The range of business out comes reach from e.g. better cost management or clearly defined responsibilities to improve the project management to visualizations and 3-D models for better public relations work.

Based on the findings of the above-described, a guideline for action is being developed. In conformity with the frame of ISO 19650 different steps and sub steps are identified to use and implement the method BIM. Up from the view of asset owners and operators as stakeholders of the building owner organization have to understand what information’s are required to support their organization objectives. Required information’s should be defined at first by the owner- and

operator organization to set out asset information requirements. Also, external Stakeholder information requirements can be the objective, e.g., to the portfolio- or fund management. The BUW has identified exemplary beneficial business outcomes with asset owners and operators in workshops.

Also project responsible organizations can have benefits while using BIM. Based on the BUW process map, representatives from various companies defined relevant project organization decision points. Project decision points are important milestones on which the building owner or its project organization have to grant approvals. As a result of the BUW Process map, decision points required information's can be easier generated by interfaces through other lifecycle parties, e.g., planning and construction companies. Individual required information's can be defined and imported into the process model as well.

Within finishing the research of information requirements, exemplary business outcomes will be assigned into the categories of BIM targets, BIM uses and BIM requirements, the so-called BIM application container. This is currently taking place in a set of workshops. The defined application containers, within in their Information requirements, will be part of the tender documents, that the information can be most efficiently produced down supply chains.

The guideline for action will contain step by step descriptions to give also BIM unexperienced building owners / operators and project managers a good understanding about the potential business outcomes. Specific content will be available in example BIM application containers to greater re-use existing knowledge during the lifecycle.

## 4 CONCLUSION

Over the next few years BIM will appear to be well established. In doing so, the processes as a basis for the planning of digitally supported or fully automated processes will inevitably gain in importance. To this end, standardized process models, such as the process landscape developed by the BUW, will serve as a basis for the specific situations in companies and projects to be displayed more quickly. The process landscape of the BUW is best suited for this task, since you describe the human processes in general. In addition, due to the structured structure, you can flexibly adapt and expand.

The essential basis for the implementation of BIM is to implement the process landscape as well as the will of the industry and the acceptance of the employees. An essential factor for a comprehensive use of the method BIM depends on the collective action of the lifecycle parties and the interests of the building owners, operators and project managers. The guideline for actions will be a part to bring the method BIM more into the focus of this important group and also a particular step by step guideline for the implementation.

**Acknowledgements**

This research project is funded by the Federal Institute for Building, Construction and Spatial Development (BBSR) by the German Federal Ministry for Building, Building and Regional Planning (BBR), funded by the Forschungsinitiative ZukunftBAU of the Federal Ministry for the Environment, Nature Conservation, Construction and Nuclear Safety (BMUB). In order to ensure a direct reference to the applicability in practice, the following practice partners support the research project:

- die developer Projektentwicklung GmbH
- vrame Consult GmbH
- Chamber of Engineers in North Rhine-Westphalia

## References

ARGE BIM-Leitfaden AEC3 & OPB 2013, BIM-Leitfaden für Deutschland, www.bmvi.de, 2013. Retrieved from https://www.bmvi.de/SharedDocs/DE/Anlage/Digitales/bim-leitfaden-deu.pdf?__blob=publicationFile on March 1, 2017.

Bauindustrie NRW e.V, Positionspapier Digitalisierung der Wertschöpfungskette Bau, 2014. Retrieved from www.bauindustrie-nrw.de/politik/positionspapiere/?cid=2285&did=813&sechash=71524b04 on March 1, 2017.

Helmus, M., Meins-Becker, A., Kelm, A., and Laußat, L., Endbericht zum Forschungsvorhaben: Sicherung von Datendurchgängigkeit im gesamten Lebenszyklus eines Gebäudes, Bundesinstitut für Bau-, Stadt- und Raumforschung (BBSR) im Bundesamt für Bauwesen und Raumordnung (BBR), Germany, 2014.

International Organization for Standardization 2016, ISO 29481: Building information models - Information delivery manual, www.iso.org, 2016.