Building Information Management (BIM): From planning towards work process tool?

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Large building project such as the Berlin "International Airport" demonstrate how difficult it can be to integrate planning and construction processes effectively. Massive time delays, cost expansion, etc. call for better coordination under the building actors, such as planners and architects, construction workers as well as foremen and head masons (Poliere).

The need for better integration and higher coordination in order to deliver the envisaged building requirements should avoid problematic situations in which the various professionals are not well informed about the building plans. This situation calls for more cooperative and interactive work practices e.g. at the interface between planning and production. Beside organisational gaps there are also technical dysfunctions to face. For example, there is no common platform for all B&C companies. The different planning systems from traditional analogue up to digital are difficult to integrate. Co-existence of different planning systems can make an integrative and well coordinated approach for planning and construction difficult. Extra costs as well as damages and delays could be the result of these gaps.

To overcome planning processes as well as to better integrate planning and other building phases such as construction, the Building Information Modelling (BIM) was created. The BIM model can be understood as a planning tool to allow more cooperative working methods. They should help to better integrate different domains and building occupations in such a way that the whole building and construction life cycle (from planning, construction, building service, re-modernisation etc.) is represented by one basic virtual software artefact and is going beyond computer aided design, such as CAD tools. Thorough information and demonstration of the building object is centrally stored in a BIM cloud. BIM is a involving the generation and management of digital representations of the physical and functional characteristics of the building. While such overarching plans are not yet fully realised and take a lot of time and money to develop them, there exist several pilot projects to give first answers for BIM enabling and constraining more integrative working methods and tools.

Approaches of Industry 4.0 (BMBF 2014) are further developed since the framework conditions are not hampered by highly diverse and in terms of digital tools not well integrated companies. Cooperation on building sites often lacks a well integrated working integration. One reason might be that not all planning details available during the construction process and beyond are at hand. There is a digital memory of all information on all building materials and technical systems missing. This calls for integrated platforms like a BIM Cloud. All data on the building plans is available for all actors and organisations involved in the building process. Within Industry 4.0 this is already practiced for quite a while as digital transformation has proceeded towards process control, including self-steering of all physical processes.

The intention of BIM is that this could improve communication under all building professionals from planning and construction up to building maintenance. The dimensions height, width and depth are enhanced by information on costs, colour, weight, material and the producer. The aim is to deliver more transparency as well as monitoring information of the building process in real time. In an early stage, an assessment of possible constructive collision could take place or precautionary health and work safety issues could be studied by the building and construction actors. By such new working methods, a more cooperative culture under the diverse construction workers could be introduced also to give feedback about construction mismatches to the planning departments.

The introduction of BIM (Building Information Modelling) Systems will change process management. But to what extend will be studied in this presentation. This could mean that the work on the building site can be better used for giving construction workers a precautionary work

instrument. By showing the construction process in advance the building site is not just a site for executing the building plans but also a learning site where work processes could be coordinated beforehand. A reflection by the construction teams on potential risk and conflicts would be more easy.

Another question would be, how BIM on the construction site could be implemented and which kind of pro-active up-skilling training measure will be needed to overcome barriers and risk arising from the BIM technology. Are there extra tools that support the BIM use needed? There is still the danger that BIM is not involving the direct building construction level into this BIM Cycle! A dangerous scenario would be: BIM is getting officially obligate but it 'cuts off' the construction workers while they are not well prepared. If the topic of BIM is not dealed within the curricula as well as not during further training it might be difficult to develop technical and social advantages for this technology.

Methodology, Methods, Research Instruments or Sources Used

BIM is a relatively new technology in an industry typically slow to adopt change. Yet many early adopters are confident that BIM will grow to play an even more crucial role in building documentation. As the BIM implementation is rather at its beginning (in the UK its use at present is much more advanced than in Germany!) but will be much more present in the near future as public offerings (see Dobrindt announcement, German Federal Ministry of Traffic and Building, Berlin) on building projects will be handled more and more via such systems, there is clear need for dealing with the impacts of this technology on the qualifications of construction workers and engineers.
The article researches different sources:

(1) the extensive literature around BIM implementation on potential and functions of this technology, purposes as well as design features,
(2) the involvement of the authors in the establishment of an innovation cluster in 2015 and its accompanying research. This network covers building and construction companies, ICT software houses and VET Training Centers within building and construction as well as several research bodies from the Northwest of Germany.

Conclusions, Expected Outcomes or Findings

We will present research on the implications of BIM. The establishment of a BIM R&D cluster in the North West of Germany (Bauen 4.0, 2015) has led to extensive documents which enroll the sectoral conditions as well as the future perspectives on the work and technology implications and pilot projects. The learning and knowledge exchange concepts ot three former and current BIM Pilot Projects (Norway, Spain and Germany) will be analysed in order to show some effects of BIM onto work process cooperation and individual learning.

The first example picks up the situation of a German producer that produces tailormade pre-fabricated timber frame houses on a serial basis. Here a high grade of pre-fabrication and extensive planning is realised in order to realise a rather short construction time. This company wants to use BIM information on the construction site. The intention is that they want to have a better integration of planning and construction processes. The organisational and qualificational implications for the construction workers and planners are discussed in our presentation. We will try to show also the technical support ideas for this BIM construction site project (Deitmer et.a.., 2017).

The already finalised SAM BIM project (Bräthen, 2017) in Norway showed that the presence of BIM portable solutions are bringing clear advantages during construction on the building site. The presence of a precise digital BIM Model of the future building helps to improve understanding for the construction workers. The Norwegian experiment showed that the construction worker knows better what exactly he should build and which plan of the building is to be realised. It is also helpful that it avoids working without coordination with other workers from other trades.

The Norwegian BIM station experience showed that there are clear advantages for the construction phase which means a better cooperation between engineers, building coordinators and workers. The realised building showed the quality as planned and this while planners and constructors worked more closely and integrative by using BIM technology.

The BIMporTABLE (Llopis 2016) is a mobile digital office for the construction site that is being developed as part of SCAVE, a Spanish national project by COMSA, a large construction company, Portable Media Solutions, a provider of digital spaces, and CIMNE, an engineering R&D centre. The aim is to make BIM information available to skilled workers. This is done by providing a construction lab space for meetings. The size of BIMporTABLE allows it to be placed exactly where it is needed most, reducing the time to get information from the work cabin that might be located far away. The aim is to increase the potential of adoption of BIM as a tool for the construction site.

We will analyse the three BIM pilots in order to show possible use cases of construction workers to manage the building site in a new innovative way and what kind of implications this has in respect to working tools as well as for skills and learning of the professional actors.

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