

Building Information Modeling – Digitizing the construction industry

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The technology of Building information modeling (BIM) promises a significant increase in productivity in the design, construction and operation of buildings and infrastructure facilities (Eastman et al. 2009). In the entire world, the AEC industry is under transformation - overcoming the conventional inefficient and error-prone practices based on 2D drawings by moving to modern procedures based on digital building models. These digital models that do not only represent 3D geometry of the building components, but also all non-geometric data required throughout the building's lifecycle. As this technological change impacts all stakeholders of the AEC industry in a fundamental way, a carefully planned transition is necessary to avoid economical damage.

In many countries around the world, government-driven initiatives are underway to initiate the necessary standards, guidelines and contract templates. The most prominent example is the United Kingdom where in 2010 the Cabinet office has initiated the BIM initiative with April 2016 demarking the official starting point for mandatory use of BIM in all public projects (Cabinet Office, 2011). During the preparation process, a large number of carefully elaborated guidelines and standards defining BIM processes, contents and handovers have been developed. Other examples of government-driven national BIM initiatives include Finland (Senate Properties, 2007), Sweden (Statsbygg 2013), Denmark (BIPS 2013), the Netherlands (Rgd 2013) and Singapore (BCA 2013).

Also the German government is preparing the transition to BIM-based workflows in its AEC industry. In 2014, after analyzing the reasons of failure in a number of large-scale construction projects, a national commission recommended as one measure for reducing projects risks to make extensive use of digital methods such as BIM in order to make the complexity of large projects manageable (BMVI, 2013).

In consequence, the German Ministry of Transport and Digital Infrastructure has developed a strategic plan for stepwise introduction of BIM methods in public construction projects. The resulting Step-by-Step plan ("BIM-Stufenplan") has been published on December 15th, 2015 (BMVI, 2015).

It defines the following general goals:

- Increase in planning preciseness and reduction in cost overruns
 - in-depth evaluation of planning alternatives
 - improved communication with the public
 - less design errors by collision checks and enforced collaboration between stakeholders
 - precise assessments of cost increases caused by owners' change requests
 - improved reliability of construction processes by simulation of construction sequences
- Optimization of life-cycle costs
 - simulation of life-cycle costs (including operation and maintenance costs)
 - provision of the digital model to the owner as a basis for asset management

The step-by-step plan contains a clear definition of Niveau 1 of BIM-based project delivery encompassing the following key features:

- project delivery based on ISO 19600 (the upcoming international version of PAS 1192-2:2013)

- employer's information requirements (EIR) for defining which data is required by the employer, when and in which detail
- principle of federated domain-specific BIM models merged into a coordination model
- creation of a BIM Execution Plan (BEP) by all stakeholders defining: frequency of model coordination, level of detail delivered in which phase, usage of the model for visualization, quantity take-off, simulations and life-cycle assessment
- usage of a common data environment according to ISO 19600
- derivation of 2D plans from 3D BIM models
- use of open data exchange standards (mainly IFC, but also OKSTRA and GAEB)
- checking of data/models for fulfilment of the EIRs

Apart from these characteristics, the general execution of construction projects is kept stable to the largest extent possible. This includes the legal frameworks as well as the remuneration regulations in effect today (Honorarordnung für Architekten und Ingenieure – HOAI). These decisions were taken to allow an easy and hurdle-free transition to BIM-based project execution. For a future Niveau 2, changes in laws and remuneration regulations may be possible.

The defined Niveau 1 is expected to be implemented for all public infrastructure projects starting in 2020. To reach this goal, three phases (steps) have been defined:

- 2015 – 2017: Preparation Phase
- 2017 – 2020: Extended Pilot Phase
- from 2020: Mandatory BIM usage for all new projects

Within the preparation phase, early-bird pilot projects are conducted, standards and codes are defined and measures for educating the professionals are initiated. Also, BIM guidelines will be developed including templates for contracts, Employer Information Requirements and BIM execution plans. The first four pilot projects have been started in September 2014 in order to gather practical experiences and identify development gaps and required actions.

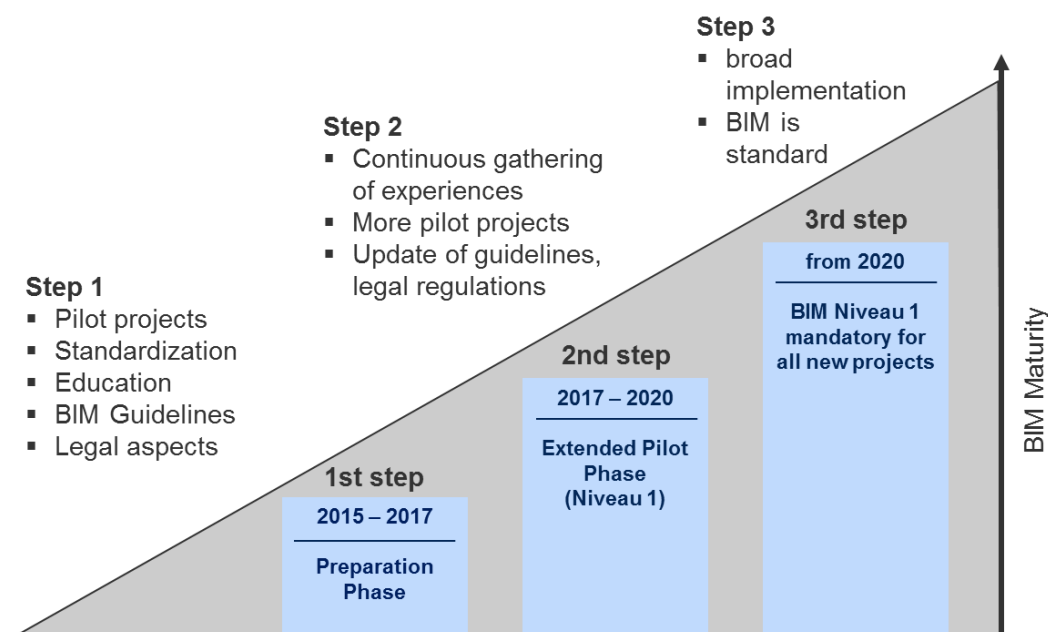


Figure 1: German Roadmap to the BIM mandate in 2020