

ARCHITECTURE AND UNIVERSAL DESIGN IN THE DESIGNER'S EYE

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**HOW TO IMPROVE CURRENT AVAILABLE SOFTWARE
PRODUCTS IN ORDER TO INCREASE BIM ADOPTION?**

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A

INTRODUCTION

Since 2009 the architecture engineering and construction industry, *AEC industry*, is in a crisis. Already about fifty thousand jobs have been lost in the Netherlands only. Only substantial changes will stop the industry's decrease. An advantage of crises though, is that it often is accompanied by fundamental changes.

Since several years there has been a development going on in the AEC industry due to the increase of complex design tasks, the need for improved collaboration, and the increase of digitization. Based on other industries' collaboration and work methods (e.g. the automobile industry and the *U.S. Department of Defense*) the *BIM*-concept has been established. This concept already exists since the 1970s, but is not thoroughly developed yet. That is also why different definitions exist on what BIM exactly is.

Currently, the concept is best explained using the *openBIM* definition, developed by different organizations, with *buildingSMART* as the largest initiative on open innovation. This definition highlights the concept as a tripartite philosophy (figure A.1):

Building Information Model
Building Information Modeling
Building Information Management

The definition not only implies the shift in working with building models, but also the way how models should be developed, how the additional data should be organized, and how information should be delivered internally and externally. It means a shift of practice covering the entire process from the design phase until the operational phase.

The AEC industry can be divided in four levels where changes will have to be made in order to complete adoption, benefit from the entire

OpenBIM Concept BI(M)³

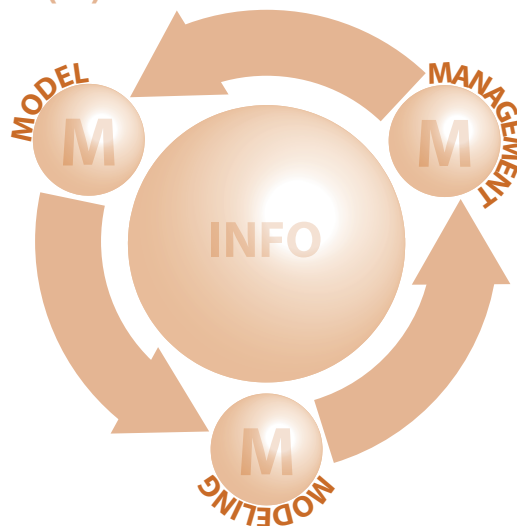


figure A.1: *openBIM* Concept

concept, and improve the industry's practice. These are the *metalevel* (interoperability), *macrolevel* (data management), *mesolevel* (intercommunication), and *microlevel* (business processes) (figure A.2). Despite of the need, the majority of the enterprises is only familiar with the building information model on microlevel. Most of the developed means are also only focusing on these aspects, but there are products available for most of the other facets that need to be improved.

For this paper the question is about what importance the current available means have for the development of the AEC industry, but also what types are and have to be developed. Why is it that the adoption of the new method of working going so slow and what means are needed in order to decrease the threshold and increase efficiency of design, communication, and processes? ■

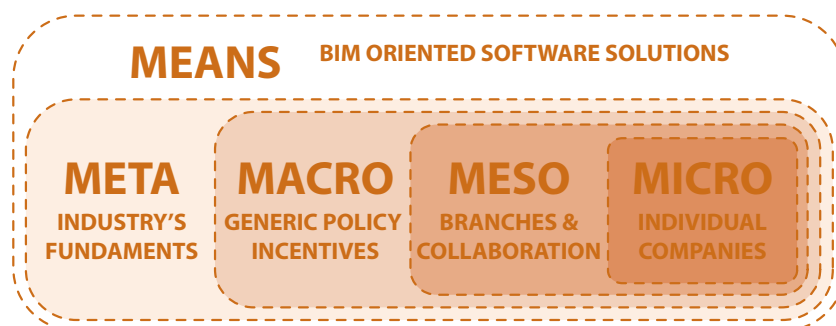


figure A.2: *Vertical Division AEC Industry*

B

ANALYSIS

MEANS

SOFTWARE SOLUTIONS

Currently there is an important shift going on in the way of working of AEC industry's enterprises. Due to more complexity, higher demands, and the need for more efficiency, collaboration (in an early stage), quality, and automation are becoming increasingly important. This is where software developers can play an important role.

There are many kinds of different means for different parts and elements of an AEC industry project. In here with means, actual software products are meant. There is a wide range of different software products available currently. And software is becoming more and more important due to the introduction of the openBIM concept.

The main focus of these softwares can be divided in eight categories (figure B.1) of which 'manage' is the connecting category and is becoming more important. Most of the BIM-oriented software products though currently are focusing on the design and construct category (Institute for BIM in Canada, 2011), containing ArchiCAD and Revit for instance. The remaining categories still are more or less being neglected although these are essential parts for the success of BIM. Based on the four industry levels the benefits of BIM can be highly improved, according to the industry's enterprises, by the following:



figure B.1: Means Categories

Meta: "Improved operability between software applications."

Macro: "Improved functionality of BIM software."

Meso: "More clearly defined BIM deliverables between parties."

Micro: "More internal staff with BIM skills." (McGraw-Hill Construction, 2012)

These four aspects all have lots to do with software products in the current situation of the AEC industry and should all being taken in account by the developers. ■

META

INTEROPERABILITY

The meta-level for software development should be focused on the fundamentals of the AEC industry. Project's complexity is increasing and the need for better methods of working gets higher. This affects the fundamentals directly.

In addition to this complexity "integrated project delivery (IPD) is a relatively new procurement process that is gaining popularity as the use of BIM expands and the AEC (architecture, engineering, and construction) facility management (AEC/FM) industry learns how to use this technology to support integrated teams" (Eastman, 2011). It is a method that focuses more on integrative building processes and how to structure it (figure C1.2). It is often mapped in combination

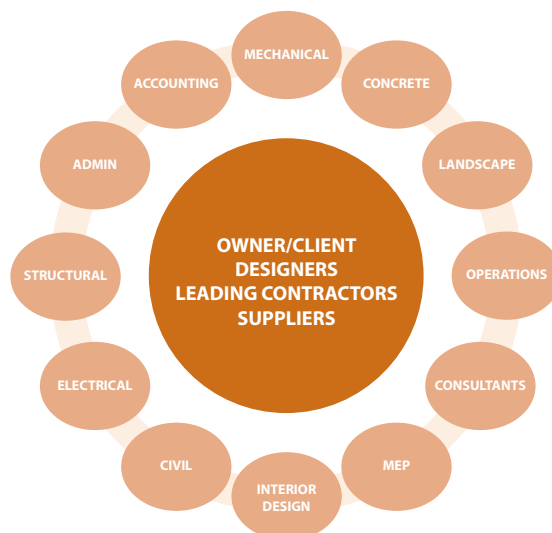


figure B.2: Integral Project Delivery

with more automated and structured data management.

This way of working also asks for close communication with the data model of the building or structure. To make this possible, also better norms and standards are needed. Next to that, it is important that governments try to increase this process, but also review and improve national building regulations in order to make them more generative. This will improve the way of communication, collaboration, and automation.

Currently, hardly any software offers a solution where the model data is directly linked with the planning of operation phase for instance. That is partly because of the poor standards, norms and regulations. Everyone tried to develop their own way of working

ignoring other's requirements. Therefore, different kinds of software solutions had to be created operating individual from each other with hardly any link. In many projects a lot of double work is done because of that, creating an inefficient and costly way of working. Not even taking in account the high risk of making errors while manually recreating data and making it compatible with your own used software.

Due to the current developments though, projects getting more complex, owners demand more quality, early collaboration gets more important, and data models with interoperability are becoming indispensable. New types of software projects, interlinked with each other, but also offer the ability to link other data will probably be highly welcomed. ■

MACRO

DATA MANAGEMENT

On macro-level, focusing on industry incentives regarding generic policies, data management is an important factor due to the industry currently.

The Dutch AEC industry, like in more countries, consists of mostly *Small and Medium Enterprises, SMEs* (figure B.3). Often, they do not possess enough financial and human resources in order to make the complete shift to the way of working using all benefits of BIM.

The importance of BIM and data management can also be partly explained using the W18-concept (figure B.4). The data management is not only important during the design of construction phase, but also during the entire operate and maintain phase. When any error will be discovered during the construction phase it can cost twenty times more than during the design phase and during the maintenance phase it can cost up to sixty times more.

These failure costs though, occur too often nowadays during the construction

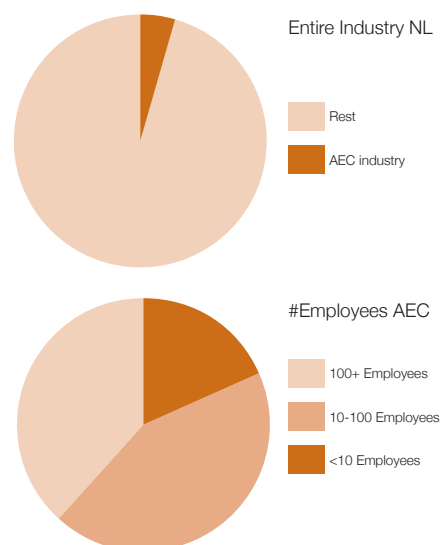


figure B.3: AEC-industry NL

or maintenance phase, often due to miscommunication in data delivery. The engineer should receive the right information on time of the architect for example. When something goes wrong in the traditional way of working, an error is quickly made. Using the BIM method it is easy for instance, to use a clash detection combining different



figure B.4: W18-theory

data models and solve errors before the construction phase saving a lot of financial resources.

The threshold for the adoption is high though, and should be lowered in order to make the concept function the right way in the industry.

MESO

INTERCOMMUNICATION

Intercommunication internally and externally is highlighted in the meso-level, which is about industry branches and collaboration chains.

Current projects increase in complexity (figure B.5). Especially during the early phases of a project, data input is high and there is a lot to change about a design. Due to the involvement of more parties, also better collaboration is increasingly important during the early phases. This also means that a lot of knowledge has to be put together smart in order to be able to keep an overview on all the data during later phases.

A lot of data streams come together during these projects. Databases and -models, time planning, and work processes of all the

To lower the threshold the concept should be made less complex. In order to improve data management, linking important aspects, this can be accomplished. Software developers could develop products where the data management will be easier to adopt by AEC industry's enterprises. ■

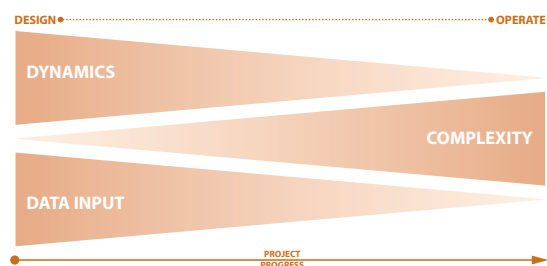


figure B.5: Project Complexity

different parties need to be coordinated and combined. Unfortunately most of the current available software focuses on specific tasks branches and enterprises. This, in combination with poor norms and standardization creates an even higher threshold for the adoption of BIM. The real benefits cannot put into practice without the right software, especially without enough financial resources. ■

MICRO

BUSINESS PROCESSES

At the micro-level, focusing on individual companies, a lot of changes have to be made regarding the current business processes. All kinds of new processes and methods have to be implemented in order to benefit from the BIM concept.

Regarding the company value chain (figure B.6) on several facets changes have to be made. The firm infrastructure has to be adapted to the collaboration increase for instance. Employees have to be educated on BIM and the involved methods en means, and the procurement also will be changed. But due to the little financial and human resources, all of this cannot happen when the technology will not fundamentally change. New software has to be adopted in order to be able to develop building information models, collaborate and exchange data with other involved parties, and increase the project's quality and efficiency.

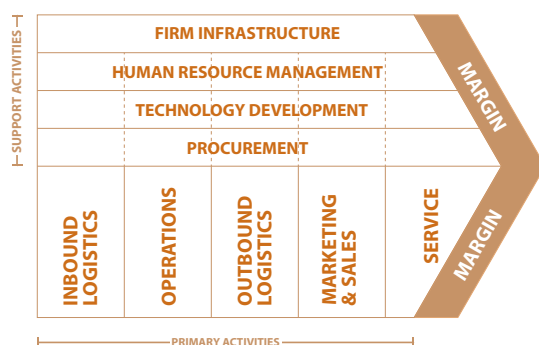


figure B.6: Value Chain

All these changes will affect the primary activities of the company, but these changes will only be made by an enterprise when the margin will be increased. ■

C

CONCLUSION

As stated, there are a lot of gaps to fill within the software industry that is focused on the AEC industry. Currently most of the software products are focused on specific categories, without the right options to link data with other software products and parties.

The BIM-concept is not only beneficial for enterprises itself, but also to make sure overall costs are lower, maintenance costs are lower, the building life-cycle will be longer, and in the end building will be way more sustainable overall.

In order to reach that level, and improve building quality, a lot had to happen in all levels of the AEC industry. The norms, regulations, and standardization has to be improved, requiring involvement of national or even international governments; interoperability between data, software, methods, and parties have to be higher; data management has to be improved for the entire industry during the entire building life-cycle; intercommunication of companies internally and externally with collaborating parties had to increase formal and informal; and business processes have to be fundamentally changed in order to be

adapted to the new way of working.

As is understandable, software developers are not eager to take these big risks and create new software products without knowing the exact benefit and future of BIM in the AEC industry. They rather stick to their core business. On the other hand, it seems a big shift is upcoming and the risk can be kept within bounds when collaborating with other developers for other categories.

In this way the use of applications like Revit can be extended and even more useful when you are able to import a third-party BIM-model properly, combine it with all planning data linked to all involved contact's information, in order to communicate about specific changes to be made.

The market of BIM is still steadily growing, but probably will stagnate too soon if available application developers do not improve their open innovation and extend functionality and usability of software products to decrease the threshold to implement the BIM concept as a company, benefit fully of it, increase the bad image of the AEC industry again, and improve the sustainability. ■

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