Building Information Modelling in the Netherlands: A Status Report

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Abstract

Building Information Modelling (BIM) is nowadays widely accepted as a key enabler for innovation in construction. In the Netherlands, people have been working on BIM for more than twenty years, although most activities have been research efforts. But since the leading CAD vendors have embraced BIM as a key development in CAD innovation, the implementation and use of BIM technologies in practice have increased significantly.

Apart from various "pseudo-BIM"- initiatives (BIM-solutions within a single commercial software platform, "closed" BIM-solutions that are not accessible by external parties, fancy CAD-solutions presented as BIM-solutions), there are a number of interesting BIM-related developments in the Netherlands.

The first development is the COINS project. This project aims for agreements for the storage and exchange of construction objects. The main results of COINS are currently specifications for these agreements and software tools for implementation of COINS-based systems. COINS uses the OWL format for object definitions; interfaces with the IFC-models have also been developed. The COINS project is initiated by the Dutch civil engineering industry, but the current focus is on products of the entire building industry. Several pilot projects are currently taking place both in civil engineering and in office and residential building.

The second development is somewhat different: it is the BIM Case Week, an initiative that brings together professionals in the construction industry for a week, and lets them work together on a design of a building project. The approach is fairly down-to-earth but it has provided very useful insights in how exchange and sharing of construction information takes place in practice.

The third development is the Dynamic BIM initiative; this is currently an academic initiative that aims at the support of project dynamics in a BIM context. The focus in this initiative is on innovative design and engineering processes enabled by BIM technologies.

Keywords: building information modelling, the Netherlands, status report

1. Introduction

One of the current keywords in building innovation is Building Information Modelling, or BIM. Since a few years, BIM is a buzzword. But Building Information Modelling is not a new activity or technology; in fact people have been working on BIM (using different terms) for decades, although mainly in research settings.

People in the Netherlands have been involved in BIM research since the early days of BIM, the eighties of last century. Over the years, Dutch researchers have been working on BIM in various projects. In recent years, a transition can be seen in the Netherlands from mainly research oriented activities towards dissemination and implementation in building practice. More and more people and companies become active with BIM. Articles on BIM appear in practice oriented journals, new courses for building professionals are set up, and new dedicated BIM websites are set up, and so on.

This paper gives an overview of some important BIM-related developments in the Netherlands. First a short historical overview of BIM in the Netherlands is given. Next the COINS project, the BIM Case week and the Dynamic BIM initiative are discussed, followed by a short discussion of other developments. But before all that, a short statement is made about the definition of BIM.

2. What is BIM?

There are a number of different definitions of BIM around. As more people are working with BIM, this number increases, and as a consequence more misunderstandings occur. As long as BIM is mainly a research topic, this is a little unpractical, but more or less unavoidable, just like with many other definitions in research. But with the transition from BIM as a research topic towards BIM as a commercial product or service, the need for a clear definition becomes really apparent. For example, many companies claim they are doing BIM while critics say they are only offering smart CAD solutions.

A useful definition for the term Building Information Modelling is the following by Lee et al (2006), which is also used on Wikipedia: ***Building Information Modeling (BIM)*** *is the process of generating and managing building data during its life cycle. Typically it uses three-dimensional, real-time, dynamic building modeling software to increase productivity in building design and construction. The process produces the Building Information Model (also abbreviated BIM), which encompasses building geometry, spatial relationships, geographic information, and quantities and properties of building components*

In addition, a useful definition for the term Building Information Model is the following by Van Nederveen et al (2009): *a* ***Building Information Model*** *is an information model of a building (or building project) that comprises complete and sufficient information to support all lifecycle processes, and which can be interpreted directly by computer applications. It comprises information about the building itself as well as its components, and comprises information about properties such as function, shape, material and processes for the building life cycle.*

The last definition is a little bit long term oriented, as life-cycle support by BIM is currently far from common practice.

But let us go back to the initial question: what is BIM? A key question in this respect is: how can we distinguish between "BIM" and "non-BIM"? For that purpose, the following characteristics of BIM can be highlighted:

- BIM aims at the exchange of semantic information. That is: the model that is developed does not only cover geometric information, but also material properties, functional information, etc. For example, many advanced CAD systems that use concept of parametric modelling can be very useful design aids. But if their internal model is solely based on geometric entities, you cannot call these BIM modellers.
- A prerequisite for BIM is the use of open standards. A Building Information Modeller may be a "closed" system, but the information that is exchanged or shared must be defined according to an open standard, such as IFC. Although closed systems can be very effective, in the long run they can lead to vendor-dependency and to outdated systems that are very difficult to upgrade.

Neither of the definitions stated above explicitly mention open standards as a prerequisite for proper BIM. Open standards are indeed often mentioned as a prerequisite. On the other hand, one can question whether it is absolutely necessary to use for example IFCs in a BIM environment. In our view this is an open issue.

3. History of BIM in the Netherlands

The Netherlands has quite a rich history in BIM research and development, which goes back to more than twenty years ago. In the nineteen eighties, several groups in the Netherlands were involved in research on CAD systems for architecture, and on the issue of data exchange between CAD systems. The Dutch architectural CAD system Arcos/Arkey CAD was launched with some "building intelligence" built in. A discussion started on the use of so-called reference models for CAD exchange.

A key reference model in this context was the General AEC Reference Model by Wim Gielingh of the Dutch research institute TNO (1988). This model was developed for the ISO STEP (ISO 10303) project, and it provided a number of concepts and principles that we can regard now as BIM concepts: as required and as designed information, generic-specific-occurrence information, life cycle data, views on building data, etc. The famous "Hamburger" notation and the associated ideas are still used in publications from all over the world.

Another interesting publication out of that period is the so-called IOP Bouw Informatie Model (Van Merendonk and Van Dissel 1989). This model was the main end result of a large Dutch research project aiming at the modelling of building information. Most of this publication consists of process

models in IDEF0, furthermore some data models have been presented in IDEFx. The models are nowadays rarely used or referenced, but the title of the model is definitely remarkable.

In the early nineties, some very interesting BIM-related work was carried out in EU-projects in which TNO was involved, such as ATLAS, PISA and COMBINE (Tolman 1999). In all of these projects, product modelling based on ISO STEP played a key role. Many key concepts and principles of IFC origin from these projects.

From the late nineties until today, a number of smaller scale national activities related to BIM took place. Participants involved include among others the building specification organization STABU, the organization for installation systems UNETO. Some of the initiatives have formed a platform called PAIS, see www.paisbouw.nl. A significant national development has been VISI, a standard for communication in building projects based on transactions and messages, see www.visi.nl. VISI uses protocols for common communication processes using transactions that consist of a sequence of messages between participants.

At the moment there are a number of interesting BIM developments going on in the Netherlands. Three developments will be discussed in the next three sections of this paper. The first development is the COINS project. This project is interesting because many key players from the Dutch construction industry are participating. The approach taken can be regarded as pragmatic, yet they do use an open standards approach based on IFC and OWL.

The second development is the BIM Case Week. This initiative brings together professionals in the construction industry for a week, and lets them work together on a design of a building project. The BIM Case Week is similar to the Build London Live events in the UK. Its biggest value is the great amount of public attention for BIM that it attracts.

The third development is the Dynamic BIM initiative. This is currently an academic initiative that aims at the support of project dynamics in a BIM context. This initiative is particularly interesting because it tries to bring BIM another step further through new research and innovation.

An important development in the Netherlands that is not directly about BIM, but that has a significant impact on BIM work, has been the growing interest in Systems Engineering. Since the late nineties, Systems Engineering was introduced at the large infrastructure principals ProRail and Rijkswaterstaat, when these organizations became involved in large scale projects such as the High Speed Link railway project between Amsterdam and Paris. With Systems Engineering, infrastructure projects became more formal, with explicit procedures for requirements management, verification & validation and risk management. Of course the companies that work for Rijkswaterstaat and ProRail had to follow the Systems Engineering process, which meant that almost the entire civil engineering sector had to deal with Systems Engineering. The impact of Systems Engineering on BIM work in the Netherlands can be seen in current developments that will be discussed below.

4. The COINS project

The first Dutch development to be discussed in this paper is the COINS project. This project aims for agreements for the storage and exchange of construction objects. The acronym COINS stands for 'Construction Objects and the INtegration of processes and Systems (see www.coinsweb.nl and click on "Introduction COINS program").

The COINS project was started in 2003 by a number of organizations from the construction industry most of which were already involved in the VISI project, see above. Similar to the VISI project, the COINS project has quite a strong support from industry: about 30 organizations (public principals, construction companies, engineering offices, research institutes, universities, colleges and software companies) are involved in the project. But while in VISI the focus is on the communication process, the focus in COINS is on the content of the communication between participants: the construction object information. This information deals with 3D geometry and other object characteristics such as material, planning data, cost data etc., in fact any BIM data that is needed for the project.

The COINS system architecture has two important components: the COINS Building Information Model (CBIM) and the COINS Engineering Method (CEM). The CBIM is as could be expected the building information model: the structure of objects and their associated data. For the definition of this the Ontology Web Language (OWL, see www.w3.org/2004/OWL) is used. Interfaces with IFC have also been developed. The COINS Engineering Method, or CEM, describes the methods and procedures that are followed in the engineering process. The CEM is especially used for the definition of systems engineering methods that have become popular in the Netherlands (see above), for example requirements specification procedures, or verification and validation procedures. The combination of a CEM and a CBIM for a specific application is called a COINS Framework, see Figure 2.

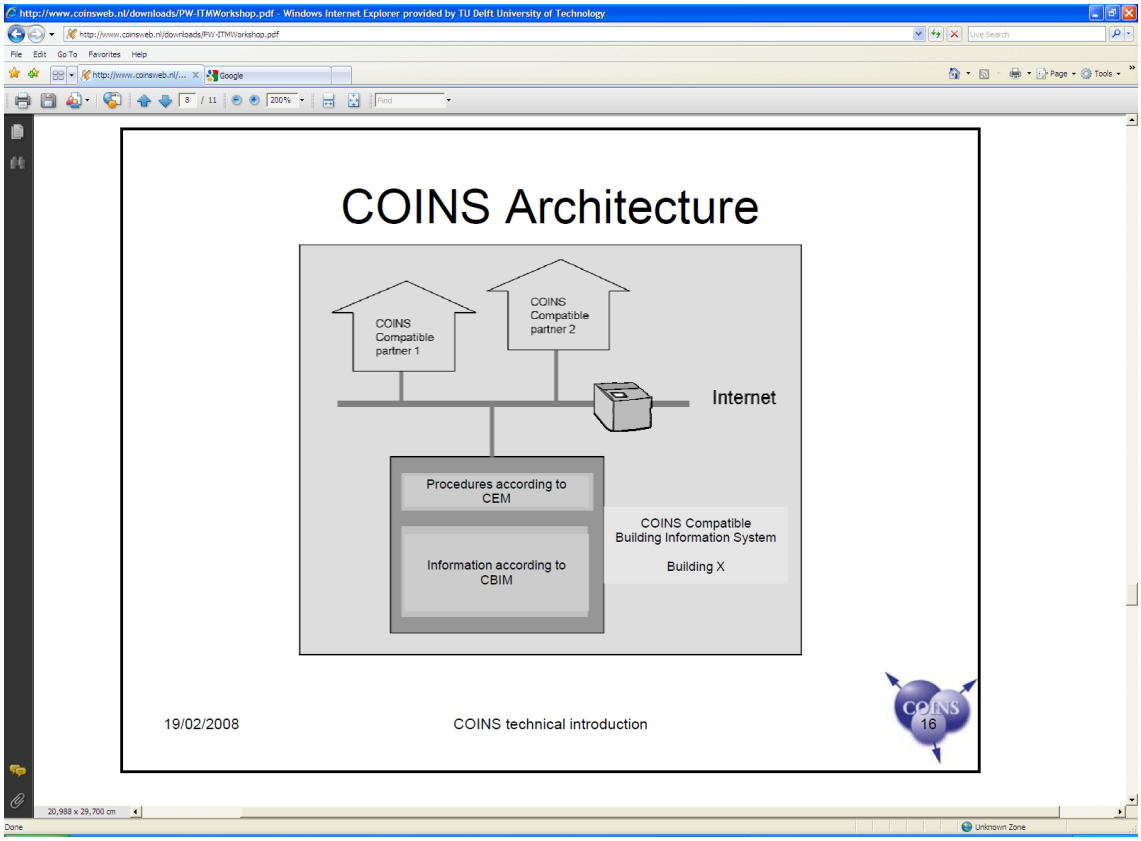

Figure 2: COINS architecture

A number of COINS pilot projects have been carried out to date. In each of these projects a COINS CEM/CBIM Framework has been elaborated for a specific scope. Examples are:

- RSS/Lunetten: functional specification/design of a railway station
- BAM: engineering, 3D-objects and quantity take-off
- IT-partners: engineering and interoperability
- IBU: functional specification/design of a waste water buffering facility
- Groningen: concurrent 3D-design of a small bridge
- Structon: 4D/BIM object management for a parking garage

(See www.coinsweb.nl).

Furthermore, a useful piece of software called the COINS Navigator has been developed. This software can be used to import, explore, query and export a COINS model (CBIM). This software is

freely available, but it has a prototyping status. The intention of COINS is that IT companies take over the concepts of this software and turn it into professional products.

5. BIM case week

The next development is somewhat different: it is the BIM Case Week, an initiative that brings together professionals in the construction industry for a week, and lets them work together on a design of a building project. The BIM Case Week has been organized in the Netherlands in 2007 and 2008, with approximately 100 participants each time, mainly from building and construction practice (architects, engineers, public authorities, etc). The next edition will be in March 2010. The main goals of the BIM Case Week are (1) to enlarge the awareness of the BIM concept and BIM technologies in the building and construction industry and (2) to disseminate knowledge and experience among building and construction professionals.

The general setup is as follows: the participants arrive on Monday morning, the assignment for a construction project is presented, and from Monday afternoon onwards, different teams work on the development of their design proposal, using BIM for the exchange of design and engineering information between the different disciplines in the team (architectural, structural, HVAC etc.). In fact this kind of event can be called a true "workshop" where the participants are really *working* on a project, instead of the numerous workshops that are in fact small-scale conferences with paper presentations of papers, where working mainly means listening to other presentations.

Figure 1: Participants at work in the Dutch BIM case week

The BIM Case Week formula has turned out to be very successful. There is no doubt that the participants of the BIM Case Week have learned a lot from each other and from the project that they have been carried out. Furthermore, the BIM Case Week has gained attention from key persons and organisations in the Dutch building sector, such as the public principals Rijkswaterstaat, ProRail and the large cities. One reason for the success is the pressure cooker effect: the participants are in the same room for a week and they are thus forced to solve problems right away. Furthermore, the degree of interaction between participants is very high. In a few days, the people at work share a lot of knowledge, experience, ideas and thoughts, and often become friends. In "normal life", it could take at least months to reach this degree of sharing knowledge and ideas. Apart from that, the BIM Case Week proved to be a very useful test facility for all kinds of BIM technologies. With so many experts around, the shortcomings of the current state of BIM technologies became quite clear, both technical shortcomings and process-related and human-related shortcoming.

Of course not everything went perfect in the BIM Case Week. In 2007, the emphasis turned out to be on exchange of 3D geometry information, rather than on true semantic BIM information. Also very practical problems such as the network connections took too much attention. These aspects were significantly improved in 2008. Some issues that are still remaining are (1) a common understanding of the concept of BIM, (2) the need for arrangements for the exchange between participants, and (3) the need for process modelling and process management. These and other experiences and conclusions of the BIM Case Week have been well documented (Adriaanse et al 2007 and Baayen et al 2008), but unfortunately only in Dutch.

The Dutch BIM Case Week is very similar to the Build London Live event that has been organized in the UK in 2008 and 2009. The authors do not know all the details of the Build London Live events, but it is expected that much of what has been said on the BIM Case Week is also applicable to the Build London Live events.

6. Dynamic BIM

The next development discussed in this paper is the Dynamic BIM initiative. This is currently an academic initiative that aims at the support of project dynamics in a BIM context.

The motivation for Dynamic BIM starts from the observation that current building projects are carried out in a way that is ineffective and inefficient: construction projects are usually delivered too late, too expensive and not what the client wanted. The Living Building Concept (LBC) research at Delft University (De Ridder and Vrijhoef 2005) has learned that building processes can be improved by a shift from cost orientation to value orientation, and by a shift from a client-driven perspective to a supplier-driven perspective. The latter shift means that a building solution does not start with the clients' requirements, but with a suppliers' building system: a system of parametric building elements and components that can be utilized for fast, industrial development of building structures as a solution of the demand of a client.

When BIM projects are considered from an LBC perspective, it can be concluded that BIM projects are normally based on common building processes, that is: traditional client-driven and cost-driven building processes.

In contrast, Dynamic BIM aims at the support of a supplier-driven and value-driven building process. The key to Dynamic BIM is that the idea of the suppliers' building systems described above is implemented according to BIM principles. This means that the building system can be seen as a building box in which standardized building elements and components are described with their (parametric) dimensions, material properties, dynamic behaviour, cost data etc. Furthermore, information on relationships such as connections is stored in the building box. The elements, components and relationships together form the building system.

The advantage of this Dynamic BIM system is that a designer is able to make a design in a very short time, because the design comes down to the configuration of standardized building objects. And not only the design is developed in a short time, also the consequences of the design (on life cycle cost, energy use, environmental impact, waste production, etc.) can be assessed at short notice, using dedicated simulations on the proposed configuration of standardized objects.

The key point in this approach is that the main part of the design process has moved from the design for a specific project to the design of multi-purpose objects and connectors for the building box.

The Dynamic BIM approach described above is new and has not been applied before. But the needed technologies are available. The next step is to combine and use these technologies in order to develop the Dynamic BIM system as described.

7. Discussion

The discussed developments all have their strengths and weaknesses. The COINS project is probably the most important and also the most mature development. One of the strengths is the large number of key companies and organizations that take part in COINS. The somewhat pragmatic and practice/oriented approach of COINS seems necessary to keep the large number of participants interested. From a technical point of view, COINS can be regarded as state of the art. An open standards approach using IFCs and OWL is used. The only "weakness" of COINS is that it is not really a breakthrough development. But that cannot really be expected with this line-up of participants.

The biggest value of the BIM Case Week is the fact that it attracts so much public attention for BIM. This pressure cooker event with 50-100 participants trying to accomplish something in a week is really appealing. From a technical point of view it is less spectacular. Especially in the first edition, the emphasis was more on 3D modelling than on BIM, but this has significantly improved.

The Dynamic BIM development is most interesting from a research point of view as it aims for new, innovative additions to the concept of BIM. But until now it has been only an academic development and there are not yet any real results to show.

A remaining issue is the use of open standards for BIM. In the Netherlands the IFC standard is generally accepted as the main standard for BIM. Also it is generally accepted that open standards are preferable above closed solutions, although there are also Dutch examples of "closed BIM" solutions. But above all there is a general feeling that standardization is a slow and difficult and not very exciting process. Moreover we can see that even a small country such as the Netherlands has enough room for concurrent standards that are really difficult to integrate (i.e. the IFC and the IFD standards, both of which have strong supporters in the Netherlands).

8. Other developments

Apart from the developments above, there are a number of other interesting developments related to BIM in the Netherlands.

8.1 BIM servers

Since a number of years there is a growing need for a piece of software that can be used to import, explore and store IFC models that are produced by design or engineering software: a BIM server. In the Netherlands this has led to the development of the so-called Fidumo, the First Dutch Model server, launched in 2007. The Fidumo was developed by a consortium of two architectural offices, an engineering firm and two software companies under the lead of two the Dutch organisations CUR/PSIBouw and SBR. The Fidumo software was based on software by the Norwegian software company Jotne EPM Technologies.

Meanwhile, a small academic consortium of TNO and TU Eindhoven developed an alternative: the BIM Server. This is a rather simple piece of open source software with the same aim as the Fidumo server: to import, explore and store IFC models that are produced by design software. The software is partly based on prototype software that was earlier developed for EU research projects. More information can be found at www.bimserver.org.

8.2 BIM as a marketing brand

A development that is not really research-related but yet interesting, is the emergence of the use of the BIM acronym as a marketing brand. One example is a consultant who calls himself "de BIM-specialist". Of course he can be found at www.debimspecialist.nl. A similar example is a company offering professional education in BIM called the BIM Academy, see www.bimacademy.nl. Both examples indicate that BIM is no longer a research acronym, but that it has become a buzzword in building and construction practice.

8.3 EU Research

Not as visible, but more interesting from a research point of view are the Dutch contributions to EU research on Building Information Modelling. Already for many years, the main Dutch contributor to BIM/related EU/research is TNO. They have been involved in three 6th Framework projects: Manubuild, SWOP and InPro, and they are now involved in the 7th Framework project IntUBE. IntUBE stands for Intelligent use of buildings' energy information, and aims at lower energy consumption of existing buildings through the use of advanced information technologies. One of the project activities is the development of an energy-oriented BIM-server. Of course the earlier described BIM Server by TNO will play a role in this activity.

An interesting aspect of the EU research by TNO is its follow-up. Sometimes it seems that EU research mainly results in more EU research. But in the case of TNO there are some nice examples of research results with a follow-up in practice – or in more practice-oriented research. For example, in the COINS project discussed earlier and in the VISI-project (see www.visi.nl) some results from EU-research play an important role, especially in the chosen software approach. Furthermore, the BIM Server by TNO can be seen as another spinoff of EU research that seems to be (or become) a valuable and welcome contribution for building and construction practice.

9. Conclusion

This paper has given an overview of BIM-related developments in the Netherlands. The discussed developments show a shift from middle-to-long term research activities towards dissemination, implementation and commercial activities. BIM has become a true buzzword in the Netherlands and it is exciting to see what is happening now and what will happen in the near future.

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Web sites

BIM Academy website www.bimacademy.nl

BIM Case Week website www.bimcaseweek.nl

BIM Server website: www.bimserver.org

Build London Live: www.buildlondonlive.com

COINS website www.coinsweb.nl

De BIM Specialist website: www.debimspecialist.nl

PAIS website www.paisbouw.nl

VISI website www.visi.nl

World Wide Web Consortium: www.w3c.org.