

# THE IMPACT OF BIM ON THE ARCHITECTURAL PRACTICE AND PARTNERING IN THE BUILDING PROCESS

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### Abstract

*This paper reflects the first experiences of two Dutch architectural practices with the use of 3D modeling and Building Information Modeling (BIM) in design projects. It is written from the architect's perspective, but it inevitably covers the whole supply chain. It is felt that the introduction of 3D modeling and BIM will change the building process – and especially the way participants co-operate in that process – fundamentally. All project information will be captured in one digital document (the BIM), instead of in hundreds and hundreds of separate documents. Working with 3D modeling/BIM requires a completely different way of thinking working co-operating in the building process, resulting in better quality, less costs and more added value for the client and the end users. It is to be expected that the introduction of BIM will lead to supply chain integration, Design & Build contracts and project independent co-operation in a very natural and logical way.*

**Keywords:** 3D modeling, Building Information Model, Integral Design, Architectural Practice, Supply Chain Integration.

### INTRODUCTION

Slowly but surely at first, but every day more quickly Dutch architects take their first steps on the road to working with Building Information Modeling (BIM). Pioneers usually start with implementing 3D modelling applications and, in time gradually move on to implementing BIM. This paper reflects the experiences of two Dutch pioneer architectural firms: a larger firm with approximately 60 employees and a small practice with 5 employees. The first firm is involved in a number of projects – a hospital, a town hall, several school buildings – where 3D modelling is fully implemented. The smaller firm has experience with outsourcing 3D modeling to a specialized service provider in two design projects. For the larger firm we will focus on the 'hospital case'. For the smaller firm we will focus on a project to be referred to as the 'housing for the elderly case'.

It is not pretended that this paper reflects the state of the art of BIM implementation in the Dutch architectural practice. The content is only based on the experience of the two architectural firms involved. It is felt though, that these firms operate in the very frontline of the application of BIM technology in daily practice of design projects.

### **Hospital case**

In the hospital case the client played a decisive role in implementing 3D modelling. In the briefing stage the client had experimented with a relatively simple 3D modelling application and experienced that this facilitated the communication with user groups very much. The simple 3D models helped the users to express their functional needs much better than 2D drawings and/or written text had ever done before. The result was – more or less – a ‘drafted’ brief in 3D. Subsequently, when the architectural services for the hospital were tendered, experience with 3D modeling and/or the willingness to use 3D modeling in the project was one of the important criteria for the selection of an architect. The architectural firm had also been experimenting with 3D modeling in some smaller projects. One of the firm’s managing directors became quite convinced of the potential possibilities and benefits of this new technique and was waiting for a chance to really implement it in a major project. So the firm tendered for the job and won. It was a happy coincidence that both the client and the architect really wanted to go for it. The client was even willing to pay an extra fee to enable the architect’s employees to get themselves deeply acquainted with the technique of 3D modeling.

### **Housing for the elderly case**

The architect of this project strongly believes in the concept of integral thinking and design. He combines that with a passion for designing at - what he calls - “the edge between confection and tailor made buildings”. He feels that he as the architect and director in a design team, is responsible for delivering a design that both enables the end user to be successful and that is exactly built as it was intended. He is convinced that 3D modeling and BIM are powerful tools to help to achieve this. Experience teaches that without such a model, there are too many hazards in the design, in the process and consequently in the end product. In several projects the architect had to conclude in the end, that ‘the model’ apparently only existed in his own head. 3D modeling gives him the opportunity to share it with the client, the end users and all other relevant parties involved. That is why he decided to invest in the introduction and implementation of 3D modeling in a relatively early stage.

Moreover, the architectural practice mainly works for vulnerable target groups like the elderly and people who are dependent on health care. For those groups the architect feels the need to mobilize maximum expertise in his projects. The challenge is to make beautiful, successful and technically sound buildings within the low budgets that are available. Also in this respect 3D modeling is expected to be a powerful tool, as it may help to do the right things first time right. The housing for the elderly case is one of the firm’s first projects where 3D modeling was fully introduced.

## **3D MODELING/BIM AND ITS IMPACT ON THE DESIGN PROCESS**

### **Hospital case**

In the client presented a ‘drawn brief’ in 3D and demanded that the architect and the other project partners would build on this. This was more or less considered as an experiment: “Let’s try and see how far we can get”. In the first design stage (Master Plan) the architect

decided to shadow run with the traditional design system as a backup. After four month the backup plan was promoted to 'Main Model' and put into the 3D modeling system. After this the traditional design system was not used again in the project, but afterwards it can be concluded that the shadow run process eased the startup of the 3D modeling process.

By the time this paper is written, the project is in the stage where the technical specifications have been prepared and the detailed engineering has been started up. The execution has already been tendered. The architectural design is still represented in one 3D model/database file. This is quite an achievement for such a large project and has never been done before in the Netherlands on such a large scale.

The structural engineering consultant works directly in the architect's 3D model. This implies e.g. that the architect does not draw or model any of the concrete and steel structures, the structural engineer is the 'owner' of these data. From his own office, the structural engineer works online in the structural model that runs on a computer in the architect's office. Every now and then the structural model is merged with the architectural model. These are critical moments, as it may appear that any changes the structural engineer has made, conflict with the architectural design. As an example: the structural engineer had made a concrete wall a bit thicker with the result that the insulation layer did not fit anymore. A big advantage of 3D modeling is, that these 'clashes' can be detected and dealt with immediately.

For the service engineering consultant it was a step too far to directly work in the 3D model. At that time there simply were no adequate applications to support that. Another problem was, that in the Netherlands service engineering consultants nowadays are used to restrict themselves to designing general service concepts and giving additional guidelines and performance requirements, leaving the actual engineering to the services contractor after tendering. In practice this causes problems in almost every building project, because the service installations never seem to fit and are always conflicting with the architectural and structural designs. This should not be tolerated in any case, but is certainly intolerable in design projects where 3D modeling is applied. 3D modeling requires an integral approach, the engineering of the service installations must keep in pace with the engineering of the architectural and structural components, as they are strongly interrelated. It took some effort to convince the service engineering consultant that he should provide the design team with the exact positions and dimensions of e.g. air ducts in an early design stage. Finally the consultant also used 3D modeling for this, but he had to use a different application. However, it was possible to use an interface application to perform clash controls. Several major clashes were detected and could be solved in the Final Design stage. More often than not in traditional projects, these kind of clashes only come to surface in the execution stage, resulting in a lot of improvisations on the building site, extra costs and poor quality.

The client uses the architect's 3D model to plot the furniture and hospital equipment in the different rooms and spaces. This is done interactively with the layout design by the architect. Both parties can see almost immediately what is possible or not. The architect gets better insight in the intended use and hospital logistics and thus can optimize the layout.

It is experienced that there are no clear cuts between design stages, e.g. the stages of Preliminary Design and the Developed Design. At a logical moment the model is 'frozen' and called a Preliminary Design. Design assessments and approvals go much quicker than in traditional projects, because the 3D model allows the client to gain good insight in the design during the process. Besides that, the model can be (and really is) tested against the client's brief constantly.

During the design process, the trust in the 3D modeling technique has grown substantially with all parties involved. The client now will demand a 3D model of the building 'as built' at delivery. This does not mean that nothing goes wrong. There is still a lot of discussion between project partners about the information that has to be exchanged in the different design stages. It still occurs that internet connections cannot handle the huge amount of data that has to be processed. There is a lack of standards for the exchange of 3D object oriented data and operational object libraries, so that the design team has to invent a lot by itself. Nevertheless they are convinced that this is the way to proceed in future and that suitable solutions will be available in the near future.

### **Housing for the elderly case**

Other than in the hospital case, where the architect builds and manages the 3D model, in this case the architect outsources the 3D modeling work to a specialized service provider. This provider acts under the responsibility of the architect and is paid by the architect out of his own fee. He not only models the architectural design, but also the structural and the building services design. The information for this is provided by the usual structural and service engineering consultants. In practice the service provider, though he is formally 'just' a subcontractor, acts as the director of the design team and has a much influence. He determines which design partners have to deliver which information at which moments.

In fact three different 'aspect models' are being made: the architectural model, the structural engineering model and the service engineering model. The design team members, with the assistance of the service provider, work separately on the basis of their own aspect models. Periodically these models are connected for a clash control. All clashes are recorded in an online database and ranked on the basis of seriousness. This includes e.g. any 'clashes' between client and user requirements on the one hand and the budget on the other. The solving of any clashes is teamwork, in which also the client is involved. Not before all clashes have been tackled in a satisfactory way, the aspect models are merged into one common 3D model, that then is the basis for new aspect models in the next stage.

The structural engineering consultant is quite suspicious of any mistakes that the 3D modeler might make concerning the building structure. This may be overcome by periodical quality assessments of the structural aspects in the 3D model. This implies another infill of the structural engineering tasks in the project.

Also in this case the service engineering consultant had to be convinced that he had to provide (much) more information than he is used to in 'traditional' design projects. To make a valid model, it was essential that all critical piping and duct routes were positioned and dimensioned.

There is no paper based communication in the design team. All information is shared digitally through a project web application. The team members can view and consult the central 3D model online any time. A strict document management system is being maintained; there is an excellent central online archive of all relevant project documents. Also a workflow management tool has been installed; the team members receive automatic e-mails to remind them that they have to deliver scheduled input. The architect and the service provider feel that these are key conditions for a successful use of 3D modeling and BIM.

## General observations

In both cases it is experienced that a 3D modeling or BIM based design process differs substantially from the 'traditional' design process. It is felt as logical and necessary that the design team is complete and that all team members co-operate closely from the very start of the project. It is also experienced that 3D modeling demands that all kinds of decisions that traditionally are made in the stages of Technical Design (specifications) and Workshop Drawings, are made in a much earlier stage. There seem to be no clear cuts between different design stages any more. Standard descriptions of design outputs per stage, like the Royal Institute of Dutch Architects and the Dutch Association of Engineering Consultancies have issued [1], don't (fully) apply and will have to be adapted substantially when 3D modeling /BIM becomes standard practice. One of the problems now is, that there is no clear picture of what the content of a 3D model or BIM should be in the various stages of the building process.

## 3D MODELING/BIM AND ITS IMPACT ON DESIGN

It is clear to all participants involved, that in general the quality of the (integral) building design can improve substantially through the application of 3D modeling/BIM. When the model is consistent, discrepancies between any aspect designs or between different drawings cannot occur. Team members can have instant insight in the consequences of any design changes for their own part of the work, so they can deal with them immediately. The result is better quality, more value for the end user, less failure costs, less improvisations on the building site. This is no less than a paradigm shift in a sector, where the contractor's ability to improvise is considered a merit.

The 3D technology enables the client to gain much better insight in the design than on the basis of the traditional 2D drawings and therefore can give better feedback. In both cases it is experienced that the client is a full member of the design team, who provides valuable input from his own expertise: the intended use.

Not only the client, but also the architect and the other team members have much better insight in the design and the impact of their decisions. The architect e.g. can very quickly view and evaluate the form and sequence of spaces and components, the impact of daylight and shadow, and so on.

Quantity surveyors and cost estimators who are involved in the cases, are both skeptical and positive about the merits of working with a BIM. In theory bills of quantities can be extracted from the BIM, but the reliability of the data strongly depends on, amongst others, the way components are drawn or modeled, classified and coded (a roof is not the same as a floor, although the same prefab concrete slabs may be applied). There are no operational, general standards for this as yet. Besides that, not all information that is needed for a good cost estimate, is modeled in the 3D models. In 'traditional' design projects, the information in CAD drawings is supplemented with numerous additional documents, like technical specifications, lists of materials and finishings for every room and so on. Theoretically these documents are redundant when a BIM is applied, because all information **can** be incorporated in the model. There is a strong emphasis on the word **can**, because all parties concerned will have to put the information in first. Moreover, this has to be done in such a way that the data can be reused by the cost engineers (and – in fact – all other participants). At this moment in time this is not done consistently. There is a lack of the right information standards and object

definitions; there no 'common language' in the BIM world as yet. So at this stage of the development and – especially – the implementation of BIM technology it is considered wise for cost estimators to keep their usual methods and tools at hand. But also here the big advantage of working with a 3D model/BIM is better insight in the design. After all, making a good cost estimate is far more than merely multiplying quantities and prices! It takes good judgment of the specific context, size and location of each and every building component. The 3D technology greatly helps the cost engineer to make the right judgments.

### **3D MODELING/BIM AND ITS IMPACT ON PARTNERING WITH CONTRACTORS**

#### **Hospital case**

When the execution of the work was procured, the 3D model/BIM was handed over to the contractor. This contractor already had quite some experience in using 3D modeling for 'virtual building' in preparation of the real execution. To the regret of all parties involved, the architect's model could not be used for that purpose. The architectural practice had set up the 3D model from the viewpoint of the functionality of the building and its spaces, spatial development and esthetics. The contractor would need a model that reflects the building technology and the sequence of execution activities on the building site. The two viewpoints turned out to be fundamentally different. This also showed in the fact that the bills of quantities of both parties differed quite substantially. The contractor, from his point of view, would define and measure building components ('objects') differently from the way the architect had done in the 3D model. For instance: where the architect had defined a row of columns, the contractor would define a concrete wall with large openings, because he would use a wall mould to make the row of columns. Modeling experts of both the architectural practice and the contractor sat together for some weeks and put a lot of effort in adjusting the 3D model to the intended use in the execution stage. The architect states that his firm learned a lot from this and that in future projects they will surely set up the 3D model differently. He feels that it would still be better if an 'execution expert' would participate in the design process from the beginning. Both the architect and the contractor expect that further implementation of 3D modeling and BIM will naturally lead to supply chain integration and, as a result, more Design & Build contracts. They anticipate that new, very logical forms of co-operation within the supply chain will emerge from this, resulting in more satisfactory work, less costs, better product quality and more added value for the client and the end user. Both the architect and the contractor participate in a community of firms, representing the complete supply chain, who share experiences and best practices of co-operation and information exchange on the basis of 3D models/BIM. The best practices are published on an open source website.

Not only the contractor will have to comply with and contribute to the project BIM, but also the subcontractors will. The contractor, who himself is a convinced advocate and user of BIM technology, planned to purchase goods and services from his contractors and suppliers in the traditional, paper based way. The client did not accept that, as he demanded an electronic 3D model of the building 'as built' after delivery. In the Netherlands nowadays, a lot of detailed engineering in a building project is done by the subcontractors and suppliers. This information is very important for proper maintenance and operation. Therefore it should be incorporated into the project BIM, either by the contractor or the subcontractors and suppliers themselves.

### **Housing for the elderly case**

In the housing case the problem of different 3D models, set up from different viewpoints does not occur. The service provider used to work for a contractor. He makes sure that the 3D model/BIM is set up from an execution process' viewpoint from the very start. This is crucial from the architect's point of view too, because he wants to make sure that the design concept can keep intact during execution and that the actual building will look exactly like he meant it. Of course there is always a chance that the contractor who will build the facility, will choose other execution technologies than the architect and the service provider have anticipated, but it is not to be expected that this will cause major problems.

The ambition and estimation in the housing project is to realize a 10% cost reduction, compared to a similar project where 3D modeling/BIM is not applied. To accomplish that, the 3D model was handed over to the contractor(s) before the bidding process started. By the time that this paper was written, the bidding process was still going on. Therefore it is not possible to conclude whether or not a 10% cost reduction has proved to be possible.

The contractor is obliged by contract to work with and contribute to the model. He is allowed to adjust the model to his own execution method if necessary. Former projects taught that 3D modeling facilitates co making with subcontractors and suppliers. This identifiably leads to project independent co-operation and relationships.

### **3D MODELING/BIM AND ITS IMPACT ON THE ARCHITECTURAL PRACTICE**

Both architects feel that the adoption of 3D modelling/BIM technology will have an large impact on the architectural practice. Not only will it affect the design process, the design itself and the nature of deliverables, it will also affect the architect's role and position in the building process. Already in 1994 the Dutch Council for Building Technology Policy (ARTB) stated in a report, that the participant who will be able to manage the digital data flow in future building projects, will be in the leading position. In this respect, architects in general have a favourable starting position. Indeed an essential part of the (digital) information flow in a building project starts with the architect and a lot of (digital) information comes together in the architect's work. Both architects' experiences so far underline the ARTB statement. They are convinced the 3D technology may enable architects to regain long lost positions in the building process, provided that they embrace the new technology very quickly. A threat may be that senior architects consider 3D modeling/BIM as 'just' another step in the automation process, that can be delegated to the firm's ICT department or computer wizkid. On the contrary: 3D modeling/BIM affects the very core of the architect's profession and business. Therefore, successful implementation requires strategic planning, policy making and decision making at the firm's board table. As a board member of the architectural practice in the hospital case states: "The ideal situation is to have a 'BIM supporter' who really wants to go for it, combined with a board that sees the opportunities."

A precondition is a positive and open attitude towards sharing information in a transparent way. This is not only true for the architect, but for all project participants who co-operate on the basis of a 3D model/BIM. People must be willing and able to co-operate interactively in a design team. Only then the advantages of applying 3D modeling/BIM will become manifest. The technology allows the design team to evaluate design decisions 'real time' on numerous aspects, like stability, energy consumption, physical building behavior, the spread of smoke

in case of a fire, environmental impact, life cycle costs and so on. This can only be done when all the specialists in the design team work closely and interactively together.

Already on the basis of today's experiences, it is to be expected that the further development and implementation of BIM technology will change the traditional organization of an architectural practice (or in fact any other kind of engineering consultancy practice) substantially. The borderlines between different functions will blur. A designer and a draftsman (3D modeler) will work together in a much more intensive and interactive way, as the designer may want to react instantly to any alterations in the model. Sometimes it may be hard to tell who is who and in the end maybe the designer will become a modeler himself. Similar developments will be seen in structural engineering firms. Traditionally the engineering and calculating of building structures is the structural engineering consultant's job, while there is a draftsman in place to 'translate' the results into graphical representations. But when a 3D model is applied, the engineering/calculation and representation of structural object is so closely linked, that they can hardly be separated. So the question is: will the structural engineering consultant model the structural elements in a building design himself in future? The answer is not clear yet.

In the hospital case the architect already started to incorporate technical specifications in the 3D model. This means that in the project database the specifications information is directly and uniquely connected to the building 'objects' they refer to. The result is that in the near future there will be no separate specifications document any more in the design documentation. This will certainly have an impact on the content and organization of the tasks and probably on the positions of the specialist who usually produce such documents.

Any firm that wants to start using 3D modeling and BIM technology, will have to invest in the training of 3D modelers. In the hospital case the draftsmen who had to learn how to work with the 3D modeling application, reached about 90% of their usual production rate in the design stage within a period of two to three months. Some of them will stay at that rate, other will further improve their performance. It is expected though, that everybody will reach 130% or more in the stages of the technical design (specifications) and detailed engineering. This is due to that every unique object in the building is only modeled once. 2D drawings, like layouts, façade projections and cross sections (that still will be necessary to some extent) are generated from one and the same model. Discrepancies between different representations of the same object will be impossible. In today's practice the handling of these discrepancies in 2D drawing take a lot of effort and are one of the main sources of failure costs in the building process in general and specifically in architectural practices.

The fees for architects and other design team members require special attention when 3D modeling/BIM is applied. The traditional fee structure is certainly not applicable. Developing a 3D model requires a substantial investment by the architect, while other participants like the contractor benefit most of it. In the housing for the elderly case the architect, from his point of view, has a lot of work done that he usually is not paid for. The structural engineering and service engineering consultants e.g. don't make their own drawings any more, these drawings are generated from the 3D model that the architect's service provider makes. In other words: a 3D model or BIM represents a considerable added value, that deserves adequate compensation for whoever put effort in it. In the housing for the elderly case it is negotiated that the contractor pays the architect up to 10% of the execution budget for obtaining the digital 3D model. The contractor anticipates that he can earn this back in the project.

## **LEGAL ASPECTS**

A building design in a BIM environment is made by more than one person. All contributions of a team of experts is gathered in one single digital document. Often the question arises who has the 'intellectual ownership' of the information in the BIM. Who can be considered the legal author of the design? Is it the architect or lies the copyright with the design team as a whole? And probably the most important question of all: who can be held liable for any mistakes that are made in the design work? In the housing for the elderly case e.g. the question can be raised in how far the architect is liable for the information that is supplied by consultants, but that is incorporated in the project's 3D model under the architect's responsibility? Questions like these are addressed by dr. Monika Chao-Duivis, who is a professor in building legislation and regulations at the Technical University of Delft, in an article called "Legal implications of working with BIM" [2].

Professor Chao concludes that it is possible to automatically label any piece of information that is added to a 3D model or BIM. Therefore it will always be possible to determine afterwards which participants added certain information and made certain decisions. Based on this, professor Chao states that in a BIM environment it will even be easier than before to determine who is responsible for a certain part of the design. She concludes that BIM is a new and exciting method to facilitate co-operation in a building project, but that it basically does not raise any new questions concerning the intellectual ownership of information. For the same reasons professor Chao that there will be much difficulty to locate liabilities for any design faults. This is apart from the fact, that in a 3D model or BIM environment faults or mistakes usually are detected (and dealt with) in an early stage. On the one hand the technology makes discrepancies and clashes clearly visible and on the other hand the design is much more teamwork than before (team members look at each other's work more intensively).

Nevertheless it is evident that this modern way of co-operation and exchange of digital information requires modern contract conditions. Professor Chao indicates that in the USA new contract documents are already being made available. The institution ConsensusDOCS issued the "Electronic Communications Protocol Addendum" [3], while the American Institute of Architects published the "Building Information Modeling Protocol Exhibit" [4]. There are plans to develop similar documents for the Dutch situation shortly.

## **SOME CONCLUSIONS**

Ever since the introduction of computers in the building industry in the early 1970's, there has been this dream of all project participants working together in one central, digital building model. But for more than 30 years no suitable applications were available to support the realization of this dream. Moreover, computer were too slow, did not have enough capacity and data networks could not handle the huge data flows that the use of 3D modeling and BIM implies. Since a couple of years good 3D modeling applications are available and affordable and also the computers and the data infrastructure have enough capacity to support working with these applications. Slowly but surely the Dutch building industry is adopting the new technology. Architects play a key role in the introduction of 3D modeling and BIM technology in the design process. A key success factor though is a client who supports it and really wants to go for it.

Architects, engineering consultants and other participants in the building process who start using 3D modeling and/or BIM technology, will soon experience that this new technology requires different skills and a completely different way of thinking, working and – especially – co-operating. 3D modeling and BIM strongly support integral design. The best results are made when all necessary experts, including execution experts, work together interactively from the very start of the design process. Design process participants who seriously start to explore the possibilities of 3D modeling and BIM, will soon become aware that the new technology will probably affect their practices more fundamentally than any innovation has ever done before. Where in retrospective the introduction of CAD can be seen as the mere translation of handicraft drawing to the computer, but essentially business as usual, it is clear that BIM will alter that business fundamentally. Some may consider that as a threat, but for e.g. architects it can be a genuine opportunity to regain or strengthen the director's role in the design process. The biggest threat will be that architects don't grab the opportunity.

The experience from both cases that are describes in this paper is, that once a client, an architect or any other project partner really starts using 3D modelling, developments can go very fast. At first in the hospital case, 'some experience with 3D modelling' would be a recommendation for any architect who would apply for the job. It was not long after the design process had started, that the client demanded a BIM of the hospital 'as built' at delivery. This implies full commitment of all parties involved, including consulting engineers, contractors, subcontractors and suppliers.

When the hospital design project was in full progress, the architectural firm became involved in the briefing process of a new project. Very soon it was decided to define the client's functional and spacial needs in a 3D model. In this model, all client and user requirements were directly linked to the areas and spaces they concerned. Thus the initial requirements can be related to and checked in all stages of design, execution, delivery and use. We are sure that by the time this paper is published, we could report about new developments that we don't even think of while writing this.

Unvariably, design team members who get involved with 3D modeling and BIM appear to be quite suspicious of the applicability and the advantages of the new technology and tools. Once they experience the merits (better co-operation, consistent designs, less faults, more insight, better quality, more added value for the client), they get enthusiastic and start to invest in it. They soon realize that this is the way to work in the future. There is no way back. At the same time it is clear that we are just at the beginning. A lot of additional technology, protocols and standards will have to be developed. There is a lack of standards for the exchange of object oriented data. In a 3D model or BIM, all information is linked to the 'objects', the 'things' that make up a building. To make sure that (the computer applications) of all building process participants know exactly what the architect means when he models a floor, it is crucial that all participant use the same concept of the object 'floor'. For this purpose 'object libraries' are needed: standard definitions of possible objects in buildings and their most important properties. The IFC standard, developed by the BuildingSMART consortium ([www.buildingsmart.org](http://www.buildingsmart.org)) is a good start, but insufficient, as it deals only with the geometric properties of building objects. Additional definitions are being developed in a second international initiative, the 'IFD Library for BuildingSMART' ([www.ifd-library.org](http://www.ifd-library.org)). The IFD Library is expected to be operational within a few years. Also it is clear, that the use of BIM technology deeply affects design and engineering processes. The design and engineering process needs to be re-engineered. This – amongst other things – is investigated in the Dutch research programme COINS ([www.coinsweb.nl](http://www.coinsweb.nl)). The aim is to develop process protocols for working and co-operating in a BIM environment.

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