Changing Business Process Management in Project Development

Debby Goedknegt
University of Applied Sciences Utrecht
THE NETHERLANDS

ABSTRACT

The construction sector is in transition. All related manufacturing industries face the challenge to improve the processes within the whole sector. Building Information Modelling (BIM) could be a tool to make production and control chains more efficient (Verbaan, 2013). The question that is being answered her is: What are the business enabling capabilities regarding efficiency and effectivity of BIM in the domain of project development in the built environment for architects and project developers in the context of the current reality of the Dutch built environment? The answer to this question is found through literature research. These findings were validated through five interviews with BIM experts. The business enabling capabilities regarding efficiency and effectivity of BIM are: (1) planning / delivering on time and within budget, (2) communication, (3) coordination, (4) integrating sustainability, (5) decrease failure cost. However, the introduction of BIM requires a change in mind-set amongst all companies within the whole built environment, but also in understanding the processes of other construction related companies. It requires collaborating with other companies and altering the project exceeding chain of processes, making these processes Lean, and sharing knowledge for mutual gains. However, this is still in the future, the construction industry needs to undergo radical change. This research was conducted within a limited amount of time, therefore a limited amount of interviews have been taken. In order to give a proper answer to the research question, more interviews need to be done and more information has to be gathered on the current and future business processes within the built environment.

Keywords: Business Process Management, Project Development, Change, Building Information Modelling (BIM)

INTRODUCTION

The construction sector is in transition. All related manufacturing industries face the challenge to improve the processes within the whole sector. Building Information Modelling (BIM) could be a tool to make production and control chains more efficient (Verbaan, 2013).

"The worldwide marketplace is forcing the optimization of all functions and services. There is no place for waste in today's economy. As processes become more efficient, they need less management, control and regulation, and more leadership, alignment of expertise, vision and value" (Dean Kashiwagi in Verbaan, 2013).

Chain integration has been made possible through ICT. The idea behind a building information model (BIM) is that all data regarding an object are entered once and are available for all parties within the chain, from design, build and maintain. The benefits are evident: less balance failure and failure costs, and shorter durations (Verbaan, 2013). However, it is hard to find scientific

ISSN: 1543-5962-Printed Copy ISSN: 1941-6679-On-line Copy

information on the use of BIM in the field of project development. BIM is mostly used in the executing phase of the building process; the question is whether it can be used to contribute to sustain business processes in the whole of the built environment. Song and Choi (2012) state that existing process management models need to advance and reflect new environments in the construction industry, emerging needs for business process management and particular demands from IT.

Still, since the 1990s, just a handful of construction companies have considered and attempted to innovate their business structure, by adopting Business Process Management (BPM) (Song & Choi, 2012). Sustainable business management is a paradigmatic shift from that of traditional business management, aspiring towards the delivering of balanced and integrated performances in the three sustainability dimensions: social, economic and environmental. A business model that addresses win-win-win strategies for these sustainability dimensions is the means to successful assimilation an application of the sustainability concept into business management (Ahmed & Sundaram, 2011). The use of BIM by project developers could be just the paradigm shift this branch needs because it helps to deliver large, complex projects on time and within budget and it contributes to social themes such as sustainability and the reduction of failure costs (Verbaan, 2013). BIM has a potential use for construction project managers in improving collaboration between stakeholders, reducing the time needed for documentation of the project and, hence, producing beneficial project outcomes (Bryde et al., 2013). Also BIM is no longer just another design tool, BIM is evolving towards an environment of planning, communication and coordinating in which classical roles must change and different parties must learn to join forces. New roles emerge in order to optimize and exceed in the execution phase (Verbaan, 2013). This is where the project development branch can benefit from BIM. It is, however, not yet completely clear what this means for project developers. There seems to be a need for making the project development process more sustainable. However it is not clear in what way the project development process should evolve, and what the new paradigm will be. Stolze et al. (2012) state that BPM could be a tool to help managers around the globe to tackle questions of sustainability by changing the way activities are performed. Researchers should offer innovative, relevant solutions to those practical problems at the intersection of BPM and sustainability. This is confirmed by Byrne et al. (2013) who state that a likely driver for BIM is the link to the sustainability and green agenda. The question that is being answered here is therefore: *What are the business enabling capabilities regarding efficiency and effectivity of BIM in the domain of project development in the built environment for architects and project developers in the context of the current reality of the Dutch built environment?*

Little literature is available on the combination of BIM and project development. This paper aims to contribute to this specific area within the BIM related body of knowledge. At the same time this research aims to find practical information on BIM; for instance in how the use of BIM will change the old division of roles within project development and how it will affect the role fulfilment of the project developer. Also, the fields of sustainability and BPM offer many research opportunities at their intersection for at least two reasons: First, there are not many works that integrate both topics yet as is shown above. Thus it has a vast field of research opportunity. Second, sustainability concerns in companies grow, so most likely there will be practical demand for problem-solving artefacts (Stolze et al, 2012).

ISSN: 1543-5962-Printed Copy ISSN: 1941-6679-On-line Copy

This research is started with a literature review of the most related topics of BIM and SBPM. The literature consists of books and papers. The papers are found through a literature search in Science Direct, Academic Search Premier, Web of Science, NARCIS and with various combinations of the following search words: BIM, building information model(ing), construction, building construction, construction industry, project development, sustainable business process management, business process management.

This study will be conducted within the methodology framework of Design Research (Hevner et al., 2004). Based on the literature review a new approach is developed to enable the use of BIM. This is described in the next section. Section 3 describes the operationalization of the approach. In section 4 it is validated by interviewing relevant stakeholders and experts. This validation is analysed and conclusions are drawn in section 5 of this paper, followed by advice for further research in the final section.

DEVELOPING AN APPROACH TO USE BIM

The decision maker's attitude towards sustainability is changing from cost factor to being an integral strategic rationale where the social, ecological and economic aspects are more equally important. BPM could be a tool to help managers tackle questions of sustainability by changing the way activities are performed (Stolze et al., 2012). In BPM processes are designed to direct the organisation towards the objectives and strategic positioning of the organisation and the optimisation of the organisation's processes towards pre-defined customer results (Boers & Graaf, 2012). The processes of a business imply a strong emphasis on how work is done within an organisation, in contrast to a product focus's emphasis on what, and as processes are a structure for action, these are key to achieving the benefits of process innovation (Davenport, 1993). Consequently, an important measure of a process is customer satisfaction with the output of the process (Davenport, 1993).

The goal of sustainable development is to integrate the economic, social en ecological impacts of our patterns of production and consumption into forms of development that are designed for long-term sustainability (Kleef & Roome, 2007; Ahmed & Sundaram, 2011). Sustainable business management (SBM) is identified by Kleef & Roome (2007) as: *management of business that recognizes its embeddedness in social, environmental and economic systems, and focuses on management and relationships to meet the environmental, social and economic requirements of many different stakeholders in its network.* SBM is a system to improve and visualize the business process within and out of the company by applying the business process which is related to the strategy of the construction company; to execute and control human resources and systems (related to work performance) suitable to the business process; to continuously monitor and improve the business process. To apply this, continuous business process improvement by eliminating unnecessary tasks and operation of information system that supports the business process is required, but also work implementation, performance management and information management. An optimal work structure can be established by continuously extracting wasteful factors in the implementation process and improving those (Song & Choi, 2012). Although a plethora of methods for modelling business processes has been developed and deployed in research and practice, there seems to be no widely accepted method, approach or toolbox for sustainable BPM as a whole (Stolze et al, 2012).

Sophisticated commercial computers and data communications are at our disposal for many decades now. It is time to capitalize on them fully by employing them as enablers for business innovation (Davenport, 1993). At a macro-economic level, information technology has fallen short of its promise for effecting business transformation. There a numerous large-scale examples of IT investment with little or no associated process change, because organizations commonly tailor IT application packages to fit the existing practice, with the result that most business applications are functionally orientated. The most prevalent use of computers by individuals in business is word processing – hardly a process innovation (Davenport, 1993). The communication of the need for a process view and the failure of most firms to identify measurable productivity or competitive benefits from IT investments make the use of IT for process innovation a virtual necessity. A key role of information from the process customer perspective is to enable the tailoring of process output to customer needs (Davenport, 1993).

In contemporary construction a lot of information is shared between the cooperating organisations. Without an adequate information system, the processes will become unmanageable, the quality of the end product will decrease and failure cost and legal conflicts will rise (Straatman et al., 2012). BIM is perceived to be the crucial facilitator to re-engineer the processes in the construction industry through more effective and efficient cooperation, e.g. to better integrate the different stakeholders involved (Straatman et al., 2012; Bryde et al., 2013). BIM already has emerged from a three-dimensional (3D) architectural design technology to a comprehensive methodology to manage the essential building design and project data throughout the building's lifecycle. (Wong et al., 2010; Bouwend Nederland, 2012; Straatman et al., 2012). It has the attributes of both an approach and of a process. It is an approach because it provides an alternative to the traditional, paper-based, two-dimensional (2D) or 3D computer-aided design (CAD)-based approaches to project design and management. It is a process in that it creates a product called a building information model which can be manipulated for various business purposes and whose performance can be measured (Wong et al., 2010). BIM technologies can lead to major productivity improvements by integrating the work of the construction network and thus decreasing the tremendous level of coordination between different organisations collaborating for the duration of one project, e.g. move towards applying lean principles (Rajendran et al., 2012; Bryde et al., 2013). Because all relevant information is known throughout the whole lifecycle of a building (Straatman et al., 2012), the use of BIM improves (Rajendran et al., 2012; Bryde et al., 2013):

- Project planning, coordination of program, cost and schedule projections, and clearly communications of intent to the design team;
- The assurance of program compliance through ongoing analysis of the building model against owner requirements;
- Cost control from the beginning of projects through early comparative estimates and feedback during design.

ISSN: 1543-5962-Printed Copy ISSN: 1941-6679-On-line Copy

However, the application of BIM will have more added value when all stakeholders within the construction industry are cooperating and all processes are streamlined and adjusted to each other. This, however, is still in its infancy (Straatman et al., 2012).

Technology changes the nature of competition in ways companies do not expect (Hammer & Champy, 2001). Therefore, although the central idea behind BIM is a digital three-dimensional building model which contains all process related data regarding design, build and maintenance, and a BIM is nothing more than a virtual building, it is regarded as the symbol for a mentality change in the construction industry where all the different specialists work together on the development of the best possible building (Buurman, 2012; Feiter, 2013). This decreases failure costs like delay and exceeding of the budget and it prevents the completion of inhabitable buildings. The power of BIM lies not in its technique, but in the required cooperation between the different parties. Roles and mutual relations change by working with BIM, every party stays involved until the demolishment of the building. This also implies other contract models, which are more aimed at cooperation and processes in order to deliver optimal services to the end user (Feiter, 2013).

With the introduction of BIM, the integral way of working, it is increasingly important to gain information during a project in order to make the right adjustments if something appears to go wrong (Hulsebos, 2013). Although BIM is often presented as a technical innovation, the real innovation lies in the radical cultural change in the way partners cooperate when working with BIM (Buurman, 2012). Success will be more dependent on the way information is handled (Hulsebos, 2013). Partners in the construction industry are no longer natural enemies, but cooperate on a mutual trust base in which they share knowledge, are transparent about fees, costs and sales prices (Buurman, 2012). This cooperation is not without obligations to all parties involved (Bouwend Nederland, 2012). However, with BIM ultimately better and more sustainable project value can be delivered at lower construction cost (Rajendran et al., 2012; Bouwend Nederland, 2012; Straatman et al., 2012).

Buurman (2012) states that the role of the coordinating project manager is still missing in the BIM process, while Bos (2014) states that BIM has several advantages to a project developer: (1) the development of plans is more detailed with BIM; (2) the costs and benefits of a development plan are easier to calculate with BIM and different calculation methods can be used in order to come up with the best profit model; (3) possible risks can be identified in an earlier phase of the project, as is risk management. Bos (2014) adds that project developers are able to use BIM for the development of single buildings and for the development of areas, especially when BIM is linked to GEO-information systems. A project developer's work will not change rigorously, however, the way his work is executed will change with BIM.

Figure 1 shows the project developer's communication process model without BIM. Figure 2 shows the project developer's communication process model with BIM, in which all stakeholders work together on the same project. The business enabling capabilities of BIM that improve the business process of the whole project development process are divided into three aspects: (1) project (or product); (2) project management; (3) social.

ISSN: 1543-5962-Printed Copy ISSN: 1941-6679-On-line Copy

Figure 1: Communication Process Model without BIM (Goedknegt, 2014).

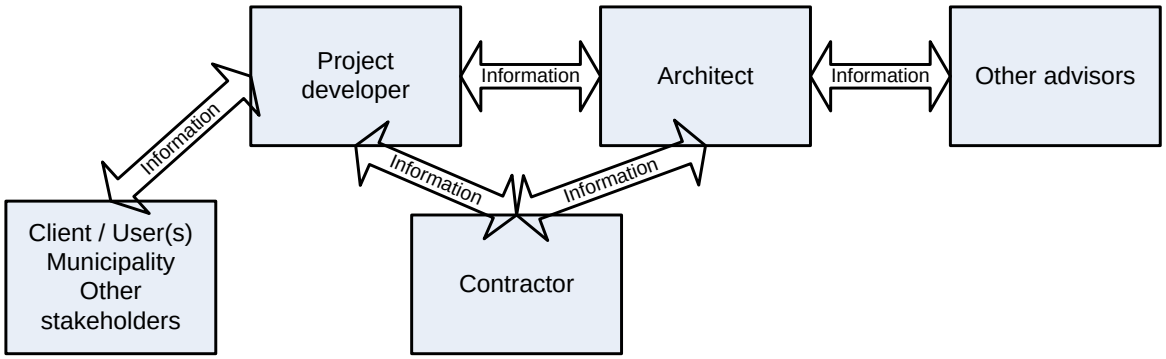
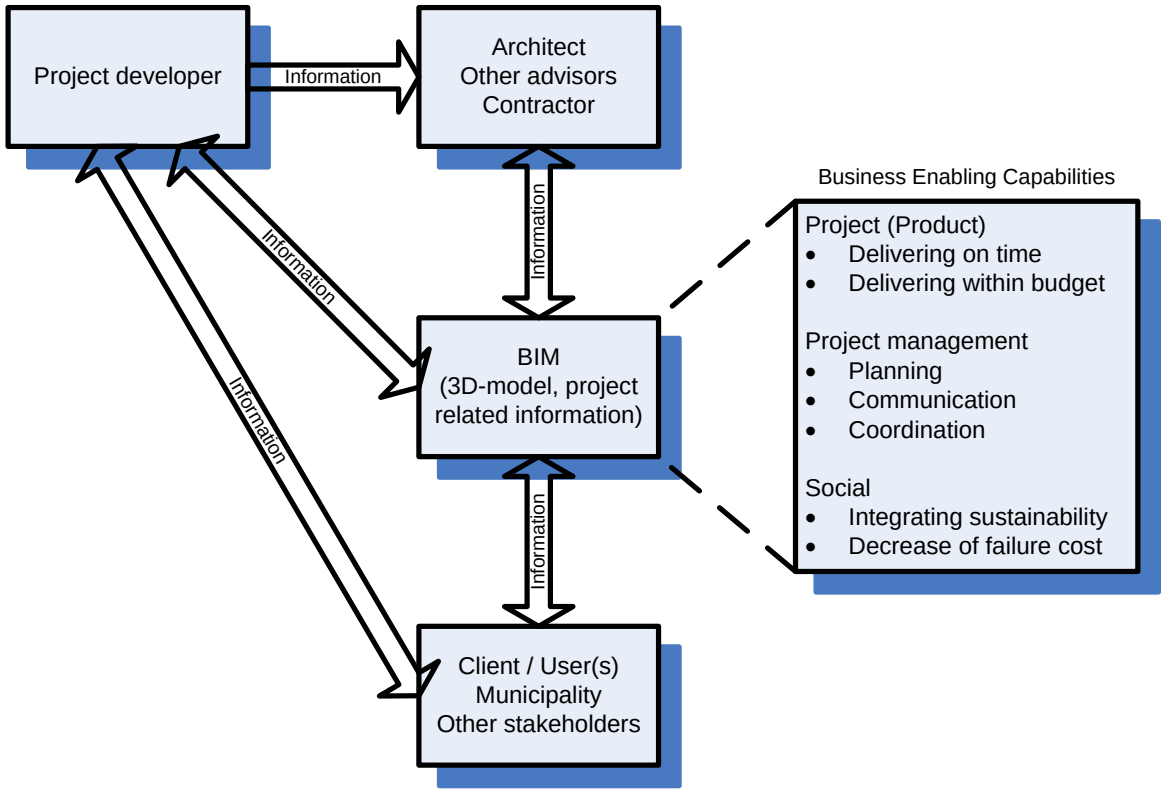


Figure 2: Communication Process Model with BIM (Goedknegt, 2014).



An approach for communication during a building project

In this section the research method is explained and validated. In figure 2 the new approach for communication during building projects is shown. This approach is constructed based on the literature study in section two. It shows a transition from the old situation towards the new situation. This transition beholds a paradigm shift in the way project related stakeholders cooperate. The validity of the artefact will be researched through qualitative, explorative research. In qualitative research, interactions and documents are seen as ways of constituting social

processes and artefacts collaboratively (or conflictively). These represent ways of meaning, which can be reconstructed and analysed in order to develop (more or less generalizable) models, typologies and theories (Flick, 2008).

This qualitative, explorative research will be executed through interviews. In this particular case, interviews are thought best, because the limited time frame available for this research does not allow for one or more complete case studies; projects in the construction industry last for several years. Therefore, a minimum of six interviewees is selected. These interviewees must meet the following criteria: (1) work in the construction industry in either the field of project development (two interviewees), architecture (two interviewees), or (applied research (two interviewees); (2) have experience in working with BIM; (3) preferably have started and finished at least one complete project with BIM. The interview questions all relate to the presumed business enabling capabilities of BIM. The interviewees will be asked to indicate on a 5-point Lickert scale whether or not a certain capability is indeed a business enabling capability. They are also asked to give one or more examples to accompany their statement. The full questionnaire can be found in the appendix.

The found data is analysed through several consecutive steps. Before the findings can be analysed, these are presented and explained. The answers to the Lickert-scale questions are presented in a table. Because the number of respondents is low, the total score is calculated through simple mathematics. The findings of the open questions are described narratively. The analysis of the findings will start with the analysis of the findings presented in the table (table 1). These findings will be analysed both horizontally and vertically, thus per business enabling capability and per expert group. These will be further supported with the narrative findings. Conclusions will be drawn based on these findings. Here also directions for future research will be stated.

VALIDATION

In this section the findings of the interviews are presented and the approach is validated or rejected based on these findings. First the findings of the Lickert-scale questions are shown and explained followed by a narrative description of the findings of the open questions. This is followed by a short discussion of the most important findings and the analysis of the findings.

Planning is regarded to be a neutral business enabling capability. According to Slob (personal communication, 6 March 2014) it is still time consuming to work with BIM, therefore this is yet an obstacle. This will improve in the future though. Bos (personal communication, 25 February 2014) and Sterkenburg (personal communication, 6 February 2014) state that when the BIM 3D model is connected to a Lean planning tool, the project planning can definitely be improved. But, it is crucial for the planning to have all parties involved from the beginning of the project and most profit will be gained through changing the way different parties cooperate within a building process.

ISSN: 1543-5962-Printed Copy ISSN: 1941-6679-On-line Copy

Table 1: Presentation of findings (Goedknegt, 2014).

	Expert	**Architect**	**Project manager**	**Total**
	De Jong / Sterkenburg	**Blokzijl / Bos**	**Slob**	
BIM helps to improve the following aspects of **project management**:				
Planning	1 / 5	1 / 3	4	**3**
Communication	4 / 5	3 / 4	4	**4**
Coordination	4 / 4	1 / 4	4	**4**
BIM helps to deliver the **product** of large, complex projects …				
On time	3 / 5	3 / 4	4	**4**
Within budget	5 / 5	3 / 2	5	**4**
BIM contributes to **social themes** such as:				
Sustainability	3 / 4	4 / 5	5	**4**
Reduction of failure cost	5 / 5	4 / 5	5	**5**

BIM is considered to improve the project communication. N. Slob (personal communication, 6 March 2014) states that a 3D BIM model works well in the communication with the client and that construction problems are visible in an early stage. However, it is still difficult to decide what is communicated to who and thus to get the right information at the right moment to all parties. This is confirmed by Bos (personal communication, 25 February 2014) who adds that miscommunication and misinterpretation are the two biggest sources of failure cost and that BIM could improve the project communication if communication is unambiguous. Blokzijl (personal communication, 24 February 2014) is critical. He adds that this could be solved when different parties work closely together and make unambiguous agreements. This is, however, still difficult to realise as the agreements differ per project.

BIM is considered to improve the project coordination. Bos (personal communication, 25 February 2014) explains that coordination here means gaining information from the model and managing this information, detect possible problems and make known that needs to solve the problem and efficiently direct towards the project goals and benefits. Sterkenburg (personal communication, 6 February 2014) argues that with BIM, coordinating becomes simpler as all changes are instantly visible. Especially when the 3D BIM model is used to visualize the actual building process and to use it as a management tool (Slob, personal communication, 6 March 2014). Blokzijl (personal communication, 24 February 2014) and BIM expert De Jong (personal communication, 13 February 2014) do not agree with this. They state that the project manager's job will be more challenging because he now also has to make sure that all parties cooperate in a certain way and project managers still have no idea what to do with BIM and what they can gain through BIM.

BIM is considered help deliver large, complex projects on time. Slob (personal communication, 6 March 2014) is a bit hesitant to agree with this fully. He argues that a lot of energy is still needed in the 3D modelling phase; however the added value will be visible in the following phases. Sterkenburg (personal communication, 6 February 2014) agrees with this as he states that with the BIM 3D model the virtual building can be checked in advance, pre-building preparations can be

ISSN: 1543-5962-Printed Copy ISSN: 1941-6679-On-line Copy

executed in a shorter amount of time, and when the 3D model is connected to the project planning, the building phase can be shortened through better logistical planning.

BIM is considered to help deliver large, complex projects within budget. Blokzijl (personal communication, 24 February 2014) is positive as he explains that in a 3D model, all problematic connections are made visible, and solutions can be developed in the preparation phase. Thus, since more information is available, the project can be budgeted more accurate. Sterkenburg (personal communication, 6 February 2014) adds that the project budget can be managed better when the 3D BIM model is connected to planning and cost calculation tools. Variants can be simulated and cost and time effects can be made visible, controlled and monitored. He states that on the other hand, companies within the built environment are still not transparent about their budget.

BIM is considered to contribute to sustainability. Bos (personal communication, 25 February 2014) argues that the focus is now on efficiency, sustainability is still perceived to be a luxury not a necessity. It is expected that sustainability and efficiency eventually will be interwoven and BIM is the perfect means for this and sharing knowledge will be the main prerequisite. This is confirmed by Slob (personal communication, 6 March 2014), Blokzijl (personal communication, 24 February 2014) and Sterkenburg (personal communication, 6 February 2014) who all state that BIM is a means to visualize the sustainable aspects and possibilities of the project. When the right information is available, right choices regarding life cycle cost, GPR, energy efficiency, daylight entry, etc. can be made.

BIM is considered to contribute to the reduction of failure cost. However, Blokzijl (personal communication, 24 February 2014) states that as long as the communication between parties does not improve, failure cost will not decrease. Slob (personal communication, 6 March 2014), Sterkenburg (personal communication, 6 February 2014) and Bos (personal communication, 25 February 2014) are more positive. They stat that when all parties work together in the same 3D model, it means no loss of information due to several drawings made by several parties. Difficult construction intersections and construction flaws and clashes in the input of the different advisors are visible in an early phase, and several solutions can be simulated.

The most important benefits of the use of BIM are (Sterkenburg, personal communication, 6 February 2014):

- The possibility to test variants;
- Improving the cooperation between the different partners;
- Accelerating the process through better cooperation, the use of one 3D model, testing of variants to help make better choices.

The prerequisites are that the 3D model has to be built properly and that a fourth (planning) and fifth (cost) dimension are added. Blokzijl (personal communication, 24 February 2014) claims that there is a need for a cultural change. Now, parties have no interest in putting all their information in a BIM 3D model, they want to have and keep full control over their own part of the project and do not want a BIM manager to control and manipulate the project's information. De Jong (personal

communication, 13 February 2014) claims that the success of BIM depends on the focus on quality. This means that integrated contracts and supply chain management are conditional for the success of BIM. BIM can only become fully mature when the processes of the whole supply chain within the built environment are made (more) efficient (e.g. Lean) from beginning to end, exceeding single companies and single projects. BIM is just a technical tool that supports this purpose.

CONCLUSIONS AND FURTHER RESEARCH

This research started with the following question: What are the business enabling capabilities regarding efficiency and effectivity of BIM in the domain of project development in the built environment for architects and project developers in the context of the current reality of the Dutch built environment?

The answer to this question is that the business enabling capabilities regarding efficiency and effectivity are: planning / delivering on time and within budget, communication, coordination, integrating sustainability and decrease failure cost. However, the introduction of BIM is not just a change of software package. It requires a change in mind-set amongst all companies within the whole built environment, but also in understanding the processes of other construction related companies. It requires collaborating with other companies and altering the project exceeding chain of processes, making these processes Lean, and sharing knowledge for mutual gains. However this is still in the future. Some companies are trying to make changes, but really sharing knowledge, really changing the way the company works, really committing to just a few partners and making mutual processes Lean is a challenge not easily made. The construction industry needs to undergo radical change.

Getting people to accept the idea that their work will undergo radical change is not a war won in a single battle (Hammer & Champy, 2001). In fact, Hammer and Champy (2001) state that the companies that have the most success in selling change to their employees are those that have developed the clearest messages about the need for reengineering.

This research was conducted within a limited amount of time. Therefore a limited amount of interviews have been taken. In order to give a proper answer to the research question, more interviews need to be done and more information has to be gathered on the current and future business processes within the built environment. It is time to state the need for reengineering the business processes within in the built environment, especially in the definition and development phases of projects.

REFERENCES

Ahmed, M. D., & Sundaram, D. (2011). Sustainable business transformation. AMCIS 2011 Proceedings - All Submissions. Paper 356. Derived from: http://aisel.aisnet.org/amcis2011_submissions/356 on September 2013

Boers, A., & Graaf, N. de (2012). The BPM book. Theory and practice of process aimed organizing. (in Dutch) Amsterdam, The Netherlands: Uitgeverij Boom Nelissen.

Bos, P. (2014). Telephonic discussion on 13 January 2014.

Bouwend Nederland (2012). Broad BIM. Information on building virtually. (in Dutch). Year 2012, 1

Bryde, D., Broquetas, M., & Volm, J. M. (2013). The project benefits of Building Information Modelling (BIM). *International Journal of Project Management*, 31, 971-980.

Buurman, M. (2012). Building with BIM. Engine for renewal. (in Dutch) in: De Architect, 75-81.

Davenport, T. H. (1993). Process Innovation. Reengineering work through information technology. Boston Massachusetts, U.S.A.: Harvard Business School Press.

Feiter, A. (2013). BIM: Science or willingness? (in Dutch) derived from http://www.vastgoed-vitaal.nl/vv/index.php/Nieuws/bim-kwestie-van-wetenschap-of-willenschap.html on 13 January 2014.

Flick, U. (2008). Designing Qualitative Research. United States of America: Sage Publications Ltd.

Hammer, M., & Champy, J. (2001). Reengineering the corporation. A manifesto for business revolution. New York, United States of America: HarperCollins Publishers, Inc.

Hevner, A. R., March, S. T., Park, J., & Ram, S. (2004). Design science in information systems research. *MIS Quarterly*, 28(1), 75-105.

Hulsebos, M. (2013) A different project approach needs different handling of information. (in Dutch) In: Business Information Magazine, 04, December 2013.

Kleef, J. A. G. van Roome, N. J. (2007). Developing capabilities and competence for sustainable business management as innovation: a research agenda. *Journal of Cleaner Production*, 15, 38-51.

Rajendran, P., Seow Ta Wee, Goh Kai Chen (2012). Application of BIM for managing sustainable construction. In: Proceedings International Conference of Technology Management, Business and Entrepreneurship 2012 (ICTMBE2012).

Song, Y. W., Choi, Y. K. (2012). Sustainable Business Process Management model for construction companies. In: proceedings of the 28th ISARC, Seoul, Korea. Derived from: www.iaarc.org/publications/fulltext/S12-6.pdf on July 2013

Stolze, C., Semmler, G., Thomas, O. (2012). Sustainability in Business Process Management Research - a Literature Review. AMCIS 2012 Proceedings. Paper 10. (http://asiel.aisnet.org/amcis2012/proceedings/GreenIS/10)

Straatman, J., Pel, W., Hendriks, H. (2012). Working with BIM; just do it! Help building virtually. (in Dutch) Zoetermeer, The Netherlands: Stichting Research Rationalisatie Bouw.

Verbaan, W. (2013, May). Housing construction & architecture. re-establishing the chains (in Dutch). *De Architect*, 58-63.

Wong, A. K. D., Wong, F. K. W., & Nadeem, A. (2010). Attributes of building information modelling implementation modelling implementations in various countries. I*Architectural Engineering and Design Management*, 6, 288-302

APPENDIX A

Interview Questions.

	Strongly	Disagree	Neutral	Agree	Strongly agree	
BIM helps project developers / architects to …						Can you give an example?
1. … improve the project planning.	1	2	3	4	5	…
2. … improve the project communication.	1	2	3	4	5	…
3. … improve the project coordination.	1	2	3	4	5	…
4. … deliver large, complex projects on time.	1	2	3	4	5	…
5. … deliver large, complex projects within budget.	1	2	3	4	5	…
BIM contributes to social themes such as …						Can you give an example?
6. … sustainability.	1	2	3	4	5	…
7. … the reduction of failure cost.	1	2	3	4	5	…

ISSN: 1543-5962-Printed Copy ISSN: 1941-6679-On-line Copy