

Aspect 1 the relationship between research and design.

Due to the fact that I am following the MBE (management) track, I did not make a real design, although I set up a list of recommendations for future projects, on basis of the research. I can reflect on the research process, looking at it more as a cyclical process of researching and adjusting the research when gaining more knowledge about the subject, rather than the relationship between research and a 'real' design. During my research, I did a literature review, and a first session of interviews, to find out what aspects of the subject were relevant in theory and in practice. After this, my research question(s) developed in their theoretical and practical relevance. Doing a second round of observations and interviews, with these research questions, led to my final proposal of recommendations for future projects. During the process, I also took into account feedback from my graduation mentor and other professionals (from practice), from my MBE mentors and students of my graduation lab, which could be helpful, in terms of looking at it from another point of view. After the P4, I approached some of the interviewees to reflect on my results and recommendations, as a sort of 'validation of the own research'. This feedback was implemented in the recommendations.

Aspect 2 the relationship between your graduation (project) topic, the studio topic (if applicable), your master track (A,U,BT,LA,MBE), and your master programme (MSc AUBS).

My graduation topic is: communication with BIM in complex projects (observations and interviews on two hospital cases, and extra more exploratory (not included in this report) observation and interviews about a factory, also a complex project).

My main research question is: In what way are the 1) **functionality of the design of hospital buildings, and 2) the suitability of the corresponding BIM model for the use (phase), validated and verified** between the **various stakeholders**, while making use of **BIM**, and what are the **critical points** toward a **successful process**?

The corresponding **sub questions** are:

- 1) *To what extent, and in which way is BIM used in the design phase of hospital buildings as a means to share information about the hospital between the design team and the client/end-users of the hospital?*
- 2) *To which extent is there a well-functioning communication/information sharing between the actors within BIM (e.g. due to their competences) and a well-functioning BIM model (e.g. compatibility and interoperability)?*
- 3) *How are the design and BIM model validated and verified between the project team and the client/end-user, and how is BIM used in this process?*
- 4) *In which way does the use of BIM influence the collaboration and work process (positive/negative)?*
- 5) *To what extent is the BIM ready for use by the client during the operation phase (functional process), and maintenance?*

The main theme of my graduation studio is health care, in which an important topic is user centeredness. My graduation relates to both. Considering health care: I researched the validation

and verification, using BIM, of two hospital cases. Considering user-centeredness: In my research, to get a total view of the process, I look at the project team, client and involvement of end-users. So next to the design team and the client (which can be seen as a user all well), the involvement of end-users is investigated in my graduation project.

My graduation relates to my master track (MBE), because I looked into the processes of communication with BIM between various actors that participate in these building projects, which relates to design and construction management, and process management.

My graduation relates also to the master, in a broader sense, because I interviewed all different kind of stakeholders that participate in the building projects: architects, BIM modelers, BIM managers, project managers and also installation and construction professionals. With my graduation I got a broad view and extensive knowledge about BIM, communication and collaboration within the AEC industry.

Aspect 3 Elaboration on research method and approach chosen by the student in relation to the graduation studio methodical line of inquiry, reflecting thereby upon the scientific relevance of the work.

My graduation research method was: an explorative research on basis of case studies. Due to the fact that there was not that much known about my exact topic of study, It was chosen to conduct case studies to find practical examples, in order to conduct a more in depth research about the subject. To analyse the results, grounded theory and senzittings concepts, by means of coding in atlas TI was used. The extensive research method is as follows:

- 1) First a literature review was conducted, and a first session of observations and interviews were held, to find out what aspects of the research subject were relevant in theory and in practice. My teachers told me it would be good to start with primary interviews early to know also what was experienced in practice, and I think this really helped.
- 2) After this, from the literature and first interview conclusions, it was defined which sub-topics were relevant to investigate in more detail. The topics were investigated further, by means of literature and interviews. After this second round, the final research questions were formed to conduct the research by observations and in depth interviews in the two case studies.
- 3) The interviews were fully transcribed, and coded in Atlas TI. This gave some new insights, for example that people mentioned negative aspects more often than positive aspects, thus it could be seen that still a lot of improvements are possible within my the investigated subject.
- 4) From the conclusions, recommendations were formed to implement in future projects, and for future research. See the report for details.
- 5) After the P4, interviewees were asked to reflect on their quotes, the conclusion and recommendations, and some even reflected on the full report. This feedback was implemented in the final version of the report.

Looking back at the process, I think my approach worked in the sense that I knew early in the process what was relevant in theory and practice, so my research was going the right way in terms of relevance. The former is emphasized by the extensive interest of interviewees from practice: they

were all very interested in my research topic and my report, even people from outside the Netherlands (I investigated one foreign case).

In terms of planning, I think it is very important to arrange things early. Of course, when you investigate a case study, you will always be dependent on the process of the project you follow. I experienced that getting reactions from people from practice could take up to a few weeks (because they are all so busy, and possibly due to other things). For me and the research I think it was just in time, however I experienced quite some pressure close to the deadlines. At the P2, the intention was to do a focus group if possible, but the process demanded otherwise, and instead I asked interviewees to reflect on the almost final report.

I choose to do research on BIM, a technology which is still in development, although from the extensive information I gathered from the interviews I think I really got some answers that can be implemented, or at least be considered, in future projects, as a “best practice”.

With the extensive amount of information I gathered, I found it difficult to extract the most important parts of all the information I gathered. I was really happy with the feedback of everyone, to verify if I mentioned the right things/things right. At the end, I got mostly positive feedback from the interviewees: most had no comments, some had some things to think about, with which I could improve and finalize my report.

Aspect 4 Elaboration on the relationship between the graduation project and the wider social, professional and scientific framework, touching upon the transferability of the project results.

A lot of research has been done, and is currently going on about BIM. It is stated many times how critical the communication (with BIM) is for a successful project and BIM implementation. However, not many research can be found about my exact topic of study. Thus, I think my research really adds something to the information currently available about this topic.

Furthermore BIM is really actual, and more and more companies are implementing it into their projects. During my research, I experienced a lot of interest from interviewees for my graduation topic. Next to their interest for BIM, most of them stated how important communication is, so that is also very relevant. All of them were interested to receive my final results and recommendations. At the end, both organizations of the cases I explored were interested in the results of report I sent them for feedback: of one case they asked to share the results internally and externally, and of the other case, the project director was interested in giving a training to define things better at the start of other projects, based on my results and recommendations. So I think I could say that my research already will be of influence in practice. So, next to the scientific relevance, it also adds to the knowledge of and ways of working by professionals in the AEC industry. .

Aspect 5 Discuss the ethical issues and dilemmas you may have encountered in (i) doing the research, (ii, if applicable) elaborating the design and (iii) potential applications of the results in practice.

i. Because I followed case studies with the involvement of different companies (project partners), I had to be very careful with sharing information. Because they had a working relation, I could say something, but for my own integrity, and to stay on the safe side, I chose mostly to not tell too much about the other cases, other than very general conclusions. Furthermore, I told every interviewee that they could reflect on the quotes, before they get published. I think experiencing this way of being careful with information is really useful for work in practice after my graduation.

ii. N.A.

iii. Most interviewees asked for the final report with recommendations. Based on the beformentioned feedback of the professionals, I think my results will be used in practice for trainings/workshops to improve project processes of communication between various stakeholders who work with BIM, or at least to think about the way they structure their processes now.