



THE BARRIERS TO 3-d CONSTRUCTION PRINTING A CEMENTITIOUS OUTER WALL

P5 GRADUATION REFLECTION

Thesis, P5 Report (reflection)

The barriers to 3-d construction printing a cementitious outer wall

“What are the barriers to 3-d construction printing a cementitious outer wall in the construction industry?”

Personal data

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Reflection

I had a very engaging research experience. I started the research by reading more about 3-d printing and its adoption in the construction industry. I did so because my goal all along was to

come up with a reliable and valid product that can be used to solve some the pressing concerns that are being experienced in Netherland's construction industry. Important conditions for me where that the product would be scalable and commercially interesting. In the meanwhile, I used questionnaires and interviews to find possible answers to my research question. I structured the research questions basing on the respondents that I was targeting. The good questions that I came up were simple and covered important areas that formed the basis of this research. After reaching out to the study participants, I noted that finding the right number or targeted number of participants (9 participants) was somehow challenging. I merged the two interviews that I had initially developed into one interview before carrying out the interviews. Initially, I had developed a point of departure to help me formulate research goals and more importantly, ensure that everything was on the right track.

Despite reaching out to 10 architects with potential experience in 3-d printing technology, only 2 were willing to participate in the questionnaire whereas the other 8 stated that they were too busy. Apparently, the 2 respondents were not entirely experienced about 3-d printing technology. However, I happened to gather findings from 4 interview participants who identified themselves as researchers and architects with knowledge in 3-d printing technology. I decided to formulate as many questions as possible because the more the number of questions, the higher the chances of gathering more information on 3-d printing and its adoption in the construction industry.

The small pool of research made it difficult for me to engage as many participants as possible. After all, the response rate of the questionnaire was a bit disappointing. This is because the industry is small and therefore I took a risk. I am glad I listened to my supervisors and made the choice to conduct additional interviews. Nonetheless, I was lucky to have met real experts in the field of architecture who helped me carry out this research. I used phrasing technique to formulate my research questions. At the back of my mind I knew that with 3-d printing, it will be possible to get new forms of buildings that can serve housing needs of people of the Netherlands and at the same time promote environmental sustainability and effective use of materials. Hence, I even though many people are not entirely familiar with the technology, similar researches can play important roles in enhancing enlightenment in the sector. Technology has become part and parcel of human life in the modern world. Hence, I think it is high time that the same technology should be made commercially viable and scalable in the construction industry. Other than being profitable, my focus is to help ensure that product of 3-d printing technology can provide a basis for dealing with issues of socio-economic problems

and inability to access quality housing, depletion of natural resources and climate change that is being accelerated by carbon emissions.

I measured the success of this research by comparing the conclusions that I made with my initial study expectations. Moreover, I evaluated the significance of this study by ascertaining the change the extent by which I was going to contribute to change in the construction industry by publishing this thesis and making it available for public access. I also understood that adoption of 3-d printing in the construction industry was going to affect various things that includes and are not limited to competition between firms, power, politics, and access to quality housing. Both the interview and questionnaire questions that I formulated to guide the documentation of this research were great and played their roles well. However, due to time restrains from my side the focus became on the qualitative part. Looking back, I would have liked to focus more on the scalability issues as I did not define the term scalability well enough for myself in the beginning, mostly because I was too focused on the barriers of 3-d construction printing itself. If I had focused more on scalability sources, in the beginning, it could have resulted in better conclusions and my research could have been better.

I encountered several challenges trying to deliver my thesis. First, I had to rewrite the thesis basing on the comments on the P1 report. It was as well difficult for me to change the research angle after conducting further assessment on the technology subject of this research. This was mainly because I was very enthusiastic on the research approach that I had taken earlier on. The underlying need to switch gears quickly was also a presenting challenge. Nonetheless, this piece of reflection and critical assessment has provided me with different views and insights that I might have risked to lose after all.

Second, the novelty of 3-d printing as well as the limited literatures and studies that are available on the subject made the documentation of this study more challenging. The missing link was unavailability of RRI framework. Third, I solemnly understood that the foundation of conducting an effective and constructive research is beginning by asking the right questions. Hence, I had to spend a lot of time trying to figure out some of the possible questions that could help me find solutions to the research problem. It was difficult for me to phrase the main questions and sub-questions thereby limiting the general scope of my research study. Because of that, my main focus was on trying to have a coherent understanding of research problem first from where I used that to come up with questions that were in line with the research problem. The interest that I had on the research subject made it difficult for me to limit the scope of this research. It was a challenge that I had to focus on and subsequently address the most critical findings of my study research. Switching gears and changing the research approach has

improved my ability to sharpen and scope research studies. I remember having it difficult to proceed further after delivering my first P3 report. At the back of my mind, I knew that it will take another two months for me to complete my P4 report after handing in my P3 report. I also knew that I had a short time frame and that I had to push myself and remain focused to have it done. Nonetheless, things never turned out as initially planned because despite being too optimistic, I struggled to write and put everything together such that because of concentration concerns. This was a significant setback on my side because I did not have enough time for the P4 registration. After the Go for my P4 report, it was hard for me still to continue due to personal reasons. It was a relief that I passed my P4 presentation, which means I was close to my graduation. However, at the same time, I just wanted to move forward, and that was quite the challenge for me due to personal reasons. It was challenging to keep the overview and to connect my literature findings to my research results because I could only work a few hours effectively per day. I would have liked to evaluate my literature that I already possessed more thoroughly and draw better conclusions between the literature, the statistical analysis and the interviews. Also, I would have liked to refine the measures section amongst other sections. In retrospect to scientific relevance, I think my thesis is quite relevant in terms of the newness of the topic concerning barriers, adoption and scalability of 3-d construction printing. For me, it was hard to get the focus point of my thesis, that was a process on itself. I think it was good to use mixed-methods as a methodology, but in retrospect, I could have fine-tuned the research question and questionnaire better to scalability and adoption. On the other side, that is quite a risk because there are not so many people knowing about this subject. The dilemma's that I found was that I got the feeling that some participants were defending their 3-d printing business in terms of 'sales talks'. On the other hand, I can not prove this, but there must be a bias here. Unfortunately, I found out that there is a reflection format for this year. I have agreed with my supervisors that I could use the manual of the year that a started in, so I hope this is not an issue. I wished I had the time to spend more time on this and that I found this out earlier. On the other hand, I had to choose my focus point, and that was on finishing the thesis itself. It is a pity that I did not follow the format because reflecting gives me a good feeling after project delivery, and I would have like to learn from it in a more focused way. Despite these ups and downs trying to meet deadlines and struggling with personal issues, I remained positive and relaxed as possible all the way through.

