

## Graduation reflection P4

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During the graduation process I learned multiple competencies, like problem analysis, take initiative, detailing with a large amount of data, planning, organizing, presenting and developing a vision. Moreover, working in a result-oriented manner and combining knowledge areas. In addition, being critical, flexible, self-steering and having environmental awareness. I will explain the development of each competency per research part; plan of approach and literature study, methodology, analyses, results, company and Covid-19, graduation process, social relevance. This resulted in new perspectives about the building environment.

### Plan of approach and literature study

*Learning competency: problem analysis and taking initiative.*

During the first phase of this research, the plan of approach and literature study, the problems and goals were not clear. This had to be shaped by many conversations and reading literature. Related to the indoor comfort and circularity, I had to map the building process and the desired progress of both the building users and the team I worked with. This was a difficult process, because different problems were intertwined, like the current building state, the preferences and needs of the buildings users and the already existing program of requirements created by the team. This problem analysis costed more time than expected. Therefore, I read many different indoor comfort and circularity perspectives to get a grip on the existing situation. This gave me a great overview of which factors had to do with the indoor comfort. As a result my focus during the P2 was too broad and this had to be reduced to a feasible study with more detail. I took initiative to formulate clear problems and goals for both myself and the company.

### Methodology

*Learning competency: being flexible.*

The methodology is adjusted during every phase of this research, because of the changing situation of the case study or the research possibilities, being flexible was needed. The method, described in the graduation plan presented at the P2 was too broad. In addition, some of the measurement devices were not available. Therefore, the plan changed after the P2 presentation with a focus on the indoor air quality. To be able to perform this adjusted plan, extra measurement devices have been borrowed from an external company. The structure of the method was effective. For example, first the criteria were described by reading literature study and later these criteria were tested with the case study.

For next research, I would describe the method of the research in an earlier stage, including space for flexibility and new insights. This provides a clear plan of approach, what was now missing around the P2. The feedback given by the mentors helped to adjust this method; to create more detail and finding out which elements were feasible, out of my scope or even not possible to perform with the existing measurement devices and knowledge nowadays.

Furthermore, after the P2 an English course was recommended. This course has given me insight in the structure of a text and how parts of the text can be linked together. After every consult, I translated the given feedback in the texts or illustrations of my thesis report. These consults contributed to write more precise and getting my message across.

## **Analyses**

*Learning competency: dealing with a large amount of data.*

During this phase of the research, I was overwhelmed by the amount of data I had obtained from both the questionnaire (various Excel sheet with raw data) and the measurements (30.000 lines in Excel). I tried multiple methods to make the data manageable, some ways were too much time consuming and the others were too broad without much detail. After a few weeks I found a way with formulas in Excel to get the results from the data. I learned to convert data into results.

## **Results**

*Learning competency: working in a result-oriented manner and combining knowledge areas.*

The result phase was mostly focused on connecting and comparing knowledge from various fields. For example finding ways to improve the indoor comfort in a circular way, by reducing the amount of raw materials and integrating circular business models. This provides a broader view on the topics and the endless possibilities to improve multiple challenges with one solution. I had to work result-oriented, because otherwise I got lost in the large amount of measures. During this process, I noticed that I created measures which were not meeting the criteria from this research. Therefore, I had to get back to the research question, to find the optimal solutions. A complete indoor comfort and circularity assessment tool did not exist, whereas I analysed various tools and created a circular indoor comfort framework to identify the influence factors on both areas, the indoor comfort and circularity in the case study.

## **Company and Covid-19**

*Learning competency: being critical, flexible and self-steering and being able to plan, organize and present.*

Next to the learning process provided by the university, the company added great value to the research and to my own development. Learning to deal with a large organization and being critical, flexible and self-steering. In addition, with the great amount of feedback and options, being able to define a plan which provides input to the research. Moreover organizing the needed activities, input and feedback and present the interim results to various teams within the company.

Firstly, dealing with a large organisation. This was very interesting to translate the theoretical knowledge into practice and communicate the interim results with the project teams. Coordinating the research and the possibilities supported new learning objectives and skills. Skills such as: project management, procurement and communication to transfer information and making decisions. This coordination was mainly about the measurement phase; convincing and motivating different teams to participate in my research, procuring the plants and discussing and making decisions about the current situation, how performing and how to interpret the measurements and survey. Moreover, how to apply the possible solutions in the current situation.

Secondly, being critical about the methodology and adjust it when needed. For instance, some floorplans were not available to measure, because of the confidential information. Because of this, we searched for the best possible floorplan to measure including no consequences for the business and looking critical at the security of the measurement devices.

Thirdly, being flexible and reaching the boundaries to adjust the research to the requirements of the university, the wishes of the company and the current situation; Covid-19 pandemic. Sometimes it was difficult to meet every person aims and adjust the feedback in a correct way. Because of Covid-19, the company was busy adjusting to the new situation, whereby it was not feasible to perform the interviews, therefore additional analyses were performed to fill in this knowledge gap.

Lastly, being self-steering and referring always to my own research question, to meet at the end the goals which were established with the university. Sometimes I lost track and worked too much on the indoor comfort and too less on the circularity part of this research, this came together in the proposed measures.

### **Graduation process**

*Learning competency: being critical.*

During the entire graduation process I needed to develop the skill being more critical. This applies to various parts, like writing the words which define the certain ideas and results, the use of English and the detail level of this research.

Firstly, choose specific words that describe the ideas and results. I needed to be more critical on the words that I used to get the message across, therefore I introduced the terms and definition list to clarify the meaning of the words used in this research.

Secondly, use of English, write as simple as possible and use linking words. I rewrote multiple times the graduation thesis. This improved the structure and clarity of the text, however this is a point of attention during the last phase of this thesis as well.

Lastly, being more critical on the detail level of the various elements in this research. This was a challenge, because the more I read and discovered about this topic the broader the research got. Because of the unlimited factors that influence the indoor comfort, circularity and energy efficiency. I wanted to take every factor into account and at the same time find detail in certain parts to specify where the focus of the research was. I was confronted with this issue every phase of my research. Looking back at the process, I would have add more detail and leave out some less important factors. However, you can only know which are the less important factors at the end of the research.

### **Societal relevance**

*Learning competency: environmental awareness.*

The relevance of this research is mainly focused on the social aspect, by improving the working conditions of humans and the environment. This research invested the requirements of the Dutch regulations, rating certifications and the companies criteria about the indoor comfort, circularity and energy consumption. Moreover, it analysed the current situation if it meets the requirements mentioned above and visualised potential solutions.

The indoor comfort can influence indirectly the financial business case of a company and the job guarantee for the employees. Improving the indoor comfort can increase the productivity and decrease the sick leave of employees. Besides the indoor comfort, renovating the buildings more energy efficient can reduce the energy use, which has a positive impact on the environment and the financial position of the building owners. The indoor comfort has great influence on the society, like the happiness and health of the building users. The principle circularity has potential impact on the society by creating new systems, another way of thinking and opportunities for new jobs. Circularity reuses raw materials and close systems to contribute to the environment. This way of working ensures material resources for future generations and it contributes to the global 'Sustainable Development Goals', created in 2015 as the 'Paris Proof' agreement.

## **New perspectives about the building environment**

*Learning competency: developing a vision.*

This research and the Covid-19 pandemic changed my view on the building environment by developing a new vision on how the current situation is and how the future can look like. In addition, I gather more knowledge, mostly about the indoor comfort and circularity. Nowadays these topics are not interconnected with each other, but through this research I have seen very good opportunities how these can complement each other. For example, making the interior and specific the furniture demountable or detachable, it makes it easier and faster to clean these elements, which improves the indoor air quality and the possibilities how to reuse the raw materials. In the next few years, I would like to develop myself further in this field of expertise; to make the building environment healthier, while providing a positive contribution and adding value to the environment.

Moreover, being even more critical on my own work, the results and how it can be improved to create realistic and new knowledge. I learned, during this process, that it can make a big difference, the way how you communicate knowledge. For example, circularity contains many processes, which all need to meet the circular thought. Before this is accepted and used in companies, we need to realise that the building environment what we have now is only half or not even circular. The positive part is that we can still improve and innovate many processes, only the negative part is that many companies found it difficult to change their way of working and thinking. My goal is to contribute to this process in the next few years and make small changes possible.