

(RE)DEVELOP THE FUTURE

Reflection Report

Delft University of Technology

**Faculty of Architecture, Urbanism and Building Sciences
MSc Management in the Built Environment**

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3rd April 2018**

Introduction

Between September 2016 and April 2018, I have been graduating as part of the final step towards my masters' degree Management in the Built Environment. The topic of this thesis regards to the development and implementation of circularity for the redevelopment initiation phase. This reflection reflects upon the graduation process and finally the results presented.

The process in chronological order

Now that the final report is finished, it feels good to look back and take a moment to reflect upon the process. To start with the initially intended research; the research scope for the first research proposal was difficult due to varying interests and possible topics, clearly visible in the changes in scope between P1 and P2. At P1, the research question was very broad, generating valuable input to start at least four major research topics separately. Whilst the intended proposal was "to find a solution for the vacancy and dilapidation issues heritage currently faces, related to the socio-economic value", the societal value of heritage was difficult to determine within the given period. Apart from some private circumstances, the quest for a more concrete and thereby motivating topic resulted in a delay of 3 months. Eventually a shift towards circularity in the built environment refreshed my ambitions to proceed. This topic has been chosen as the final scope of this thesis in order to make the research feasible, which subsequently changed the direction of the main research question as well.

At P2, a clear goal, research outlines and research methods were defined. These have not been adapted much during the remaining graduation project, thus proved to be a solid basis for the research. The objective gradually narrowed perspective towards the circularity indicator.

The period between P2 and P3 was mainly focussed on acquiring knowledge regarding the two main aspects of this research, through literature study and interviewing. Up until P3, a diverging perspective was necessary to gain the proper insights on the available information from literature and interviews. During this phase, a considerable amount of information gave the impression the demarcation was still not sufficient, due to the wide variety of insights noticed during the interviews. A lot of knowledge is required to realize and integrate circular economy principles with redevelopment projects and this knowledge is shattered among different parties and knowledge institutions, which makes it hard to make (the right) decisions.

The first idea was to combine all knowledge in a decision support model. The tool would propose an optimized reutilization strategy, based on multiple variables to accelerate decision-making in multi-actor environments of sustainable redevelopment. However, as things moved forward, the final concept for modeling proved sufficient basis to add to the body of knowledge by focussing merely on the technical value of elements. LCA and financial feasibility regards to the market and makes the model to complicated, not to forget the necessity of system boundaries to define LCA.

In November 2017, the start of a six-months internship at the Ministry of Internal Affairs and Kingdom Relations (Rijksvastgoedbedrijf) proved to be a huge step towards finalizing the concept. Based on their broad field of expertise and deep rooted networks, it was possible to get the appropriate experts interviewed. This can be seen as an essential turning point. Another delay of three months was calculated. But by postponing the P4, more time has enabled to improve the report the case study analysis significantly. Therefore, it can be concluded a wise decision and has improved the overall quality of the thesis.

From this moment onwards to P4, the concept development and a case study have been carried out relatively independently with periodical feedback. Due to the clearly defined research objective, progress could be made in a regular pace.

One of the more underestimated aspects was to extract information out of the expert interviews with professionals. Identifying the sufficient parameters for circularity assessment is a rather complex aspect, in which the market is currently investigating the most appropriate direction. Due to the broad network of the Ministry of Internal Affairs and Kingdom Relations, arranging the interviews did not take much time, but the whole process, including traveling, conducting the interviews, interpreting and summarizing the interviews was considerably time-consuming.

However, in the end the interviews are extremely valuable in the case study as they gave the proper insights to develop a sufficient assessment tool.

Within the sequence of interviews, a gradually developed understanding on which parameters the model would be built is recognized. The internal expert meetings focused on a variety of perspectives (strategic, financial, construction, procurement) in the earlier phases of the research proved to be an important step in the research. Due to the holistic approach of the circular economy, initially the concept of an assessment model was too comprehensive. By extracting knowledge and the collaborative approach with these professionals, this was resolved. Especially the notion to focus on the condition, and subsequently to assess this through a widely accepted procedure are prove of the added value from experience on the job.

However, it took quite some effort before the conditional aspects and conditions for a objective assessment model to be useful were clarified. One of the major aspects concerned, but not sufficient was 'quality'. This rather subjective element is difficult to measure, and at the end of this phase towards P3, during an external interview the final opinion to exclude this element was developed. In other words, initially it was not fully anticipated that the thesis would take a turn to be this data-oriented.

After the P3 evaluation, the deadline for P4 became more and more apparent. One of the main challenges was to include the case study, since this rather innovative way of assessment requires a fair amount of data, with unusual level of detail. The only sufficient case study was 'The Green House', where Alba Concepts identified the necessary input. One of the main points of feedback at P3 was this translation.

Finally, around 20 persons were invited for the expert panel for a final valorization. The dialogue from governance/market perspective proved to be fruitful and provided the last piece of the puzzle for this thesis. Especially the objective to distinguish circularity into physical and environmental aspects is an important element to be reviewed further on. Circularity can be fully achieved with environmentally unsustainable materials, where biobased can reach out to 'circular' initiatives by demountability.

In summary, the internship was supportive and due to their sincere interest into this topic, the Ministry of Internal Affairs and Kingdom Relations facilitated at full length. It has been very helpful to get access to additional scientific insights and practical knowledge. Moreover, the opportunity to explore freely and act independently within the organization was lucrative. The balance between appropriate supervision and relative explorative approach has led to valuable research outcomes. The complete report at P4 proved a sufficient progress, for which the last month was subject to finetuning the explanation with an additional flowchart. Especially the complexity and multiple perspectives of the model is hard to clarify towards the general public.

Finally, the progress of this thesis flourished from the research into the transition towards a circular economy currently being conducted by the Government. Many aspects, like material passports and measuring circularity, in this research align with the research already conducted. Diverging focus into the condition assessment for existing real estate clearly adds to the body of knowledge within the organization.

Scientific relevance

Within the chair of Adaptive Reuse at the Delft University of Technology, the focus lies on the transition toward sustainable reuse of the existing built environment. Adaptive reuse means to deal with buildings when user requirements change and the current functional lifespan ends. The drivers and barriers for adaptive reuse are social, economic and environmental and vary in different contexts.

Adaptive reuse is part of real estate strategies for aligning demand and supply of buildings, portfolios and areas. Moreover, adaptive reuse is a strategy for maintaining, conserving and reusing cultural and industrial heritage. Assets, like churches, industrial buildings, offices etc., are facing functional redundancy, vacancy, dilapidation and finally demolition. Often, adaptive reuse costs cannot be supported by the public sector or by traditional private sector models. Research

has focused on the technical, functional and financial aspects that influence the adaptive reuse potential and feasibility. Methods of analysis and decision-making on adaptive reuse have been developed. The challenge for society however is evident.

Research have shown that around half of all non-renewable resources mankind consumes are used in construction, making it one of the least sustainable industries in the world. In Europe, the built environment accounts for 40% of the energy and material consumption and waste generation, and further contributes around 35% of all CO₂ emissions. Within this perspective, the challenge of adaptive reuse relates closely to the challenge of creating a circular economy (CE) - a concept widely considered the future for the building industry, replacing the take, make and dispose industry. However, existing real estate business, governance and financing models are not applicable to adaptive reuse and CE.

Scientific literature to combine adaptive reuse and CE approaches however is not abundantly available; the scientific knowledge gap is remarkable. This thesis provides a contribution to close this gap. Interestingly to mention, the Dutch government issued a program 'Netherlands 100% Circular in 2050'. A nationwide debate on the strategic implementation is currently a hot topic. This thesis has linked the two dominant ways of thinking with research similar to the 'Highest and Best Use (HBU) theory' related to the technical potential reuse value of elements and embodied energy within these buildings. Conclusively, this thesis adds new insights to the rather new phenomenon circularity in the adaptive reuse environment. Therefore, the contribution of an instrument to measure circularity during the redevelopment initiation phase is perceived of scientific relevance.

Reflecting back on the expected results during P2, it can be concluded that the applicability and scientific relevance is still justified. The theory regarding measuring circularity objectively, coupling actual condition with objective values, and ultimately the connection to the redevelopment process in practice are more profound than expected. On the contrary, the ambition of intended operationalization of the issues at hand through linear programming within a multi-actor environment was downgraded, since an 'optimization problem' was lacking. By identifying on the technical reutilization potential of elements, the focus have shifted away from the integrated decision-making aspects. Whether the information necessary to identify financial feasibility from perspective of the developer, or to focus on the lifecycle assessment (LCA) to implement variables on which optimization can be calculated, the constraints to properly identify the boundaries of 'the system' of CE (in which LCA could be referred to as a method to measure effects on a global level) affected the applicability of an accessible and easy-to-use instrument. The focus shifted more towards the possible effects an assessment instrument with objectively gathered data has.

Societal relevance

Societal relevance is clearly apparent in this thesis, as 80% of the real estate needed by society for the next 100 years is already built, new accommodation demand primarily has to be accommodated in the current stock. Potentially, 50% of the existing real estate can be reused, but still adaptive reuse is not taking place on a large scale. As mentioned before, the challenge of adaptive reuse relates closely to the challenge of creating a circular economy (CE) - a concept widely considered to be the future for the building industry, replacing the so-called 'take, make, use, and dispose' industry. However, existing real estate business, governance and financing models are not applicable to adaptive reuse and CE.

If assessment instruments lead to more circular redevelopment, supply for new housing will increase and the supply-demand mismatch could be resolved, avoiding further dilapidation and vacancy issues. Additionally, contributing to the knowledge of circularity assessment models and simultaneously depicting the good and bad practices of existing methods, actors that are currently exploring the opportunities to implement circularity in the built environment have a properly structured document to consult which possibilities are available in practice. The information gathered from suppliers, contractors and finally maintenance results into useful data to finally decide the most beneficial intervention strategy.

Despite a slight adjustment into the proposed operational model between P2 and P4, the expected societal relevance depicted in the P2 report still relates to the outcomes in this report. Within this perspective, one could even argue that an assessment instrument focused on building

level would be off higher added value, since it directly enables to identify possible interventions. Altogether, the societal value of this thesis has been proven.

Discussion

This section includes a final discussion to reflect on the overall approach of the thesis, and elaborates shortly on the good and bad aspects of the research.

During the initial approach to identify a problem analysis, set-up relevant research questions, select the applicable research methods, and determine the aim and final results were easily obtained. The combination of my interest to provide a solution for existing built environment, and the collaborative approach within the graduation lab proved to be useful to brainstorm on current topics. In addition, my strong preference to obtain for operational research reflected in the stated ambitions.

One, more difficult aspect of this research was the rather innovative perspective to combine CE with adaptive reuse, in which the selection of possible case studies to research were scarce. The selection criteria obtained have proven to be very specific, requiring a fair amount of data. This is currently hard to find in the real estate sector. Finally, the circular pavilion 'The Green House' in Utrecht was found to be a valuable case due to the applicable assessment tools (BCI) used for this project, also are integrated in the final instrument of this thesis. Furthermore, there were no representative/exemplary cases applicable that would significantly contribute to the rationale of this instrument.

Another very important aspect during the development of the assessment model was to define relevant key performance indicators. Initially, the interviews were focused on three aspects: circularity, condition and quality. During the explorative interview internally held, no significant conclusions could be drawn from the answers experts gave. As progress was made, identifying the appropriate KPI's became more apparent. External interviews resulted with the final outcomes, since these experts were actively related with the topic of redevelopment and CE. The use of KPI's helped to structure not only the analysis but also the conclusions and setting up the potential variants, and finally select the preferred variant. This process is recognized by Bryman (2012) by his description of the main steps of qualitative research. Within these steps, an iterative process is clearly perceptible. It relates to the interpretation of the initial data, setting up a conceptual framework, tighter specification of the initial research questions and enables the collection of further, more reliable data.

As stated by the graduation course book, the goal is to deliver a thesis with a main body up to 80 pages. Despite the relation of two major aspects covering the theoretical framework, the thesis have been set-up with sufficiently conciseness. The interconnectivity with a variety of relevant aspects (e.g. perception of systems theory, the reutilization list, the disassembly methods, the condition assessment, the building circularity indicator) of the existing revolving instruments are wel elaborated within the general boundaries of this theoretical framework.

An important side note to consider regards to the relevance of each research component, which leads to the conclusion that an assessment instrument cannot be fully disconnected from its real-life context when a decision of intervention is at hand. Therefore, the relation towards financial feasibility and lifecycle assessment theories have to be made separately. However, in order to keep this assessment model from becoming indecipherable, preferably, this model merely focused on circularity on its own. Another issue to address relates to the limited capacity of case studies, resulting into the limited opportunity to generalize stated conclusions of the model. Preferably, additional case studies are executed in order to validate the assessment model.

A final remark is that this thesis was not intended to become this technically-driven. Financial knowledge was limited at the start and due to the innovative approach, a lot of uncertainty regarding the financial KPI's is evident. Moreover, aforementioned difficulty to relate circularity into the system of LCA make numerous important aspects difficult to identify at the start. By acquiring additional knowledge through the internship at the Ministry of Internal Affairs and Kingdom Relations and the external interviews, the final aspects of the full thesis started to fall in the right place along the way.