Graduation Plan

Master of Science Architecture, Urbanism & Building Sciences

Graduation Plan: All tracks

Submit your Graduation Plan to the Board of Examiners (Examencommissie-BK@tudelft.nl), Mentors and Delegate of the Board of Examiners one week before P2 at the latest.

The graduation plan consists of at least the following data/segments:

Personal information	
Name	Arthur Knibbe
Student number	4869427
Private e-mail address	-

Studio		
Name / Theme	Theme 1: Circular-adaptable real estate reuse to react to societal changes	
Main mentor	Hilde Remøy	Real Estate Management
Second mentor	Peter de Jong	Design & Construction Management
Argumentation of choice of the studio	I am interested in the circular economy, how real estate developers can implement it, while still having feasible projects. Moreover, I think that circularity will only increase in importance in the building industry in the near future.	

Graduation project	
Title of the graduation project	From linear to circular real estate development projects: How real estate developers could gather extra investments to make the business case for circular projects financially feasible
Goal	
Location:	(Internship at a real estate developer in) The Netherlands
The posed problem,	The implementation of the circular economy in the built environment is still lacking. The Dutch government wants to be completely circular and climate neutral in 2050. Therefore, change is needed to reduce the waste and emissions from the building industry and to reach the governmental goals. Despite studies into CE implementations, barriers and enablers, real estate developers are still struggling to make their business cases for circular projects financially feasible. Therefore, they are looking for ways to gather extra investments to make this happen. Developers will not be willing or able to shift to a circular economy if it means that their business cases are not financially feasible anymore.
research questions and	Main research questions: How can real estate developers gather extra investments to finance their business cases for circular building projects in the short-term? Research subquestions: SQ 1.1: What does the circular economy entail? SQ 1.2: What does the transition from the linear to the circular economy entail?

	SQ 2: What are the triggers for developers to move towards a circular economy? SQ 3: What is the difference between a business case for a circular and a non-circular building project? SQ 4: What are the stakeholders that could contribute to making the business case for a circular building project financially feasible? SQ 5: How can the stakeholders contribute to help make the business case for a circular building project financially feasible? SQ 6: What do the stakeholders want or need in return to justify their extra investments?
design assignment in which these result.	The aim is to gain insight into business cases for circular real estate development projects and to find ways for developers to make them financially feasible. The objective of the research for this is that it results in an advice for developers how they could do this with help from stakeholders of these business cases. In additions, other deliverables are related to the subquestions. A description of the CE definition and the difference between the business cases. An overview of the CE triggers and how which stakeholders could help, and what they want in return.

Process

Method description

For this study, qualitative research will be done. First a literature study will be conducted. After which case studies and semi-structured in-depth interviews will be carried out. The case studies will investigate the business cases to determine the differences and to identify the stakeholders. The case studies also include qualitative interviews. The semi-structured in-depth interviews will be conducted with employees from the internship company (such as developers, cost experts and other actors involved with decisions for development projects and business cases) and with stakeholders from the business cases (such as investors, or other related actors). This will help study the triggers for developers, and how stakeholders could help and what they want in return.

The analysis of the data will make use of the methods of making descriptions, coding the data, and comparing results, but also the collection of data during case studies is also part of the data analysis. For the interviews, the ATLAS TI software will be used to assist the researcher.

Figure 1 shows the subquestions and its research methods and figure 2 shows the overlap in the use of methods and related subquestions.

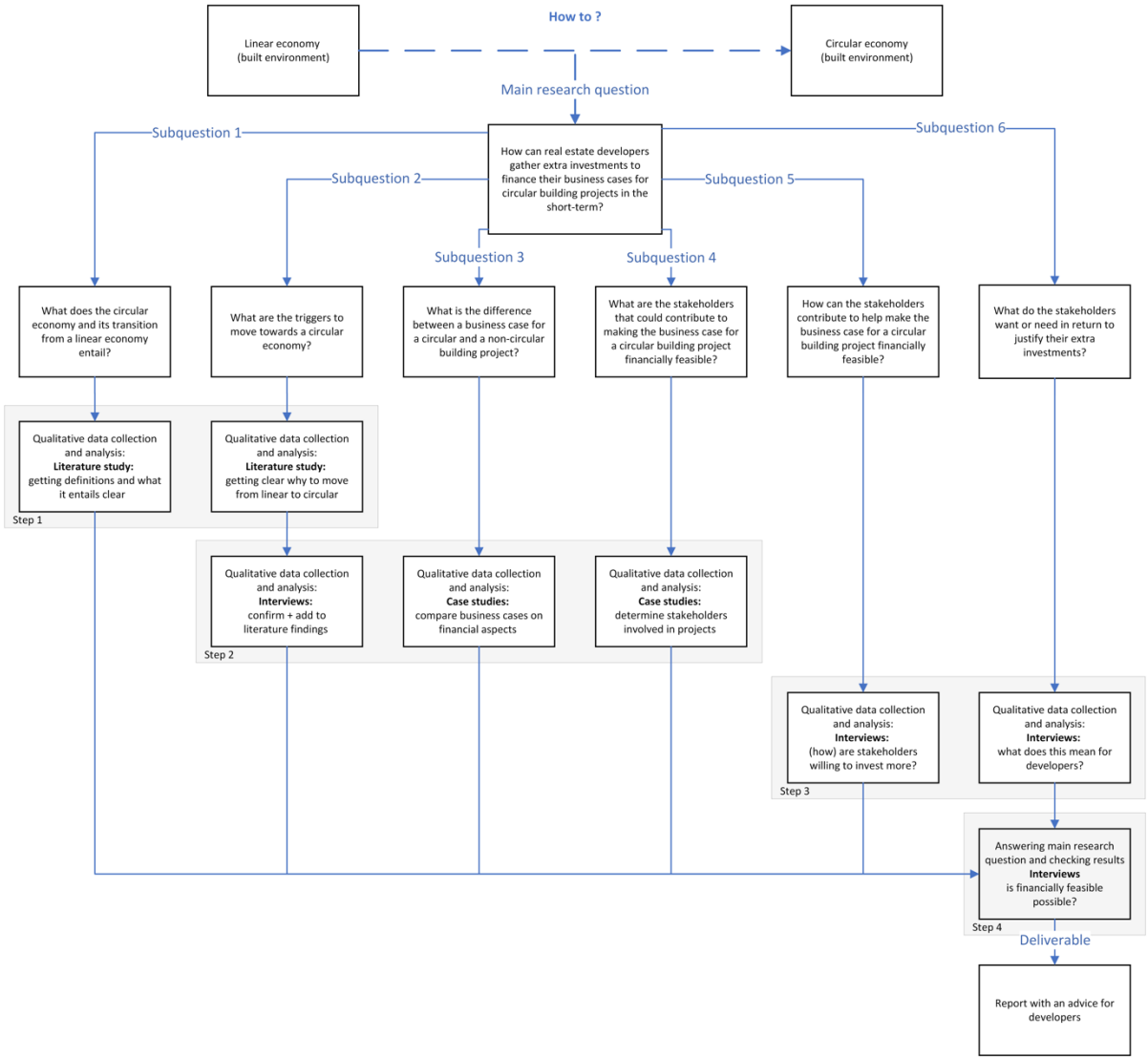

Figure 1: Research design method (own work).

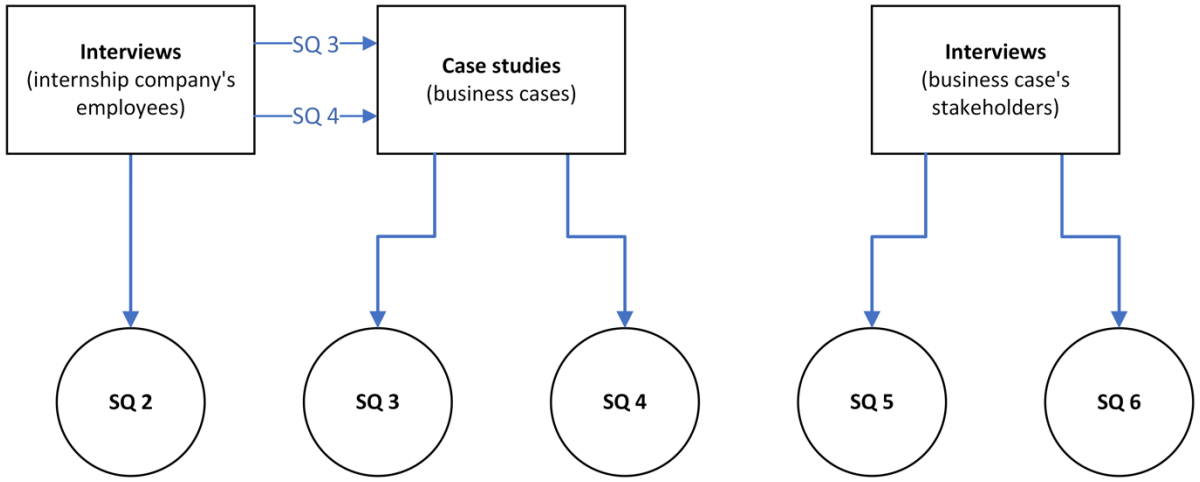

Figure 2: Empirical research method per subquestion (own work).

Literature and general practical preference

For this thesis, literature related the circular economy will be used and examined. Such as, researchers who explain the definitions, strategies for the transition and other relevant topics such as about barriers, triggers, and enablers. Several literature review sources will be used, but also empirical research sources will be studied. This all will help understand the current knowledge about the topic and its subquestions, but these references will also help explain the research problem statement. However, as communication with a circular strategist and developer at a Dutch real estate developer indicated. More (empirical) research is needed in this topic. Therefore, case studies and interviews will be done to accompany the literature in this study.

Reflection

1. What is the relation between your graduation (project) topic, the studio topic (if applicable), your master track (A,U,BT,LA,MBE), and your master programme (MSc AUBS)?

   The management part of the MBE master track is related to the management of development projects and between the actors involved with business cases. If this process changes and becomes more circular focused, other aspects of the master programme such as the architects will also be challenged to learn more about the circular economy. In practice, the knowledge of the different aspects of the broad MSc AUB master programme needs to be combined.

2. What is the relevance of your graduation work in the larger social, professional and scientific framework.

   Societal relevance
   This research has societal as well as scientific relevance. First of all, the constructions in the built environment have a significant impact on the environment, society and economy (Gencel et al., 2012; Smol et al., 2015). The current linear economy used in the built environment has a societal relevance, because its activities are mainly responsible for resource and material shortages (Ghisellini et al., 2018), but also for increased pollution (Çimen, 2021). Moreover, the waste generated from construction equals 37.1% of the total waste created in Europe (Eurostats, 2022) and the construction sector is one of the largest CO2 contributors (Licciardello et al., 2017). Therefore, finding solutions to this problem is of great importance to society. But also developers are interested in the results of this subject (Perenboom, 2022a). This became clear from a vision document 'Synchroon Circulair' (Synchroon Circular), by a Dutch real estate developer (Synchroon, n.d.). But also during personal communication with developer and circular strategist Perenboom at Synchroon.

   Scientific relevance
   Second, this thesis also has a scientific relevance. Not only is the circular economy a relevant and much talked about topic in literature, this study will also explore current research gaps and future research will also be able to use outcomes from this thesis to continue with recommended future research. In addition, as Perenboom noted, according to Developers there is currently not enough information in the current sources for developers to actually implement it in feasible business cases (Perenboom, 2022b).

Cited literature

Çimen, Ö. (2021). Construction and built environment in circular economy: A comprehensive literature review, *Journal of Cleaner Production*, Volume 305, 127180, https://doi.org/10.1016/j.jclepro.2021.127180.

Eurostat. (2022, September). *Waste statistics*. Eurostat Statistics Explained. Retrieved on 24 November 2022, from https://ec.europa.eu/eurostat/statistics explained/index.php?title=Waste_statistics

Gencel, O., Ozel, C., Koksal, F., Erdogmus, E., Martínez-Barrera, G. and Brostow, W. (2012). Properties of concrete paving blocks made with waste marble. *J. Clean. Prod*. 21, 62e70. https://doi.org/10.1016/j.jclepro.2011.08.023.

Ghisellini, P., Ripa, M. and Ulgiati, S. (2018). Exploring environmental and economic costs and benefits of a circular economy approach to the construction and demolition sector. A literature review. *J. Clean. Prod*. 178, 618e643. https://doi.org/10.1016/j.jclepro.2017.11.207.

Licciardello, D., Spatafora, S. L., Vizzini, L., Martelli, C. and Martelli, C. F. V. (2017). Carbon dioxide balance of wooden structures: circular economy in the ecological building industry. *In: Procedia Environmental Science, Engineering and Managemen* (P - ESEM), vol. 7.

Perenboom, M. (2022a, November 28). Personal communication [phone call].

Perenboom, M. (2022b, December 29). Personal communication [meeting].

Smol, M., Kulczycka, J., Henclik, A., Gorazda, K. and Wzorek, Z. (2015). The possible use of sewage sludge ash (SSA) in the construction industry as a way towards a circular economy, *J. Clean. Prod*. 95, 45e54. https://doi.org/10.1016/j.jclepro.2015.02.051.

Synchroon. (n.d.). Circulaire businesscases. Retrieved on 18 January 2023, from https://synchroon.nl/circulair/circulaire-businesscases/.