

Individual Research Plan (under development)

Circular Economic Transformation in the Construction Industry Case Study of Reuse

Research Field: Industrial Engineering & Management

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Introduction

Background

The Swedish Government writes in its report "*Från värdekedja till värdecykel* [From value chain to value cycle]" that the circular economy should be a societal tool to attain the set global goals by 2030 (Regeringen, 2017). Following this report, several large Swedish companies have demanded strategies and restructuring support from the government in order to secure their survival as, according to Niskanen et. al. (2020), structural and operational changes lead to production decline. Today, there is an investigation into financial instruments for industry and business for use in the transformation to a circular economy which should be completed in 2024 (Regeringen, 2022).

The transformation from linear to circular requires companies to rework their business models; however, according to Kanzari et. al. (2020), there are obstacles to such changes. Nußholz et. al. (2020) believe that it is financial uncertainty in the change from a linear to circular business model which creates resistance to change within companies. This is in line with Kanzari et al. (2022) who say that companies must adapt their financial measures according to their own conditions and take a long-term perspective already in the design stage of their proposed circular business model. Companies cannot use a traditional financial management during restructuring to measure profitability (Lindvall, 2011); instead they must gain knowledge of other business management methods (Lindvall, 2011; Kanzari et al., 2022). Kanzari et al. (2022) state that more empirical studies are needed regarding financial profitability during the transformation to a circular economy. Further, Kanzari et al. (2022) state that financial "guidelines" or strategies are needed to guide companies when managing the circular economy.

Nußholz et al.'s (2020) research shows that construction companies can attain profitability already in the first loop of the circular business model in terms of material reuse. Nußholz et al. (2020) state that, when introducing a circular economy, the workflow within circular business models takes place in recurring improvement loops. Kanzari et al. (2022) also describe a development model with recurring loops, the so-called Plan-Do-Check-Act (PDCA) cycle which is an improvement process where companies work incrementally with continuous improvements within recurring loops (Sokovic et al., 2010).

Although Nußholz et al.'s (2020) research shows that there is profitability when working towards a circular economy, according to Wielopolski and Bulthuis (2022) there is a great resistance to change within the construction industry. One influencing factor is that construction projects often have many actors involved in them which creates complex organisations (Matinaro & Liu, 2016). This, in turn, creates complex obstacles as there is a lack of knowledge and methods about recycling and circular economy (Wielopolski & Bulthuis, 2022; Benachio et al, 2020; Matinaro & Liu, 2016). Already in 2018, Hossain and Ng (2018) wrote about the construction industry's adaptation to a circular economy. Their conclusion was that it is a question of a paradigm shift whether the construction industry is to start with reuse and resource efficiency in its sustainability work.

Purpose and Problem Formulation

The general purpose of this research is to observe and study various actors within the construction industry and their collaboration during the transformation to a circular economy.

This research focuses specifically on a so-called 'construction chain' which is defined to include the many actors involved in the construction process, e.g. clients, architects, manufacturers, developers, contractors, and waste disposal centres. One specific purpose is to investigate the individual and collective challenges and opportunities for the various actors within the defined construction chain. Another specific purpose is to investigate which solutions these actors, both individually and collectively, need to develop. From the collected empirical data, it is hoped that a set of guidelines can be created specifically for the various actors within the defined construction chain for use during the transformation to a circular economy.

Thus, this research has three clear focus areas:

- (1) Observe & study current situation
- (2) Study challenges and opportunities
- (3) Create guidelines

Research Questions

- (1) What do the various actors in the studied construction chain currently do regarding circular economy?
 - (2a) What are the challenges and how are they handled?
 - (2b) What are the opportunities and how are they handled?
- (3) Based on the studies, what kind of normative guidelines can be created to facilitate the transformation to a circular economy?

Theoretical Overview

Focus categories (mainly academic articles):

- Circular Economy
- Circular Business Models
- Sustainable Business Models
- Operation and Innovation Management
- Other relevant theoretical articles within Industrial Engineering field

Metod (under development)

The research will be carried out during the PhD candidate's licentiate education (2023 - 2027) and several case study methods such as triangulation will be used to obtain high reliability and validity.

The method is based on empirical case studies which are suitable for use within the Industrial Engineering & Management field regarding studies over a longer timespan (Yin, 2018). Case studies answer questions such as what and how (Merriam, 2019; Yin, 2018). Collaboration with *Byggdialogen Dalarna* [Construction Dialogue, Dalarna Region] will give direct access to the various actors within the construction industry.

Data Collection Methods

Observations, interviews, documentation

Analysis Methods

Qualitative thematic analysis (Fejes, 2019; Alvinus et al. 2023)

Three Studies

In order to answer the set research questions, the research will be divided into three studies with different perspectives on the transformation to reuse and the circular economy.

Study 1 – Current situation analysis

The first study is a qualitative case study which will be conducted via observations and interviews. The study will be carried out in collaboration with *Byggdialog Dalarna* during their training workshop in reuse for the construction chain. The workshops are given as a series on nine occasions at *Byggdialog Dalarna's* premises and are run by a consultant from the company Invite-To-Do. The focus of these workshops is the transformation towards reuse and circular business models through horizontal innovation.

Study 2 – Follow-up of Various Cases

The second study is a qualitative case study which will be carried out via observations and interviews with the various actors in the construction chain. The focus is on mapping the challenges and opportunities which exist when introducing circular business models.

Study 3 – Results and Produced Guidelines

The third study is a qualitative case study which will be conducted via observations on and interviews about the entire transformation towards a circular economy at the construction chain. The results will provide material for proposals and recommendations, i.e. a set of guidelines, which the various actors in the construction chain can use during the transformation to a circular economy.

Expected Results

It is expected that this research will generate two academic articles and one licentiate thesis.

If the results from the three studies create good conditions for a transformation to circular business models, the actors within the construction chain can be used as good examples for other construction chains in the industry. The results and the good examples can be used to create guidelines which the various actors in the construction chain can use during the transformation to a circular economy.

The entire research is expected to contribute to sustainable business models within the construction industry and, by extension, to the "Viable Cities" project where e.g. Borlänge and 23 other cities in Sweden are expected to be climate neutral by 2030 with the remainder of Sweden's cities being climate neutral by 2045.

Ethical Research Considerations

The research will be carried out in accordance with research ethics guidelines and the basic principles of "good research practice". Any ethical issues in the research project will be discussed with supervisors and colleagues for each research study individually. For those research studies which involve data from different actors, the participants will be informed about the purpose of the research, consent to the research procedures will be requested, and information on how their data will be handled will be made available. The collected data will be handled confidentially and in accordance to GDPR requirements. As the research does not focus on personal data, no review by the ethics committee is required.

Connection to the Research Education Subject and Examination Area

Connection to the research education subject and examination for this research lies within the subjects of Industrial Engineering & Management and Environmental Technology based at the University of Gävle's research profile for the Built Environment 2016. Within Industrial Engineering & Management, business models, logistics and strategies will be affected by sustainability changes. The analyses concern problems and challenges in how industrial operations can develop towards a circular economy to attain sustainability. The research will be based on case studies which answer *what* and *how* questions in order to promote sustainability and efficient resource management.

Time Plan

Activity	Spring 2023	Autumn 2023	Spring 2024	Autumn 2024	Spring 2025	Autumn 2025	Spring 2026	Autumn 2026
Individual Research Plan	Start	Update		Update		Update		
Empirical Studies	Observations, Construction chain workshop	Interviews						
Analysis	Qualitative							
Articles		Article 1		Article 2		Article 3		
Licentiate Thesis							Thesis	Licentiate presentation & defence
Courses	Re-Framing Sustainability 5 credits	Classical Industrial Engineering & Management 7.5 credits	Qualitative Research Methods 10 credits	Introduction to Research within Industrial Engineering & Management 7,5 credits	Sem-krit vet-dok 2.5 credits Scientific Theory 5 credits	Forsk-kom nat-intern. 7.5 credits	Subject Relevant Course 7.5 credits	

References (needs to be updated)

Al-Awlaqi, M. A., Aamer, M. A. (2022) Individual entrepreneurial factors affecting adoption of circular business models: An empirical study on small businesses in a highly resource-constrained economy. *Journal of Cleaner Production* 379 (2022) 134736,. doi.org/10.1016/j.jclepro.2022.134736, Science Direct

ALMI. (2022). Kom igång med cirkular ekonomi. <https://www.almi.se/kunskapsbanken/tips-och-rad/kom-igang-med-cirkular-ekonomi/>

Alvinus, A., Borglund, A., Larsson G. (2023) Tematisk analys – din handbok till fascinerande vetenskap. Studentlitteratur. Lund

Benachio, G. L. F., Freitas, M. d. C. D. & Tavares, S. F., 2020. Circular economy in the construction industry: A systematic literature review. *Journal of Cleaner Production*, Volym 260. DOI: 10.1016/j.jclepro.2020.121046

Bilal, M., Khurram, I. A. K., Muhammad, J. T., Abdur R. N. (2020) Current state and barriers to the circular economy in the building sector: Towards a mitigation framework, Science Direct

Bocken, N. M., de Pauw, I., Bakker, C. & van der Grinten, B., 2016. Product design and business model strategies for a circular economy. *Journal of Industrial and Production Engineering*, 33(5), pp. 308-320.

Boverket. (2018). Kartläggning av fel, brister och skador inom byggsektorn. Rapportnummer: 2018:36. Utgivare: Boverket, December, 2018

Boverket (2020). Bygg- och anläggningslogistik. <https://www.boverket.se/sv/PBL-kunskapsbanken/teman/godstransporter-i-fysisk-planering/godstransporter-i-planeringsprocessen/x/bygg---och-anlaggningslogistik/>

CCBuild, 2022. Centrum för cirkulärt byggande. [Online] Available at: <https://ccbuild.se/> (Använd Januari 2023).

Elkington, J. (1997) *Cannibals with Forks: The Triple Bottom Line of 21st Century Business*. Oxford. Capstone.

Elkington, J. (2021) *GREEN swans – the coming boom in regenerative capitalism*. Fast Company Press. New York.

EU., Europaparlamentet (2023) Hur vill EU uppnå en cirkulär ekonomi senast till år 2050?. http://europarl.europa.eu/news/sv/headlines/society/20210128STO96607/hur-vill-eu-uppna-en-cirkular-ekonomi-senast-till-ar-2050?at_campaign=20234-

Economy&at_medium=Google_Ads&at_platform=Search&at_creation=DSA&at_goal=TR_G&at_audience=&at_topic=Circular_Economy&gclid=Cj0KCQiAjMKqBhCgARIsAPDgWlxrFcLVVqOllh1dVgyycuiagAMGrIx0Nit8Miz9cDYv6ryXaE8iux4aAmFgEALw_wcB

Fejes, A. (2019) Handbok i kvalitativ analys. Liber AB. Malmö

Godfrey, S. S., Ramsay G. C., Behrendt, K., Wynnd, P.C., Nordblome, T., Aslam, N. (2017). Analysis of agribusiness value chain servicing small-holder dairy farming communities in Punjab, Pakistan: Three case studies. Researchgate.
https://www.researchgate.net/publication/328491065_Analysis_of_agribusiness_value_chains_servicing_smallholder_dairy_farming_communities_in_Punjab_Pakistan_Three_case_studies

Hossain, U., Ng, T. (2018) Critical consideration of buildings' environmental impact assessment towards adoption of circular economy: An analytical review. Journal of Cleaner Production 205 (2018) 763-780, Elsevier Ltd.

Jansson, T. (2020) Cirkulär Business Model Canvas. Tillväxtverket.se
<https://circulareconomy.se/industriell-symbios-cirkulara-floden-av-restmaterial/>

Kanzari, A., Rasmussen, J., Nehler, H., Ingelsson, F. (2022) How financial performance is addressed in light of the transition to circular business models - A systematic literature review. Division of Business Administration, Department of Management and Engineering, Linköping, Sweden, Science Direct

Matinaro, V., Liu, Y. (2016) Towards increased innovativeness and sustainability through organizational culture. A case study of finish construction business. Journal of cleaner production 142 (2017) 3184-3193. Science Direct

Merriam, S. B., & Grenier, R. S. (2019). Qualitative research in practice : Examples for discussion and analysis. John Wiley & Sons, Incorporated.

Niskanen, J., Anshelm, J., McLaren, D. (2020) Local conflicts and national consensus: The strange case of circular economy in Sweden. Journal of Cleaner Production 261 (2020) 121117. Science Direct

Nußholz J., Nygaard Rasmussen, F., Whalen, K., Plepys, A. (2020) Material reuse in buildings: Implications of a circular business model for sustainable value creation. Journal of Cleaner Production Volume 245, 1 February 2020, 118546. Science Direct

Osterwalder, A. & Pigneur, Y., 2010. Business model generation. 1:a red. USA: John Wiley & Sons, Inc.

Regering (2017). Från värdekedja till värdecykel. Statens offentliga utredningar SOU2017:22. Elanders Sverige AB. Stockholm

Regeringen (2020). Ekonomiska styrmedel för att främja omställningen till en cirkulär ekonomi. <https://www.regeringen.se/49e2a5/contentassets/85ffeed63b6c448db645e0f60064f4b5/ekonomiska-styrmedel-for-att-framja-omstallningen-till-en-cirkular-ekonomi-dir.-202267.pdf>

Ritzén, S., Ölundh Sandström, G. (2017) Barriers to the Circular Economy integration of perspectives and domains. ©2017 The Authors. Published by Elsevier B.V., Peer-review under responsibility of the scientific committee of the 9th CIRP IPSS Conference: Circular Perspectives on Product/Service Systems, Science Direct

Sokovic, M. Pavletic, D. och K. Kern, Pipan. (2010). Quality Improvement Methodologies – PDCA Cycle, RADAR Matrix, DMAIC and DFSS. Journal of Achievements in Materials and Manufacturing Engineering, 43(1). ss. 476-483.

Vetenskapsrådet (2022) God forskningssed. <https://www.vr.se/analys/rapporter/vara-rapporter/2017-08-29-godforskningssed.html>

Wielopolski, M., Bulthuis, W. (2022) The Better Building Initiative — a Collaborative Ecosystem Involving All Stakeholders as Catalyst to Accelerate the Adoption of Circular Economy Innovations in the Construction Sector. Circular Economy and Sustainability (2023) 3:719–733 <https://doi.org/10.1007/s43615-022-00205-6>, 2023-10-04.

Yin, R. K. (2018). Case study research and applications: design and method. Liber AB. Malmö