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	Preksha Rautela
Student number	5784786

Studio		
Name / Theme	Metropolitan Ecologies of Place	
Main mentor	Alex Wandl	Environmental Technology and Design
Second mentor	David Peck	Architectural Engineering and Technology
Argumentation of choice of the studio	The project focuses on developing a resilient supply chain for NdFeB magnets in the Netherlands. The theoretical lens that is used to relate the problem field to urbanism integrates concepts of circularity and socio-ecological resilience, to maintain the system's operations within ecological boundaries. These concepts are fundamental to the studio's approach, making it the ideal choice for evolving this topic. The studio's approach is rooted in the concept of territorial landscape transformation. This perspective involves a deep analysis of how ecological, artificial, and morphological systems interact and influence one another (Furlan, 2022). The studio's proficiency in mapping and understanding the flows of materials, energy, and people within urban contexts is crucial in addressing the intricate challenges posed by this project.	

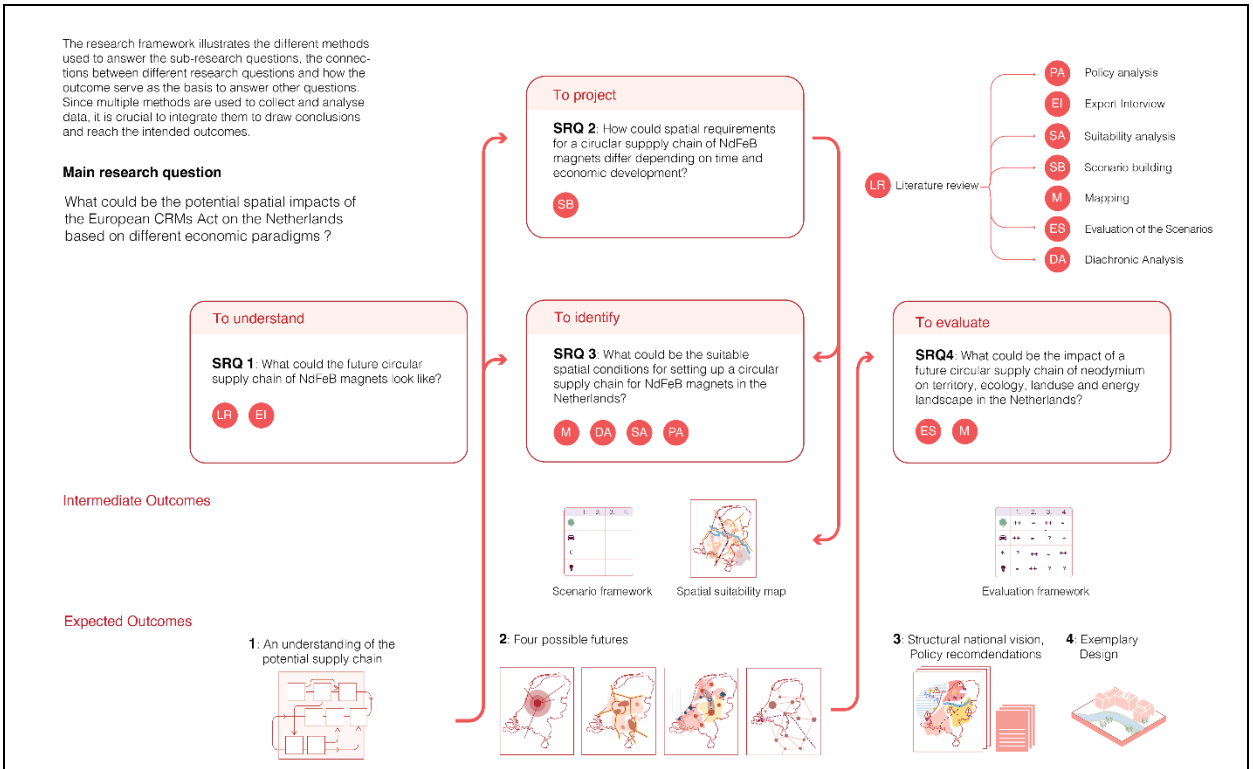
Graduation project	
Title of the graduation project	Extractivism To Circularism An exploration of the spatial implications of the CRMs act in the Netherlands
Goal	
Location:	The Netherlands
The posed problem,	[problem] Currently, Europe faces significant bottlenecks in the supply chain of its critical technology, making

	its ambition to deliver the green deal by 2050 vulnerable to geopolitical uncertainties (JRC analysis, 2023). Therefore, the EU and the Dutch national govt have formulated the CRMs act and the Dutch raw material strategy to build strategic autonomy by creating domestic supply chains. Despite the policies being an incredible initial move, there is currently no roadmap for their implementation. Moreover, they overlook the territorial transformation and the environmental implications of these facilities. The primary focus of these initiatives is to build a closed-loop system through green industries, but they need to acknowledge the ecological limits of the system, which are challenged by our current overconsumption patterns. [vision] In order to build socio-ecological resilience from global supply chain disruptions through a circular approach, it is important to understand the territorial perspective on circularity and look for alternate growth models to maintain the ecological limits of the system. [issue statement] [A] The current research on the relationship between CE and industrial facilities is mainly focused on a material flow perspective based on technical and entrepreneurial advancements (Cornell et al., 2021; Palm et al., 2021), rooted in an industrial ecology way of thinking (Ghisellini et al., 2016; Marin & De Meulder, 2018b). However, territories play a crucial role in transitioning to CE, as territory is an essential link between circular development strategies to ecosystems, landscapes, or territorial assets, and it allows different international, national, regional, and local goals to be linked in spatial organization (Forster et al., 2021). CE

	concepts are integrated within urban planning primarily at the theoretical level. However, the amount of space needed, the spatial conditions for circular activities, and the implications of these activities on territory and the environment are not clearly known. [B] The current economic growth models have highlighted how capitalistic societies prioritize economic objectives over equitable and ecologically sustainable development (Prigmaier, 2020). The current approach to a circular economy is often with the intention that green industries could solve the problem, which unintentionally promotes extractivist practices by insufficiently reducing overall resource consumption(source). Existing literature on alternative growth models have been developed from an economist's point of view and lacks detailed spatial implications. The relationship between growth paradigms and urban planning is limited. While there is some research on the reorganization of urban areas and their consumption within these paradigms, they usually overlook industrial production areas. [knowledge gap] The knowledge gap addresses the need for a territorial perspective on circularity and how it can be operationalized to formulate a regional strategy for future circular industries. It also involves the gap in the existing knowledge of growth paradigms in relation to the organization of industrial areas.
research questions and	What could be the potential spatial impacts of the European CRMs Act on the Netherlands based on different economic paradigms?

	[Sub question1] What could the future circular supply chain of NdFeB magnets look like? [aim] To understand the preconditions, processes, interdependancies, spatial claims and environmental impacts of a circular supply chain of neodymium used in NdFeB magnets. Sub question2: How could spatial requirements for a circular supply chain of NdFeB magnets differ depending on time and economic development? [aim] To project the potential spatial requirements of a local, circular supply chain neodymium in NdFeB magnets based on different possible actions and decisions. Understanding how a circular supply chain can adapt to and integrate with varying economic landscapes over different time periods. Sub question3: What could be the suitable spatial conditions for setting up a circular supply chain for NdFeB magnets in the Netherlands? [aim] To identify the physical spatial condition within the Netherlands for establishing the various stages of a circular supply chain for NdFeB magnets based on the spatial scenarios. Sub question4: What could be the impact of a future circular supply chain of neodymium on territory, ecology, land use and energy landscape in the Netherlands? [aim] To evaluate the impacts that a future circular supply chain for neodymium would have on the territorial and ecological fabric, land use, and the energy landscape depending on the decisions.

	Articulating a comprehensive roadmap for a resilient and circular supply chain of NdFeB magnets.
design assignment in which these results.	[aim] The study aims to spatially implement the CRMs act by devising a spatial strategy to establish a resilient, circular supply chain in the Netherlands for Neodymium magnets. However, the scope of this research extends beyond the immediate logistical challenge and delves into critiquing the current capitalistic approach to economic growth and consumption patterns by exploring the extent of processing and manufacturing capacities in alternative growth paradigms. The results would include 1] an understanding of the circular supply chain of NdFeB magnets 2] Four possible futures are illustrated through maps, showing the implications of a circular NdFeB magnet supply chain in the Netherlands, considering the variabilities of processing and manufacturing capacities in different economic growth paradigms. 3] A structural national vision, including policy recommendations for the supply chain of NdFeB magnets for the Netherlands. 4] An exemplary design to test the spatial vision at a neighborhood scale.
Research Framework for the project	



Process

Method description

Policy analysis: This method involves reviewing policy documents and reports to align the research with the government's strategies and visions. These are critically reviewed to understand the direction of development and existing limitations and conflicts of the European and Dutch governments. This process was done to understand the direction of development policies, formulate the problem, and identify existing limitations and conflicts at the national and EU levels.
SRQ 3: To understand the suitability of potential locations of a circular supply chain.

Expert Interview: Understanding the processes involved in a circular supply chain of neodymium for NdFeB magnets is complex and extends beyond the conventional boundaries of urbanism. This complexity is further compounded by the scarcity of readily accessible information in online resources. Therefore, engaging in a discourse with an expert in this field would offer practical knowledge, enhancing the understanding of this specialized chain.
SRQ 1: An expert is interviewed to understand in detail the specialized circular supply chain process and spatial claims involved in producing NdFeB magnets.

Literature review: A literature review involves a review of relevant scholarly articles, books, and other sources to synthesize the existing body of knowledge on a particular topic. A literature review was done to formulate the problem statement, identify the gaps in existing research, and formulate the conceptual and theoretical foundations of the project.
Databases: Google Scholar, Scopus, TU Delft Library
SRQ 1: To understand in detail the processes and environmental impacts of a future circular supply chain of NdFeB magnets.
SRQ 2: To understand the future demand forecast for NdFeB magnets for the Netherlands and the European Union.
To understand the economic development paradigms, their consequences, and their impacts.
SRQ 4: To understand the procedure involved in formulating an assessment framework.

Diachronic analysis: A diachronic study is an analytical approach that explores phenomena across different periods of time, focusing on their evolution, development, and historical changes. In this research, a comprehensive diachronic analysis of the industrialization process in the Netherlands, with a specific focus on the metal industry, is done. The aim is to understand the spatial patterns and distribution of the industries and to explore their relationship with the economic structure and socio-ecological dynamics over time.

SRQ 3: To understand historically the spatial distribution of the industries in relation to the economic structure.

Mapping: Mapping is used as a research method for analyzing spatial relationships and phenomena and effectively translating complex data into visually understandable formats. In this research, Geographic Information Systems (GIS) is used for spatial analysis, which facilitates an understanding of existing conditions, identifies spatial patterns, and enables the geographic representation and contextualization of problems. Thus, the relationships and patterns across multiple scales, from local to global, provide an in-depth perspective on the topic's spatial dimensions.
SRQ 1: To understand the spatial claims and infrastructural requirements for different facilities within the supply chain and geographical locations and flow relations in the supply chain at the global scale.
SRQ 3: Analyze existing and potential geographical locations, find suitable locations for a circular supply chain at the national scale, and spatially depict the scenarios.
SRQ 4: To visualize the integrated national vision.

Suitability spatial analysis: is a geographical and analytical method used to determine the potential and feasibility of a given area for a specific purpose or use. In this research, Geographic Information Systems (GIS) is used to evaluate characteristics like soil type, proximity, and the symbiotic relationships among land uses to determine the most optimal locations for different processes in the future circular supply chain of NdFeB magnets.
SRQ 3: To understand the spatial distribution of industrial areas and circular activities under different scenarios.

Scenario building: Scenario planning is a method to respond to the uncertainties and complexities in future material demand, socio-economic trends, and political decisions. It is based on recognizing multiple potential futures rather than a single predetermined outcome. This method facilitates the exploration of different possible options to speculate on future developments while also generating valuable insights about the present.
SRQ 2 & 3: To illustrate and understand how a circular supply chain can adapt to and integrate with varying economic landscapes over different periods.

Evaluation of Scenarios: Evaluating scenarios is used to analyze the scenario outcomes based on different parameters. A vital component of this approach is developing an evaluation framework, which allows for systematically comparing scenarios according to specific criteria, revealing their strengths and weaknesses. This research compares scenarios based on spatial, social, economic, environmental, technical, and political factors.
SRQ 4: To compare and evaluate the different scenario outcomes.

Literature and general practical references

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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 project focuses on enhancing socio-ecological resilience to global supply chain disruptions. A circular approach is adopted for the urban metabolism to ensure that the system's capacities are developed within ecological limits. The theoretical lens used for relating the problem field to urbanism is circularity and socio-ecological resilience; hence, evolving it within the MEP studio is most fitting. The project situated in the Netherlands' territorial context involves urban planning and design,

landscape, energy, and ecology domains .This interdisciplinary and multiscalar approach rightly fits within the MSc Urbanism program.

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

[scientific]
Existing research on Critical Raw Materials (CRMs) primarily focuses on evaluating their criticality and projecting their future consumption trends. This focus often centers on quantifying the required quantities of these materials. However, there is a notable gap in understanding such transitions' spatial and environmental impacts. While numerous studies on critical materials concentrate on the vulnerabilities of supply chains, this project adopts a socio-ecological resilience framework. This approach addresses the spatial implications of a robust supply chain within the ecological limits of the system.

[professional]
The project delves into exploring the territorial implications of a circular economy, a relatively unexplored area of study. It focuses on the spatial and territorial aspects by understanding the spatial conditions and requirements for circular activities. Furthermore, the project aims to connect alternative growth paradigms with their impact on the spatial organization of industrial zones, an aspect not extensively explored before.

[social]
This thesis addresses the challenge the EU currently faces due to supply chain bottlenecks and aims to protect people from the potential consequences of resource scarcity due to geopolitical uncertainties. The societal relevance of this project also arises from the pressing issues around existing extractive and refining industries. Additionally, the project highlights that our current way of living, which promotes material accumulation and consumption in the search for higher standards of living, has a significant environmental cost and offers the potential to reduce these ecological pressures.