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	Christos Zinelis
Student number	6058884

Studio		
Name / Theme	MBE Graduation Lab: Value and valuation in the Management of the Built Environment	
Main mentor	Michael Peeters	Management in the Built Environment
Second mentor	Alessandra Luna Navarro	Façade Design and Engineering
Argumentation of choice of the studio	I chose to join the "Value and Valuation in the Built Environment" studio with an initial interest in exploring how smart buildings influence real estate portfolio valuation. However, I sought to integrate the ESG dimension into this exploration, recognizing its increasing significance in the built environment. This focus naturally led to the Corporate Sustainability Reporting Directive (CSRD), which provided a robust framework for investigating the intersection of smart building technologies and sustainability in valuation practices.	

Graduation project	
Title of the graduation project	**Smart Buildings and the Future of Sustainability Reporting:** **Pathway to CSRD Compliance**
Goal	
Location:	European Union
The posed problem,	Buildings account for nearly 40% of the EU's energy consumption, creating significant reporting obligations under the CSRD. However, stakeholders face challenges in efficiently gathering and organizing the required data. This research examines how smart building technologies can facilitate compliance with CSRD reporting requirements.
research questions and	**Main Research Question (MRQ):** How can smart building solutions facilitate compliance with the Corporate Sustainability Reporting Directive (CSRD)?

	Sub-Questions (SQs): Based on the double materiality analysis, what is the data needed from an ESRS perspective for companies active in the built environment? *(Data need)* How can smart building data be validated to ensure it measures the intended metrics and aligns with ESRS? *(Data validation)* How can smart building technologies support evidence-based ESG reporting from a supervisory perspective to ensure compliance with CSRD standards? *(Data assurance & Supervision)* What data required by the ESRS cannot be provided by smart building technologies, and how can these gaps be addressed? *(Addressing Gaps)*
design assignment in which these result.	The design assignment resulting from these research questions will involve developing a framework that will facilitate compliance with the CSRD by integrating smart building technologies. The framework will focus on identifying, collecting, and organizing the data required by the ESRS, tailored to the needs of companies in the built environment. It will ensure that the data aligns with ESRS metrics and standards while providing mechanisms to support evidence-based ESG reporting and regulatory compliance. Additionally, the framework will address gaps in the data provision of smart building technologies and propose strategies to overcome these limitations, offering a comprehensive solution for stakeholders.

Process

Method description

The methods and techniques of research and design utilized in this thesis focus on systematically addressing the data requirements of the Corporate Sustainability Reporting Directive (CSRD) through a structured framework and a qualitative research approach.

The research framework integrates regulatory guidelines, including the CSRD and the European Sustainability Reporting Standards (ESRS), with their mandatory and conditional reporting standards. It emphasizes the Double Materiality Assessment, which evaluates both financial and impact perspectives, and incorporates cross-cutting, topical, and sector-specific standards. The framework is designed to systematically identify operational and data standards required for CSRD-aligned sustainability reporting while engaging key stakeholders. It includes interviews with built environment experts and smart technology providers to understand the alignment between data needs and the capabilities of smart building technologies. Market analysis of available solutions is complemented by a process of identifying and addressing unmet data requirements, ensuring the framework provides actionable insights for both industry and regulatory compliance. The analysis is further enhanced by qualitative tools like ATLAS.ti,

which help map relationships between CSRD compliance, smart technologies, and ESG reporting requirements.

Semi-structured interviews are the primary method of data collection, targeting professionals such as senior sustainability managers, ESG reporting advisors and consultants, and compliance managers from sectors including property development, commercial real estate, construction, and technical consulting. These interviews provide the necessary depth and context to capture the nuances of CSRD reporting and the role of smart building technologies in facilitating compliance.

The methodology prioritizes the identification of key metrics, indicators, and challenges in CSRD compliance, focusing on actionable solutions tailored to the real estate and construction sectors. This combined methodological approach ensures that the research not only meets academic rigor but also delivers practical insights to enable the adoption of smart building technologies for ESG reporting, effectively bridging data gaps and meeting evolving sustainability requirements.

Literature and general practical references

The research is informed by an extensive review of literature and precedents, focusing on the interplay between EU sustainability legislation and smart building technologies. Central to the theoretical foundation are the Corporate Sustainability Reporting Directive (CSRD) and its predecessor, the Non-Financial Reporting Directive (NFRD), which establish the regulatory framework for sustainability reporting. The European Sustainability Reporting Standards (ESRS) further detail the requirements for environmental, social, and governance (ESG) reporting, making them a critical component of the research. A key aspect of the study is an in-depth analysis of these EU legislations to understand their implications for data requirements and the role of smart building technologies in compliance.

Industry standards, including BREEAM (Building Research Establishment Environmental Assessment Method), LEED (Leadership in Energy and Environmental Design), WELL Building Standard, and SRI (Smart Readiness Indicator), provide practical insights into sustainability performance and offer a basis for obtaining smart building data. These standards are particularly valuable for capturing environmental metrics such as energy efficiency, water usage, and indoor environmental quality. However, they provide limited coverage of social and governance aspects, highlighting the need for additional frameworks to address these dimensions comprehensively.

For smart buildings, the literature analysis aims to establish a clear and unified definition, as numerous interpretations currently exist. Additionally, the study seeks to gain an overview of the most commonly implemented smart building systems, focusing on their capabilities for real-time data collection and their relevance to addressing the data needs mandated by EU sustainability directives. This comprehensive review ensures a robust understanding of both regulatory and technological contexts, enabling the integration of smart building solutions with ESG reporting requirements.

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)?**

   My graduation project focuses on exploring how smart buildings can automate data collection to meet the requirements of ESG reporting, particularly under the CSRD framework. This aligns with the studio topic, "Value and Valuation in the Built Environment," as it critically examines how innovative technologies in the built environment contribute to creating and communicating value across social, environmental, and economic dimensions.

   As a student in the Management of the Built Environment (MBE) track, my research is deeply rooted in understanding the managerial and technological aspects of the built environment, focusing on operational efficiency, governance, and sustainability. The MSc Architecture, Urbanism, and Building Sciences (AUBS) programme provides a multidisciplinary platform, enabling me to integrate architectural knowledge with technical and managerial strategies to address challenges in valuation and sustainability. Together, these connections underscore a cohesive framework for advancing value-driven decision-making in the built environment.

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

   My graduation work addresses the critical intersection of smart building technologies and sustainability reporting, which holds significant relevance within social, professional, and scientific contexts. Socially, it contributes to the growing need for transparent and standardized ESG practices, aiding stakeholders in understanding the environmental and social impact of the built environment. Professionally, it provides actionable insights for real estate developers, policymakers, and technology providers, helping them integrate smart building solutions into ESG reporting frameworks, particularly under the CSRD.

Scientifically, the research advances the discourse on smart technologies by exploring their potential to enhance and streamline compliance processes. It bridges gaps between technical innovation, sustainability governance, and valuation methodologies, offering a framework that aligns industry practices with contemporary sustainability demands. By focusing on these interrelations, my work contributes to a broader understanding of how the built environment can adapt to and support global sustainability goals.