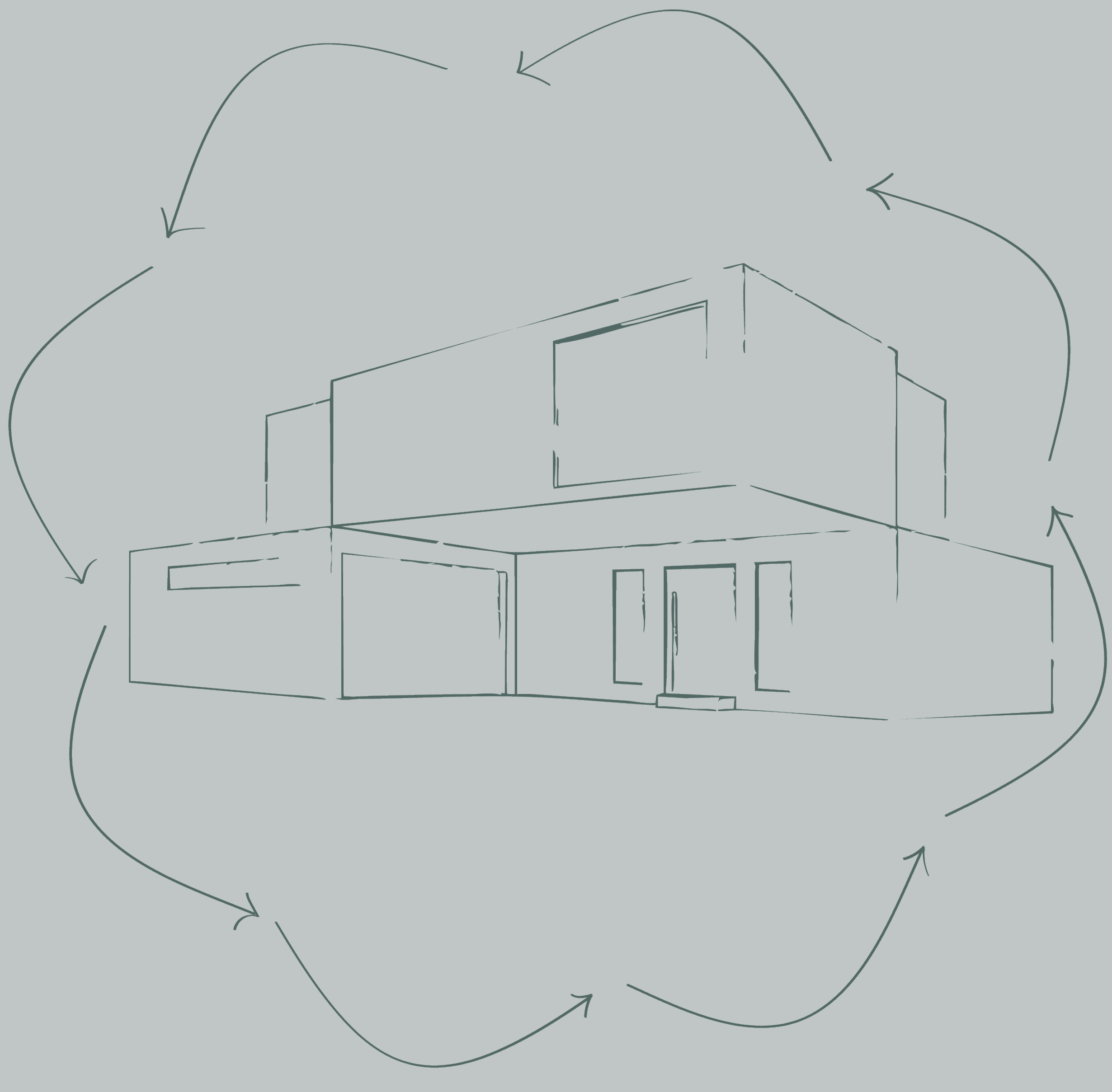
CIRCULAR CONSTRUCTION

The Role of the DGNB Circularity Tool in the Danish Building Sector



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Abstract

In Denmark's construction sector, circularity is gaining momentum, but what it actually means and how to implement it remains unsettled. One response to this challenge is the DGNB Circularity Tool: a recent addition to the Danish DGNB certification system that quantifies circularity through a material-based index. While it offers structure and comparability, it also shapes the very definition of circularity by making certain strategies visible and others invisible.

Through real case studies and project data from a collaboration with Sweco Danmark and interviews with practitioners, this thesis traces how the tool works in practice, what it gives value, what it overlooks, and how it affects roles and decisions across the sector. Using the lens of Actor-Network Theory, it shows how the tool translates complex goals into measurable values, and how these values influence design strategies, project priorities, and professional boundaries.

What becomes clear is that the DGNB Circularity Tool supports a particular version of circularity, quantifiable, standardized, and often limited to material inputs. Still, when used critically and in combination with broader design and institutional strategies, it can serve as a useful device for navigating circular ambitions. Rather than rejecting or idealizing the tool, the aim is to better understand what it does, and how to work with (and around) it to support more meaningful transitions.

Acknowledgements

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Lastly, our deepest thank you go to our supervisor, Troels Krarup, for his guidance, encouragement and academic support throughout the entire process.

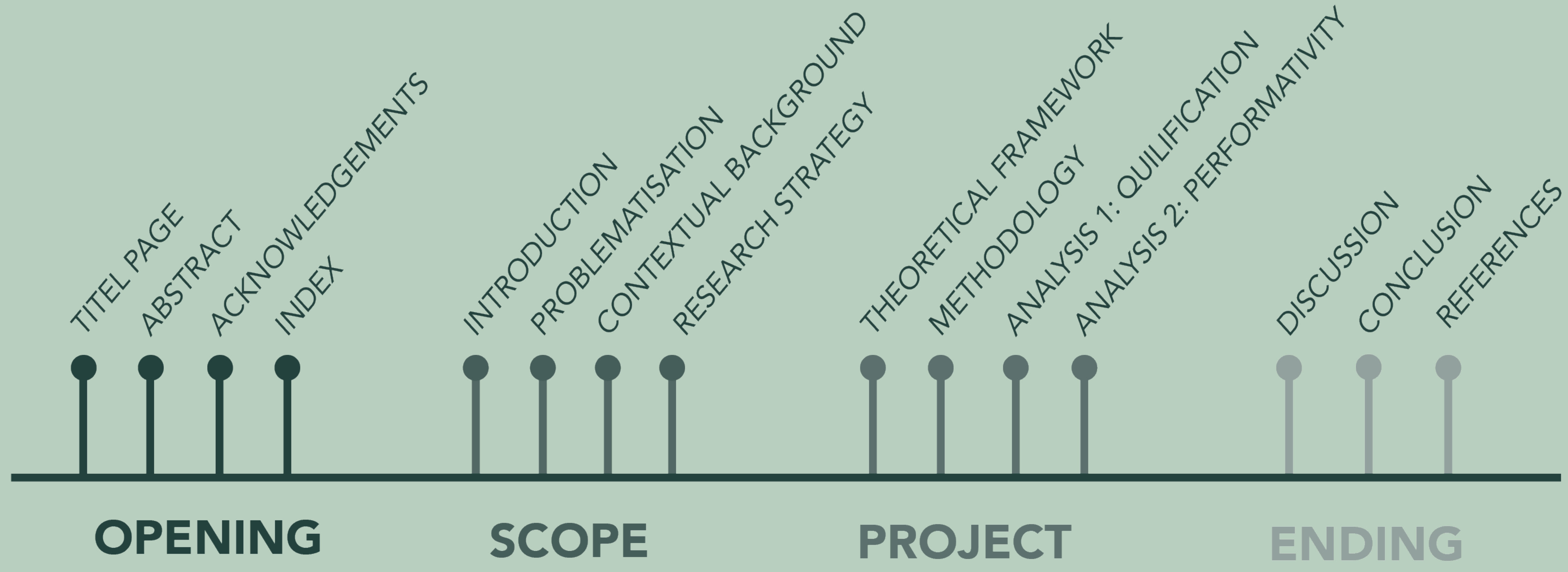

Figure 1 - The report structure

The report is organised into four main parts: the opening, the scope, the project, and the ending (Figure 1).

The opening includes a title page, a brief abstract summarising the purpose and findings of the thesis, an acknowledgements section, and a table of contents.

The scope outlines the background and focus of the research. It begins with an introduction to the topic, followed by a problematisation of current approaches to circularity in construction. This section also presents the contextual background for the study and formulates the main research question.

The project section presents the analytical core of the thesis. It begins with the theoretical framework, which draws on Actor-Network Theory and the concept of performativity, followed by the methodological approach. The analysis is divided into two parts: the first investigates how the DGNB Circularity Tool qualifies circularity through its scoring logic and structure; the second examines how the tool performs circularity in practice, using Callon's four moments of translation as an analytical lens.

The ending consists of a discussion of the findings, a conclusion summarising the main insights and contributions of the study, and a list of references.

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1. Introduction

This chapter introduces the environmental challenges of the construction sector and presents circular economy as a necessary but complex shift. It introduces the DGNB Circularity Tool as an answer to the lack of shared metrics and guidance in circular construction. The thesis is framed as a critical investigation of how the tool not only measures but also helps shape the meaning of circularity. The research question is outlined, along with the collaboration with Sweco Danmark and the theoretical approach based on Actor-Network Theory.

1.1. Challenges in the Construction Sector

The construction industry is one of the world's most resource-intensive and environmentally impactful sectors. In the European Union, construction and demolition activities accounted for around 35% of total waste generated in 2022 (Eurostat, 2024), making construction the largest single waste-producing sector. Construction is also responsible for around 40% of total energy consumption and 36% of CO_2 emissions (European Commission, 2020). Even though there is growing attention to sustainability, less than 1% of building materials are reused on a large scale, and the sector is still heavily dependent on the linear model of extraction, use and disposal (OECD, 2022).

In Denmark, construction and demolition activities generate over 40% of the country's total waste, amounting to around 5 million tonnes per year (Ministry of Environment, Denmark, 2020). While political focus and regulatory measures, such as CO_2 limits for new buildings, have emerged in recent years, the sector continues to rely on raw materials and high-waste practices. To meet Denmark's sustainability goals and international climate commitments, a fundamental shift in design practices and in how construction materials are used and valued is urgently needed.

The circular economy offers an alternative to the dominant linear model of extraction-use-disposal. It is an economic and social model based on reducing the use of raw materials, extending the life of products and minimising waste. By keeping materials in use longer and designing for reuse and recovery, the circular economy can significantly reduce emissions and relieve environmental pressures in the construction sector (Ellen MacArthur Foundation, 2013). The circular economy provides a direction, but it is still difficult to implement in practice. In the construction industry, for example, circularity is limited by fragmented responsibilities, issues with material traceability, and a lack of standardised assessment methods (Güngör et al., 2024; Pomponi & Moncaster, 2017).

1.2. Introducing the DGNB Circularity Tool

One response to the challenges in the construction sector has been the development of new tools aimed at operationalising circular economy principles in practice. The Deutsche Gesellschaft für Nachhaltiges Bauen (DGNB), or German Sustainable Building Council, founded in 2007, is one of the leading private organisations promoting sustainability in the built environment. Its certification system evaluates not only environmental performance but also economic, sociocultural, and technical qualities across the entire lifecycle of buildings. Since 2012, DGNB has played an important role in setting sustainability benchmarks in Denmark, influencing the design and evaluation of both public and private construction projects.

After years trying to integrate circularity into its assessment frameworks, the DGNB introduced a new Circularity Tool in its 2025 manual. Designed to evaluate a building's contribution to circularity, the tool uses a Circularity Index measured on a scale from 0 to 1. It assesses current contributions, such as material origin, pollutant load and waste generation, as well as future potential, including dismantlability, material compatibility and recyclability (DGNB, 2024) (figure 2).

By moving from checklist-based assessments toward a systemic evaluation of material cycles, the tool aims to create a strong and comparable measure of a buildings circular performance.
The DGNB system has grown in influence in Denmark, supported by the Green Building Council Denmark. It has become a key reference for sustainable construction, particularly in large-scale projects. More than a technical instrument, the DGNB certification acts as a market device that shapes what is considered valuable in sustainable building practices. The addition of the Circularity Tool strengthens this role, positioning DGNB as a key actor in defining and evaluating circularity.

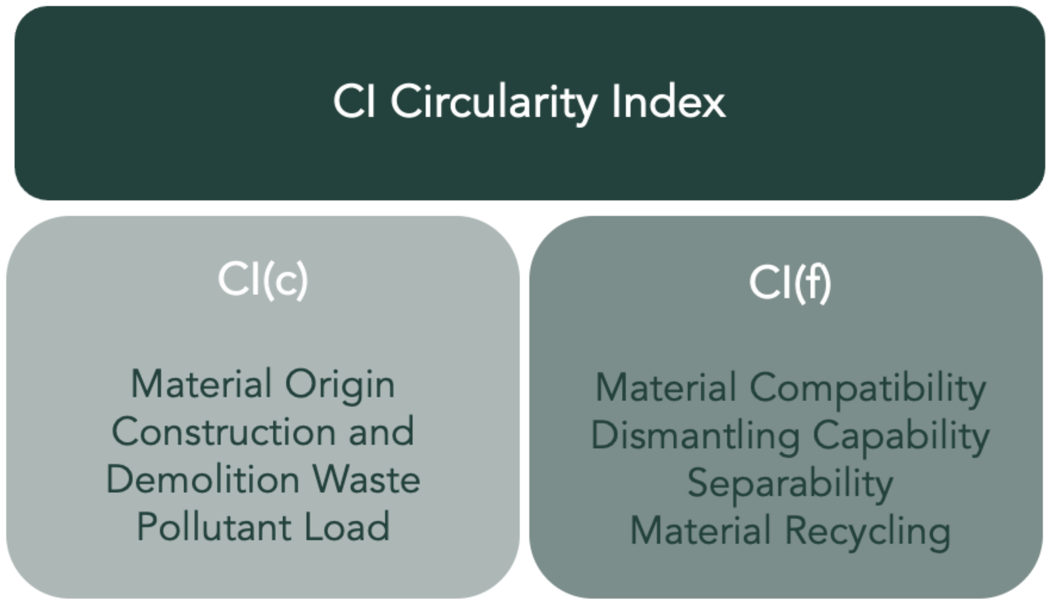


Figure 2 - Conformation of the Circularity Index in the DGNB Circularity Tool

1.3. Research Collaboration and Research Approach

The potential of the DGNB Circularity Tool to shape and standardise circularity within construction practices is key on this study. Since the tool is still being tested and negotiated by various actors, it offers a good opportunity to study how circularity is framed, qualified, and potentially performed.

The research was conducted in collaboration with Sweco Danmark, an engineering consultancy with expertise in sustainable design and a key user of DGNB certification tools. This collaboration provided access to ongoing projects and enabled an in-depth investigation of how the tool is interpreted and integrated into design and consultancy workflows. As a member of the Green Building Council Denmark, Sweco also contributes to shaping how DGNB tools are implemented in the national context.

This thesis approaches the tool as a socio-technical device that participates in defining what circularity means, instead of viewing it only as a technical instrument. Drawing on ANT and the sociology of quantification, particularly the concepts of qualification (Callon et al., 2002) and performativity, the study considers how the tool influences the definition of circularity. These frameworks help analyse how the tool selects indicators, defines value, and influences design strategies, actor roles, and decision-making. This perspective allows the research to examine not only what the DGNB Circularity Tool makes valuable, but also what it excludes and the effect of this framing on the broader transition towards circular construction in Denmark.

Source: Sweco internal image archive

2. Problematisation

This section presents the core problem that this thesis addresses: the tension between the growing demand for circular construction practices and the lack of shared tools, definitions, and processes to support them. The DGNB Circularity Tool emerges as a response to this gap, but also introduces new challenges by framing what counts as circularity. By situating the tool within this unsettled landscape, the following problematisation explains why it is important to study how the tool is used and how it shapes the very concept it wants to measure.

2.1. The Gap Between Ambition and Practice

There has been growing policy attention and strategic ambition around circularity, but it remains difficult to implement in the construction sector. While the concept is widely promoted, there is no standardised or shared definition, measurement method, or implementation process across projects. Tools, definitions and practices vary broadly, resulting in a fragmented landscape. As Pomponi and Moncaster (2017) observe, the circular economy in the built environment frequently lacks common metrics, shared definitions, and practical implementation pathways. In consequence, the transition from ambition to action is slow and inconsistent.

The DGNB Circularity Tool was developed in response to the need for a measurable approach to circularity. It provides a structured way of evaluating circular performance using a quantified Circularity Index. The tool is currently in the pilot phase in Denmark, with its use being tested by different stakeholders. This creates a central tension: assessment tools such as the DGNB Circularity Tool measure circularity and help define it. By selecting what is visible and measurable, they influence what circularity means. As Callon (1998) argues, tools and models act as framing devices, they structure attention, define boundaries and make certain aspects calculable while overlooking others that fall outside their scope.

2.2. Sweco as Mediator

In this context, SWECO is both a user of the tool and a mediator between the tool and its clients. As a consultancy advising clients on DGNB certification, SWECO needs to understand what the Circularity Tool values, which methods it uses, and how it qualifies circularity in concrete terms. This includes identifying which indicators carry the most weight, what types of documentation are required, and how different material or design choices affect the outcome. Their goal is to guide clients to achieve strong certification results, particularly in view of the fact that the 2025 DGNB manual will make the Circularity Tool mandatory for high-level certification.

This research takes a broader view by considering not only how the tool is used, but how it participates in shaping what circularity means in real world. Using the theoretical lens of ANT, and particularly the concepts of qualification and performativity, the study considers the dual role of the DGNB Circularity Tool as both a measurement instrument and a socio-technical actor.

2.3. A Socio-Technical Approach to Circularity

Qualification refers to the way in which tools define what is valuable by translating complex goals into quantifiable indicators. This process makes certain attributes visible and measurable while excluding others (Callon, 1998).

Performativity goes further. A tool is performative when it helps to construct the reality it aims to assess. This includes influencing workflows, actor roles, and decision-making processes (MacKenzie, 2006). The DGNB Circularity Tool is performative if it succeeds in aligning actors (consultants, architects, and clients) around a shared understanding of what circularity entails, and how it should be achieved. Since the tool is still evolving, its performativity is not yet fixed. It is being shaped through the ways it is introduced, interpreted, and tested across projects.

According to Latour (2005), sustainability is not a fixed endpoint, but something that is continuously redefined by tools, standards and institutional arrangements. The DGNB Circularity Tool is part of this ongoing process of negotiation. It operates in an environment where the concept of circularity is still evolving, and where organisations such as SWECO must translate its principles into practical guidance for clients.

In conclusion, this thesis is a reflection on how the DGNB Circularity Tool shapes what circularity means and how it is understood. It asks what kinds of circularity the tool promotes, how actors work with or around it, and what consequences this has for the broader transition toward circular construction.

Source: Sweco internal image archive

2.4 Research Question

Together, these questions position the DGNB Circularity Tool as a technical instrument and a socio-technical actor. This problematisation shows that the tool not only measures but also defines and shapes circularity in a practical way. To understand its role, the next section presents the current state of the art in circular economy and construction and situates the tool within this broader context.

- How does the DGNB Circularity Tool qualify circularity in buildings?
- Which indicators and criteria are selected, prioritised, or excluded by the tool's logic?
- How does the tool differentiate between building types, and what patterns of valuation emerge across cases?
- Which parameters most significantly influence the Circularity Index and associated DGNB score?

How can the DGNB Circularity Tool qualify and perform circularity in the Danish construction sector?

- How is the DGNB Circularity Tool introduced as a solution to the fragmented circularity landscape in Danish construction?
- How different actors interpret and use the tool in ways that align with or challenge their interests.
- What roles and responsibilities emerge through the tool's use, and how are they negotiated between actors?
- To what extent does the tool help stabilise new forms of network around circularity, and what limitations remain?

3. Contextual Background and State of the Art

This section situates the DGNB Circularity Tool within the broader discourse on the circular economy and its application in the construction sector, in order to understand how it operates and what it aims to address. It provides an overview of the conceptual foundations of circularity, highlights the challenges involved in translating these principles into building practice and reviews existing tools designed to assess and guide circular design.

3.1. Circular Economy

Circular economy provides an alternative to the traditional linear model of extraction, production, use and disposal. Based on reducing the use of raw materials, extending product lifespans, and minimising waste, it aims to decouple resource consumption from economic growth and regenerate natural systems through closed-loop material flows (Ellen MacArthur Foundation, 2013).
Circular economy is increasingly being described as a broader sustainability paradigm, offering more than just waste reduction. It challenges existing production and consumption patterns, introducing new ways of thinking about value creation, system resilience and innovation (Geissdoerfer et al., 2017). As the concept becomes more ambitious and expansive, translating it into practical projects is becoming more complex and controversial.

3.1.1. Circular Economy and Construction

The construction sector is one of the most resource-intensive and environmentally impactful industries globally. It is structured around linear value chains, high levels of extraction, and low reuse rates. In this context, circularity means designing out waste, keeping materials in use, and regenerating value over time (Ellen MacArthur Foundation, 2020). The implementation of circular strategies in architecture and engineering practice is a real challenging issue. It requires coordination across supply chains, stakeholders, regulatory systems, and measurement frameworks (Francart et al., 2022).

This shift implies rethinking how buildings are designed, constructed, and dismantled in order to retain the value of materials and avoid unnecessary resource loss. Although the environmental and economic benefits of circular strategies are well documented, implementation remains limited. As Pomponi and Moncaster (2017) argue, circularity in the built environment often lacks consistent definitions, operational frameworks, and practical tools.

Circularity in construction is both a technical and socio-institutional issue. Creating long-term value depends on collaboration between diverse actors with potentially different interests, such as clients, contractors, consultants, and certifiers (Aminoff et al., 2020). Fragmented responsibilities, siloed decision-making, and risk-averse practices often prevent the adoption of reuse strategies or circular design approaches.

A core principle in circular construction is the distinction between biological and technical material flows. Biological materials can safely return to the environment, while technical materials should circulate through reuse, refurbishment, or recycling. The value hierarchy prioritises keeping materials at their highest possible utility for as long as possible (Ellen MacArthur Foundation, 2013). The butterfly diagram (see figure 3) developed by the Ellen MacArthur Foundation visualises these loops and highlights the importance of uncontaminated, reversible flows. In construction, however, components often have mismatched life spans, complex assemblies, and limited traceability, making disassembly and reuse difficult in practice.

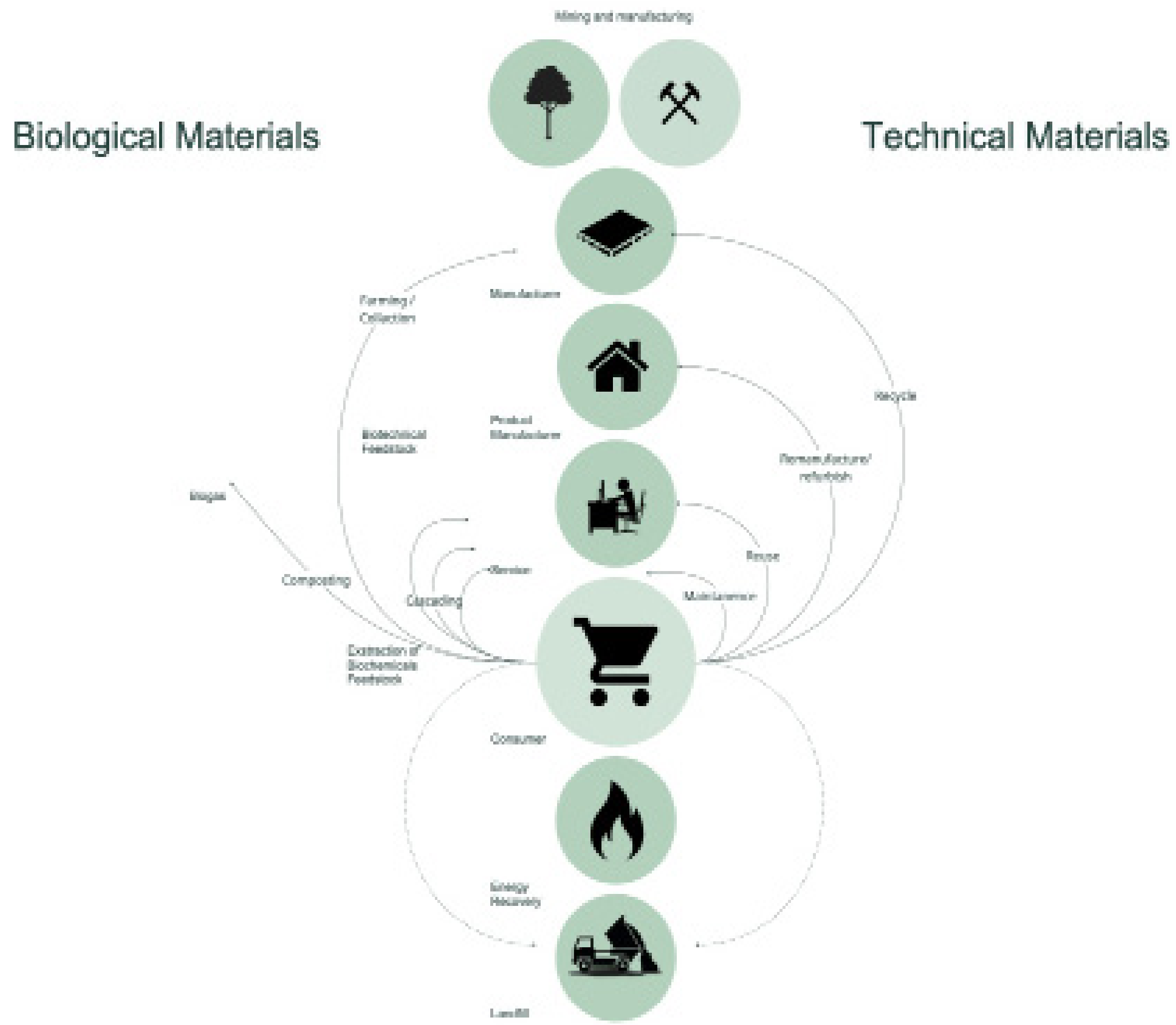


Figure 3 - The continuous flow of technical and biological materials in the value circle, divided into four circles of value creation. It includes key terms that help explain the activities driving a circular economy. The diagram is a reinterpretation of one from the Ellen MacArthur Foundation.

Barriers such as regulatory ambiguity, underdeveloped secondary markets, and liability concerns usually complicate the implementation (Rasmussen et al., 2020; Neri & Bianchi, 2024). For example, reused materials may lack documentation or warranties, leading to reluctance from clients and insurance providers. As a result, many buildings that could be renovated are demolished instead (Bentzen, interview, 2025).

Circularity in construction is described in the literature as a multidimensional concept that extends beyond material recycling. Functional adaptability is argued as a key principle, allowing buildings to accommodate changing use over time and thereby extend their service life and reduce demand for new resources (Geraedts, 2017).

Early-stage strategies such as avoiding new construction, reusing structures, and designing for flexibility are seen as essential to circular practice (Arup & Ellen MacArthur Foundation, 2021). Circular business models, including product-as-a-service, leasing, and take-back schemes, are recognised for enabling material recovery and long-term reuse (Bocken et al., 2016). Some authors argue for system-level approaches, where buildings are considered part of larger urban material flows and digital infrastructure supports reuse across projects (van der Hoek et al., 2020). Assessment tools often narrow this complexity by translating circularity into a set of quantifiable indicators, which may omit more systemic or contextual dimensions (Francart et al., 2022). Literature shows that circularity is not only a technical property, but also a spatial, organisational, and strategic approach to long-term sustainability in the built environment.

Denmark has taken regulatory steps, such as introducing CO_2 limits for new buildings, but the shift toward circular practices has been uneven. Cross-European studies confirm that systemic obstacles are still there across policy frameworks, market structures, and professional cultures (Bottero et al., 2022). These findings reinforce that circularity cannot be treated as a purely technical optimisation. It requires institutional transformation, new actor coalitions, and a redefinition of what constitutes value in design and construction (Espeland & Stevens, 2008).

These conditions position the DGNB Circularity Tool within a contested field. On one hand, it responds to the growing need for integrated evaluation frameworks. On the other, it contributes to shaping what circularity is by selecting certain criteria, assigning value to specific practices, and excluding others. As Callon (1998) notes, tools act as qualifying devices, they define what counts as valuable by making certain attributes visible, calculable, and comparable, while ignoring others.

This way, it becomes necessary to examine how tools like the DGNB Circularity Tool not only respond to the challenges of circular construction but also participate in constructing its meaning. The next section explores the current landscape of circularity assessment tools in the built environment.

3.2. Measuring Circularity: Tools and Approaches

The implementation of circular economy strategies in construction depends not only on intent but also on the capacity to measure, evaluate, and compare circular performance. Metrics are essential for supporting early-stage design decisions, aligning actors, and enabling transparency and accountability across the life cycle of buildings (Peng & Cao, 2025; Mani et al., 2025). However, there is currently no consensus on how circularity should be measured, and existing tools differ significantly in scope, assumptions, and data requirements (Güngör et al., 2024; Wong et al., 2024).

A growing number of tools and frameworks have been developed to address this gap. These tools assess circularity at different scales, materials, components, systems, and buildings, and draw on both quantitative and qualitative indicators (Güngör et al., 2024). Circularity is commonly evaluated through factors such as material origin, disassembly potential, adaptability, recycled content, and end-of-life recovery scenarios (Cramer et al., 2023). Some tools prioritise data availability and ease of use, while others focus on detailed material flows or digital integration through BIM systems and material passports.

The following tools are frequently referenced in current literature:

- Material Circularity Indicator (MCI) (Ellen MacArthur Foundation): Assesses material loops, recycled content, and product lifespan.
- Building Circularity Indicator (BCI) (TU Eindhoven): Measures disassembly, component layers, and reuse potential at building scale.
- Circularity Index Tool: Offers simple scoring based on predefined criteria such as reuse, modularity, and durability.
- OneClickLCA Circularity Score: Integrates circularity into LCA software, focusing on virgin input and waste output.
- Circular Buildings Toolkit (Arup & Ellen MacArthur Foundation): Provides qualitative strategies for stakeholders without generating scores.
- Circular Economy Assessment Method (CEAM) (Güngör et al., 20 24): Combines qualitative and quantitative metrics tailored to buildings.

These tools reflect different understandings of circularity. Some define it in terms of material loops and physical flows, others focus on strategic or stakeholder-oriented processes. As Morseletto (2020) explains, indicators do not merely reflect circularity, they shape it. They turn abstract goals into concrete categories and thresholds, influencing what is counted, what is ignored, and who is held accountable.'

In contrast to score-based tools, the Circular Buildings Toolkit, developed by Arup and the Ellen MacArthur Foundation, takes a non-metric approach. It proposes ten circular strategies and practical actions for different stakeholders. Its main strength is its ability to support early-stage decision-making and cross-disciplinary coordination by framing circularity as a series of actionable pathways instead of a fixed score (Arup & Ellen MacArthur Foundation, 2021).

A key limitation of many tools is their dependency on structured data. BIM-based tools and LCA integrations offer greater traceability, but their application is restricted by digital maturity and the availability of consistent product information (Cramer et al., 2023). In the early stages of design, when decisions have the greatest impact, data is often unavailable or uncertain, making accurate assessment difficult. This creates a tension between the desire to influence design and the ability to calculate performance.

Table 1 below provides an overview of key tools currently used to assess circularity in the built environment, highlighting their strengths and limitations.

This overview shows that no single tool can fully capture the multidimensional nature of circularity. Instead, tools act as framing devices that qualify circularity in specific terms. As Callon (1998) suggests, these devices determine what is visible and valuable by selecting indicators, assigning weights and standardising comparisons. These choices influence which strategies become dominant, which actors are empowered and how success is defined.

In this sense, circularity cannot be measured by tools alone; it must be constructed through them. The development and adoption of a tool such as the DGNB Circularity Tool should therefore be understood as not only a technical intervention, but also a political and institutional act.

TOOL	ADVANTAGES	DISADVANTAGES
Material Circularity Indicator (MCI) (*Ellen MacArthur Foundation*)	Simple, quantifiable, applicable to materials and products	Does not capture design intent or long-term use; needs detailed material flow data
Building Circularity Indicator (BCI) (*Cottafava & Ritzen / TU Eindhoven*)	Building-scale application; considers layers and disassembly	Complex to apply without info on lifespan and disassembly
OneClickLCA Circularity Score (Bionova Ltd.)	Integrated in LCA software; easy to use	Simplified logic; focuses only on virgin input and output
Circular Buildings Toolkit (*Arup + Ellen MacArthur Foundation*)	Multidimensional; includes technical, economic, and social indicators	Requires interpretation; doesn't give a single "score"
Circular Economy Assessment Method (CEAM) *Güngör et al., 2024*)	Tailored for buildings; mixes qualitative and quantitative metrics	Still evolving; requires further adaptation to local settings
BIM-based tools (e.g., BBCA, Material Passports)	Enable traceability and integration with digital design workflows	Enable traceability and integration with digital design workflows
Circularity Index Tool (Authors of Circular Construction for Urban Development – A System)	Fast assessment; clear criteria (reuse, disassembly, longevity); design-friendly	Do not account for environmental impacts or multiple cycles

Table 1 - Overview of Key Circularity Assessment Tools in the Built Environment

3.3. Research Collaboration with Sweco Danmark

This thesis is developed in collaboration with Sweco Danmark, an engineering consultancy specialising in sustainable building design and infrastructure development. Sweco plays a key role in advising clients on DGNB certification and integrates methods such as Life Cycle Assessment (LCA) and Life Cycle Costing (LCC) into project workflows. Through this collaboration, the thesis gains access to ongoing projects, internal knowledge, and practitioner insights related to the implementation of the new DGNB Circularity Tool.

Although the tool is not yet part of standard practice, it is included in the 2025 DGNB manual, which will become mandatory for all certified projects after July 2025. As a result, Sweco is actively testing the tool and exploring how it could support design decisions, particularly in renovation projects where achieving circularity has historically been difficult to document. This transitional moment offers an opportunity to observe how the tool is interpreted and negotiated while its use is still being defined.

Sweco is interested in the tool for strategic and practical reasons. As many clients aim to achieve DGNB certification, Sweco wants to understand how the tool works, which indicators matter most and how to effectively guide clients towards strong performance. Sweco is more concerned with the practical application of the tool than its theoretical foundations, especially in the early design phases where decisions have the greatest impact but there is not enough documentation. This collaboration facilitates an in-depth study of the adoption of a sustainability tool within a consultancy setting. Sweco's role as a translator between certification systems and client needs means that it also helps to shape the interpretation of the DGNB framework in the Danish context. As the largest member of Green Building Council Denmark, the organisation responsible for adapting the DGNB system nationally, Sweco contributes to the definition of circularity.

The partnership offers a dual perspective, combining internal experimentation with the tool and external influence on its institutional framework. These dynamics position Sweco as a key point of entry for exploring how the DGNB Circularity Tool qualifies and performs circularity in the construction sector.

The following section presents the theoretical framework used to analyse how this tool qualifies and performs circularity in Danish construction practice.

Section Summary

The introduction outlines the environmental challenges of the construction sector and presents circular economy as a needed but difficult shift. It introduces the DGNB Circularity Tool as a response to the lack of shared metrics and practical guidance. The chapter frames the tool not only as a measurement device, but as a socio-technical actor that helps define what circularity means. The research question focuses on how the tool qualifies and performs circularity, using Actor-Network Theory and concepts like qualification and performativity. The chapter also explains the collaboration with Sweco Danmark, which grounds the study in real project contexts.

4. Theoretical Framework

This chapter provides the theoretical lens through which the DGNB Circularity Tool is analysed. Drawing on Actor-Network Theory, it introduces the concepts of qualification and performativity to understand how tools shape what becomes visible, valuable, and actionable. It also presents the idea of tools as boundary objects and outlines Callon's four moments of translation, which guide the second part of the analysis.

Before analysing how the DGNB Circularity Tool qualifies and performs circularity, this chapter provides an overview of the theoretical concepts that guide the thesis. As this thesis sees the tool not as a neutral measurement instrument, but as a device that shapes the meaning of circularity, a socio-technical perspective is adopted.

This thesis uses Actor-Network Theory to study how the DGNB Circularity Tool qualifies and performs circularity in Danish construction sector. ANT provides a lens to understand how technical tools are not passive or neutral, but instead shape the social and material networks in which they are embedded (Latour, 2005). In this view, tools act not only as instruments of measurement, but as actors that help construct the realities they want to "describe".
Two core concepts guide the analysis: qualification and performativity.

4.1. Qualification: Framing Circularity Through Tools

The concept of qualification refers to how tools assign meaning and value by selecting certain indicators and excluding others. In the context of sustainability and circularity, tools qualify by translating broad ideas into specific metrics, categories, and scoring systems. As Callon (1998) argues, these tools act as devices of valuation, they do not only record qualities, but actively define what counts as sustainable or circular. In other words, they frame part of the reality and exclude others in order to measure and set a parameter.

In the case of the DGNB Circularity Tool, qualification involves defining circularity through a set of weighted indicators such as material origin, disassembly potential, and pollutant load. This process creates a measurable version of circularity that can be compared across projects. What is made visible through qualification is only a partial version of the concept. Other aspects may be excluded if they are not supported by data or easily quantifiable (figure 3).

From a sociological perspective on quantification, this process also entails trade-offs and exclusions. Following Espeland and Stevens (2008), quantification is also a political act. By producing scores, benchmarks, and comparisons, tools shape decision-making and accountability, legitimacy, and power dynamics. In this sense, the DGNB Tool measures circularity and it constructs a particular way of understanding and acting on it.

Qualification is not a neutral or technical step, but an act of framing sustainability in certain ways and not others. The DGNB Tool participates in defining what counts as "good" practice, which affect the score and what becomes overlooked.

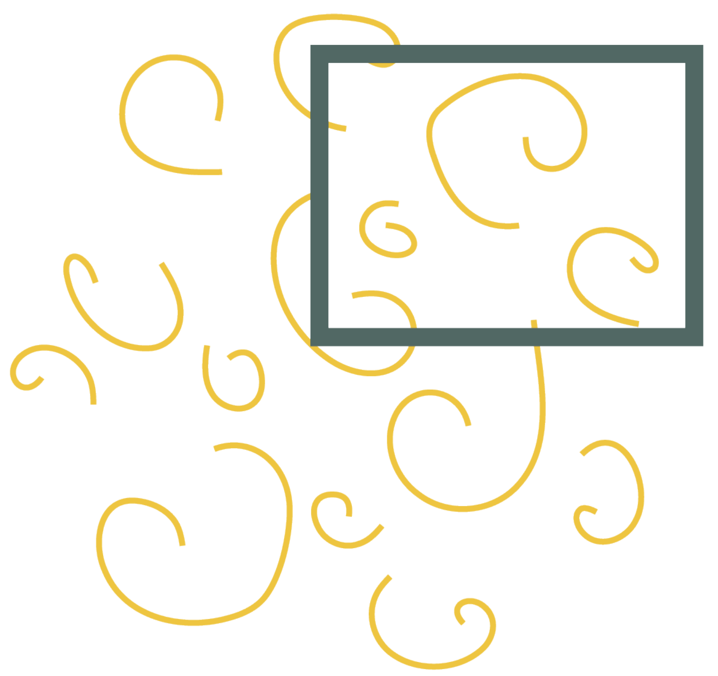


Figure 3 - Figure showing the landscape of circularity in construction and how Tools frame cirtain aspects, while overlooking other.

4.2. Performativity: From Measurement to Intervention

The second key concept in this thesis is performativity. A tool is performative when it helps produce the reality it aims to represent. In contrast to the idea that tools simply describe the world, performativity emphasises that they can actively shape practices, decisions, and relationships.
Michel Callon (1998) introduces the idea of performativity in economic sociology, arguing that theories and devices not only observe and explain markets, but also participate in their construction. A model or tool becomes performative when it changes the practices it is meant to describe. Donald MacKenzie (2006) provides detailed empirical analyses of financial markets to show how models like the option pricing theory influenced traders' behaviour, market structures, and even regulation. MacKenzie describes different levels of performativity. In its strongest form, a tool or model is performative when it contributes to the construction of the reality it claims to represent. In this view, models are not "cameras" that passively record the world, they are "engines" that contribute to shaping it.

The concept of performativity has also been developed by authors like Fabian Muniesa, who identifies the material, procedural and theatrical aspects of how tools are used in practice. Here. performativity does not only occur through theories or language, but also through calculative devices, metrics, indicators and tools that organise the assignment of value, the coordination of actors and the distribution of responsibilities (Muniesa, 2014). These tools do not operate in isolation. They are embedded in sociotechnical networks, making certain things visible, actionable and comparable while obscuring or excluding others. They help stabilise categories, roles and expectations. In doing so, they create new forms of alignment.
Applied to this thesis, this means that assessment tools not only evaluate whether a building is circular. They contribute to defining what circularity is, how it should be documented, and

who is responsible for achieving it. The tool distributes roles among consultants, designers, and clients. It frames which strategies are counted as circular and which are not. It introduces thresholds, scoring logic, and documentation formats that reorganise how actors think and act. The tool participates in reconfiguring professional practice.

From an ANT perspective, networks are assembled and maintained through the enrolment of actors (both human and non-human, such as tools) and the alignment of their interests and actions. Performativity is not a side effect. It is a central mechanism by which tools shape reality once embedded in project routines and institutional practices. As Callon (1998) argues, devices do not simply measure reality, they also help define what and who counts, and how. The presence of the tool creates a "before" and "after" in how sustainability is enacted. This distinction is important in the context of the DGNB Circularity Tool. As it is still in the pilot phase, how it is performative is ongoing and evolving. It is already influencing material choices and becoming part of coordination practices, as well as mobilising new negotiations. However, it is still unclear whether and how it will eventually predict and stabilise circularity outcomes.

In this thesis, performativity is not seen as something that either happens or does not happen. It is understood as something that depends on the situation. It depends on how the tool is used in each project, how people understand it, and how they respond to it. Some may follow what the tool says, while others may question it, adapt it, or try to use it differently. The idea of performativity here is about seeing how the tool influences practice, not in a perfect or total way, but in small, sometimes unclear or uneven ways.

4.3. Tools as Boundary Objects

To understand how the DGNB Circularity Tool circulates across different professional domains, this thesis uses the concept of boundary objects (Star & Griesemer, 1989). Boundary objects are frameworks, tools, or representations that are robust enough to maintain a shared identity across contexts, yet flexible enough to be interpreted differently by different social groups.

In the construction sector, a tool like the DGNB Circularity Tool must operate between architects, engineers, consultants, certifiers, and clients. Each of these actors engages with the tool through distinct priorities and vocabularies. For example, architects may view it as a guideline for design strategies, while engineers may treat it as a technical scoring system, and consultants may use it to meet certification targets. The tool does not require these actors to fully agree on what circularity is. Instead, it enables coordination by offering a shared reference point that each actor can work with according to their role. This flexibility is not a disadvantage; it is essential for the tool's mobility and usability. As a boundary object, the DGNB Circularity Tool can travel across institutional and professional boundaries. This makes it a practical device for standardising sustainability efforts while allowing for situated interpretation.

The tool's ability to function as a boundary object also helps explain why it can be adopted even while its categories, scoring logic, or data requirements are still under discussion. It allows different actors to work together without necessarily resolving conceptual or methodological differences (Star and Griesemer, 1989). This function is also relevant in a context like Denmark, where the tool is still in a pilot phase and its institutional role is actively being shaped.

4.4. Four Moments of Translation

To understand how the DGNB Circularity Tool is embedded in the construction sector and how it structures relationships between actors, the second part of the analysis of the thesis draws on Callon's (1986) framework of translation. Translation refers to the process by which heterogeneous actors are aligned around a common problem and their roles, interests and identities are progressively negotiated and stabilised. This process develops through four interrelated moments: problematisation, interessement, enrolment, and mobilisation.

Problematisation is the stage where a problem is defined, and a particular actor positions itself as essential to its solution. In this case, the DGNB Circularity Tool frames the challenge of assessing circularity as a lack of consistent metrics at the project level. By introducing the Circularity Index and a structured set of indicators, the tool presents itself as an obligatory passage point (OPP), a device that actors must engage with to achieve or certify circularity. The problem is constructed in such a way that consultants, designers and clients become dependent on the tool's categories and scoring logic to navigate regulatory and institutional requirements (Callon, 1986).
Interessement means the strategies and tools used to attract and stabilise the involvement of actors. For example, the tool promises added value to consultants such as Sweco by enabling them to guide clients through the certification process. At the same time, it appeals to regulators and clients by offering transparency and comparability. Interestement devices can include software platforms, guidelines and reporting formats that try to align actors with the logic of the tool. These mechanisms work to 'lock in' actors to the proposed roles and displace competing definitions of circularity (Callon, 1986).

Enrolment is the moment when specific roles are negotiated and accepted. The tool defines who provides the data, who interprets the indicators and who validates the results. For example, sustainability consultants are enrolled as interpreters and coordinators of the tool's logic, while architects may be positioned as responsible for design strategies that meet certain thresholds. These roles are not pre-determined but emerge through iterative adjustments as actors engage with the tool in project contexts.

Mobilisation involves the stabilisation and extension of these roles into broader networks. At this stage, actors begin to act in alignment with the tool's definitions, using its outputs to make decisions, justify strategies, or claim sustainability credentials. If mobilisation is successful, the tool becomes institutionalised, and its categories are treated as legitimate representations of circularity. However, this outcome is not guaranteed. Mobilisation can fail if actors resist, reinterpret or ignore the requirements of the tool.

This framework is useful for understanding how the DGNB Circularity Tool moves from a technical proposal to a structuring device in practice. It highlights how circularity is not simply defined by the tool, but is co-constructed through the negotiations, compromises and alliances that emerge as different actors engage with it. As Callon (1986) notes, translation is never neutral, it produces networks of power, responsibility and representation.

4.5. Theory Summary

This theoretical framework positions the DGNB Circularity Tool as more than a technical assessment tool. It is treated as a socio-technical device that qualifies circularity, distributes roles and influences how sustainability is performed. The analysis uses the concepts of qualification, performativity, boundary objects, and translation to understand how the tool operates within networks of actors and projects. The next section outlines the methodological approach used to investigate these dynamics in a situated context.

Source: Sweco internal image archive

5. Methodology

This chapter outlines the qualitative and situated research design, developed in collaboration with Sweco Danmark. It describes the selection of case studies and interviews to explains how the empirical material was gathered and analysed. The goal is not only to test the tool's effectiveness, but also to understand how it operates in practice and how actors engage with it during its early implementation phase.

This chapter presents the methodological approach used to investigate how the DGNB Circularity Tool qualifies and performs circularity in the Danish construction sector. The research follows a qualitative and situated strategy , drawing on empirical data collected through project case studies, semi-structured interviews, and informal observations during the tool's early implementation phase. The chapter describes the research design, the selection of cases and data sources, the interview process, the analytical strategy, and the main methodological considerations that guided the study.

5.1. Research Design and Approach

This thesis takes a qualitative research design approach that is grounded in the principles of ANT. It does not assume fixed categories or linear cause-and-effect relationships, but treats circularity as constructed and negotiated through tools, practices, and actor networks. The aim is not to evaluate whether the DGNB Circularity Tool works as intended, but to examine how it can be used, what it makes visible and what kinds of roles, decisions and forms of value it helps to shape.

The research focuses on the early implementation phase of the tool in Denmark, a period in which its categories and practical meaning are still being tested and defined. The research is situated, i.e. it does not look for generalisable findings for the entire construction sector, but rather aims to provide an in-depth insight into how a specific tool is interpreted and negotiated. The study combines two complementary lines of analysis. First, it analyses how the DGNB Circularity Tool is used in a small number of active projects. Second, it draws on semi-structured interviews and conversations with consultants, designers and stakeholders involved in the construction sector and sustainable development. These data sources make it possible to trace how the tool is mobilised in specific contexts, what challenges emerge and how actors engage with its logic, language and outputs.
This approach is consistent with the ANT perspective that tools are not neutral instruments, but actors involved in structuring networks, defining categories and producing knowledge.

5.2. Case Study Selection and Purpose

The empirical material for this study is based on a small set of building projects where the DGNB Circularity Tool has been applied. The cases were selected in collaboration with Sweco based on their accessibility, relevance to the research questions, and variation in building type and function. The set includes both renovation and new construction projects, covering residential and mixed-use buildings. The projects were already in advanced design stages or completed, with detailed documentation available, including material specifications, construction methods, and environmental data. All of them included Life Cycle Assessment (LCA) as part of the existing certification process. These LCA datasets served as the primary input for the Circularity Tool. The tool was not used during the design phase, but its application in these cases gives insight into its scoring logic, usability, and potential implications for future projects. This approach creates a testing ground for assessing how the tool qualifies circularity based on available project documentation and actual practices.

Further details of each case are explained in appendix 1, including key characteristics, structural types and materials used.

Each project was assessed using the DGNB Circularity Tool (ØKONOMI 3) to generate its Circularity Index and final score. The objective was to test how the tool translates material choices into a quantifiable score, and to identify which aspects of circularity are rewarded or neglected. Environmental Product Declarations (EPDs) were consulted and, where needed, manually entered into the tool in order to improve the accuracy and specificity of the assessments.

5.3. Interviews and Actor Perspectives

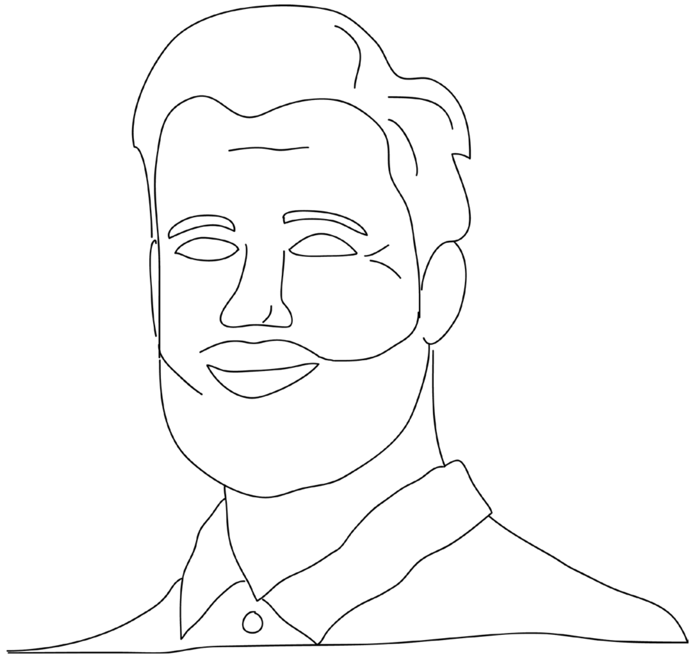
To examine the performativity of the DGNB Circularity Tool, a set of qualitative interviews were conducted with professionals working in architecture, engineering, sustainability consultancy, tool development, and institutional leadership. The objective was to understand how the tool is interpreted and used, and how it influences project strategies, actor roles, and coordination processes.

The interviewees were selected on the basis of their direct involvement with circular building practices, sustainability assessment tools or certification processes in Denmark. The group includes representatives from engineering and architectural firms, tool developers, research institutions and certification bodies, providing a broad and complementary set of perspectives. The interviews were conducted between February and May 2025. Each session lasted between 60 and 90 minutes, and all interviews were recorded and are summarised in Appendix X. They were conducted in English, except for one with Bo Flink Nygaard, which was conducted in Danish due to the participant's language preference and later translated into English using DeepL (www.deepl.com).

The interview questions focused on how circularity is understood, how assessment tools are used or perceived, and what kind of opportunities or constraints they present. Topics included design strategies, material choices, professional roles, and regulatory expectations. This method generated qualitative data to support the analysis of the performativity of the tool in different actor networks.

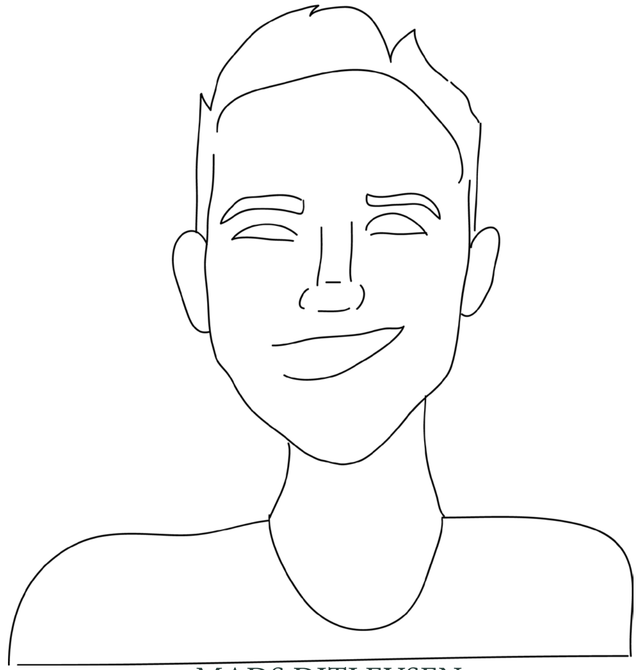
In addition to the interviews, the research also made use of informal interactions and observations from the ongoing collaboration with Sweco Danmark. These included several meetings, explanations of the DGNB system and technical guidance on how to use the tool and interpret LCA data. These interactions were not recorded, but they were important in understanding how the tool was implemented and tested internally, and how consultants responded to uncertainties and implementation challenges.

The Actors Interviewed are presented on the next page (see appendix 2).

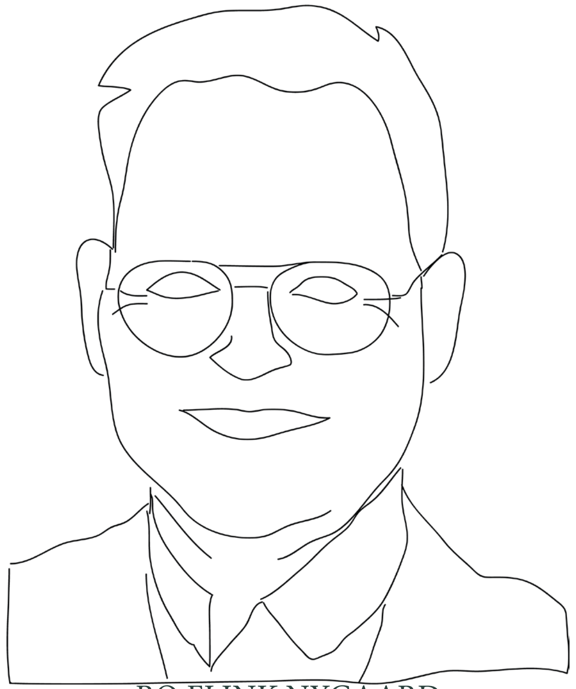


JACOB BUKH
Senior Consultant, Existing Buildings, Sweco Danmark

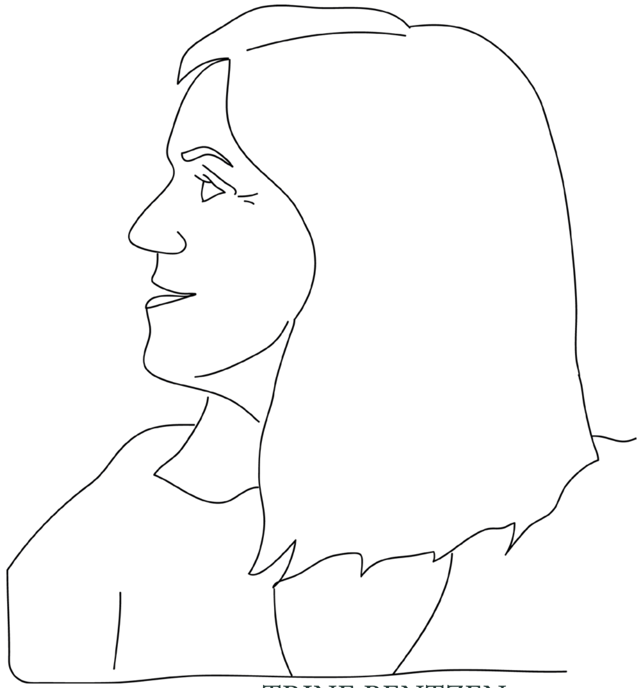
REBECKA BLOMQVIST
Architect & Founder, Blomqvist Architecture



MADS DITLEVSEN
Sustainability Lead, Real-Time LCA



BO FLINK NYGAARD
Quality and Sustainability Manager, Egil Rasmussen



TRINE BENTZEN
Technical Lead and Team Manager, Green building Council Denmark

NICOLAS FRANCART
Climate Change Analyst, CONCITO

5.4. Limitations of Research Methods

As the DGNB Circularity Tool is still in a pilot phase in Denmark, this study captures an early moment in its implementation. This provides an opportunity to observe how the tool is tested and interpreted, but also means that its long-term impact on design practice and project outcomes is still unknown.

On the other hand, the access to case material depended on the cooperation with Sweco, which could have influenced which projects were selected or how complete the documentation was. In all cases, the tool was applied retrospectively, based on data from previous certification processes. This limits the analysis to how the tool qualifies circularity based on existing documentation. The interview sample is small and focused on professionals with experience in sustainability or DGNB-related work. They provide relevant and informed perspectives, but the findings cannot be taken as representative of the wider sector. That said, the objective of this work is not to generalise, but to explore how tools such as the DGNB Circularity Tool work and how they influence the way circularity is understood and acted upon.

5.5. Methods Summary

This chapter has described the methodological approach used to explore how the DGNB Circularity Tool is used and interpreted in practice. Through case studies and interviews, the study looks at how the tool works in real projects and how it influences roles, decisions and understandings of circularity. The aim is not to evaluate the tool itself, but to examine what it does in context. The following chapters present the analysis, using the theoretical concepts introduced earlier to understand how the tool qualifies and performs circularity.

Source: Sweco internal image archive

6. Analysis

This first part of the analysis focuses on how the DGNB Circularity Tool qualifies circularity by translating it into quantifiable indicators. The chapter presents how the tool constructs the Circularity Index, which parameters are prioritised, and which strategies are excluded. It also shows how the tool's internal logic influences project outcomes and what types of circularity are recognised or overlooked.

6.1. Analysis 1: How the DGNB Circularity Tool Qualifies Circularity

The first part of the analysis looks closely at how the tool constructs what it recognises as circularity, focusing on how the DGNB Circularity Tool qualifies circularity within Danish construction practice. Drawing on Callon's concept of qualification, this process is understood not as a neutral act of measurement but as a socio-technical intervention that defines what counts as circularity by selecting specific attributes and rendering them measurable and comparable (Callon, 1998; Espeland & Stevens, 2008).

Qualification, in this context, involves the translation of broad, multidimensional sustainability goals into calculable indicators. This process highlights certain practices, materials and strategies, while others remain invisible or undervalued. The DGNB Circularity Tool performs this framing by structuring the Circularity Index (CI) around mass-based logic and predefined evaluation categories. As a result, it produces a partial and specific version of circularity that may or may not align with broader sustainability intentions.

The goal of this analysis is to understand how the tool defines circularity through its internal scoring structure, what types of value it recognises, and how its use affects the visibility of different circular strategies. The empirical basis consists of project cases in which the tool is applied to identify patterns in score distribution and the most influential material choices or practices.

The analysis is guided by the following research sub-questions:

- How does the DGNB Circularity Tool qualify circularity in buildings?
- Which indicators and criteria are selected, prioritised, or excluded by the tool's logic?
- How does the tool differentiate between building types, and what patterns of valuation emerge across cases?
- Which parameters most significantly influence the Circularity Index and associated DGNB score?

By addressing these questions, the chapter provides a critical account of the tool's qualification logic. This serves as a foundation for the following chapter, where the focus shifts to how this logic becomes performative, reshaping project priorities, actor roles and the way circularity practices move through the Danish construction sector.

6.1.1. Constructing the Circularity Index: Logic and Indicators

The DGNB Circularity Tool qualifies circularity by constructing a Circularity Index (CI), calculated as the sum of two equally weighted components. Implemented Circularity and Future Circularity. Each component can contribute up to 0.5 to the total CI, generating a maximum theoretical score of 1.00. While these two components are presented as having equivalent weighting, they are based on distinct logics and are not equally applicable in practice (figure 2).

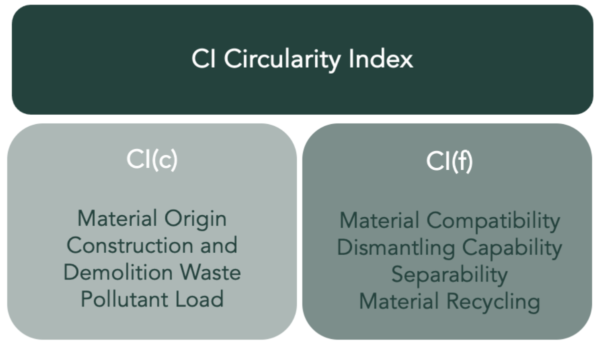


Figure 2 - Conformation of the Circularity Index in the DGNB Circularity Tool

Implemented Circularity refers to a building's current contribution to the goals of circular economy. It is primarily determined by the origin of the materials used; reused, recycled, or renewable materials are given a higher score than raw materials. Although the tool includes indicators related to pollutant load and construction or demolition waste management, they have limited practical influence. In most Danish projects, pollutant content is considered negligible due to regulatory restrictions, and waste management data is often missing or insufficiently detailed. Therefore, the material origin effectively becomes the defining factor of implemented circularity.

Future Circularity assesses the potential of buildings to enable material recovery at the end of their life. This component includes four qualitative dimensions: chemical compatibility, disassembly potential, material separability, and end-of-life recovery scenarios. Each material is scored according to standardised categories, such as "optimised" or "problematic," and the results are averaged using mass-based weighting. The availability of data to document these dimensions is often limited. When information is unavailable, the tool assigns a default score of zero, which can penalise projects that are circular in practice but lack technical documentation.

The Danish ØKONOMI 3 version of the tool offers predefined material scenarios that provide an approximation of typical performance. These default scenarios reflect standard materials, such as concrete, recycled steel or certified timber, based on average known values for the industry. It is possible to replace these with Environmental Product Declarations (EPDs) or detailed specifications, but this requires technical expertise and access to project resources, often unavailable in early design phases. Therefore, it is common for users to base their decisions on predefined inputs, particularly in the early stages of a project. This creates a clear difference in the way the two components of the Circularity Index are treated. Future circularity assessments depend on detailed design information (joint types, disassembly strategies and chemical compatibility) rarely defined or documented in the early stages. When such information is missing, the tool marks those criteria as 'not assessed', assigning a default score of zero. This is consistent with findings that, although reversible design strategies like mechanical joints or prefabrication have potential for future circularity, they are rarely prioritised or documented at early stages of design (Jørgensen, Hinge, & Møller, 2023). This disadvantages some projects because conventional design practices do not usually consider end-of-life scenarios. On the other hand, information related to the origin of materials is relatively easy to determine or can be reasonably assumed from standard specifications. This makes implemented circularity more accessible and influential in determining the final score. The qualification of circularity depends heavily on data availability and standardisation, favouring materials and strategies that align with the tool's structure.

6.1.2. Translation to DGNB Points

Once the Circularity Index (CI) is calculated, the DGNB Circularity Tool converts this result into a score used within the category of the DGNB certification system. The tool does not assign equal weight to each dimension; it distributes the available points according to a fixed structure that reflects the perceived reliability and impact of each component:

- **50 points are awarded based on the origin of materials, reflecting the implemented circularity.**
- **20 points correspond to the future circularity potential of materials and design.**
- **10 points are allocated to the management of construction and demolition waste.**

This allocation reinforces the fact that the origin of materials is the main factor in determining the final score. The most effective strategy for improving performance is to focus on a limited range of high-mass materials, such as concrete, wood or steel, and to ensure that they are reused, recycled or certified as renewable.

This framing promotes a material-based, present-oriented and documentation-driven version of circularity. It prioritises what can be measured with confidence and standardised across projects. In contrast, it marginalises circular strategies involving adaptability, alternative business models or design intentions that cannot easily be codified. These exclusions show the selective way in which the tool defines circularity and suggest the effects this will have on professional practices and decision-making, a topic that will be discussed in the next chapter.

6.1.3. Dimensions of Circularity Outside the Tool's Framing

The DGNB Circularity Tool provides a structured, quantifiable method of assessing circularity. But as the theory describes, it only captures a partial view of the concept. It prioritises technical attributes that can be standardised, weighed by mass and easily documented or already familiar to practitioners. In consequence, some significant aspects of circular construction that are widely recognised in the literature remain outside the scope of qualification.

A notable omission is the lack of consideration for functional adaptability. The tool does not assess whether a building has been designed to accommodate changes in use, layout or occupancy over time. Adaptability is central to circular thinking because it enables buildings to extend their service life and minimise the requirement for demolition or significant alterations (Geraedts, 2017). As adaptability is challenging to quantify using static, material-based indicators, it is excluded from the tool's logic. The tool begins its assessment only after the decision to build has been made, thus eliminating strategies that avoid new construction entirely. Approaches such as

adaptive reuse, spatial optimisation or the preservation of existing structures are not considered. Tools like the Circular Buildings Toolkit (Arup & Ellen MacArthur Foundation, 2021) promote these strategies by treating circularity as a design choice made during the planning stage rather than as a material condition that is applied afterwards. By contrast, the DGNB tool is framed from the perspective of new construction and primarily evaluates circularity through the lens of material inputs and outputs.

The tool also overlooks circular business models such as product-as-a-service, leasing and take-back agreements with suppliers (Bocken et al., 2016). While these models are difficult to quantify, they play a fundamental role in facilitating the long-term recovery and redistribution of materials. Excluding them reinforces a static understanding of circularity that is based on physical properties rather than systemic or economic arrangements that enable reuse over time.

Another critical blind spot is the urban or territorial scale. The tool evaluates buildings in isolation without considering their participation in broader material flows across the city or region. Emerging frameworks like Madaster a nd Buildings as Material Banks (BAMB) treat circularity as a networked system where buildings act as material reservoirs that are connected via digital platforms and policy mechanisms (van der Hoek, 2020). In contrast, the DGNB Circularity Tool treats each building as a separate entity, missing opportunities to account for synergies or shared infrastructure.

Together, these omissions show the limitations of the tool's qualification logic. It recognises and rewards practices that are easily quantifiable, standardised and aligned with conventional documentation formats. But at the same time, it excludes or undervalues practices that may be highly circular in intent or effect, but do not fit within its predefined categories. This does not mean that the tool is necessarily flawed, but simply that it reflects the inherent trade-offs involved in translating complex sustainability goals into quantifiable forms Circularity is a multidimensional concept spanning materials, systems, behaviours, and contexts. (Francart, 2022). Being aware of these limitations is important for critically engaging with and strategically using the tool. It suggests that, although the DGNB Circularity Tool can support circularity at the material level, other frameworks, practices and forms of evaluation need to be employed to account for the more systemic, functional and contextual dimensions of circular construction.

6.1.4. Applying the Tool in Practise: Case Observations

To understand how the DGNB Circularity Tool functions beyond its internal logic, it is important to consider how it is used in actual project settings. The tool is a structured framework for assessing circularity, but its practical application presents opportunities and limitations. The qualification logic described earlier can be observed in action through empirical testing in a series of building projects.

The analysed cases include new constructions and renovation projects with different structural types, as well as a model case (Tscherning House), developed specifically to explore circular design strategies. Material data from these projects was exported from LCAbyg and imported into the Danish ØKONOMI 3 version of the DGNB Circularity Tool. Each material was classified by type and assigned either a predefined scenario or, where available, an adjusted scenario based on project-specific documentation, including EPDs, design specifications, or known construction methods. Therefore, in some cases, more details regarding construction techniques, fixings, or disassembly potential had to be entered manually (table 2).

One of the biggest challenges across all projects was the limited availability of data and its uneven quality. The tool allows custom entries to override default assumptions, but this requires technical details that are often missing in the early design phases. Therefore, many assessments depend on generic inputs, particularly in renovation projects where documentation on reused materials, joint methods or disassembly strategies is usually unavailable. This disparity significantly impacts the assessment of future circularity, as this depends on detailed information regarding material compatibility, detachability and end-of-life planning.

These aspects are often overlooked during the design process and, if not documented, are given a default score of zero. This does not necessarily indicate an absence of circular intent but shows the difference between current practices and the logic of the tool's assessment.

In contrast, implemented circularity based on material origin is much easier to assess. Information on whether a material is reused, recycled or renewable can often be estimated or confirmed at an early stage in the process. This not only makes implemented circularity more accessible, but also more influential in shaping the final score. Across the analysed projects, altering a small number of high-mass materials or key components such as structural concrete, wood, and green roofs has the strongest impact on the Circularity Index. For example, using a recycled aggregate alternative instead of conventional concrete or specifying certified timber instead of raw materials, produced measurable increases in the circularity score. This pattern confirms the tool's mass-based bias: a small number of high-weight materials have a large influence on the outcome, while innovative strategies involving less massive components often are not recognised.

This practical application exemplifies the key challenge in the qualification process. While the tool has the capacity to facilitate circular design, its effectiveness depends on the extent to which project documentation aligns with its predefined structure. The tool functions well in projects that use conventional materials and follow standard documentation practices. But in more experimental or circular projects, relevant strategies may not be recognised if they fall outside the tool's logic, in which case extra documentation and work are needed.

These findings show that the DGNB Circularity Tool promotes a specific type of circularity. One that can be measured and documented, and that is aligned with current data structures. This approach may facilitate comparability and integration into certification systems, but it also limits what is considered valuable, potentially discouraging alternative methods that cannot be captured by mass-based metrics alone.

Building part	Main group	Subgroup	Construction	Building product	Recycling ?	Entered quantity	Device	Calculated quantity	Device	Weight	Device		Standard scenario	Changes to the default scenario?	Source / documentation
Data from LCA standard reporting format	Data from LCA standard reporting format	Data from LCA standard reporting format	Data from LCA standard reporting format	Data from LCA standard reporting format	Data from LCA standard reporting format	Data from LCA standard reporting format	Data from LCA standard reporting format	Data from LCA standard reporting format	Data from LCA standard reporting format	Data from LCA standard reporting format	Data from LCA standard reporting format		Select a default scenario from the dropdown	If yes, please specify which changes. If no, the field can be left blank	Reference to documentation if the default scenario has changed
Bygningsdel	**Hovedgrup**	**Undergrup**	**Konstruktion**	**Byggevare**											
Load-bearing in	Inner walls	Load-bearing	Load-bearing inner wall - Lightweight concrete 2	Lightweight concrete wall element, 200 mm CRH MD-22012-5		1,1	m^2/sqm	7209,4	m^2	2465614,8	kg	18,60%	Lightweight concrete wall element, 20	2.05% Steel (Armadura) - 97.95% concrete - A	
Exterior walls	Exterior walls	Basement ext	Back wall 3 - concrete 180 mm	Concrete element walls 200 mm, C35 CRH MD-21066-10		0,9	m^2/sqm	2570,4	m^2	791683,2	kg	5,97%	Concrete, regular	Based on EPD: 97% recycled, 3% landfill; 1.6%	
Basement deck,	Ground slab	Ground slab	Basement deck, other basement	Ready-mixed concrete (C20/25 SCC and C25/30) in exposure cl		0,2	m^3/m^2	314	m^3	705244	kg	5,32%	Concrete, regular	Based on EPD: 97% recycled, 3% landfill; no r	
Strip foundation	Foundations	Edge foundat	Edge foundation	Ready-mix concrete (C35/45), C35/45 - CEM I (Set size concrete		0,556	m^3/m	226,57	m^3	513634,19	kg	3,87%	Concrete, regular		
Exterior walls	Exterior walls	Basement ext	Back wall 1 &5 - Lightweight concrete 180 mm	Lightweight concrete wall element, 200 mm CRH MD-22012-5		0,9	m^2/sqm	1432,8	m^2	490017,6	kg	3,70%	Concrete, regular	2.05% Steel (Armadura) - 97.95% concrete - A	
Exterior walls	Exterior walls	Basement ext	Exterior wall - Formwork - Brick+insulation	Red and yellow bricks, Red brick		138,22	kg/m^2	476583	kg	476582,56	kg	3,59%	Bricks, new (cement mortar)		
Basement deck,	Ground slab	Ground slab	Ground deck over parking basement	Hollow deck element, 220 mm CRH		1,45	m^2/sqm	1470,5	m^2	447024,096	kg	3,37%	Concrete, lightweight aggregate concr	1.6% Steel – 98.4% Concrete (incl. 3.46% fly a	
Intermediate flo	Deck	Intermediate	Ground floor, 2nd floor	Hollow deck element, 220 mm CRH		1	m^2/sqm	1443	m^2	438672	kg	3,31%	Concrete, lightweight aggregate concr	1.6% Steel – 98.4% Concrete (incl. 3.46% fly a	
Intermediate flo	Deck	Intermediate	Ground floor, 3rd floor	Hollow deck element, 220 mm CRH		1	m^2/sqm	1443	m^2	438672	kg	3,31%	Concrete, lightweight aggregate concr	1.6% Steel – 98.4% Concrete (incl. 3.46% fly a	
Intermediate flo	Deck	Intermediate	Ground floor, 1st floor	Hollow deck element, 220 mm CRH		1	m^2/sqm	1441	m^2	438064	kg	3,30%	Concrete, lightweight aggregate concr	1.6% Steel – 98.4% Concrete (incl. 3.46% fly a	
Intermediate flo	Deck	Intermediate	Single deck, st	Hollow deck element, 220 mm CRH		1	m^2/sqm	1417	m^2	430768	kg	3,25%	Concrete, lightweight aggregate concr	1.6% Steel – 98.4% Concrete (incl. 3.46% fly a	
Roof constructior	Roofs	Roofs	Roof construction, 5th floor	Hollow deck element, 220 mm CRH		1	m^2/sqm	1024	m^2	311296	kg	2,35%	Concrete, lightweight aggregate concr	1.6% Steel – 98.4% Concrete (incl. 3.46% fly a	
Load-bearing in	Inner walls	Load-bearing	Shower cubicle interior wall - concrete 100 mm	Concrete element walls 200 mm, C35 CRH MD-21066-10		0,5	m^2/sqm	952	m^2	293216	kg	2,21%	Concrete, regular	Based on EPD: 97% recycled, 3% landfill; 1.6%	
Load-bearing in	Inner walls	Load-bearing	Load-bearing inner wall - basement Lightweight c	Lightweight concrete wall element, 200 mm CRH MD-22012-5		1,1	m^2/sqm	849,2	m^2	290426,4	kg	2,19%	Concrete, regular	2.05% Steel (Armadura) - 97.95% concrete - A	
Non-load-bearir	Inner walls	Non-load-bea	Aerated concrete	Ytong AAC		0,1	m^3/m^2	635,8	m^3	278480,4	kg	2,10%	Concrete, aerated/gas concrete		
Intermediate flo	Deck	Intermediate	Ground floor, 4th floor	Hollow deck element, 220 mm CRH		1	m^2/sqm	868	m^2	263872	kg	1,99%	Concrete, lightweight aggregate concr	1.6% Steel – 98.4% Concrete (incl. 3.46% fly a	
Basement deck,	Ground slab	Ground slab	Basement deck, underground parking	Ready-mixed concrete (C20/25 SCC and C25/30) in exposure cl		0,11	m^3/m^2	115,72	m^3	259907,12	kg	1,96%	Concrete, regular	Based on EPD: 97% recycled, 3% landfill; no r	
Basement exteri	Exterior walls	Basement ext	Basement exterior wall - 200 mm concrete	Concrete element walls 200 mm, C35 CRH MD-21066-10		1	m^2/sqm	769	m^2	236852	kg	1,79%	Concrete, regular	Based on EPD: 97% recycled, 3% landfill; 1.6%	
Basement deck,	Ground slab	Ground slab	Basement deck, underground parking	Sand 0-2 mm		210	kg/m^2	220920	kg	220920	kg	1,67%	Natural stone, gravel		
Roof constructior	Roofs	Roofs	Roof construction, 4th floor	Hollow deck element, 220 mm CRH		1	m^2/sqm	620	m^2	188480	kg	1,42%	Concrete, lightweight aggregate concr	1.6% Steel – 98.4% Concrete (incl. 3.46% fly a	

Table 2 - DGNB Circularity Tool – First step of the tool - Materials and scenarios assignations

Picture - Tscherning House (Photos from Tscherning House)

6.1.5. Results of the Case Analysis

6.1.5.1. Tscherning House as a Model Project

Of the cases analysed, Tscherning House is a standout model project that aligns particularly well with the internal logic of the DGNB Circularity Tool. Tscherning is a Danish company specialising in sustainable demolition. The project involved the transformation of a former warehouse into a new company headquarters and was guided by the explicit ambition to apply circular design principles to the structure, architecture and interior.

One of the project's defining features is its extensive use of secondary materials. Around 89% of all materials and fixtures were reused, recycled or upcycled, with many of these sourced from Tscherning's own demolition activities. These included bricks from a demolished school, repurposed hostel stairs, and custom-made furniture constructed from salvaged materials such as gymnasium flooring and beer kegs. The project's consistent application of this high degree of material circularity across structural, architectural, and interior elements positions it as an example of best practice within the current Danish context.

When assessed using the DGNB Circularity Tool, the project achieved a Circularity Index (CI) of 0.68, the highest among all the evaluated cases. Most of this score comes from the implemented circularity component, in which the project received 45 out of 50 points in the material origin category. This result directly reflects the project's high reliance on reused and recycled materials in major components, including the building envelope and interior finishes.

The score for future circularity was more moderate: 8.2 out of 20 points. This lower score does not necessarily indicate poor design choices but reflects the absence of detailed documentation concerning future disassembly, material compatibility and end-of-life strategies. Even though the building probably incorporates features that facilitate future reuse or transformation, these aspects were not formally specified or recorded in a format that could be assessed by the tool. The tool's scoring logic could not recognise these potential benefits if they are there. This outcome provides valuable insight into the qualification structure of the tool. It does not recognise circular strategies in general, but only those that are explicitly documented and formatted according to predefined assessment criteria. The tool produces a form of 'measurable circularity' that rewards documentation as much as, if not more than, design intention.

Even with this limitation, Tscherning House achieved the highest circularity score of all the cases analysed in this thesis. Its score is the result of more than just numerical calculations; it also reflects a clear strategic alignment with circular principles. The project shows that a strong focus on material reuse and upcycling can improve circular performance even without detailed end-of-life planning.

Tscherning House serves as a reference point for understanding the types of circularity that the tool can recognise and reward. It also addresses key questions about balancing implementation with future potential within the scoring logic. The Tscherning House project not only scored high because of its reuse practices. It also exemplifies how circularity becomes legible and valuable only when it is translated into the language of the tool. This is a preliminary sign of the tool's performativity, a point we return to in the next chapter.

6.1.5.2. General Cases in Danish context

In addition to Tscherning House, which is a model example, the other cases analysed in this study offer insight into how different project types perform under the DGNB Circularity Tool, as well as what patterns emerge in the qualification of circularity.
This section presents the results of the case study analysis carried out using the DGNB Circularity Tool in its Danish ØKONOMI 3 version. The goal of this comparison is not only to observe the final Circularity Index values and DGNB scores, but also to understand how the tool rewards specific material strategies and design decisions, and how it responds to different project typologies and levels of documentation. The table on the next page summarises the key characteristics and results of the analysed cases (Table 3).

The comparative results demonstrate a clear trend, where projects incorporating reused, recycled or certified renewable materials, particularly in high-mass components, achieved significantly higher scores in the circularity component. On the other hand, projects with conventional material selections and limited documentation of reuse strategies performed worse. This pattern was most evident when evaluating structural elements, such as concrete and wood. In multiple cases, replacing conventional concrete with variants containing recycled aggregates or specifying certified timber instead of virgin wood resulted in substantial improvements to the Circularity Index. Due to the tool's mass-weighted logic, these substitutions had an amplified effect, as changes to a small number of heavy materials can influence the overall score considerably.

Renovation projects are often closely aligned with circular economy principles, as they aim to extend the lifespan of buildings and retain the value of existing materials. However, under the DGNB Circularity Tool, achieving a high score in such projects is more demanding than in new construction. This is primarily due to the difficulty of documenting the origin and properties of pre-existing materials. Since most of the materials used in renovations are already installed, they usually lack traceable documentation like EPDs or certificates of reuse. Without a detailed study of the materials, identifying and estimating their type, origin and potential for future recovery, these materials risk being classified under default scenarios with lower circularity values.

As the existing materials were not originally designed with disassembly or reuse in mind, evaluating their potential future circularity is more challenging. Renovation projects can still achieve high scores, but this requires significant technical effort, including making assumptions and estimations and carrying out on-site investigations. This makes the tool more demanding for renovation projects, even those that embody circularity in practice. Projects with the greatest reuse potential require additional resources to demonstrate and quantify their circularity within the tool's framework.

In all cases, it is evident that the implemented circularity component has a more significant impact on the final score than future circularity indicators. The future circularity indicators often remained unassessed due to a lack of information regarding disassembly potential or material compatibility. These criteria are rarely specified during the initial design phase and are not prioritised in conventional workflows.
The comparative findings suggest that the DGNB Circularity Tool promotes an interpretation of circularity, focusing on mass, traceability and standardisation. While projects that fit this model are recognised, those with more adaptive or context-specific strategies are overlooked. Thus, the tool not only measures circularity but also actively shapes which practices are made visible, valued and likely to be pursued in certified construction.

Source: Sweco internal image archive

Table 3 - DGNB Circularity Tool - Case studies results

Project Name	Building Type	Area (m2)	Total Mass (kg)	Main Contributor by Mass	Implemented Circularity (CI(C))	Future Circularity (CI(F))	CI	DGNB Points - Material Origin (Out of 50)	DGNB Points - Future Circularity (Out of 20)	Key Observations
Ballerup 2	New - Residential - concrete structure	11272	13257009	1. Inner load-bearing walls (28%) – concrete; 2. Decks/floors (25%) – precast hollow deck concrete; 3. Exterior walls (19%) – concrete	0,017	0,159	0,18	1,4	9,1	DGNB Gold. Main impacts from concrete decks/walls. - Long material lifetime, low replacements. - LCA: 8.07 kg CO_2-eq/m^2/year. - Dominated by concrete decks, limited separability
Gjessø	New - Residential - concrete structure	1444,91	1223149	1. Ground slabs (35%) – concrete; 2. Load-bearing inner walls (25%) – lightweight concrete; 3. Exterior walls (15%) – lightweight concrete	0,035	0,135	0,17	2,9	7,7	Long material lifetime, but very low implemented circularity; minimal recycled content, almost all materials are virgin. No significant design for disassembly or separability. Typical Danish row house structure; lightweight blocks reduce total mass compared to full concrete frame.
Home.Earth	New - Residential - concrete structure	11522	6148610	1. Interior walls (25%) - Prefabricated reinforced concrete 2. Foundations (23%) - Reinforced concrete 3. Exterior walls (13%) - Reinforced concrete	0,075	0,118	0,19	6,3	6,7	Very low implemented circularity; almost all materials are virgin with negligible recycled content. No significant design for disassembly or separability.
Kelleris	New - Residential - concrete structure	25069	23101136	1. Slabs (22%) – concrete 2. Internal walls (22%) – concrete or lightweight blocks 3. Exterior walls (18%) – concrete or brick	0,01	0,145	0,16	0,9	8,3	Main impacts from floor slabs/decks and internal/external walls, all made predominantly of reinforced concrete. Very low implemented circularity; almost all materials are virgin with negligible recycled content. No significant design for disassembly or separability.
Smedeland 8A	New, Concrete	16042	17396513	1. Floors (35.2%) – reinforced concrete (hollow-core slabs) 2. Inner walls (25.6%) – reinforced concrete (wall panels) 3. Exterior walls (24.8%) – reinforced concrete (wall panels with possible cladding)	0,006	0,123	0,13	0,5	7	Very low implemented circularity; materials are mostly virgin with minimal recycled content. No significant design for disassembly or separability was identified. The building relies heavily on industrialized prefabrication
Them	New - Residential - Concrete	688	590526,30	1. Ground slabs (34.3%) – reinforced concrete 2. Roofs (21.9%) – timber structure with insulation 3. Outer walls (16.8%) – aerated concrete blocks with façade cladding	0,033	0,115	0,15	2,8	6,6	Ground slabs are the dominant mass contributor. Structure relies on cast-in-place concrete and aerated block walls. Very low implemented circularity; materials are mostly virgin with minimal recycled content. No design for disassembly or reuse identified.
Agorahaven – Roberthaven	New - Residential – timber modular construction	5588	3244442	1. Ground floor slab (40.9%) – hybrid timber/fiber cement 2. Roofs (15.4%) – polycarbonate + glulam 3. Foundations (8.7%) – concrete	0,101	0,089	0,19	8,4	5,1	DGNB Gold. Modular timber building with glulam atrium. Main impacts from roofs and ground floor (polycarbonate, timber, fiber cement). LCA: 6.50 kg CO_2-eq/m^2/year. Very low material replacement; limited disassembly design.
Rækkehuse – Skovgårdene	New, low-rise residential – modular timber structure	7728	12835953,4	1. Roof (48.2%) – glulam and insulation 2. Exterior walls (15.2%) – timber frame with insulation 3. Ground slab (12.4%) – timber cassette	0,018	0,158	0,18	1,5	9	Timber-based row houses using prefabricated elements. Roof represents nearly half of the mass (green roofs). The high weight of the green roof, composed mostly of raw materials, significantly lowers the implemented circularity (CI(C)) and thus the DGNB points. Very low circularity overall. No design for disassembly.
Travbyen	New, low-rise residential – concrete structure	393	189671,93	1. Foundations (39%) – reinforced concrete 2. Ground slabs (21%) – concrete 3. Exterior walls (11%) – concrete	0,084	0,128	0,21	7	7,3	Traditional concrete rowhouse. Mass is concentrated in foundations and slabs. Very low reuse potential and limited separability. Some potential for improved circularity in future design iterations.
Tscherning HQ	office building, concrete and reuse-based structure	1786	1662969,86	1. Ground slab (33%) – mostly retained concrete 2. Exterior walls (23%) – retained 3. Slab (17%) – partially recycled concrete	0,53	9143	0,68	44,9	8,2	Over 80% of the building mass is retained. Significant use of recycled materials in slabs and inner walls. Very low share of new materials.

6.1.6. Conclusion: Qualification of Circularity

The first part of this analysis starts describing how the DGNB Circularity Tool qualifies circularity, translating a broad, multidimensional concept into a measurable, standardised index. Primarily relying on material origin, mass, and predefined scenarios, the tool creates a quantifiable, trackable version of circularity that is aligned with conventional data structures.
A clear pattern across the analysed cases showed that a small number of high-mass materials, especially when reused, recycled or certified, have a decisive influence on the final score. Projects that align with this logic are more likely to perform well. Others, including renovation projects or those employing unconventional strategies, can only achieve high scores if additional effort is made to collect, interpret or reconstruct material data. Without this, many circular practices remain invisible to the tool.

Future circularity indicators, such as disassembly and chemical compatibility, currently have a relatively minor role to play. This is not necessarily because they are less important, but because they are more difficult to document and are rarely prioritised during the initial design stages. As a result, the tool promotes a present-oriented, documentation-driven view of circularity. A significant aspect of this framework is how the Circularity Index is converted into DGNB certification points. Of the total score, 50 points are assigned to material origin, compared to 20 points for future circularity and 10 points for construction and demolition waste. This weighting reveals a clear institutional prioritisation: circularity that has already been realised and documented is considered more valuable than potential future circularity. The tool promotes a form of circularity that is grounded in certainty and standardisation rather than flexibility or long-term design potential. This reflects a broader shift in construction practice, where materials are no longer selected solely based on cost or performance, but increasingly based on environmental attributes such as origin, renewability, or reuse potential (Jørgensen, Hinge, & Møller, 2023)

These findings confirm that the tool not only assesses circularity but also participates in shaping it. By assigning value to what can be measured and excluding what cannot, the tool provides a partial representation of circular construction. This affects which practices are legitimised, which strategies are prioritised and how circularity is understood in professional settings.

This act of framing is not neutral. As Callon (1998) argues, framing is performative by nature: it determines what is visible, comparable and valuable. Once circularity is stabilised in calculable terms, the tool begins to influence how it is interpreted, practised and institutionalised. In this sense, qualification and performativity are interconnected processes. As MacKenzie (2006) also notes, a model or tool is performative if it changes the reality it seeks to represent through its own use.

This transition from calculation to intervention is the focus of the next chapter, that looks at how the DGNB Circularity Tool can influence the behaviour of stakeholders, the decisions made on projects, and the professional routines of actors involved.

6.2. Analysis 2: From Measurement to Intervention

The previous chapter looks at how the DGNB Circularity Tool qualifies circularity by translating a complex concept into a measurable, standardised framework. This second part of the analysis shifts attention to the tool's performative effects. In other words, it asks how the tool may influence the behaviour of stakeholders, the decisions made in projects, and the professional routines of actors involved in circular construction in Denmark.

Performativity is key here, not as a theoretical add-on but as a way to understand how the tool reorganises practice and shapes the network around it. This implies that tools and models not only describe reality, but also help to construct it (Callon, 1998; MacKenzie, 2006). A tool becomes performative when it begins to influence the very practices it seeks to assess. In this sense, the DGNB Circularity Tool, which is currently in a pilot phase and not yet fully embedded in project routines, is already positioning itself as a device that could influence how circularity is understood and enacted within the sector. This moment allows a reflection on how different stakeholders, from consultants and architects to certifiers and contractors, might engage with the tool, interpret its categories and position it within project processes.

To explore this potential, the analysis is structured around Michel Callon's (1986) four moments of translation: problematisation, interessement, enrolment and mobilisation. This framework helps to identify how actors align (or do not align) around a shared problem, how they negotiate roles and responsibilities, and how the tool could contribute to the stabilisation of new forms of coordination and decision-making in the future.

It is important to note that the DGNB Circularity Tool is not appearing in isolation. It is being developed within the DGNB certification system, which is already institutionalised and holds significant legitimacy in Denmark as a reference for sustainable construction. Therefore, the tool builds on an established socio-technical infrastructure involving certification frameworks, consultancy workflows and regulatory expectations, into which it is gradually being introduced. Understanding this context is important for assessing the potential performativity of the tool. At the same time, the tool functions as a 'boundary object', as defined by Star and Griesemer (1989), a shared reference point that enables coordination across diverse professional domains without requiring full consensus. Consultants, clients, architects and certifiers engage with the tool from different perspectives. Despite this, its structured flexibility enables collaboration and alignment.

The emerging performative effects of the DGNB Circularity Tool is important in this section, considering how the tool is interpreted, translated and mobilised by different stakeholders, and the networks it begins to assemble. Drawing on qualitative interviews and case studies, the second part of this analysis focus on the influence of the tool in decision-making processes, redefine roles, and how it establishes a specific understanding of circularity within the Danish construction industry.

To answer this, the section analyzes:

- How is the DGNB Circularity Tool introduced as a solution to the fragmented circularity landscape in Danish construction?
- How different actors interpret and use the tool in ways that align with or challenge their interests.
- What roles and responsibilities emerge through the tool's use, and how are they negotiated between actors?
- To what extent does the tool help stabilise new forms of network around circularity?

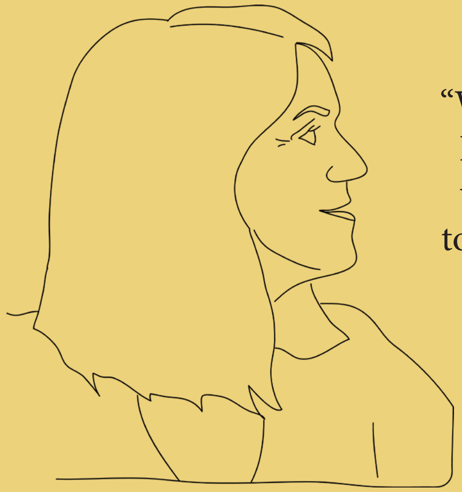
6.2.1. Problematization: What problem does the tool try to solve?

According to Callon (1986), the first stage of translation, problematization, involves defining a shared problem that requires coordination between different actors. The actor that defines the problem also positions itself as indispensable to its solution by presenting itself as an obligatory passage point (OPP). In this case, the DGNB Circularity Tool is introduced to address a key challenge in the Danish construction sector: how to define and measure circularity in a consistent and actionable way.

Circularity is increasingly mentioned in strategies, policies, and certification schemes, but the shift from ambition to practice is still difficult. In all interviews, actors described the construction sector as conservative. This was not presented as a cultural critique, but as a practical constraint. As all interviewed actors has stated, "It's a conservative sector. That's the baseline we are working with." Architect, Rebecka Blomqvist said, "Even if a material is good, unless you can show five projects where it worked, they won't take the risk." Bo Flink Nygaard pointed out that no one wants to take responsibility for reused materials, especially in structural elements. These observations point to a situation where risk-aversion limits the possibility for change, even when actors are aware of the need for more circular practices. Circularity is not just a technical ambition but part of a system that is risk-averse and slow to innovate.

Jacob Bukh, a senior consultant at Sweco, shared this concern from the perspective of certification: "A lot of buildings that should be renovated are not renovated today. They're just waiting to be torn down instead." He linked this to current tools and systems that fail to reward reuse or transformation: "Historically, it has been difficult to certify such projects under the DGNB system"

The DGNB Circularity Tool enters this network with the 'promise' of to make circularity calculable. It defines circularity through mass-based indicators, documentation requirements, and point-based scores, The tool reframes circularity as something that can be measured, compared, and certified. This creates a form of consistency that is currently missing in the sector. At the same time, it narrows what counts as circularity. As Nicolas Francart noted, tools define what parts of a problem are made visible and what is excluded. The DGNB tool values materials that are documented, standardised, and traceable. Renovation strategies and undocumented reuse are more difficult to integrate (see Analysis 1).



"We kind of made a manual where the Circularity Index is part of the economic criteria… and we were told: 'This tool is really brilliant. You need to have it, bring it into the Danish context" (Trine from the Green Building Council Denmark)

At Sweco, consultants recognise the need for such tools, but also describe current barriers to using them effectively. Jacob Bukh explained that while the tool is now part of the 2025 DGNB manual, its logic is not fully understood: "We use it for early screenings, but we don't really know how to improve the score." This makes it difficult to use the tool proactively in the design phase. Sweco is not working to define circularity across the sector, but responds to client demands, especially around certification: "It's not really our role to define circularity," Bukh said. The same challenge appears at the level of design. Blomqvist described how tools are not accessible to most architects. "You basically need three years of education to use it properly," she said. This limits the range of actors who can work with circularity in projects. She also explained that measuring tools that are made for certification are often introduced too late to change design outcomes: "Often they come in too late to make a real difference.". At the construction level, similar barriers exist. Bo Flink described how contractors are asked to support reuse strategies but are not equipped to carry the responsibility. "We don't expect to become LCA experts ... It's extremely time-consuming, and we don't have the resources to carry that burden alone." This creates a situation where circularity is promoted in principle but difficult to implement in practice.

The tool thus positions itself as an obligatory passage point for circular construction and as a method of evaluation, as well as acting as a certifying body. Trine explained: "If you want a gold certificate under the 2025 manual, it's pretty difficult to get around not using it."

However, actors do not all problematize circularity in the same way. From the interview it is possible to see that consultants often see the challenge as a lack of clear guidance. Architects, on the other hand, describe the challenge in terms of complexity and opacity. As Rebecka said, "You need to be able to do an LCA in the first place. And then get that data into this other tool. It's still very hard."

The tool's aim is to offer a common framework and measurable standard. Its presence already shapes conversations and introduces new forms of comparison. But as the interviews show, the tool enters a network where roles are undefined, expectations vary, and few actors are positioned to push for change. This forms the problematisation: circularity is recognised as necessary, but there is no agreed way to act on it. In other words, as a problem that requires alignment: there is demand for action, but not yet a shared or operationalised language. The DGNB Circularity Tool presents itself as the solution, not by resolving circularity conceptually, but by making it calculable and enabling coordination and accountability but its ability to do so depends on how it is received and interpreted by the actors it seeks to coordinate.

6.2.2. Interessement: How are actors attracted and aligned with the tool's logic

The second moment of translation, interessement, refers to the strategies and mechanisms through which the focal actor seeks to lock other actors into the roles defined during the problematization. In this case, the DGNB Circularity Tool, supported by consultants such as Sweco and promoted by the Danish Green Building Council, tries to attract and align a range of actors (architects, engineers, clients, contractors) around a shared calculative framework for circularity.

One key mechanism of interessement is the tool's promise of transparency and comparability. As Rebecka noted, "You do unfortunately need exact numbers to force people to do it... That's the only way to make everyone implement it — legislation." In other words, the presence of a score, even if imperfect, is already a powerful incentive. Jacob Bukh at Sweco expressed a similar stating that the fact that an output can be calculated allows the concept of circularity to be discussed in concrete terms in project meetings, even if the principles behind it are not fully understood. The tool also aligns with existing certification incentives. As Trine from the Danish Green Building Council explained, although the tool is still being tested, "projects working in the 2025 manual are going to be forced to work with it if they want to get a gold certificate". In this way, the tool becomes part of institutional logics that drive its adoption, not because of its intrinsic value, but because of what it enables: access to certification, alignment with the EU Taxonomy and reduced investor risk.

Interessement is not uniform. For Sweco, the tool is seen as an expert device, one that requires insider knowledge to be used effectively. As Jacob Bukh consultant noted, "We use it for early screenings, but we don't really know how to improve the score". For architects, the tool's technical nature can be a barrier to engagement, especially in early phases when material decisions are still fluid. This creates a dependence on consultants, who act as translators between the tool's logic and the design language of architects and clients. At this stage, the tool's function as a boundary object becomes more relevant. As Nicolas Francart argued, "It acts like a boundary object and actually makes negotiations... the important thing isn't what the number is, but that it's there".

The tool brings together actors with different perspectives and enables them to negotiate around circularity without needing to agree on its definition. It is this structured flexibility that allows it to circulate, but it also limits its transformative potential when it is used only for compliance.

The interessement phase shows that the tool is attractive not because it resolves circularity completely, but because it offers a credible, standardised way of talking about it. It simplifies a complex systemic issue, making it more manageable and legible to clients, certifiers and consultants.

6.2.3. Enrolment: What roles and responsibilities emerge through the tool?

The third moment of translation, enrolment, refers to the process by which roles are defined and accepted within a network (Callon, 1986). In the case of the DGNB Circularity Tool, these roles are not assigned in advance but emerge through interaction with the tool. As actors engage with the tool's structure and requirements, new forms of responsibility take shape. The guides decisions but also helps define what different actors are expected to do in order to make circularity visible and measurable.

A central actor in this process is the consultant. At Sweco, the DGNB Circularity Tool is handled by sustainability consultants, who interpret its scoring logic and translate its categories into advice for clients and project teams. Jacob Bukh described how consultants work with the tool in response to client demands for certification. If a client wants DGNB Gold, then a high score on circularity becomes necessary. Despite this uncertainty, the presence of the tool allows Sweco to assign concrete actions to other actors in the project. In this way, consultants become interpreters of the tool. Their role is not only to calculate a result but also to connect the tool's technical logic with the language and routines of building design. For instance, a circularity target in the DGNB system may result in specific advice about materials, such as the requirement to use reused façade elements or recycled concrete. These are not general ambitions but responses to how the tool distributes value across material categories.

Architects describe how their influence on the tool's outcome is limited by its late application in the process. Although the tool could support early-phase choices, it is usually introduced after core design strategies have been decided. When the tool does enter, it can set new constraints. "You can't use that façade, it's not circular enough" becomes a design limitation derived from tool logic, not architectural intention. This complexity means that architects are often dependent on engineers or consultants to produce scores, even though they are the ones shaping early design concepts. As she put it, "Architects need to have a very good perception from the beginning… because it is us essentially making the project."

At the construction level, contractors are drawn in through requests for documentation and sourcing. Bo Flink described how reused materials are often requested but rarely supported with the structures needed to implement them. "Responsibility for reused materials is a huge grey zone," he said. "No one wants to own the risk." Despite not being LCA specialists, contractors are sometimes asked to justify material choices or support certification efforts. "We don't have the resources to carry that burden alone," Bo explained. This points to an enrolment process that imposes expectations without always providing the capacity or clarity to meet them.

These examples show how roles in circular construction are being defined through the operation of the tool. Consultants become translators of the tool's categories. Architects are asked to align design with technical requirements they may not fully control. Contractors are drawn into verification processes that exceed traditional responsibilities. As Trine Bentzen put it, the tool aims to support more actors in engaging with circularity, but uptake depends on familiarity: "We try to give it (The Tool) away, but people need to understand how to use it first.". The tool's scoring structure reinforces these shifts. Because the score is based on mass-weighted inputs and predefined scenarios, it privileges certain materials and strategies. It shapes what becomes visible and valuable in a project. For example, a reused interior door without documentation may be excluded, while a standardised recycled material with an EPD is rewarded. These valuation mechanisms influence how actors are expected to contribute, and what kinds of work are recognised within the certification process.

In this way, the tool does not only guide choices. It participates in the redistribution of professional responsibility. The roles it enacts emerge from its internal logic, its connection to certification frameworks, and its ability to structure how circularity is understood across projects. Throughout this process, the tool acts as a boundary object, connecting actors without requiring full consensus. Each group engages with it differently, as a technical challenge, a design constraint or a negotiation device, for example, but the shared reference enables limited coordination. Enrolment, in this case, is a process of aligning practice with what the tool is able to count.

6.2.4. Mobilization: To what extent does the network become stabilised?

The final moment of translation, mobilisation, refers to the extent to which a network becomes stabilised around shared roles, practices, and goals (Callon, 1986). In theory, this would imply that the DGNB Circularity Tool becomes widely used, its logic embedded in workflows, and its scoring system accepted as a basis for decisions.

At the time of this thesis, the tool is still in a pilot phase. While it has been included in the 2025 DGNB manual and is actively being tested in projects, it is not yet fully implemented across the sector. This transitional status means that the roles and routines surrounding the tool remain open to negotiation. Consultants, architects, and contractors are still learning how to engage with the tool, and its use varies significantly between projects. Despite this, there are signs that the tool is beginning to structure conversations around circularity. Jacob Bukh from Sweco noted that "even just having a number helps frame the conversation. It gives us something to react to." In projects where it has been introduced, the tool provides a common reference point and contributes to the coordination of expectations. This suggests that the tool is performative, not only by measuring circularity but by helping actors organise around it.

The network around the tool remains fragile. Implementation gaps are evident, especially in early design stages. Most actors described the tool as difficult to use without technical support. As Trine Bentzen from Green Building Council Denmark explained, "We lack an even more simplified guide on how to use the tool." In the absence of such support, users rely on assumptions or apply the tool retrospectively. "The first projects that use the tool will probably just use it after they've built their building and then evaluate," she noted.

This limits the tool's ability to intervene in design decisions. Rebecka Blomqvist pointed out that "you don't have to be an expert, but you need a tool that lets you say something early in the project." While the DGNB Circularity Tool is intended to support early-phase choices, it is often applied too late to influence core strategies. In these cases, it functions more as a validation mechanism than as a design tool. Responsibility and accountability also remain unresolved. Bo Flink described how unclear expectations prevent contractors from fully engaging with reuse. "Right now, it doesn't make business sense for anyone to take on that testing and liability burden," he said. Although the tool creates new roles and expectations, it does not resolve the underlying structural barriers. Without clearer agreements on risk and documentation, the tool's uptake may remain limited.

Despite this fragility, the tool still plays a coordinating role. Its ability to circulate as a shared reference point, even in contexts of partial adoption, reflects its role as a boundary object. As Nicolas argue: "The important thing isn't what the number is, but that it's there". The score enables negotiation, justification, and alignment, even if not all actors agree on its meaning or validity.

In this sense, the mobilisation around the DGNB Circularity Tool is more ongoing than complete. The tool is entering the field with institutional support and growing interest, but the network it proposes, with clear roles, responsibilities, and practices, is still in the making. Its performativity will depend not only on technical refinement, but on whether the surrounding institutions, professionals, and markets are willing to adapt to the roles it assigns.

6.2.5. Conclusion on Performativity

This chapter has examined how the DGNB Circularity Tool performs circularity in Danish construction through the four moments of translation. The analysis has shown that the tool enters a conservative and risk-averse sector with the promise of measurement and coordination. It defines what circularity means in practice, aligns actors through certification frameworks, and can help redistribute roles across consultants, architects, and contractors. At the same time, its influence is limited by technical complexity, unclear responsibilities, and the late stage at which such tools are often applied. As a boundary object, the tool supports cooperation without requiring full agreement, but this same flexibility may weaken its capacity to drive change. The tool is still in a pilot phase, and its future impact depends on whether it can support early-phase design decisions and become embedded in broader institutional routines. The findings suggest that while the tool performs circularity in a structured and visible way, it does so selectively, and its transformative potential remains contingent on how it is used and developed further. The following chapter presents a set of design recommendations aimed at supporting consultants in using the tool in early design phases and at informing future development of the tool.


Source: Sweco internal image archive

6.3. Analysis Chapter Conclusion

This analysis has shown that the DGNB Circularity Tool is not a neutral or purely technical device. It qualifies circularity in a specific way, mass-based, data-driven, and grounded in material documentation, and in doing so, it performs a particular version of circularity. This logic begins to shape roles and expectations across the construction sector: consultants are expected to interpret and operationalise the tool, architects are pressured to anticipate constraints they cannot fully assess, and contractors navigate unclear responsibilities for reuse and reversibility. The tool helps coordinate these actors by providing a calculable framework, but it also generates uncertainty, especially in early design phases, where its impact is limited.

At a conceptual level, the analysis reinforces the idea that circularity is not a fixed or universal concept. It is shaped by the tools used to define and measure it. The DGNB Circularity Tool performs circularity in ways that favour certain strategies, materials, and actors over others, creating what could be seen as ”winners and losers” within the sustainability discourse. There is a real risk that, while enabling coordination, the tool may also narrow the field of acceptable practices, closing down broader or more systemic understandings of circularity.

One of the tool’s main strengths lies precisely in its calculability. Across interviews, actors highlighted the importance of having a number, something concrete to discuss, justify, and negotiate around. In this sense, the tool functions good as a boundary object. It allows different actors with different agendas to work together. Its score provides a common language, which makes circularity discussable.

For this performativity to be effective, for the tool to generate real change and not just superficial compliance, the way circularity is qualified must be critically examined. A tool that rewards easily documented or mass-based strategies, while overlooking context-specific or adaptive approaches, may end up reinforcing conventional practices. Qualification must lead to constructive performativity. The categories and indicators that define what counts as ”circular” should be grounded in best practices that promote long-term environmental and social value.

Additionally, for the tool to be meaningfully adopted across the sector, it must be accessible and understandable to a broader range of stakeholders, including those without technical expertise. As Mads Ditlevsen noted in relation to OneClickLCA, simplifying tools is key to enabling broader engagement: “We wanted something that allowed more people to work with LCA without being specialists.” Similarly, providing an early-phase or simplified version of the DGNB Circularity Tool could enhance its usability, particularly during the initial design stages when decisions have the greatest impact.

In summary, the DGNB Circularity Tool shows real potential, but its impact will depend on how it evolves, not just as a certification instrument, but as an active design device. The following section develops concrete recommendations aimed at supporting this evolution and helping practitioners engage with the tool more effectively

7. Discussion

The discussion chapter reflects on the broader implications of the findings. It brings the issue that while the DGNB Circularity Tool supports comparability and standardisation, it also narrows the meaning of circularity to what is easily measurable. The section calls for a more critical and strategic use of the tool, suggesting it can support circular transitions if complemented by other frameworks and institutional changes

This thesis set out to examine how the DGNB Circularity Tool qualifies and performs circularity in the Danish construction sector. To do so, it applied two analytical lenses, qualification and performativity, from ANT and sociology of quantification.

The analyses showed that the tool successfully translates the broad, systemic concept of circularity into a structured, measurable index. It provides clarity in a context where the concept of circularity is often vague and open to debate. But by doing this, the tool performs a very specific version of circularity, one that is material-based, traceable and material-focused. The index rewards recycled content, documented reuse and predefined scenarios, favouring what is visible, quantifiable and certifiable. This is not a disadvantage. In fact it is a feature of quantification, making something calculable means defining what matters. That said, what matters in the tool is not always what matters in circular practice. By focusing on a small number of high-mass materials and excluding undocumented strategies, the tool creates a narrow framework that sidelines spatial adaptability, design for disassembly, avoided construction and other systemic approaches.

This raises a deeper issue. Tools like this do not just reflect reality. They construct it. As the analysis of performativity showed, actors begin to align with the tool's logic, not in the full sense of circularity, but in terms of what the tool can see. This creates a feedback loop, consultants optimise for points, architects adjust designs to meet criteria and clients pursue scores to gain recognition. In this process, circularity becomes a means to an end more than a question to explore.

Paradoxically, it is precisely this reduction that gives the tool its power. Throughout the interviews, stakeholders recognised the importance of having a number, a shared point of reference for coordinating, negotiating and justifying decisions. In this sense, the tool acts as a boundary object, it is flexible enough to be interpreted differently but structured enough to align diverse actors. As Francart noted, "The important thing isn't what the number is, but that it's there."

So, is the tool a problem or a solution?

This thesis suggests it is both. It helps operationalise circularity, but in a way that also narrows its meaning. It enables coordination but can also reinforce compliance over reflection. It supports better material choices but does not challenge the necessity of building in the first place.

The issue is not that the tool does too little. It is that it does exactly what it was designed to do, and that may not be enough for the kind of transformation circularity implies. The DGNB Circularity Tool forms part of a wider certification framework. It was not designed to drive systemic change, only to optimise sustainability performance within existing project workflows. This explains both its effectiveness and its limitations. It is a socio-technical compromise, providing a way to make circularity actionable without creating disruption.

This also explains Sweco's role. As a consultant, the company uses the tool pragmatically, not to challenge the system, but to navigate it. And yet, this position opens a strategic opportunity. Because Sweco acts as a translator between clients, architects, and certifiers, it is well-placed to reframe how the tool is used. The next step for this research needs to develop an internal guide for using the tool not just to meet targets, but to open conversations about what circularity could become in each project.

This thesis suggests that tools like the DGNB Circularity Tool matter, not only because of what they measure, but because of what they make possible. The question is not whether they are perfect, but whether they are open to critique, iteration, and expansion. If circularity is to move beyond optimisation, it needs tools that are not just technically robust but politically aware and strategically used.

8. Conclusion: Framing Circularity, Shaping Possibilities

The conclusion summarises the main insights of the thesis: the DGNB Circularity Tool plays a dual role as both a measuring instrument and a socio-technical actor that helps define circularity in the Danish building sector. The tool has potential to support sustainability transitions, but only if its limitations are recognised and its use is guided by reflective practice and broader systemic thinking.

This thesis set out to investigate how the DGNB Circularity Tool qualifies and performs circularity in the Danish construction sector. Through an in-depth analysis combining Actor-Network Theory, case studies, and interviews, the study found that the tool is not merely a technical device, but a socio-technical actor that shapes what circularity is, how it is measured, and how it is acted upon.

The research question has two parts: how does the tool qualify circularity, and how can it perform it?

Firstly, the DGNB Circularity Tool qualifies circularity through a specific and structured approach: it prioritizes material-based, measurable, and documented circular strategies. By rewarding the use of high-mass materials with recycled, reused, or renewable origins, the tool clearly defines what forms of circularity are recognized and valued. At the same time, this qualification logic excludes or undervalues other important dimensions of circularity, such as adaptability, avoided construction, and more systemic or qualitative approaches. Thus, circularity, as enacted by the tool, is both partial and contextually specific, aligned closely with the requirements of certification schemes rather than broader sustainability transformations.

Secondly, this qualification logic directly impacts how circularity is performed in practice. As demonstrated through interviews and empirical analysis, the tool is beginning to shape actor roles, responsibilities, and project decisions. Consultants such as Sweco emerge as key mediators, interpreting and translating the tool's demands into actionable strategies. Architects, contractors, and clients are also influenced, adjusting their practices to align with scoring logic. However, this performative influence is still incomplete and uneven, constrained by the tool's complexity, its limited use in early design stages, and fragmented responsibilities among stakeholders.

Despite these limitations, the tool holds significant value as a boundary object. Its primary strength is that it provides a concrete number, a shared reference point that facilitates discussion, negotiation, and justification across diverse actors. The presence of this calculable reference makes circularity actionable, even if the number itself is imperfect or partial.

To conclude, the thesis argues that the real potential of the DGNB Circularity Tool lies not in its current completeness or perfection, but in its openness to critique and evolution. Circularity should be understood not as a fixed quality but as an ongoing negotiation, shaped by the very tools designed to measure and implement it. For the DGNB Circularity Tool to support meaningful transitions towards circularity, it must be critically engaged with, strategically applied, and continually adapted as the certification.

Looking forward, this thesis identifies clear next steps for both research and practice. A practical outcome of this study would be the development of an internal guidance manual at Sweco, providing consultants with clear, actionable strategies to effectively apply the tool in early-stage design. By explicitly linking the tool's scoring logic to best practices in circularity, such a manual could empower consultants not only to respond pragmatically to certification demands but also to proactively shape more sustainable, circular outcomes.

This research opens a discussion about how, while tools inevitably simplify and frame circularity, their real power and responsibility lie in the opportunities they create for reflection and transformation. The ongoing challenge for the construction sector is therefore to ensure that these tools remain flexible, inclusive and open-ended enough to support genuine sustainability transitions.

Source: Sweco internal image archive

9. References

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