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Building the World: How Entrepreneurs Create and Legitimize Material Innovations

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ABSTRACT

Many of today's sustainability challenges originate in industrial practices that are difficult for established actors to change. Entrepreneurs, by contrast, are positioned as key agents capable of bringing about alternative materials and practices to replace unsustainable ones. However, many entrepreneurs tend to remain stuck in niches and fail to reach broader markets. Research to date has also largely focused on how entrepreneurs build and scale innovations in software products and business model innovation, leaving the role of materiality comparatively underexplored. This thesis therefore asks how entrepreneurs build and legitimize material innovations that have the potential to solve some of our largest challenges, and what institutional conditions enable or constrain this process, given that many material innovations must function in physical environments and conform to regulatory and industrial constraints.

To address these questions, this thesis draws on a practice-theory perspective and presents two qualitative studies conducted in European contexts. The findings yield two key contributions. The System-Practice Gap captures how dominant sustainability concepts taught to early-stage entrepreneurs at technical universities can help them legitimize their innovations, but risk being introduced too early and constraining entrepreneurial problem-solving. Integral Scale refers to how impact entrepreneurs build scalability and affordability into their innovations from the outset, enabling them to work alongside incumbents at the scale required to generate meaningful impact.

This thesis contributes to the understanding that impact entrepreneurs tackling large-scale challenges must balance developing material solutions with legitimizing them within existing industrial infrastructures and standards, while simultaneously finding ways to move beyond how problems are currently being solved.

LIST OF APPENDED PAPERS

Paper 1

Dobricic, K. (2026). *Bridging the System-Practice Gap: Translating sustainability into early-stage entrepreneurial action.*

Earlier versions of this paper were presented at the RENT conference in November 2025 and at the 3E conference in May 2026. The paper was submitted to Entrepreneurship and Regional Development at the end of April 2026.

Paper 2

Dobricic, K. (2026). *Integral Scale in science-based entrepreneurship: Exploring practices to build affordable, sustainable impact from the start.*

An earlier version of this paper was presented at the ACERE conference in February 2026 and is a working paper at the time of this thesis submission. The aim is to submit it to a relevant entrepreneurship journal.

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Here we are, 2.5 years into an academic journey that has been a very different world from the one I grew up in, and because of that, a challenging and interesting one. If I have learned and grown this much in this short time, I look forward to the next part of my PhD journey.

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1. Introduction

Many of today's largest sustainability challenges originate in material choices and production systems that modern economies depend on. Plastic from single-use packaging used to transport and preserve our food accumulates in ecosystems and breaks down as microplastics (Lee et al., 2023). Greenhouse gas emissions from our electricity generation and the way we produce goods raise temperatures and destabilize global food systems (United Nations, n.d.), and the industrial agriculture that feeds a large part of the world depletes freshwater through poor irrigation techniques and the cultivation of water-intensive crops (Yang et al., 2024). At the same time, demand for these materials is projected to grow substantially, in some cases doubling or more, over the next two decades (OECD, 2019). Unless underlying production and consumption practices change, their impact on both human health and the environment is likely to intensify.

These issues are caused, in part, by incumbent firms, which are established companies with a dominant position and significant market share within a specific industry (Cohen & Winn, 2007; Hockerts & Wüstenhagen, 2010). These firms often show limited willingness to fundamentally change their core practices, both because they benefit from business-as-usual and because they face difficulties in doing so (Sandén & Azar, 2005). Regulatory frameworks and industry standards are shaped around existing technologies, and sunk investments in infrastructure and accumulated competences built around current materials make fundamental change costly, creating a so called ‘material lock-in’ (Arthur, 1989; Unruh, 2000). Instead, incumbent firms tend toward risk reduction and incremental innovation (Etzion et al., 2017), such as sustainability communication and environmental accounting systems (e.g. Beske et al., 2008; Burritt & Saka, 2006; Friede et al., 2015; Morsing & Schultz, 2006). Although these improvements may contribute to gradual progress, they leave the underlying material logic largely unchanged.

Entrepreneurs, less constrained by the inertia and vested interests that hold back incumbents, have been positioned as drivers of sustainable transformation by challenging incumbents' unsustainable practices and developing alternative technological pathways (Hockerts & Wüstenhagen, 2010; Schaltegger & Wagner, 2008). This thesis focuses on entrepreneurs working with material innovations, defined here as novel physical products or processes designed to replace unsustainable industrial practices. Yet to do so, they must work within the existing industries, regulations, and infrastructure built around the very materials and production systems they seek to displace, shaping what solutions are considered acceptable and viable.

Despite the urgency of these issues and the important role entrepreneurs may play in addressing them, our understanding of how entrepreneurs develop material innovations so that they become both technically viable and institutionally adoptable remains limited. Little is known about how entrepreneurs aiming to solve major sustainability challenges move material

innovations from small, protected settings to broad societal adoption (Krebs et al., 2023; Markman et al., 2019; Smith et al., 2016).

Entrepreneurship research has largely treated material aspects as secondary, as neutral tools that entrepreneurs simply use (Gherardi, 2022). It has paid little attention to how the materials they work with may constrain them or how material choices shape what solutions are considered acceptable replacements for today's unsustainable practices. This is particularly true in sustainable entrepreneurship research, where the main focus has been on the individual entrepreneur, emphasizing motivations and cognitive processes (Terán-Yépez et al., 2020). Sustainability transitions research, meanwhile, has tended toward abstract models that describe how innovations move from niche settings to broader adoption. These models underspecify the social and institutional work required for acceptance by regulators, industry, and the public (Dacin et al., 1999; Fuenfschilling & Truffer, 2014; Granovetter, 1985; Lounsbury & Glynn, 2001; Pesch, 2015).

Entrepreneurship research and policy have also been strongly shaped by studies of high-growth technology ventures in software-driven industries (Audretsch, 2021). In those contexts, entrepreneurs work with what might be called "abstract materials", digital products and business model innovations, built through rapid iteration, digital marketplaces, and technologies that can scale at low marginal cost without dependence on physical material development (Giones & Brem, 2017).

This emphasis has contributed to a narrow understanding of what entrepreneurship involves (Aldrich & Ruef, 2018) and of what it takes to develop innovations that must perform in physical environments. For entrepreneurs developing material innovations, development cycles are longer, capital needs are higher, and uncertainty is both technical and market-facing (Romme et al., 2023). Legitimacy must also be actively constructed through safety certifications, regulatory approval, and demonstrated compatibility with existing infrastructure, none of which have equivalents in software development.

1.1 Purpose and research questions

The thesis aims to understand what entrepreneurs do to build and legitimize material innovations that address large-scale challenges. There is insufficient research on how entrepreneurs create solutions that aim to tackle these types of challenges, what types of actions they take, who they engage with and how they move into broader societal adoption (Krebs et al., 2023; Markman et al., 2019; Smith et al., 2016).

Research Question 1: How do impact entrepreneurs build and legitimize material innovations aimed at replacing unsustainable practices?

Research Question 2: How do institutional conditions enable or constrain this process?

This thesis focuses on what Vogel et al. (2025) call impact entrepreneurs. They are defined as problem-oriented actors who aim to address major societal and environmental challenges with

the potential to contribute to planetary and societal thriving. While closely related to sustainable entrepreneurship, which is typically associated with balancing social, environmental, and economic goals (Elkington, 1998; Muñoz & Cohen, 2018), impact entrepreneurship takes a broader view of what creating impact means and does not require entrepreneurs to explicitly balance a triple bottom line (Markman et al., 2019). However, both share a concern with developing solutions that go beyond profit maximization to address environmental and societal harm. As research on impact entrepreneurship is still emerging, this thesis also draws on the sustainable entrepreneurship literature, and the two terms are used interchangeably throughout. The particular focus here is on impact entrepreneurs working with material innovations, defined as physical products or processes based on new materials or new configurations of existing materials, which often must be adapted to fit within existing industries.

Further, this thesis adopts a practice-theory perspective that examines the ongoing, situated activities of impact entrepreneurs through a building and legitimizing lens, developed further in Chapter 2.

To answer these questions, this thesis draws on two complementary qualitative studies, reported in appended papers. Paper 1 focuses on how sustainability concepts are shaped and translated by support actors in entrepreneurial universities, while Paper 2 focuses on how impact entrepreneurs build and legitimize material innovations. The two studies together provide a practice-based account of how material innovations are built and made adoptable by entrepreneurs in situ.

The thesis makes three main contributions. First, it develops a practice-based account of how impact entrepreneurs bring material innovations beyond the niche by distinguishing between building and legitimizing practices, and by showing that these two types of practices are operationally interdependent.

Second, it introduces the *System-Practice Gap*, a concept that captures the disconnect between widely used sustainability models and the situated work of entrepreneurial problem-solving. The concept identifies two ways this disconnect operates: a systems-level framing of sustainability can bypass the problem-solving through which solutions are made, while an administrative framing can pull entrepreneurs into premature legitimacy, prioritizing risk minimization and compliance before the innovation is sufficiently specified.

Third, the thesis introduces the concept of *Integral Scale* to explain how impact entrepreneurs build innovations capable of replacing incumbent practices at scale without reproducing the "problem of more" that has driven overconsumption and problem-shifting. Rather than treating scalability as a later-stage ambition, impact entrepreneurs build it into the innovation from the outset by designing for affordability and anticipating the material lock-ins that emerge under volume.

The thesis is organized as follows. Chapter 2 defines the key concepts and outlines the theoretical framework on building and legitimizing practices. Chapter 3 describes the

methodology. Chapter 4 summarizes the two appended papers. Chapter 5 discusses the findings in relation to the research questions, synthesizes the theoretical contributions and implications, and outlines directions for future research.

2. Theoretical framework

This chapter develops the theoretical framework for examining how impact entrepreneurs build and legitimize material innovations to address sustainability challenges.

2.1 Definitions and key concepts

A practice approach is used to describe the ongoing, situated activities through which entrepreneurs translate an idea into a workable material configuration and make it acceptable to others. Following this perspective, a practice is the organized nexus of "doings and sayings" that relies on shared practical understandings of what is sensible and possible in a given setting (Schatzki, 1996). Practices are social and relational, in that they are carried out with and in relation to others, and they are sustained by know-how that is often difficult to fully articulate (Johannisson, 2011; Nicolini, 2017). Therefore, what solutions entrepreneurs build becomes possible through relationships with other actors but also with materials, tools, infrastructures, and the physical properties of the material world (Orlikowski, 2007).

Within this thesis, two specific sets of practices are examined. Building refers to the activities involved in developing a workable material solution, including material selection, prototyping, testing, recombining existing knowledge, and adapting the solution as problems arise. Legitimizing refers to the activities through which entrepreneurs make that solution acceptable and adoptable to relevant audiences such as customers, regulators, investors, and incumbents. The two sets of practices are interdependent, as each shapes the other in the process of bringing a material innovation into the world, for instance, adapting to industry standards to gain recognition, or choosing materials that avoid particularly stringent regulatory processes. Together, they capture the situated work through which impact entrepreneurs develop innovations that are both technically viable and recognized by others as worth adopting.

Material innovation, as used in this thesis, refers to novel technological products or processes that can replace existing industrial materials and the practices surrounding their production, use, and disposal. This draws on Schumpeter's (1934) notion of creative destruction, in which new innovations displace existing technologies and redefine the rules of the game, creating new and improved ways of doing that have the potential to contribute to more sustainable societies (Cohen & Winn, 2007; York & Venkataraman, 2010).

The thesis views innovation as a process built on ongoing, situated activities instead of an outcome, such as a successful product or practice. It also departs from a strictly Schumpeterian reading by not assuming that incumbents are simply replaced by rising entrepreneurs. As previous literature has noted, incumbents and entrepreneurs often collaborate as much as they compete in moving toward more sustainable practices (Hockerts & Wüstenhagen, 2010). What is being replaced are specific industrial materials and their associated practices that have created negative consequences, rather than entire industries.

The challenges impact entrepreneurs aim to solve are typically global in scope and often rooted in historical material practices. As Schatzki (2019) argues, these challenges are themselves part of the social order that human practices have constructed over time, shaping where and how homes, infrastructure, and energy systems are built and maintained. New solutions will therefore always be evaluated against the inherited material and institutional context they seek to displace.

Plastic is one such challenge. Each year, a large share of plastic is mismanaged and enters the environment, breaking down into microscopic pieces that accumulate in soil, water, and human tissue, causing significant environmental damage and health risks such as neurotoxicity (Lee et al., 2023). Yet plastic was itself once a solution, replacing animal-based materials such as ivory and horn that nearly drove the species they relied on to extinction (Freinkel, 2011). What is considered sustainable is therefore contextual, defined against the material practices and consequences it seeks to move away from, and what counts as an improvement today may itself become the problem that future entrepreneurs are tasked with solving.

For entrepreneurs aiming to solve large challenges, it involves bringing about worlds that do not yet exist (Spinosa et al., 1995), yet it is accomplished through ongoing activities in the present: testing ideas, learning from what has not worked, adjusting to feedback, and responding to the constraints of the immediate situation. To capture this present-oriented, situated character of entrepreneurial work, the thesis follows Prince et al. (2021) definition of entrepreneurship as "the act of generating and developing an idea for validation" (p. 29). This emphasis on situated action directs attention to how what is built is shaped by the materials, relationships, and conditions entrepreneurs encounter (Thompson et al., 2020).

2.2 Building practices

Building practices refer to the recurring, hands-on activities through which impact entrepreneurs translate a material idea into a workable solution, including material selection, prototyping, testing, and adapting the solution as problems arise. Entrepreneurs build innovatively by combining and recombining existing resources (Schumpeter, 1934). What this looks like in practice depends on what is available at hand (Welter, 2011) for the entrepreneurs, the properties of relevant materials, and the institutional conditions and users involved that shape technological pathways.

Entrepreneurs are often defined by being situated in uncertainty and needing to act within it (Sarasvathy, 2008). This means building under conditions where it is not known in advance whether a material innovation will work technically or whether it will later be accepted by relevant audiences. Aldrich and Yang (2013) argue that entrepreneurs generally understand the problem they are trying to solve and have a sense of what is needed but are in the process of figuring out the “know-how” and the "know-what" to build. Learning what to build and how happens gradually through direct engagement with materials, technologies, markets, and potential customers, drawing on experience in adjacent domains (Beckman & Haunschild, 2002; Haunschild, 1993) and through deliberate or accidental experimentation with different materials and configurations (Arrow, 1962; Levinthal, 1996). In practice, this includes

developing prototypes, acquiring equipment, and reaching out to potential customers, gaining insights that would otherwise be inaccessible (Fisher et al., 2020).

Sarasvathy (2008) distinguishes between two logics of entrepreneurial action. Effectual logic sees the world as still in the making, where the pathway is constructed through experimenting with available materials, accepting affordable loss, and remaining flexible as new information becomes available. This stands in contrast to causal logic which assumes that the pieces are known in advance and that the entrepreneur assembles them rationally toward a predetermined outcome. Even though impact entrepreneurs begin with a clearly defined problem, which suggests a causal starting point, the pathway toward that goal is largely shaped by what materials, resources, and networks are available to them at a given time, making building in practice closer to effectual than causal logic.

Testing and prototyping with potential users are seen as one way to understand what works. User testing generates feedback that often shapes the development of a material innovation when prototyping. As entrepreneurs engage early users, their input can influence design decisions or point toward alternative material choices, shaping how the innovation is built and refined (Rosenberg, 1984; von Hippel, 1986). Geels (2004) describes the material being built as one that "must be tamed to fit concrete routines and application contexts, a process of domestication involving symbolic, practical, and cognitive work" (p. 902) through which users integrate the innovation into their practices and develop an understanding of what it is and does. This requires adjustment and alignment from both producers and users, making user-producer learning a core part of the building process (Avdeitchikova & Coenen, 2015).

In these ways, building practices, including the input they incorporate from materials, users, and local resources, shapes the technological pathway a material innovation takes. Garud and Karnøe (2003) comparative study of the emerging wind turbine industry in the 1970s illustrates this well. Comparing American and Danish entrepreneurs, the study shows how a theory-driven, breakthrough approach and a bricolage-driven, user-engaged approach created different building pathways and ultimately different industry outcomes.

The American entrepreneurs pursued a breakthrough strategy that drew on aerospace engineering for key materials and research. The reasoning was that simpler technologies would not be sufficient for an emerging industry, and that more advanced, groundbreaking technologies would provide a stronger foundation. However, by anchoring the building process in technologies that were not yet applicable or testable, the approach became driven by theoretical models, and learning from key stakeholders and access to testing sites was limited to large, geographically concentrated wind farms, where many actors simply could not participate. Collaboration became harder, and key stakeholders with the capacity to help bring the technology closer to market, including policymakers, remained misaligned with the emerging path. As a result, the building process became increasingly isolated, leading to costly failures and delays.

The Danish entrepreneurs followed a different approach, working with what was available and improving turbines incrementally through bricolage. Bricolage refers to making do with

resources at hand to address new problems and opportunities (Baker & Nelson, 2005; Lvi-Strauss, 1967) drawing on technologies that entrepreneurs had prior experience with and could access locally. Danish entrepreneurs built on their knowledge of agricultural machinery and sourced components from local suppliers, beginning with scrap yards, where the building approach was described as "throwing metal at the problem."

Because users were closer to everyday operations and were involved in testing from early on, feedback was frequent and allowed ongoing adjustments. This enabled micro-learning and drew in a broader network of actors willing to contribute, building familiarity with what was being built and how it was presented to primary audiences. Over time, this building approach produced a stronger and more scalable technological pathway, even without the more advanced technologies pursued by the Americans (Garud & Karnøe, 2003).

2.2.1 Building sustainably

There is a continuing debate within sustainable entrepreneurship (SE) about what building sustainably actually means. One side tends to emphasize reducing, minimizing, and avoiding harm, which can be seen as reductionistic (Hulme, 2011). Dean and McMullen (2007) describe sustainable entrepreneurship as preventing environmental degradation, while others frame it around reducing harm in market economies (Pinkse & Groot, 2015) and preventing transgression of planetary boundaries (Hummels & Argyrou, 2021). While important, such approaches specify more clearly what should not be done, rather than what entrepreneurs can do to build solutions that address large societal and environmental challenges.

This framing has also contributed to a broader tension in the field. The concept of sustainable entrepreneurship is sometimes presented as an oxymoron, since entrepreneurship involves creating novel products that depend on the very resources sustainable development aims to preserve. This has led some to question whether building more is the answer at all. Advocates of degrowth, for example, reject the assumption that growth is necessary for impact, promoting instead a downscaling of production and consumption to reduce ecological harm (Hinderer & Kuckertz, 2024). Relatedly, certain sustainable entrepreneurs deliberately stay small to maintain ethical and ecological commitments, adopting slow-scaling strategies that prioritize local presence and building through bricolage, which can have meaningful local impacts such as creating community jobs and resilient local ecosystems (Kim & Kim, 2022).

However, this approach has been challenged for its capacity to generate broader change. Entrepreneurs who do not reach the larger market with their innovative offering risk being overrun by incumbents that mimic their innovations. Hockerts and Wüstenhagen (2010) argue that sustainable entrepreneurs often get stuck in low-market-penetration niches, where they are visible enough for incumbents to copy them but not scaled enough to reach broader markets. A "small is beautiful" approach (Schumacher, 1973) may therefore be insufficient for entrepreneurs aiming to generate sustainable change at a level that meaningfully displaces unsustainable practices.

One approach to building sustainably discussed in entrepreneurship literature is frugal innovation. It is broadly understood as the development of quality solutions that are cheaper than existing products (Zeschky et al., 2014). It is common in resource-constrained settings where financial, technological, and material resources are limited, and the goal is to meet the needs of underserved customers who would otherwise be unable to afford existing products and services (Hossain, 2020). Three criteria are typical for frugal building according to Weyrauch and Herstatt (2019): choosing materials and processes that substantially reduce costs, concentrating on core functionalities, and optimizing rather than maximizing performance. By focusing on basic quality, simplicity, low-cost consumption, and sustainability together (von Janda et al., 2020), entrepreneurs who build frugally can address resource scarcity and innovate with materials at hand (rather than creating new ones), including creating accessible solutions for those the market has largely passed over.

Linked to frugal building is the idea of building according to circular or closed-loop models, which requires entrepreneurs to reuse existing products and materials to reduce costs and avoid crossing planetary boundaries. For example, entrepreneurs who collect and recycle valuable metals from outdated mobile phones produce new products out of waste without extracting new materials (Hummels and Argyrou (2021). From this perspective, sustainable building primarily involves repurposing existing materials, while developing novel materials is seen as likely to generate new waste or create new challenges at scale. Hummels and Argyrou (2021) argue, for instance, that innovations such as electric vehicles depend on mining scarce materials, while recharging batteries relies predominantly on fossil fuels. Although electric vehicles may be an improvement on conventional cars, the combined effects of manufacturing, battery charging, and low recycling rates can still negatively affect planetary boundaries. This raises an important question for how entrepreneurs, developing novel materials, build in ways that address rather than reproduce these concerns.

Other approaches to sustainable entrepreneurship to build sustainably are described at an abstract level without often specifying what such building looks like in practice. As Hall et al. (2019) describe, the concept of sustainable entrepreneurship may remain as much of a "black box" as sustainable development itself. Simply stating that economic, social, and environmental factors are integral to the venture's logic and practices does not explain how this is achieved or what entrepreneurs do to make it operational.

The vague notion of how to build sustainably, beyond frugal innovation or circular models, is also reflected at a larger institutional level. Dominant policy frameworks, such as the net-zero transition, shape expectations for sustainable production but are themselves characterized by a lack of coherent, concrete implementation plans that make them actionable (Fankhauser et al., 2022; Gong & Andersen, 2024). Entrepreneurs building toward sustainability targets are therefore navigating not only the material complexity of their own products and supply chains but also a conceptual incompleteness of the frameworks they are expected to align with.

Given these limitations within SE research, the building challenges faced by impact entrepreneurs building material innovations are of a different character. These entrepreneurs often work within advanced research contexts where over 97% of science-based innovations

are aimed at one or more SDGs (Sustainable Development Goals) (Gourevitch et al., 2021). Frugal and circular approaches assume that entrepreneurs are working with what is already available, but this does not apply when entrepreneurs are developing entirely new materials, often under controlled laboratory conditions, with longer development cycles and greater technical uncertainty (Romme et al., 2023). The following section examines what building looks like in science-based settings where such conditions apply.

2.2.2 Building science-based innovations

Science-based innovations are based on scientific knowledge and research, typically emerging from university laboratories or public research institutions as part of efforts to translate research into societal impact (Etzkowitz & Zhou, 2008). Material innovations are often science-based, developed, and validated in controlled laboratory settings before being tested in real-world industrial conditions. In these settings, entrepreneurs need to move between controlled experiments and unpredictable real-world environments, a process Latour (1983) referred to as 'reversing the scale'. They start by breaking down a large, complex problem into smaller, manageable experiments to identify what works and validate incrementally what succeeds or fails.

At some point, entrepreneurs must reverse this process by integrating the science-based solution into complex, less controlled, industrial contexts and adapting to external feedback from industry partners, regulators, and users. This can create tensions, especially when there is a mismatch between practice logic and academic expectations. Scientific practice emphasizes control, incremental validation, and rigor, while entrepreneurial practice prioritizes experimentation, adaptation, and iteration driven by market responses (Vallas & Kleinman, 2008; Vohora & Lockett, 2004). Failing to move toward an entrepreneurial practice logic risks keeping material innovations locked into their original scientific framing, never moving through the experimentation and adaptation needed to connect with real-world conditions. This resembles the American wind turbine case described earlier (Garud & Karnøe, 2003), where building remained 'stuck' in theoretical models and became disconnected from the conditions in which the technology would eventually need to operate. One of the main reasons why such innovations fail is the lack of product-market fit (Romme, 2022). Entrepreneurs in university settings can draw on surrounding ecosystems such as incubators, accelerators, and technology transfer offices that help bridge this gap, though the tensions between scientific and entrepreneurial practice logics persist regardless of the support available (Bergman & McMullen, 2022; Romme, 2022; Woolley & MacGregor, 2022).

Moving from proof-of-principle validated in a lab to industrial adoption requires crossing what is commonly referred to as the Valley of Death: the period between scientific validation and market success during which science-based innovations are most likely to fail (Kask & Linton, 2023; Romme et al., 2023). The Valley of Death is typically described as three sequential gaps. The first, the tractable gap, involves translating scientific knowledge into something applicable outside the laboratory. The second, the commercialization gap, requires identifying a viable market opportunity and securing the partnerships and resources needed to move forward. The third, the venture launch gap, concerns assembling a credible team, protecting intellectual

property, and obtaining seed funding, none of which can be secured independently of the others (Meyer et al., 2011).

To move past this requires constant interaction with the outside world (Gbadegeshin et al., 2022). Entrepreneurs who seek knowledge of specific technology supply chains and engage early with competition, supplier dynamics, and customer requirements are better positioned to understand how their material needs to develop and what it needs to become to find its place in an existing commercial reality (e.g. Ai & Wu, 2016; Kogure et al., 2019; Lackéus & Williams Middleton, 2015; Midler, 2019). One way entrepreneurs can bridge the commercialization gap is by engaging in sales before the material innovation is complete, entering early pilot testing with potential customers. This provides customers with enough data to inform a purchase decision with limited risk, while generating the market feedback entrepreneurs need to determine what to build next (Gbadegeshin et al., 2022).

As Carpenter (2004) argues, the key challenge for science-based innovations is less about technology development than about how they succeed in commercialization and diffusion. Building therefore depends on engagement with other stakeholders and institutional standards, and on adapting to prevailing conceptions of what is desirable, safe, or necessary. This is the work of legitimizing practices, examined in the next section.

2.3 Legitimizing practices

Legitimizing refers to the practices through which entrepreneurs make a novel solution acceptable and adoptable by relevant stakeholders, such as customers, regulators, incumbents, investors, or partners. For impact entrepreneurs, this effort is amplified by the “liability of newness” (Stinchcombe, 1965), meaning that as new entrants in the field, they lack the familiarity and credibility that more established players have (Aldrich & Fiol, 1994). To achieve this, they must navigate the underlying rules, norms, and objective conditions of the field they are entering while managing the conflicting expectations of both "fitting in" to establish credibility and "standing out" as a newcomer providing something new (De Clercq & Voronov, 2009).

As Suchman (1995) states, “legitimacy is a generalized perception or assumption that the actions of an entity are desirable, proper, or appropriate within some socially constructed system of norms, values, beliefs, and definitions” (p. 574). For material innovations, success depends on audiences believing that the innovation will not harm them, will meet performance needs, will comply with regulations, and will integrate into dominant existing systems.

Legitimacy can be gained through three main strategies: conforming to existing expectations, selecting among environments and audiences, or manipulating environments by attempting to change what is taken as appropriate. Conforming to existing standards and infrastructures is often a dominant early route as it signals familiarity and reduces perceived risk (Suchman, 1995). At the same time, conforming too much with current standards can weaken the transformative potential of the innovation and instead assimilate into institutional logic arrangements without creating a real change (Garud et al., 2010; Hargadon & Douglas, 2001).

This creates a balancing challenge where impact entrepreneurs (and their solutions) must appear familiar enough to be accepted while being different enough to achieve meaningful sustainability impact.

The literature review by Rudat and Faems (2026) shows that institutions can both enable and hinder. For instance, entrepreneurs can gain access to financial capital through governments that are pushing for sustainable innovations. Yet high bureaucracy requires entrepreneurs to spend considerable time on and in pricing battles, and new entrants still have difficulties gaining financial access because the same regulators and access providers may favor better-known firms (Carpenter, 2004; Rudat & Faems, 2026).

Both incumbents and newcomers play a role in shaping the legitimacy environment (Hockerts and Wüstenhagen, 2010). Incumbents tend to monitor emerging technologies and practices and focus on promoting and maintaining standardized features, such as widely accepted product standards or labels, which create “a level playing field” between established players and new entrants (Hockerts and Wüstenhagen, 2010). Following these standards does not always enhance overall performance (Seuring and Müller, 2008), allowing incumbents to enter sustainability niches that impact entrepreneurs need more time and resources to develop. For example, Hockerts and Wüstenhagen (2010) mention the multinational Kraft, which entered the fair-trade niche with the "Rainforest Alliance" label without adhering to stricter requirements such as minimum prices, price premiums, pre-financing, or long-term contracts.

Conforming to existing expectations is therefore not straightforward. Entrepreneurs working in contexts where problems are deemed unsolvable within existing frameworks may need to "break free from institutional norms and defy traditional approaches to problem-solving" (Lumpkin et al., 2013, pp. 777–778). However, to do so, it might be necessary to adopt the dominant logic to gain acceptance while gradually introducing new elements. This has been described as a "Trojan horse" strategy, where entrepreneurs work within existing institutional frames while embedding the contested logic they originate from (Pache & Santos, 2013).

A classic example of this strategy is Thomas Edison's introduction of electric lighting (Hargadon & Douglas, 2001). Edison’s system was markedly different from the gas system prevalent at the time, and presenting his innovation as a disruption to this system could have been met with rejection. Instead, Edison sought legitimacy by aligning with established practices, even when this was not technically or financially advantageous. For example, he routed electric cables underground to mimic utility companies rather than above ground (as was typical for telephones and telegraph lines), despite city statutes forbidding anyone other than gas companies from digging up streets. He therefore set up his company as a gas company to secure the right to use established gas industry practices (Silverberg, 1967).

By mimicking practices and following standards of an already trusted system, Edison reduced cognitive and pragmatic friction between the incumbent order and the innovation, enabling broader acceptance. The case showcases how strategic conformance, far from undermining radical innovation, can be the work that makes its adoption possible. For impact entrepreneurs introducing material innovations into established industrial systems, similar dynamics apply.

Legitimacy depends not on rejecting the institutional order but on selectively embedding within it while introducing what is genuinely new. This work, however, is not done with a single audience but with multiple stakeholders, each evaluating the innovation on different terms.

Engaging different stakeholders throughout the process can help entrepreneurs build different types of legitimacy. Users evaluate whether the innovation delivers practical value, making their involvement a route to pragmatic legitimacy. Engaging evaluators, such as testing bodies or standards organizations, helps entrepreneurs understand and meet the technical and safety requirements that determine whether an innovation is considered acceptable within existing categories (Garud & Rappa, 1994). Engaging regulators is important because policy and regulatory frameworks are shaped by regulator's understanding of how a technology should develop and what safeguards are needed (Baumol, 1996; Dobbin, 1945; Jørgensen, 1995). Thompson et al. (2015) show how biomass entrepreneurs in the Netherlands built legitimacy by recruiting powerful allies and working directly with policymakers to establish a legal and regulatory framework for bio-coal, covering how it could be produced, sold, and used safely. Beyond direct engagement, entrepreneurs can also pursue legitimacy through developing new narratives and symbols that reshape existing understandings, building consensus among stakeholders, and forging collaborations that enable collective action toward change (Thompson et al., 2015).

2.3.1 Different types of legitimacy

While the previous section focused on conformance as the dominant strategy for gaining legitimacy, the legitimacy entrepreneurs seek is not a single thing. According to Suchman (1995), there are three types of legitimacy: pragmatic, moral, and cognitive. Each is based on the generalized assumption that an organization's activities are desirable and socially acceptable within prevailing norms, but each is achieved in different ways. For impact entrepreneurs, however, the three types can conflict and gaining one does not necessarily guarantee the other.

Suchman (1995) defines pragmatic legitimacy as being primarily based on self-interest and direct exchanges between the organization and its key stakeholders, who consider the organization legitimate if it provides value for them. For entrepreneurs, this means whether primary audiences perceive the innovation as delivering practical and desirable value and whether existing customers show interest. Entrepreneurs who involve primary stakeholders early, such as users, may benefit because they can provide feedback on what is considered pragmatic, which can also lead to better results.

Moral legitimacy is not about whether an action directly influences the audience's self-interest but rests on stakeholders' normative evaluation of an organization's activities and whether they are "doing the right thing" (Suchman, 1995). Entrepreneurs who aim to solve problems caused by incumbents are often perceived as legitimate to do so (Hockerts, 2006), and the literature broadly suggests that entrepreneurs with sustainable ambitions can solve market failures produced by incumbent firms. Further, entrepreneurs with green tech innovations may enjoy

more support because of the moral legitimacy of ‘doing something right’. For impact entrepreneurs, what is "right" may include sustainability, safety, and welfare considerations, which may be visible in impact claims or in alignment with dominant cultural understandings of "fair" and "natural'. This can mobilize early supporters but may not be sufficient for mass adoption if pragmatic demands remain unmet.

Cognitive legitimacy concerns whether an innovation is comprehensible and fits existing categories of how things are done (Suchman, 1995). Cognitive legitimacy is powerful because it is taken for granted: once a way of doing things becomes standard, it becomes difficult to imagine alternatives, and the actors who have shaped those standards tend to benefit from their continuation (Suchman, 1995). For entrepreneurs bringing novel material innovations, this creates a particular difficulty, as existing regulations, risk models, and industrial categories tend to be written around what is already in use, which can create a material lock-in that is difficult to break (Unruh, 2000). Dominant incumbents can therefore shape the normative and regulatory environment through standard-setting, procurement practices, lobbying, and control of infrastructures, creating more pressure on entrepreneurs struggling to achieve scale (Hargadon & Douglas, 2001; Rudat & Faems, 2026).

Different types of legitimacy can conflict. Impact entrepreneurs may gain moral legitimacy among early supporters while struggling to secure pragmatic legitimacy required for broader adoption. This helps explain why some sustainable ventures become stuck in niches: legitimacy among early adopters does not translate into broader market reach, leaving ventures vulnerable to incumbents that can mimic their sustainable offerings at scale (Hockerts and Wüstenhagen, 2010). Cognitive legitimacy can be particularly difficult in path-dependent systems, where infrastructures, supply chains, and regulations reinforce dominant materials and practices. Alternatives can appear “out of category” even when technically superior, because they do not match existing schemas of safety, quality, or operational fit, slowing the diffusion of better alternatives (Arthur, 1989; Unruh, 2000).

An example of this dynamic is Veg Reg, a venture that converted diesel vehicles to run on waste vegetable oil. The oil was non-toxic, biodegradable, locally sourced, and plentiful. The innovation gained moral and pragmatic legitimacy from local customers who converted their vehicles because it was cleaner than diesel and cheaper. Yet the innovation deviated from standard models of how a car should be fueled. Municipalities, which often maintained established ties with lobbying groups invested in the status quo, applied the same taxation to waste oil as to diesel, creating financial and administrative challenges for entrepreneurs despite the substantive differences between the two fuels (Montiel & Ceranic, 2015).

Cognitive legitimacy can override moral and pragmatic legitimacy: even where audiences endorse an innovation on environmental and practical grounds, established categories of how things are done can determine whether it gains traction.

3. Methodology

This section describes the methodological choices behind the two studies conducted to date. The studies together address the thesis's two research questions:

Research Question 1: How do impact entrepreneurs build and legitimize material innovations aimed at replacing unsustainable practices?

Research Question 2: How do institutional conditions enable or constrain this process?

The chapter is organized as follows. The research design is outlined first, followed by the data selection and collection process, then the data analysis, and finally a discussion of how the two studies complement each other. The section concludes with methodological limitations and plans for future studies.

3.1 Research design

To understand the practices of impact entrepreneurs developing material innovations to address large societal challenges, this thesis adopts a qualitative research design. Investigating practices means examining the situated "know-how" and "know-what" through which entrepreneurial action unfolds, though this can be complicated as many practices are implicit or relational. The approach described below attempts to navigate this challenge, while acknowledging that the author's own understanding of how to effectively capture this concept empirically is still developing.

With this in mind, this thesis adopts what Dimov, Schaefer et al. (2021) call a “second-person stance.” A “second-person stance” takes the entrepreneurial perspective into account in understanding the decision-making logic behind what entrepreneurs built, how they built it, and how they legitimized it, without presupposing in advance what theoretical model may explain such action or what they can predict.

A "third-person stance," by contrast, is driven by theoretical explanations that aim to predict what entrepreneurs do in certain contexts, addressing the scholarly community about entrepreneurs without necessarily bringing in the perspective that entrepreneurs themselves can recognize. This risks creating a divide between academic research and entrepreneurial practice, where research becomes less relevant to the very entrepreneurs it aims to study (Alvesson & Sandberg, 2011; Dimov et al., 2021). As Gherardi (2022) describes such approaches may produce abstract, decontextualized knowing that is not transferable to the "real world" of practical and situated know-how.

A second-person stance thus requires sharing the entrepreneurial perspective without “becoming” entrepreneurs ourselves by being accountable to the entrepreneurs studied. Such an approach consequently shapes what methodological approaches are appropriate. For instance, surveys might not be an appropriate choice because they are based on predetermined

questions set by the researcher. They might say more about the researcher than the entrepreneur (Dimov et al., 2021).

Because the second-person stance avoids imposing predetermined theoretical models, the thesis takes an inductive, qualitative approach that allows categories to emerge from the data. This enables exploration of relatively unexplored phenomena, supports the development of new conceptual categories, and helps challenge established theoretical assumptions (Edmondson & McManus, 2007; Gioia et al., 2013). This approach is better suited to the aim of understanding how entrepreneurial action is continually made and remade through practice, by examining what entrepreneurs do and say in the situations they encounter (Garud et al., 2018).

3.2 Data selection

Given the scope of this thesis, it draws on two complementary studies that together capture how legitimacy is translated and implemented in entrepreneurial practice, and how entrepreneurs build and legitimize material innovations in relation to industrial infrastructures and relevant stakeholders.

The empirical setting is primarily entrepreneurial universities in Europe. Entrepreneurial universities are higher education institutions that go beyond their traditional roles of teaching and research to actively facilitate the transfer of knowledge and innovation into society through entrepreneurship and the commercialization of knowledge (Etzkowitz & Zhou, 2008). These universities are considered central sites for science-based innovation (Romme, Bell et al., 2023) and have an ecosystem of support actors, such as incubators, accelerators, and entrepreneurship educators, that help entrepreneurs develop their ideas and bring them to reality (Vogel, 2017). These actors also serve as intermediaries among policy, industry, and investors, and they must convey requirements and expectations to entrepreneurs. Due to their multilevel position, they shape what is considered legitimate sustainable entrepreneurship in practice (van Rijnsoever, 2022). Entrepreneurial universities are therefore an appropriate setting for studying both the institutional expectations that hinder or enable entrepreneurs and the conditions under which entrepreneurial building takes place.

Study 1 focuses on two groups of actors in entrepreneurships support organizations (ESOs), within European universities: incubator personnel and entrepreneurship educators who train and educate nascent entrepreneurs in the exploration stage, regardless of whether they had founded a venture. Inclusion criteria required that participants hold a formal role within a university-associated ESO, have regular involvement in training and educational interactions with early-stage entrepreneurs, and have responsibility for or interest in sustainability integration. Both groups actively structure training and support interactions such as workshops, mentoring, and evaluations, which distinguishes them from other ESO roles like co-working staff who may host entrepreneurs but do not typically provide training.

Data was accessed through a research project involving ten European technical universities focused on Sustainable Entrepreneurship and Innovation (SEI), complemented by four non-

technical universities that joined through an open call, each with experience in training entrepreneurs in sustainable entrepreneurship. Participants were self-selected or recommended by their head of incubator to take part in a year-long training program in sustainable entrepreneurship.

Study 2 focuses on impact entrepreneurs who are actively building material innovations with the aim of large-scale industrial impact. Nine entrepreneurs in Sweden were identified through purposive sampling (Smith et al., 2009) via a well-known Swedish media platform specializing in impact entrepreneurship and investment. Participants were selected based on having a physical product or process innovation rooted in science, although not all originated in universities. Those that did not were still grounded in research, either through active collaboration with researchers or through support from university incubators and research institutions. The second criterion required some form of external market validation, such as off-take agreements, ongoing revenue, or investment, indicating that they were addressing a substantial problem beyond early experimental phases. The entrepreneurs focused on industrial sectors such as water infrastructure, agriculture, construction, and fashion, rather than consumer goods, to better understand the complexities of building within established, often heavily polluting industries. Their ventures ranged from approximately two to ten years old, allowing for an examination of how building practices and legitimacy strategies shift as innovations progress through different stages of development.

Together, the two studies provide a multi-perspective account of building and legitimizing material innovations in sustainable entrepreneurship. Study 1 captures how legitimacy expectations are shaped and communicated by actors who sit between institutional demands and entrepreneurial practice. Study 2 captures how those expectations are encountered and navigated by entrepreneurs doing the actual work of building. The two studies thus allow for an analysis of both where legitimacy expectations originate and how they play out in practice.

3.3 Data collection

The goal of data collection was to get as close as possible to what entrepreneurs and support actors do, rather than to test predefined propositions about what they should do. This positions the study in the context of discovery rather than justification (Guba & Lincoln, 1994). Data was collected through three primary methods: participatory observation, semi-structured interviews, and document analysis.

Semi-structured interviews were the primary data collection tool across both papers, as they allow participants to describe their experiences and reasoning in their own words while leaving room to follow up on what emerges. In total, raw primary data consists of 26 semi-structured interviews collected between April 2024 and October 2025. Participatory observation for Study 1 ran from August 2024 to August 2025, complementing the interview data. Two interviews were omitted: one from Study 1, because the participant did not train early-stage entrepreneurs, and one from Study 2, because the participant lacked external market validation.

Study 1 draws on 15 interviews with 6 entrepreneurship educators and 9 incubator personnel across 10 technical universities participating in the SEI project. Interviews were conducted mainly online, with one in person, between April 2024 and January 2025, and lasted between 35 and 60 minutes each. The aim was to understand what sustainability concepts were being taught or promoted in training settings, why, and how these concepts were translated into practice in interactions with entrepreneurs. Interviews were complemented by document data, including presentation slides, sustainability tools, and methods used in training, workshops, and lectures.

For Study 1, data collection was further complemented by participatory observation and written reflections gathered during a year-long SEI sustainable entrepreneurship training involving 20 entrepreneurship educators and incubator actors. The aim of this training was to design and pilot new ways to train entrepreneurs in sustainable entrepreneurship at their home universities. Participants recorded their experiences through a digital tool and shared reflections during six 3-hour online sessions, as well as two 2.5-day in-person meetups. This provided first-hand observation of how sustainability concepts were implemented and adapted in practice, as recorded by the educators and incubator staff themselves.

Study 2 draws on 9 semi-structured interviews with impact entrepreneurs in Sweden, alongside document data including LinkedIn profiles, press releases, and media coverage. Sweden is known for having a strong and innovative entrepreneurship sector (Balawi & Ayoub, 2022) and there is an emerging community of impact entrepreneurs aiming to solve large problems. Interviews lasted between 40 and 60 minutes and were conducted between May and October 2025 with an exploratory orientation, aimed at understanding the practical decisions entrepreneurs made about what to build and why. Entrepreneurs were contacted via LinkedIn and invited to participate in a study framed around the observation that while we understand how lean startups build for impact and how sustainable impact should be measured; we have limited understanding of how impact entrepreneurs build for impact. Interviews began by exploring how entrepreneurs identified their solution, what validated their impact, and what they specifically did to validate and build it.

All interviews were conducted online except for one that took place in person. Interviews conducted in Swedish were translated into English, and all interviews were recorded and transcribed using software.

Table 1. Data collection methods for studies

	Participatory observation	**Interview**	**Document / Archival**
Study 1	Sustainable Entrepreneurship Workshops, physical and online Aug 2024 – Aug 2025	16 semi-structured interviews (7 entrepreneurship educators; 9 incubator actors)	Training materials (slides/tools), program documentation, and university/incubator materials (e.g., annual reports where available)
Study 2		10 in-depth semi-structured interviews with Swedish impact entrepreneurs	Company websites, pitch decks/press material, news articles/press releases, and public professional profiles (e.g., LinkedIn) used for triangulation

3.4 Data analysis

The two studies used complementary inductive approaches to analysis, reflecting their different research aims. Study 1 applied (Gioia et al., 2013) structured approach to qualitative data analysis, which supports systematic identification of theoretical categories. Study 2 applied reflexive thematic analysis (Braun and Clarke, 2006), which allows researcher interpretation to play a more active role in identifying patterns. Both approaches allow categories to emerge from the data and from participants' own perspectives, rather than imposing predetermined interpretations of concepts such as sustainability.

Study 1 analyzed the data through the lens of Schatzki (2012) practice theory elements, one of the most widely used frameworks in practice-oriented research. This framework was suitable for the research question, which examined how sustainability concepts prominent in research translate into entrepreneurial practice. Specifically, the analysis focused on what entrepreneurs are expected to implement and what is practically usable in the building phase. Schatzki's framework was also useful for breaking down broad sustainability concepts, making it easier to identify where and how entrepreneurs should act "sustainably'.

Coding was carried out iteratively across several rounds using ATLAS.ti, producing 35 first-order codes that stayed close to participants' own words. Each first-order code was then tagged across two dimensions. The first dimension was Schatzki's four practice elements: general understandings, rules, teleoaffective structures, and practical understandings. The second

dimension was three domains that emerged from the data: systems, administrative, and entrepreneurial.

The intersection of these two dimensions allowed patterns to surface across codes, which were gradually aggregated into second-order codes and eventually into stable themes. From these themes, the concept of the *System-Practice Gap* emerged: a conceptual lens that developed through data collection and analysis in response to the observation that certain practice elements common in other fields, such as management, did not align well with early-stage entrepreneurial practice.

Unlike Study 1, where Schatzki's framework provided the analytical structure, Study 2 took a more open approach guided by reflexive thematic analysis (Braun & Clarke, 2006). The analysis began with repeated readings of the transcripts, with segments coded manually to capture recurring patterns in how entrepreneurs acted and reasoned. The second-person research stance described earlier was important for capturing the practical concerns of impact entrepreneurs. As themes developed, a pattern emerged in which entrepreneurs built with future requirements in mind well before they became pressing and adjusted their building choices over time. This became the basis for the concept of the Integral Scale, which emerged as entrepreneurs consistently addressed the limitations of prior solutions: solutions that did not account for scalability or affordability, and that therefore could not be adopted at scale.

3.5 Limitations

The methodological choices behind the two studies also impose certain limitations on what can be claimed. These concern the studies' empirical scope, the researcher's positionality, and the unresolved question of whether the practices examined produce the impact entrepreneurs aim for.

Study 1 is limited in that it only captures the perspective of entrepreneurship educators and incubator staff: what sustainability concepts they package and translate into entrepreneurial practice, and how. The entrepreneurial perspective is not directly included, other than how it was recounted by these participants themselves. This may constrain a fuller understanding of why some requirements are difficult to translate into entrepreneurial practice. In its place, the entrepreneurial perspective was inferred through the theoretical lens of the System-Practice Gap.

Although Study 1 aimed to move away from the strongly theoretical framing often used in sustainability research, it may have fallen into the trap of remaining too theoretical itself. Further studies should therefore include the entrepreneurial perspective directly, not only to understand what works and what does not, but to understand how entrepreneurs adapt (or reject) sustainability requirements on their own terms.

Nonetheless, the design of the study is valuable for understanding what legitimized sustainable entrepreneurship means in practice and what activities are expected of entrepreneurs by the university actors who support and connect them to industry and investors.

Study 2 is limited in sample size, with nine entrepreneurs interviewed once each. Many more were contacted, but the response rate was low. As paper 2 is still in development, the sample will be expanded to at least thirteen entrepreneurs in Sweden. Additionally, interviewing participants at a single point in time makes it difficult to trace how building and legitimizing practices evolve over time, which would require a longitudinal approach. Relying primarily on interviews also limits what can be said about what entrepreneurs do in practice, since accounts of building are necessarily retrospective and filtered through how participants describe their own decisions.

Further limitations concern the researcher's positionality, which applies to both studies. The researcher's dual role in Study 1, as both researcher and participant in the SEI training contributed to a practical understanding of the challenges participants faced. This participation involved applying and testing the same sustainability methods with entrepreneurs firsthand. At the same time, this proximity may have introduced bias in how the sustainability concepts discussed by other participants were interpreted, as the researcher's own experience of what works in practice could have shaped what was emphasized or overlooked in the analysis. In Study 2, the second-person research stance carries its own risk. Maintaining analytical distance while remaining genuinely open to participants' perspectives is a tension that qualitative researchers need to navigate. It was managed here through regular reflection on alternative interpretations during the analysis process.

A broader limitation concerns the nature of impact itself. The entrepreneurs studied are aiming to create large-scale impact, but their impact has not yet materialized. It is therefore not yet possible to determine whether their decisions, practices, and material choices are in fact creating impact or will lead to successful outcomes. Studying impact entrepreneurs who are still in the building phase was a deliberate choice, as it allows for an examination of practices as they unfold rather than retrospectively once an innovation has succeeded. Studying entrepreneurs with fully diffused innovations would risk hindsight bias and could obscure the nuances and complexities of building and legitimizing under uncertainty.

This means, however, that questions about which practices produce impact, and over what timeframe, remain open. Answering them would require a different methodological approach, such as longitudinal studies or archival research on entrepreneurs with established and widespread innovations.

4. Findings

This chapter summarizes the two appended papers and outlines how each contributes to the thesis's research questions.

Study 1 examines how Entrepreneurship Support Organizations (ESOs) at European technical universities translate dominant sustainability concepts into early-stage entrepreneurial practice. It contributes to understanding what is considered legitimate sustainable practice and how institutional expectations shape what entrepreneurs are encouraged to do early on.

Study 2 examines how nine Swedish impact entrepreneurs build material innovations aimed at addressing global sustainability challenges in polluting sectors such as agriculture, fashion, and construction. It contributes to understanding how these entrepreneurs build and legitimize their innovations under technical and institutional constraints.

4.1 Paper 1 - Bridging the System-Practice Gap: Translating sustainability into early-stage entrepreneurial action

Sustainability is increasingly expected to be integrated across all start-up support, yet how this expectation translates into practice effectively remains unclear. This paper examines how Entrepreneurship Support Organizations (ESOs), such as incubator staff and entrepreneurship educators at European technical universities, translate dominant sustainability concepts into early-stage entrepreneurial practice. It draws on Schatzki's (2002, 2019) practice theory and analyzes translation work through four practice-organizing elements: practical understandings, meaning know-how for acting; rules, meaning explicit requirements and prescriptions; teleoaffective structures, meaning ends, concerns, and normative orientations; and general understandings, meaning taken-for-granted assumptions about what is legitimate and worth doing. Schatzki's framework provides the analytical lens for the paper's research question: how are sustainability concepts translated into entrepreneurial practice at ESOs in technical universities in Europe?

The study is based on 15 semi-structured interviews and participatory observation in a year-long European Sustainable Entrepreneurship and Innovation (SEI) program, where incubator actors and entrepreneurship educators met to share experiences and design new practices for supporting sustainability in early-stage ventures. This was supplemented by written practitioner reflections and training materials such as presentations, tools, and slides.

The findings highlight a mismatch between sustainability expectations and early-stage realities. Sustainability is often translated through macro-level concepts intended to build awareness of the state of the world, but in practice these framings can remain too abstract to guide what entrepreneurs should do next. In some cases, they also produce overload and negative emotions, or lead entrepreneurs to disengage from sustainability sessions altogether.

Another mismatch concerns how sustainability concepts often translate as legitimacy work, orienting entrepreneurs toward building credibility early by avoiding greenwashing, documenting activities, and preparing for ESG (Environmental, Social, and Governance) and reporting expectations. This produces actionable rules, such as what metrics to follow and how to communicate claims responsibly. Although legitimacy work is important, it can arrive too early, before ventures have stable activities or products to measure and report on, which may push entrepreneurs toward conforming to large corporate practices before they know what they are building.

A smaller set of ESO practices translates sustainability into practical, material work that fits entrepreneurial iteration: prototyping choices, sourcing and production decisions, and experimentation with tools that help teams learn about impacts while the venture is still taking shape. Early-stage life cycle assessment used as a learning device rather than an audit is one example.

Overall, the paper argues that the gap between sustainability systems and entrepreneurial practice is not only conceptual but institutional. The paper introduces the concept of the System-Practice Gap to explain this mismatch. Many sustainability concepts entering entrepreneurial practice originate from either the systems level, such as planetary boundaries, global models, or SDGs, which remain abstract and difficult to implement, or from the administrative level, such as corporate reporting, compliance, and ESG frameworks, which assume measurability and stability that early-stage entrepreneurs typically lack. Both approaches tend to emphasize what entrepreneurs should avoid or minimize rather than what they should build. This creates a gap between institutional sustainability expectations and the practical realities of early-stage entrepreneurial work.

Paper 1 contributes primarily to Research Question 2 by clarifying the institutional expectations placed on entrepreneurs by university and ecosystem actors, and by showing how these expectations shape what counts as legitimate sustainable practice. The findings suggest that when administrative or systems-level sustainability demands arrive before building has begun, they can trigger rejection unless paired with practical support that connects to prototyping, testing, and material decision-making. In doing so, Paper 1 provides the institutional context for analyzing how entrepreneurs build and legitimize material innovations in practice, which Study 2 examines directly.

4.2 Paper 2 - Integral scale in science-based entrepreneurship: Exploring practices to build affordable, sustainable impact from the start

Sustainable entrepreneurship is often framed as creating positive change by "doing less," for instance by downscaling production or reusing materials to counter overconsumption and resource depletion. Yet many sustainability challenges, such as rising emissions, food security, and increasing demand for material-intensive infrastructure, are global in scope and high-volume. This creates a dilemma for sustainable entrepreneurs: how to replace unsustainable

industrial practices without reproducing the "problem of more," where new problems are created at scale even as old ones are replaced.

This paper addresses the research question: how do science-based entrepreneurs targeting large societal problems build for impact? The paper examines nine Swedish impact entrepreneurs operating in traditionally polluting industries such as construction, textiles, and food and agriculture, and analyzes how they build both the material solution and the conditions for adoption.

The findings show how impact entrepreneurs build to deviate from previous practices. Across the cases, the paper identifies a consistent building practice termed Integral Scale in this study. While scaling is typically treated as a later-stage ambition once pilot testing is complete, impact entrepreneurs build scalability into the innovation from the outset, making it a condition for solving large-scale problems.

Two main practices explain this. First, entrepreneurs avoid material lock-ins by understanding why previous solutions were not widely adopted, whether because they produced unsustainable effects at scale, created supply chain conflicts, or were too costly to roll out. This led entrepreneurs to reframe the problem they were addressing by going back to its root, understanding from the customer perspective what had failed before, and only then returning to the lab to test new materials.

Second, entrepreneurs build with affordability in mind. Many innovations with impact potential get stuck in niche areas because they are too expensive to displace existing alternatives. Entrepreneurs in this study recognized that using materials cheaper than existing alternatives was a condition for solving large challenges in low-margin industries. This led them to look for materials that are both abundant and sustainable, borrow production techniques from adjacent industries to reduce costs and speed up development, and actively work around bottlenecks that could slow progress or increase costs, such as regulatory classifications that would have required lengthy and expensive approval processes.

Together, these practices challenge how building for impact is typically understood. Starting small and scaling later carries the risk that materials, manufacturing constraints, and environmental consequences change significantly under volume, often producing unsustainable outcomes that could not have been anticipated at the pilot stage. Integral Scale offers a different logic: by treating scale as a condition for impact from the outset, entrepreneurs can select materials and production approaches that remain viable and sustainable at the scale needed to displace unsustainable practices.

Paper 2 contributes primarily to Research Question 1 by showing how impact entrepreneurs build and legitimize material innovations through Integral Scale. It also addresses Research Question 2 by showing how institutional conditions, including incumbent collaboration, supply chains, and regulatory categories, shape what entrepreneurs can build at scale.

5. Discussion

Entrepreneurs are often positioned as potential solutions to large societal and environmental challenges created by unsustainable materials and practices. Impact entrepreneurs are therefore expected to create alternative pathways by developing innovations that can improve the material world while meeting the demands of a growing population. Yet little is known about how entrepreneurs accomplish this in practice. Prior research has tended to focus either on abstract models of how innovations spread, or on software-based entrepreneurship where building often centers on business model innovation.

Therefore, this thesis asks two research questions:

RQ1: How do impact entrepreneurs build and legitimize material innovations aimed at replacing unsustainable practices?

RQ2: How do institutional conditions enable or constrain this process?

This section discusses and builds upon the findings from the appended papers to address these questions. The discussion begins with how impact entrepreneurs build for scale from the outset (5.1), then turns to how they collaborate with incumbents (5.2), and how legitimate sustainable practice is institutionally shaped (5.3). Section 5.4 outlines directions for future research.

5.1 Building sustainably through integral scale

A central insight from Study 2 is that impact entrepreneurs treat scalability not as a later-stage concern but as a necessity for impact in the early building phase. Study 2 refers to this practice as Integral Scale: scalability is built into the innovation from the outset, shaping what materials are chosen and how problems are framed.

This is due to the nature of the challenges these entrepreneurs are trying to solve. The entrepreneurs in Study 2 were addressing global challenges with no clear market borders, such as greenhouse gas emissions, and macro-trends such as the projected increase in cement and protein production. Synthetic fertilizers are one such example; they depend on fossil fuels, and their overuse can lead to soil acidification, air pollution, and marine dead zones, yet they also increase crop yields and help feed roughly half of the world's population (Townsend & Howarth, 2010). Given the scope of such challenges, a solution that works only in a limited context does not generate meaningful impact, nor does it produce the economic returns needed to sustain the venture.

In practice, this means choosing materials carefully to avoid the sustainability problems that become visible at volume, such as ecotoxicity, neurotoxicity, or supply chain conflicts. Materials that are already abundant in nature and cheap enough to be rolled out broadly are better positioned to remain sustainable and cost-competitive at scale. Many of the materials these entrepreneurs worked with, including sunlight, cells, chicken manure, rapeseed oil, oats, and specific biological compounds, share these properties. The goal is to move beyond material

that works at an experimental level or in a lab and to find one that remains sustainable and economically viable when produced at the scale needed to displace existing industrial practices.

The entrepreneurs in Study 2 were specifically trying to avoid materials that worked at small scale but became unsustainable or uncompetitive at volume. Several had learned this from previous sustainable materials that could not be scaled and led to start-up bankruptcies, such as recycled polyester techniques reliant on PET bottles, which created supply chain conflicts with the packaging industry as volumes grew. Building at small scale can therefore produce outcomes that appear sustainable locally but generate new problems as the innovation diffuses, which was a risk these entrepreneurs were actively building away from the outset.

This stands in contrast to how the sustainable entrepreneurship literature has generally approached the question of scale. The field has largely oriented entrepreneurial practice toward reduction and minimization, reducing environmental degradation (Dean & McMullen, 2007) or preventing further harm in market economies (Pinkse & Groot, 2015), and has been cautious about growth, potentially in part as a response to high-growth Silicon Valley models that emphasized opportunity exploitation (Shane & Venkataraman, 2000). Some accounts suggest that what is truly sustainable is not building novel materials at all, but reusing what already exists, with circular building offered as the cleaner alternative (Hummels & Argyrou, 2021). Yet this framing pays less attention to how material entrepreneurs might choose differently from the outset, selecting materials that avoid lock-ins before they occur.

This connects to a problem the literature has largely described in terms of legitimacy and market strategy: entrepreneurs with more sustainable offerings tend to get stuck in low-market-penetration niches, leaving them vulnerable to incumbents who replicate their offerings at lower cost (Hockerts & Wüstenhagen, 2010). By choosing materials that are scalable and cost-competitive from the start, entrepreneurs build toward the broader market rather than consolidating in a niche that larger actors can eventually enter on cheaper terms. In this sense, when scale is built into material choices from the beginning, it can be a more sustainable path than staying local and a more effective route toward the kind of transformation the literature calls for.

The findings therefore suggest that what materials entrepreneurs choose in the early building phase, and whether those materials can work at volume, shapes whether they can move beyond the niche at all. This adds a material dimension to a problem the literature has largely described in terms of legitimacy and market strategy.

Study 1 adds a further dimension to how material choice becomes legitimate sustainable building. The entrepreneurs in that study were encouraged to pay close attention to what materials are used, how they compare to alternatives, what the production process looks like, and how much resource consumption the process involves. Entrepreneurs at incubators in European technical universities were directed to use tools such as early-stage Life Cycle Analysis (LCA) to make these comparisons visible and credible. In doing so, LCA functions not only as a technical tool but as a legitimizing one, providing pragmatic and cognitive legitimacy in addition to the moral legitimacy that comes from being seen to do the right thing.

Demonstrating better material performance may provide the legitimacy needed to advance in competitions or stand out relative to similar entrepreneurs in the same space, even where the innovation has not yet reached the scale needed to address the larger problem.

5.2 Collaboration with incumbents

Study 2 also contributes to our understanding of how impact entrepreneurs collaborate with incumbents to gain legitimacy. Although the literature often portrays incumbents as resistant to change unless pushed by regulatory pressures or external shocks (Sine & David, 2003; Sine et al., 2005), many of the entrepreneurs in this thesis worked directly with incumbents in developing their innovations. In some cases, incumbents appeared to be actively looking for alternatives, often because of incoming regulations such as the EU ban on single-use plastics or PFAS restrictions. The findings suggest that collaborating with incumbents provided entrepreneurs with access to industrial knowledge, supply chains, and credibility that would have been difficult to build independently, while incumbents gained access to innovations that could support their own sustainability goals or regulatory compliance. This suggests a relationship where legitimacy is built and maintained through the entrepreneur's ability to offer something that is both sustainable and viable at the price and speed incumbents require.

Building does not always follow the linear sequence described in the science-based entrepreneurship literature, where validation moves from the laboratory to commercialization, crossing what has been called the Valley of Death (Meyer et al., 2011; Romme et al., 2023). Several entrepreneurs in Study 2 reversed this sequence. Rather than developing and validating an innovation in the lab before approaching industry, they began by engaging with potential customers, incumbents, and suppliers to understand why previous sustainable solutions had failed and what the industry would require. Some entrepreneurs already brought deep industrial knowledge of existing production systems, which informed what they would later build in the lab. Talking to industry first provided a clearer target for what to build and a better understanding of what the market had already rejected and why. Entrepreneurs who built this way gained legitimacy that distinguished them from innovations developed first in the lab and only later tested in industry. As one entrepreneur puts it, lab-first development can be a process in which "people spend years in the lab and nothing works." The entrepreneurs were also recognizing that industrial customers were skeptical of innovations originating in laboratories.

The cases studied here also raise questions about how material innovation is understood from a practice perspective. These findings support Hockerts and Wüstenhagen's (2010) argument that sustainability transformation often requires both entrepreneurs and incumbents. Entrepreneurs bring novel material configurations, while incumbents provide pathways to scale through existing infrastructures and categories. This collaboration complicates a Schumpeterian reading of creative destruction in which new entrants simply replace incumbents. From a practice perspective, material innovation might be better understood as a shift in what materials are used and how they are produced, handled, and disposed of, rather than as the wholesale collapse and replacement of entire industries.

5.3 Sustainable entrepreneurial practice as dominant institutional logic

Study 1 develops the question of what counts as legitimate sustainable entrepreneurial practice by examining the Entrepreneurship Support Organizations (ESOs), such as incubators and entrepreneurship educators, that sit at the intersection of industry, university, and public funders. These actors shape what is considered legitimate sustainability practice in early-stage entrepreneurial settings (van Rijnsoever, 2022). According to ESO participants in Study 1, sustainability training and education orient toward standardized norms, certifications, and labels. Following Suchman (1995), this can be understood as a pursuit of cognitive legitimacy: entrepreneurs seek widely recognized labels, certifications, and language to demonstrate sustainability to external audiences. Tools such as early-stage life cycle assessment or ISO certifications help entrepreneurs make their choices legible and credible, providing what Suchman (1995, p. 582) describes as a "plausible explanation for the organization and its endeavors." In practice, this allows entrepreneurs to access incubator resources, perform better in pitching competitions, and attract funding from public and private investors.

The findings also suggest that this dominant understanding of sustainable practice creates difficulties for early-stage entrepreneurs. Much of what is framed as sustainable building originates from corporate sustainability practice, rooted in accounting and reporting systems and often synonymous with the triple bottom line (Elkington, 1998). Study 1 refers to this as "administrative sustainability concepts," where accounting and reporting practices are dominant and oriented toward "doing less" and "doing less harm." This logic treats entrepreneurs primarily as economic agents oriented toward the exploitation of opportunities (Shane & Venkataraman, 2000) and applies an incremental improvement framing more suited to established firms than to early-stage ventures.

This produces an orientation toward sustainability communication and accounting, rather than toward questioning the underlying material practices that produced the problems in the first place. Sustainable practice is largely defined through measuring, documenting, and doing less: using fewer resources, reducing emissions, and tracking impact against existing benchmarks. As Suchman (1995) notes, cognitive legitimacy of this kind is difficult to argue against because it is standardized and assumed as the appropriate way to proceed. Study 1 found that entrepreneurs sometimes rejected sustainability training altogether when it felt disconnected from early-stage building work, describing it as too "top-down" to be useful. The actors with the most formal legitimacy to deliver sustainability training at technical universities were also the ones most likely to push for this administrative logic, suggesting that this is a structural tendency in how sustainability is currently institutionalized in entrepreneurship support settings.

This raises a deeper question: if incremental improvement becomes the legitimate way to build, what does this mean for the more substantive changes that sustainability transitions require? As Garud et al. (2010) note, entrepreneurs must speak the language of the dominant system to enable adoption, but if they do not deviate enough, innovative capacity is stifled and momentum is lost.

Yet many of the impact entrepreneurs in Study 2 did not challenge the core business of incumbents. Instead, they helped incumbents become more sustainable by offering novel products or processes that supplemented existing operations, without replacing incumbents' core products with novel materials. This stands in contrast to cases such as Edison's electric lighting (Hargadon & Douglas, 2001) where entrepreneurs replaced an established material with a fundamentally different one. Entrepreneurs who challenge the underlying material logic of what is considered acceptable today, such as lab-grown meat, may face greater legitimacy difficulties than those who collaborate with incumbents on incremental improvements, despite the sustainability potential of such novel innovations.

These cases suggest that cognitive legitimacy, as currently constructed in sustainable entrepreneurship support systems, may inadvertently favor incremental innovation over the more fundamental transformations that some large sustainability challenges require. This points to a broader tension that the findings highlight but do not fully answer. Gaining cognitive legitimacy is necessary for entrepreneurs to access resources, partners, and markets. At the same time, the standards and expectations that define cognitive legitimacy in sustainability contexts are produced by institutional environments in which large corporations, regulators, and standard-setting bodies reinforce what sustainable innovation is supposed to look like. For entrepreneurs whose building work begins by questioning those definitions, conforming to available standards can be both necessary and constraining. The findings suggest that this tension is not easily managed at the individual level. Treating it as a structural condition, built into how sustainability standards and expectations are produced, may therefore be a more productive starting point for both research and support practice.

5.4 Future research

Several limitations discussed in the methodology chapter point to promising avenues for future research. First, this thesis draws on a small sample of impact entrepreneurs and relies on a single round of semi-structured interviews. Future research could use ethnographic and longitudinal designs to follow entrepreneurs over time, particularly during the active building phase, from prototyping through early validation. Such studies could better capture how building work and legitimizing work co-evolve through iterative testing, feedback, and shifting audience demands.

The Swedish and European context of this thesis also presents an opportunity for broader geographical comparison. European institutional conditions, including the regulatory framework of the Green Deal and relatively settled understandings of what sustainability means and how it should be pursued, shape both what problems are prioritized and what solutions are considered acceptable. Studies conducted in other institutional contexts could reveal how these assumptions vary. For instance, material innovations such as lab-grown meat or insect protein face significant regulatory barriers in Europe that make early-stage testing and iteration difficult. In other regions, such as Singapore, more flexible regulatory approaches have been adopted, using regulatory sandboxes to experiment with new rules for evolving innovations (Pangarkar & Vandenberg, 2022). As a result, these innovations are already available to the public in some markets. Cultural understandings of what is considered safe, clean, or

appropriate in food and agriculture also differ substantially across contexts, and these differences are likely to shape both building and legitimizing practices in ways that a European study cannot capture.

As discussed in section 5.3, most impact entrepreneurs in this thesis collaborated with incumbents rather than challenging their core products. Future research should examine entrepreneurs who do challenge dominant industries with fundamentally different materials, such as lab-grown meat replacing conventional livestock or fossil-free nitrogen fertilizers replacing fossil-dependent ones. These cases may involve different building and legitimizing processes, since entrepreneurs who seek to displace rather than supplement existing practices are likely to encounter stronger resistance from incumbent actors and existing regulatory categories.

This thesis focuses on building and legitimizing practices while entrepreneurs are actively developing solutions, rather than examining innovations that are already widely diffused. Future research could use comparative case designs to examine how different building and legitimizing strategies lead to different technological pathways. Studying entrepreneurs addressing the same sustainability challenge but pursuing different material solutions within the same field could reveal how specific practice choices shape which pathway ultimately proves viable. A comparative study of green cement entrepreneurs working with different material components, for example, could trace how differences in what is built, how it is tested, who is involved, what standards are pursued, and how legitimacy is sought produce different development trajectories over time.

Together, these directions could deepen understanding of how impact entrepreneurs build and legitimize material innovations across different institutional contexts, industries, and stages of development.

6. Conclusion

This thesis sets out to understand how impact entrepreneurs build and legitimize material innovations aimed at replacing unsustainable practices. It takes a practice-based perspective and moves beyond dominant accounts of entrepreneurial building based on software contexts or a narrow set of sustainable building practices such as frugal innovation. Many sustainability challenges are material in nature and require new solutions that can replace unsustainable industrial practices, which we still know little about.

The two studies show that building and legitimizing practices are shaped by institutional conditions. Study 1 finds that sustainability training in early-stage entrepreneurial settings is predominantly oriented toward standardized norms and administrative frameworks drawn from corporate sustainability practice, which can favor compliance over the more fundamental material changes that some challenges require. Study 2 finds that impact entrepreneurs treat scalability as a necessity for making impact, selecting materials that remain sustainable and economically viable at industrial volumes. Many worked alongside incumbents rather than against them, suggesting that sustainability transformation in material industries may be less about creative destruction and more about a gradual shift in what materials are used and how they are produced.

From these findings, the thesis introduces two concepts. The System-Practice Gap captures the disconnect between dominant sustainability models and the situated work of entrepreneurial problem-solving, showing how systems-level or administrative sustainability concepts can bypass the practical realities of early-stage building. Integral Scale captures how impact entrepreneurs build scalability into their innovations from the outset, avoiding the material lock-ins that arise when small-scale solutions are later pushed to industrial volumes.

Together, these findings and concepts contribute to the understanding that impact entrepreneurs tackling large-scale challenges must balance building workable material solutions with legitimizing them within existing industrial infrastructures and standards, while finding ways to move beyond how problems are currently being solved.

7. References

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