Making Sense of Sustainability Governance Tools

Educational Intent and the Organisational Enactment of Sustainability Learning — A Case Study of Lund Formula Student

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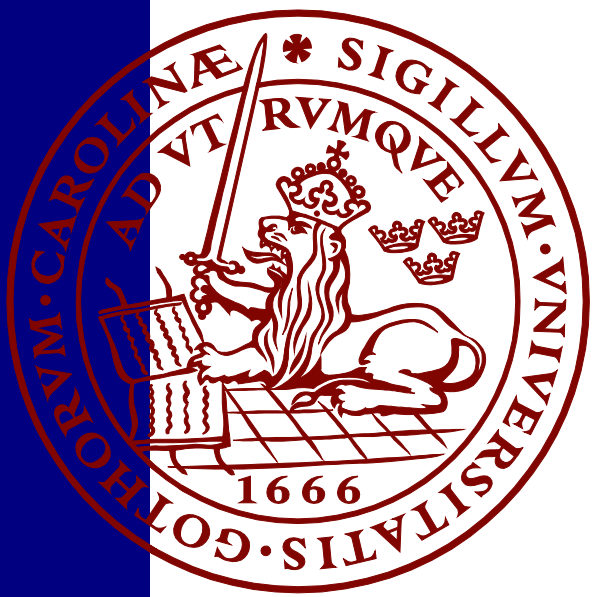

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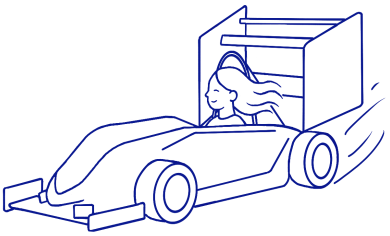

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Abstract

This study contributes to research on integrating sustainability governance tools for the development of products and services. I examine how a sustainability tool (Costed Carbonised Bill Of Materials) materialises in a student-led, quasi-business organisation. Drawing on sensemaking and institutional theory, I conducted and analysed 12 interviews with the management of Lund Formula Student. Although the tool was introduced for educational purposes, members treated it primarily as a reporting tool for gaining competition points. Thus, it became a weak sustainability implementation. The findings suggest that the establishment of sustainability tools in an organisation is shaped by its priorities and identities. Hence, this study indicates that meaningful execution towards strong sustainability requires understanding on how actors that are responsible for implementing the tools interpret, communicate and justify sustainability work within companies.

Keywords: formula student, sustainability governance tools, sensemaking, sustainability education, organisational sustainability, sustainability implementation

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Much Madness is divinest Sense –
To a discerning Eye –
Much Sense – the starkest Madness –
'This the Majority
In this, as All, prevail –
Assent – and you are sane –
Demur – you're straightway dangerous –
And handled with a Chain –

Emily Dickinson (1830–86), *Complete Poems*, 1924

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1. Introduction

Amid rising geopolitical tensions and a growing sense of despair, sustainability has not disappeared from organisational agendas. On the contrary, it has remained relevant by becoming increasingly institutionalised in both higher education and business (PWC, 2025a, Tullio et al., 2025). Higher education institutions are influential, where ideas of sustainability are developed, taught and implemented. Across different institutions and programmes, universities have been integrating sustainability more confidently into their curricula (Tasdemir and Gazo, 2020). Graduate Management Admission Council (2024) reports that the demand for sustainability teaching in engineering programmes is rising. This indicates that universities are increasingly expected to prepare graduates who can work with sustainability-related issues in their future professional roles (Abo-Khalil, 2024, Tasdemir and Gazo, 2020).

The shift is reinforced by the job market, as 'environmental stewardship' is listed as one of the top 10 fastest growing skills for future senior managers to obtain now, because it will become critical to companies by 2030 (World Economic Forum, 2025). Additionally, the number of companies making public climate commitments has increased nine-fold over the past five years (statistic prepared in 2024) (PWC, 2025a). Importantly, more than two thirds of companies that already report under the Corporate Sustainability Reporting Directive or International Sustainability Standard Board state that they have gained moderate or significant value beyond compliance from sustainability data. More than 70% of investors believe that enterprises should incorporate sustainability directly into their business strategy. Taken together, companies increasingly recognise the competitive advantage of incorporating sustainable business practices (PWC, 2025a).

Incorporating sustainable practices into business strategies often requires continuous organisational learning and adaptation (Crutzen and Herzig, 2013). This causes many companies to struggle to translate sustainability ambitions into corporate strategies that would allow them to be implemented more effectively into business activities (Beusch et al., 2022). A number of studies have found that managers find sustainability difficult to operationalise and that conflicts arise with established priorities such as performance, cost and time (Abo-Khalil, 2024, Epstein et al., 2010).

The conflicts of operationalisation are particularly visible when organisations attempt to translate sustainability into accounting tools, principles, frameworks, guidelines and standards, which within this study, I collectively call sustainability governance tools (SGTs). Such tools serve two primary purposes. Firstly, to communicate organisational sustainability efforts to external stakeholders, which is done by enhancing accountability and legitimacy through a focus on auditing and reporting. Secondly, a more hands-on and solution-oriented approach, where those tools are supposed to

support managerial decision-making and be embedded into the core of the organisational strategy (Swalih et al., 2024). Since management control systems aim to achieve the economic goals of organisations (Beusch et al., 2022), they are "limited in addressing environmental and social issues as well as their interrelationships with financial issues" (Gond et al., 2012, p. 208), this creates challenges to the solution-oriented approach.

Research has shown that organisations often adopt SGTs for legitimacy and stakeholder compliance reasons, rather than recognising their long-term value (Swalih et al., 2024). Similarly, Demastus and Landrum (2024) found that all 20 environmentally oriented sustainability schemes they studied aligned with forms of weak sustainability. This means that sustainability schemes fit into existing organisational logics without fundamentally changing them. This is especially relevant for cases in which sustainability is introduced into settings already shaped by established priorities and performance criteria. Under such conditions, sustainability may be formally recognised, while remaining marginal in practice (Demastus and Landrum, 2024).

There is a gap between research on organisational practices and sustainability performance. Halme et al., (2018) and Imbrogiano and Nichols, (2020) describe an interesting tension, where the business sector relies on academia to guide them through the transition to more sustainable organisational practices, but that academic researchers fail to identify the business-internal practices that would lead to strong sustainability outcomes. Strong sustainability means treating the environmental and social capital as equal to the economic one (Demastus and Landrum, 2024). Researchers produce and develop a growing amount of SGTs, however, there is a substantial amount of research that indicates that these frameworks and standards often do not achieve much change (Imbrogiano, 2021, Imbrogiano and Nichols, 2020).

Regarding sustainability education, researchers play a dual role of providing guidance to organisations on the adoption of sustainability practices, while also educating about it. A systematic literature review by Sult et al. (2023) found that training for corporate sustainability among managers and employees supports the implementation of better sustainable business practices. Similarly, Gadomska-Lila et al. (2024) identify green competencies among managers and employees as a significant antecedent of organisational sustainability. This emphasises that sustainability education matters, because the competencies developed in higher education enter organisations through graduates that can shape how sustainability is understood and practiced there.

This research contributes to a broader research gap that builds on three insights. First, SGTs may often serve important legitimacy and communication functions, but struggle to become integrated

into core strategies and practices. Second, SGTs are especially difficult to embed when they are introduced into settings that are already shaped by other well-established structures and dominant criteria (Demastus and Landrum, 2024). Third, there is substantially less research on how the employees who are directly responsible for the implementation of SGTs within companies interpret and enact sustainability and related governance tools in everyday work (Zaccone, 2025). Feuls et al. (2025) argue that while the external demands and formal compliance structures are important, the success or failure of sustainability initiatives depends on how organisational actors make sense of new expectations and incorporate them into practice. Informing existing research on the subjective dimensions is important to explain how sustainability regulations are implemented in practice (Zaccone, 2025).

1.1 Research Gap, Aim, Questions, Case Presentation

The aim of this study is to explore and describe how a formal sustainability requirement is constructed, interpreted and enacted in a student-led, quasi-business organisation, and to analyse how organisational conditions shape this process and its educational implications. The study contributes to the research gap on the practical implementation of SGTs by examining the experiences of those responsible for implementation through an in-depth case study of Lund Formula Student's work with the Costed Carbon Bill of Materials (CCBOM). Therefore, I ask the following questions:

1. How do members of Lund Formula Student understand the purpose and value of the CCBOM?

2. What organisational conditions influence how the CCBOM is interpreted and enacted within Lund Formula Student?

3. How does the CCBOM contribute to the development of sustainability competencies among team members of Lund Formula Student?

My research responds to Cepêda et al.'s (2025) call for more qualitative research that is capable of capturing the nuanced organisational dynamics that are often overlooked in quantitative studies. It also complements Eitrem et al.'s (2024) critique that institutional theory in social and environmental accounting research often has not been developed in a sufficiently critical way and tends to exclude key conceptual developments such as embedded agency.

The study draws heavily on the sensemaking theory developed by Karl E. Weick in the book *Sensemaking in Organizations* (1995). The sensemaking theory is useful for understanding how stakeholders assign meaning to disruptions, link them to existing routines and priorities and convert

them into action. Additionally, I draw on institutional theory because external factors influence what receives attention and what remains peripheral, which is important from a sensemaking perspective. For this reason, I consider it necessary to make these conditions explicit rather than leave them unaddressed.

Lund Formula Student is a particularly interesting case because it serves several functions at once. Legally, it is a non-profit association, however it is designed to mimic a profit-oriented business organisation. It operates as an entirely student-led, multidisciplinary racing team. Each year, the team undertakes a new project with the goal of designing and manufacturing a high-performance racing car and competes with universities from around the world in Formula Student events. The recent introduction of the CCBOM makes this setting analytically valuable, as it inserts a formal sustainability requirement into an environment where performance, cost and time are central. The purpose of the CCBOM is to track all carbon emissions and financial costs associated with materials and production processes of a specific subsystem of the car. The case therefore provides a unique opportunity to examine how sustainability requirements are understood and executed in a well-established setting, with students actively using the experience to gain advantage on the job market (Lund Formula Student, n.d.).

2. Context of the Study

2.1 Sustainability Governance Tools

Sustainability matters can refer to different practices depending on the organisation and context in which the term is used (Rahman et al., 2022). It engages primarily with issues related to climate change, pollution of air, water and soil, water and marine resources, biodiversity and ecosystems, circular economy, employment (including working conditions and equal opportunities), workers in the value chain, social context (including affected communities and indigenous communities), consumers and end-users, business conduct, corporate culture, protection of whistleblowers, corruption and bribery (Commission Delegated Regulation (EU) 2023/2772, 2023).

Organisational sustainability sets out how an organisation incorporates sustainable development into its practices (Rahman et al., 2022). Literature points to Howard Bowen's (1953) *Social Responsibilities of the Businessman* as a key turning point at which corporate social responsibility (CSR) emerged as a term used to describe the idea that corporations have obligations to their shareholders beyond profit-making (Carroll, 1999). A further important point in sustainability discourse was the 1987 publication of *Our Common Future*, widely known as the Brundtland Report (WCED, 1987). The report popularised what became the most widely used definition of sustainable development:

"development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987, Chapter 2, "Towards Sustainable Development," Section 4, "Conclusion").

The 1992 Rio Earth Summit built on the Brundtland concept of sustainable development and translated it into a more concrete international action framework through Agenda 21 (United Nations, 1992). In the business context, Elkington's Triple Bottom Line (TBL), coined in 1994, became one of the most influential frameworks for translating sustainability into corporate practice. It encouraged firms to evaluate performance in social, environmental and economic terms, also known as people-planet-profit (Rahman et al., 2022). Additionally, the Global Reporting Initiative (GRI), whose first Guidelines, launched in 2000, translated the people-planet-profit logic into a structured reporting framework for organizations' economic, environmental and social impacts (Global Reporting Initiative, n.d.).

ESG refers to environmental (E), social (S) and governance (G) criteria used to assess how companies manage sustainability risks and responsibilities. Its rise is commonly linked to the 2004 *Who Cares Wins* report and the 2006 *Principles for Responsible Investment*. ESG is much more investor oriented than the earlier concept of CSR, describing the "risk and return implications for financial investors of failing to address ESG issues in their portfolio selection and corporate engagement." (MacNeil and Esser, 2022, p. 9). In practice, this meant translating earlier CSR approaches into standards and assessments through which companies could report on and improve the sustainability aspects of their operations (MacNeil and Esser, 2022). In 2010, ISO 26000 gave social responsibility a new level of global legitimacy, emerging from one of the largest and most diverse standard-setting efforts in ISO's history and turning a broad sustainability idea into practical guidance for how organisations should govern themselves and act responsibly (Frost, 2011, ISO, n.d.). Also, in the early 2010s, platforms such as Ecovadis became a form of communicating a company's ESG efforts because they helped translate those aspects both uniformly and externally (EcoVadis, n.d.).

In 2015, all 193 UN member states adopted the *2030 Agenda for Sustainable Development*, establishing the 17 Sustainable Development Goals (SDGs) as a shared global framework for sustainable development (United Nations, 2015). Since then, the SDGs have become an important reference point for organisational strategy, with many companies integrating the goals into disclosure practices (Mio et al., 2020, Awuah et al., 2024).

Since organisational sustainability has become an established practice, a wide range of new SGTs has emerged. In 2021, one of the best known frameworks for ESG reporting was created by the

International Sustainability Standards Board (ISSB), its aim is to set universal global sustainability reporting rules that investors can use and that can also fit with local requirements (IFRS Foundation, n.d.). In the European Union, the push toward standardisation came into law through the Corporate Sustainability Reporting Directive (CSRD), which was published in 2022 and began to be applied to the biggest companies in 2024. Such companies must use the European Sustainability Reporting Standards (ESRS), these standards follow a double-materiality logic, which means that companies report both how the company can be financially affected by sustainability issues and how the company affects labour practices and the environment (European Commission, n.d., European Commission, 2022, European Commission, 2023).

It is important to mention that the growing use of SGTs is viewed against the global efforts to limit global warming "well below 2°C above pre-industrial levels… and pursuing efforts to limit temperature increase to 1.5°C" (Paris Agreement, 2015, Article 2, 1. (a)). The IPCC (2023, pp. 20 (B.6), pp. 24 (C.1.2)) states that this requires "rapid and deep and, in most cases, immediate" emission reductions across all sectors this decade, and that, the private sector, among others, plays "a crucial role in enabling and accelerating shifts in development pathways towards sustainability and climate resilient development." This is why many sustainability governance frameworks use tools that account for greenhouse gas (GHG) emissions. For example, the GHG Protocol Corporate Accounting and Reporting Standard provides the dominant framework for organisational GHG inventories, the disclosure of the GHG Protocol results is achieved through the Carbon Disclosure Project (CDP) (CDP, n.d., Greenhouse Gas Protocol, n.d). The Science Based Targets initiative (SBTi) is a voluntary target-setting and validation framework that uses emissions data, often generated through GHG Protocol-based inventories, to assess whether corporate pathways align with climate science (SBTi, n.d.). Additionally, the life cycle assessment under ISO 14040 and ISO 14044 helps evaluate various impacts on the environment through the life cycle of a product or system (International Organization for Standardization, 2006a, 2006b, 2018).

2.2 Sustainability in Educational Contexts

As all industries and professions have environmental and social implications, sustainability has increasingly become integrated into higher education curricula (Murga-Menoyo, 2014). UNESCO's *Education for Sustainable Development* (ESD) is the overarching framework for integrating sustainability into education. Later updated through the *Global Action Programme* and the *ESD for 2030 roadmap*, they seek to scale up sustainability education on all fronts. To advance policy, transform learning environments, build capacities of educators, empower and mobilise youth, as well as accelerate local level actions in order to achieve the SDGs (UNESCO n.d, 2020, 2016). The aim is to

move sustainability from a specialist topic to one that is understood as part of general professional standards.

Since organisations face growing pressure to monitor and manage their environmental and social impacts, graduates across diverse fields are increasingly expected to possess sustainability-related competencies (Redman, 2021). Competencies are "complex combination[s] of knowledge, skills, understanding, values, attitudes and desire which lead to effective, embodied human action in the world" (Crick, 2008, p. 313). Higher education faces pressure to prepare students to not only understand sustainability, but also be able to embed it in practical applications related to their future day-to-day work. Narrowing down, Wiek et al. (2011) created one of the most cited frameworks on sustainability competencies (see Table 1). The framework was developed primarily in relation to sustainability education programs. However, the authors explicitly position sustainability science as a field that cuts across disciplinary boundaries and notes that engineering, among others, are important fields for addressing sustainability issues.

Table 1. Definitions of key sustainability competencies (adapted from Brundiers et al., 2020, based on Wiek et al., 2011, Wiek et al. 2016).

Name of competency	Definition
Systems-thinking	"ability to collectively analyze complex systems across different domains (society, environment, economy, etc.) and across different scales (local to global), thereby considering cascading effects, inertia, feedback loops and other systemic features related to sustainability issues and sustainability problem‑solving frameworks." (Wiek et al. 2011, p. 207)
Futures-thinking	"ability to collectively analyze, evaluate, and craft rich "pictures'' of the future related to sustainability issues and sustainability problem‑solving frameworks." (Wiek et al. 2011, pp. 208–209)
Values-thinking	"ability to collectively map, specify, apply, reconcile, and negotiate sustainability values, principles, goals, and targets." (Wiek et al. 2011, p. 209)
Strategic-thinking	"ability to collectively design and implement interventions, transitions, and transformative governance strategies toward sustainability." (Wiek et al. 2011, p. 210)
Interpersonal	"ability to motivate, enable, and facilitate collaborative and participatory sustainability research and problem solving." (Wiek et al. 2011, p. 211)
Integrated problem-solving	"meaningfully using and integrating the five key competencies [above] for solving sustainability problems and fostering sustainable development" (Wiek et al. 2016, p. 243). It is the ability "to apply different problem‑solving frameworks to complex sustainability problems and develop viable solution options" in order to "meaningfully integrate problem analysis, sustainability assessment, visioning and strategy building" (Wiek et al. 2016, p. 251)

The relationship between different sustainability competencies proposed by Wiek et al. (2016) can be viewed in Fig 1. Competencies should be understood as an integrated and iterative process, with integrating problem-solving being the overarching competency and interpersonal competency guiding decisions across all skills.

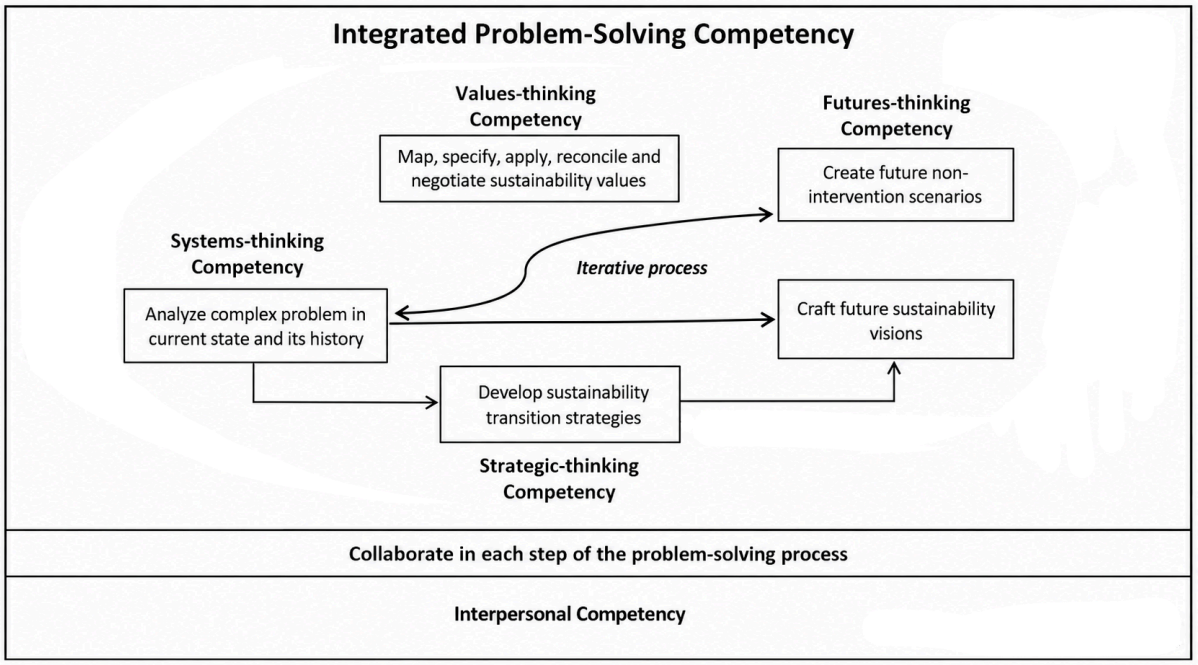

Figure 1. The relationship between different sustainability competencies. Adapted and modified from Brundiers et al., 2020, based on Wiek et al., 2011 and Wiek et al., 2016.

Educators are increasingly aligned on efficient ways to teach sustainability competencies, but the assessment of these competencies is still underdeveloped. Although many methods are used to measure students' sustainability skills, there is still little guidance on how to select the most suitable one and how it should be applied (Redman et al., 2021). There is also limited evidence to show whether specific teaching methods actually help students develop these competencies (Redman et al., 2021). This is an issue because sustainability may be included in curricula, but how it is taught and assessed can vary greatly (Kuh et al. 2014). Therefore, there is a gap in the alignment between learning objectives, teaching methods and assessment practices (Redman et al., 2021).

In professional practice, sustainability competencies involve complex and applied forms of judgement. These include making decisions in conditions of uncertainty, connecting technical choices to wider environmental and social consequences and managing trade-offs between competing values such as need for product/service, profit and resources. From this perspective, the educational question is not only whether students know about sustainability, but whether they learn how sustainability becomes part of professional judgement (Rieckmann, 2012).

2.3 Case Overview

Formula Student, organised by the Institution of Mechanical Engineers (IMechE), is Europe's leading engineering competition for connecting students to motorsport. The challenge of the competition is to comprehensively develop and manufacture an open wheel, single seater race car within an academic year. A Formula Student competition is divided into eight 'events'. Events are individual subcategories of the competition, testing the car and the team's knowledge and skills in different ways, e.g. cost and manufacturing, business plan presentation, autocross and skidpad tests. Teams receive points for each event and the overall ranking is determined by the total number of points accumulated across all the events in the competition. Formula Student's primary goal is to be "a kite-mark for real-world engineering experience, combining practical engineering experience with soft skills including business planning and project management." (Institution of Mechanical Engineers, n.d.a, para. 3)

Formula Student is closely connected to the wider motorsport and automotive industries. According to IMechE, it "is viewed by the motorsport industry as the standard for engineering graduates to meet, transitioning them from university to the workplace." (Institution of Mechanical Engineers, n.d.a, para. 3) and it helps students learn "all things that any prospective employer will be looking for" (Institution of Mechanical Engineers, n.d.b, para. 2). The competition is backed by industry and this connection is relevant in the context of ongoing sustainability transitions in motorsport (Institution of Mechanical Engineers, n.d.a). Formula 1, which represents the peak of professional and commercial motorsport, is historically famous for developing technologies that trickle down to the wider automotive industry (Roberts, 2025). Currently, it is pursuing a net-zero carbon target for 2030 and is principally testing two technologies, the development of an e-fuel in which nothing is made from crude oil (used in road vehicles and freight transport), and secondly, in-motion energy recovery systems (Formula 1, 2026, Formula One World Championship Limited, n.d.). Those Formula 1 advancements could have significant relevance, since road vehicles account for around 70% of total transport emissions and those transport emissions contribute around 15% of global GHG emissions (IPCC, 2022, Chapter 10) Against this backdrop, sustainability pressures in the wider motorsport sector increasingly shape what counts as relevant competence for future graduates in engineering.

The CCBOM is prepared for the "Cost and Manufacturing" event, alongside the regular Bill of Materials (BOM). The Bill of Materials is a detailed document listing every part of the car. The CCBOM extends the Bill of Materials by adding a summary of costs and a simplified life-cycle assessment based on ISO guidelines, these account for material, processes, tooling, fasteners and overhead emissions. The CCBOM was first introduced to Formula Student competitions in 2025.

Every year the teams are responsible for preparing the CCBOM document for a different subsystem of the car. In 2026 the subsystem taken into account is called the “the Engine and Tractive System”, which means the engine and the system that delivers the power it produces to the wheels. The previous referral to Formula 1 gives broader context to the CCBOM, as its purpose has been explicitly framed as an initiative to respond to rising sustainability pressures in the automotive sector and notes that, as companies face stricter regulation and more ambitious CO_2 reduction targets, Formula Student should also embrace it, as evidenced in the following quotation:

> Driven by evolving social values and stricter regulations, companies across the sector are racing to meet ambitious CO_2 reduction targets. Even Formula 1 has pledged to be net zero by 2030. This is why Formula Student has introduced the Costed Carbonized Bill of Material (CCBOM) as the latest challenge in the Cost & Manufacturing Event. Additionally, to the cost calculations, teams will now calculate the CO_2 emissions—expressed in CO_2 equivalents—of one race car system using a Cradle-to-Gate analysis. (Formula Student Germany, n.d., para. 2)

Lund Formula Student is the team representing Lund University in Sweden, with around 120 members (Lund Formula Student, n.d.). Lund Formula Student, like other Formula Student teams, is characterised by a high member turnover and a yearly project cycle in which a new group of students starts a new car project each autumn. In this study the CCBOM serves a dual role, it is viewed as a regular sustainability governance tool used by organisations to identify and quantify their emissions. Secondly, it is viewed as a pedagogical tool with the intention to teach students sustainability competencies that they will have to utilise in their future careers. Therefore it provides a particularly relevant case to examine the continuous character of making sense of the CCBOM.

3. Theoretical Context

3.1 Sensemaking Theory

As Weick (1995, p.4) observes in his book: “The concept of sensemaking is well named because, literally, it means the making of sense.” Sensemaking theory poses questions about how actors make meaning out of disruptions (construction), why they do it that way (interpretation) and what results from it (action). This process begins by the actors selecting “simple, familiar structures that are seeds from which people develop a larger sense of what may be occuring”, known as cues (Weick, 1995, p. 50). The actors notice these cues, connect them to what they already know and construct a plausible account of the disruption so that they can continue to act.

Disruptions are important because they trigger the need for sensemaking. A disruption can be understood as any event, uncertainty or interruption that disturbs the ongoing flow of action.

Examples of disruptions can be a policy change, a conflicting message or, more generally, a situation in which previous assumptions no longer hold true. For this reason, disruptions are often strongly tied to emotions, since they do not only create uncertainty, but interrupt ongoing projects and organised sequences of action that actors were already invested in. Furthermore, emotions are important because they intensify, in moments of disruption, and guide the search for meaning, while also shaping how people interpret the disruption and what they see as important. This makes sensemaking especially useful for analysing situations of uncertainty or ambiguity, where multiple meanings are possible and none is immediately obvious (Weick, 1995).

It is useful to clarify that sensemaking is distinguished from interpretation. Interpretation is narrower, defined as the act of assigning meaning to a disruption that already exists. Sensemaking includes interpretation, but it also emphasises the ongoing and social process through which reality becomes meaningful in the first place. In other words, actors are actively shaping the environment they then try to understand (Weick, 1995). Weick (1995) identifies seven properties of sensemaking that makes it unique from other related processes such as interpretation (see Table 2.).

Table 2. Seven properties of sensemaking (identified by Weick, 1995, own table).

Properties of sensemaking	Description
'Grounded in Identity Construction'	How actors make sense of a situation depends on how they identify themselves in that particular situation. Events are not interpreted from a neutral position, they are interpreted from existing identities e.g. a student, an employee, a manager, a team member.
'Retrospective'	Actors make sense of situations by reflecting on previous experiences. The meaning of a situation is clearer after it has already happened, when individuals select certain elements of an experience and organise them into a coherent account.
'Enactive of Sensible Environments'	Actors do not simply react to a fixed external reality, but through their actions and decisions, they partly create the environment they later try to understand. In other words, they have already impacted the situations to which they then respond.
'Social'	Even though analysis of a situation appears internal, it is deeply influenced by everyday interactions and common organisational language, shared norms and expectations. Meaning is negotiated collectively, not produced in isolation.
'Ongoing'	The process of sensemaking never begins, because actors are always in the middle of ongoing flows of experience. It just moves on from one thing to another, since actors are continuously updating their understanding as new information appears.
'Focused on and by extracted cues'	Actors' senses are constantly bombarded with information, too much to process, so they pick out certain signals, events, words, or observations from a complex situation and treat them as especially meaningful. These cues then become the basis for broader interpretations.
'Driven by Plausibility Rather Than Accuracy'	Actors do not wait until they have complete or objectively correct information. Instead, they create explanations that are believable and useful enough to allow them to continue acting.

Organisational sensemaking is the ongoing interactions between actors (enactment) and the impact of their specific surroundings, challenges and pressures that guide them in the process (ecological change) (Weick, 2015). The cues produced are then interpreted in selection, where actors make sense of what is happening by retrospectively extracting cues from past experiences. These interpretations are then held in retention, where meanings are stored and connected to identity and plausibility, helping individuals maintain a coherent sense of self and reality. Importantly, retention

feeds back into earlier stages of selection and enactment, making the process iterative and dynamic (see Fig. 2) (Weick et al., 2005).

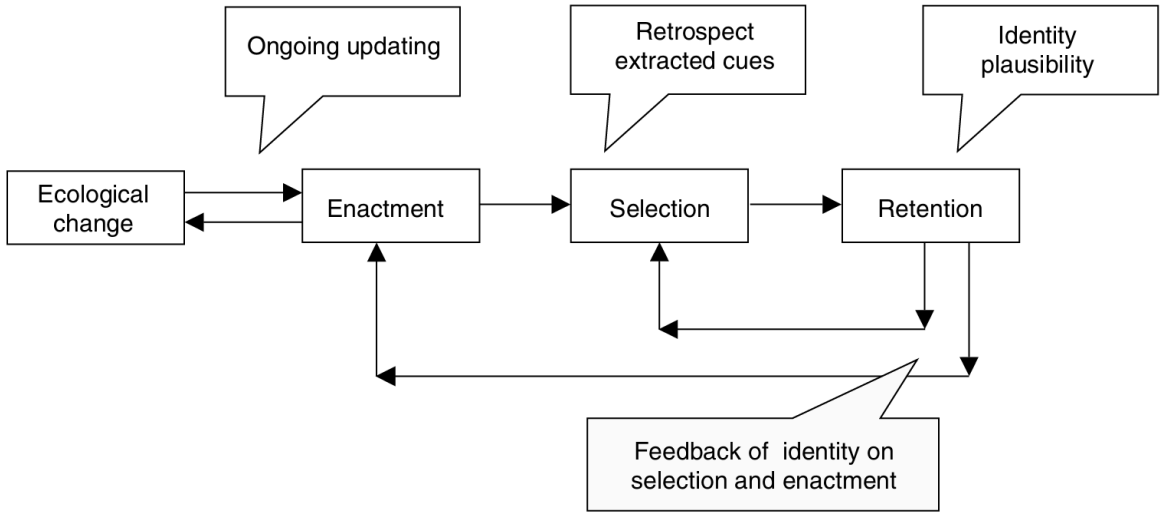

Figure 2. Relationship between enactment, selection and retention within the process of sensemaking (source: Weick et al., 2005).

3.2 Institutional Theory

A considerable amount of research has examined sustainability governance tools and their adoption in organisational settings through an institutional lens (Cepêda et al. 2025, Eitrem et al., 2024, Tullio et al., 2025). Many researchers have turned to institutional theory, since it is useful for explaining why organisations adopt sustainability practices, how they respond to external pressures and legitimacy demands, and why sustainability initiatives may become symbolic or decoupled from everyday organisational activities (Benameur et al., 2024).

Institutional theory explains organisations as shaped by technical efficiency, market competition and also socially constructed rules, such as norms and expectations. In this view, organisations adopt practices because these are seen as legitimate and rational within their environments (Meyer and Rowan, 1977). Formal structures often function as ‘myths and ceremonies’, which means that organisations incorporate widely accepted policies, roles or procedures to gain legitimacy and support, even when those structures are not strongly connected to day-to-day work (Meyer and Rowan, 1977). This is why institutional theory is useful for studying sustainability governance tools. Companies may adopt STG’s because this signals conformity to broader social expectations.

DiMaggio and Powell (1983) gave institutional theory one of its most important formulations. They argue that once an organisational field is formed, organisations experience institutional isomorphism, meaning pressure towards homogeneity. They identify three mechanisms. ‘Coercive

isomorphism' comes from laws, regulation and dependency on powerful actors. 'Mimetic isomorphism' occurs under conditions of uncertainty, when organisations copy others already seen as successful. 'Normative isomorphism' comes from professionalisation, education and expert networks that define appropriate practice. Their contribution shifts the explanation of organisational change away from pure efficiency and being seen as legitimate and conformist. For research on sustainability in organisations, this means that firms may adopt sustainability tools because such tools have become expected by regulators, professionals and industry peers (DiMaggio and Powell, 1983).

Institutional theory complements sensemaking by demonstrating how the larger mechanisms shape everyday interpretation and action that the organisational actors notice, how they define problems and which responses they adopt as legitimate. In contrast, sensemaking engages with the micro-level processes through which actors interpret cues, talk with others, construct meanings and act on those meanings. In this way, sensemaking explains how institutions are enacted, maintained and sometimes transformed through ongoing social interaction. At the same time, these sensemaking processes can also influence institutions by generating resistance and change (Weick et al., 2005).

4. Materials and Methods

4.1 Research Design and Data Collection

This study adopts a qualitative, interpretive, single-case design. The material consists of participant observation and 12 semi-structured interviews. Participant observation is a method where the researcher takes part in everyday activities such as workshop sessions and team meetings, and is present during casual conversations in the studied settings in order to gain a deeper understanding of the topic (Salmons, 2023). I began participant observation in November 2025, which helped me clarify the focus and the theoretical framing of this study. Thereafter, I conducted interviews in March 2026. My decision on the selection of participants was informed by Weick's (1995, pp. 30, 31, p. 10) view of organisational sensemaking as strongly influenced by managers "construct[ing] reality through authoritative acts" and "the leader [being] a sense-giver", and therefore it included as broad a range of managerial perspectives as possible.

4.2 Interviews

The 12 interviewees included team members in the role of 'Leaders', 'Managers' and 'Coaches' (see Table 3). An interview guide (see Appendix 1) was designed and used to accommodate both the participants with a strong knowledge of the CCBOM, as well as those with limited familiarity. I conducted all interviews in person, recorded them on a mobile device, transcribed the recordings

with the online transcription tool Otter, and then manually checked and corrected them. All interviews were conducted in English, as it is the team's official language.

Table 3. Participant labels and role descriptions.

Label	Description
L - Leader	Occupies the highest position within the team. Is responsible for setting team goals and creating a shared vision. Fosters a positive working environment and ensures that managers understand their roles and responsibilities.
M - Manager	Responsible for planning, organising and overseeing the work and resources of specific subteams. Each manager focuses on a particular area of the car and ensures that their subteam's tasks are coordinated and completed effectively.
C - Coach	Former team members who remain involved in the team to support managers by sharing knowledge and practical experience.

4.3 Data Analysis

I coded the transcribed interviews manually using reflexive thematic analysis. Elliott et al (1999) and Braun and Clarke (2023, Chapter 4) describe reflexive thematic analysis as a method of analysing qualitative data where the researcher is an active interpreter of the material, and subjectivity is treated as a resource instead of a flaw of the analytical process. Thus, the interview material was processed using inductive reasoning and patterns of shared meaning (codes) and were then organised around a shared concept (themes). The analysis of the data followed six steps: familiarisation with the data, creating codes, generating initial themes, reviewing and developing those themes and then refining and naming them to produce the final report. The coding process was iterated over three rounds. The final thematic structure consisted of themes, subthemes and codes (see Appendix 2).

4.4 Reflection on Positionality

Since I am a member of the LFS 2026 team, responsible for preparing the CCBOM document, I had to take my dual role as both researcher and team member into consideration. Reflecting on my position as an insider, it gave me important advantages, including pre-established relationships and trust, quick contextual understanding, access to everyday conversations and the possibility to identify the character of the object under study early on. Through this proximity, I could better refine the theoretical framing before conducting the interviews. At the same time, my involvement meant that I had to be highly cautious of bias. My investment in the CCBOM may have influenced what participants chose to share and how I interpreted the material. Team members may have moderated responses, assumed shared understandings, or responded to me in relation to my role within the team. I therefore did my best to approach the study reflexively and treat knowledge as co-produced.

Furthermore, I took small but deliberate steps to reduce role confusion during interviews, such as meeting outside Lund Formula Student premises, not wearing Lund Formula Student clothing, clarifying that the interviews were not a test of sustainability knowledge and encouraging participants to speak openly. At the same time, I thought about how to use my insider position as an analytical advantage, as it increased my sensitivity to subtle cues and contextual meanings, which made sensemaking theory, participant observation and reflexive thematic analysis particularly suitable for this study.

4.5 Ethics

This study involved human participants, therefore it required close attention to ethical principles in respect of people. I obtained permission and never worked under disguise, openly made clear to Lund Formula Student that I was conducting research for my MSc thesis. Before each interview, participants received a written informed consent form explaining, among other things, the purpose and scope of the study, that participation was voluntary and could be withdrawn at any time, how confidentiality and anonymity would be ensured and how the data would be stored and used. I also restated the purpose of the study and asked for verbal consent before recording each interview. All findings of this study are used for academic purposes only.

4.6 Limitations

This study is limited by its single-case design and the tradeoff is that although it provides a nuanced understanding of Lund Formula Student's experiences and challenges, the findings remain strongly shaped by local context. For this reason, they should not be interpreted as representative of all Formula Student teams. The study is also subject to limitations related to researcher positionality, which is mentioned above.

Another limitation is that the data was not quantified or coded in a way that would allow for numerical comparison, as I intentionally designed the study to focus on a qualitative interpretation, meaning and participant perspectives. This choice enables a deeper engagement with the material, but it also constrains the extent to which the findings can demonstrate the relative weight of particular themes.

Finally, a further limitation of this study is its lack of longitudinal perspective. While the research captures how participants currently understand sustainability and their experiences of implementing SGTs within Lund Formula Student, it cannot assess how these experiences shape their professional practices through their career. To examine this more fully, future research would need to follow engineers beyond their involvement in Lund Formula Student and into their later careers in order to

explore which attitudes and skills toward sustainability they ‘carry’ with them, and how these are influenced by their time in the team. This points to an important opportunity for future research, particularly for studies concerning the longer-term educational and professional impact of student engineering organisations.

5. Findings

5.1 Lund Formula Student’s Understanding of the CCBOM’s Purpose and Value

Members understand the CCBOM as valuable, but its value is split between competition performance and future professional learning. The CCBOM is recognised as potentially educational and sustainability-related, but it is enacted mainly as an externally required documentation task. Its deeper potential to be better utilised is limited by ambiguous purpose, documentation-focused judging and weak knowledge transfer.

Members primarily understand the CCBOM through its role in the Formula Student competition. Its most immediate value is that it contributes to the overall score and can therefore support the team’s competitive performance. This reflects the broader identity of the team as a driven-to-win engineering organisation, where tasks become important when they help the team score points through satisfying the judges. As one interviewee explained: “Yeah, we need to win. So we need to have the most points, and that means the fastest car and best documentation for it” (ITC). Other interviewees expressed this even more directly: “we would not do this if it wasn’t 100 points in the competition” (C5X) and “[the CCBOM] yields points, so we’re going to do it as good as possible.” (0RZ).

At the same time, there was a broad agreement that the tool has an educational purpose. Participants often interpreted it as a way of exposing students to sustainability-related practices they will encounter in their future careers. In this sense, the CCBOM is seen as contributing to the development of better engineers: “Because if you were to mass manufacture the car, which is the idea behind the CCBOM, is that if we were to manufacture it massive, on a massive scale, then we would need to account for that, or think about it.” (DG0) Members therefore see the tool as more relevant to the engineers they will become than to the immediate work they are doing within Lund Formula Student.

However, the practical purpose of the CCBOM remains ambiguous, meaning it's open to different focuses by the judges. A participant questioned whether the judges themselves shared a clear understanding of the tool’s purpose:

> Our judges at the two different competitions focused on very different things, so I'm not even sure the judges understand the point. Like, and then, how should we understand the point? So instead, it becomes documentation heavy, because it's very easy to judge documentation. (A0F)

The evaluation is based on accuracy and level of documentation, not on achieving the lowest possible carbon footprint. This further shapes how the CCBOM is enacted, since teams have a reason to treat it as a reporting task rather than as a tool for changing design practice.

Several participants nevertheless recognised that the CCBOM has a greater value. Some saw potential for the tool to be used more strategically or integrated earlier into organisational processes. As QQ6 stated “and I think that most people they subconsciously allude to, oh, this is about the environment, because we do carbon footprint counting, but it can be used for so much more, and I don't think people know that.” and S26:

> From my perspective, as I am not really involved, I can't really say how much the CCBOM has changed the team's view of sustainability. But I think just that the fact that we have a group who work with the CCBOM is a step in the right direction for the team, compared to just a few years ago. And I think there is more that can be done.

This suggests that the CCBOM was not rejected, but that its wider potential is not yet fully understood and operationalised within the team. Also, it should be taken into consideration that 2026 is only the second year of the CCBOM’s integration, so the level of understanding and operationalisation could change over time.

The weak integration of the CCBOM is connected to weak knowledge transfer. Some members felt distant from the CCBOM process, as shown by LZK’s comment: “I've been very much outside of the process of the CCBOM, other than the comment I heard about how they really should automate it for next year.” Additionally, 84H pointed to weak continuity between years:

> I'm not sure how last year's information has been passed to the design team for next year as well. [...] I think that also says a lot about the involvement of cost [...] like earlier on [during the fall], because there's not really an active role, or at least the [cost and manufacturing] subteam isn't really formed at that stage yet.

They further explained that the previous CCBOM work was concentrated around very few people: “also, because it was so separate. And I think in addition to that, we were only working with one

[manufacturing] person pretty consistently. [...] So outside of him, nobody had any idea of the data collection, or the calculations necessary" (84H).

5.2 Organisational Conditions that Influence how the CCBOM is Interpreted and Enacted within Lund Formula Student

The meaning of the CCBOM is locally constructed within Lund Formula Student. The majority of members perceive it as external, competition-driven and documentation-heavy. The CCBOM is interpreted through organisational conditions, namely, competition pressures (performance, cost, time) and internal pressures (communication, workload, compromise) (see Appendix 2.). Additionally, students perceive the tool through previous experience with the Bill of Materials and the team's racing and engineering identity. The CCBOM is therefore framed as competition documentation and point-scoring, rather than as a challenge to dominant priorities or team identity. As a result, it functions as a reporting tool, rather than a tool that could support design and decision-making.

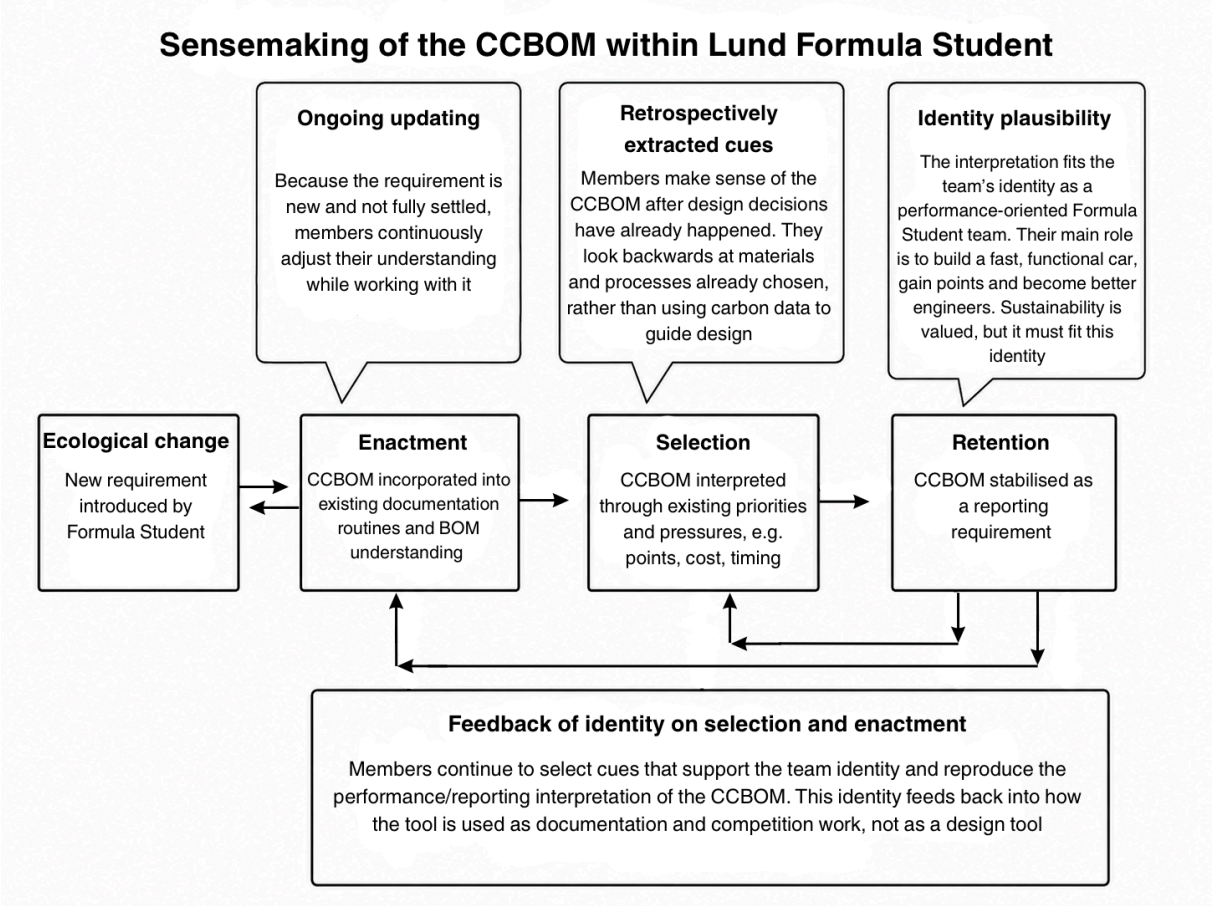

Figure 3. Sensemaking of the CCBOM within Lund Formula Student (based on Weick et al. 2005, own figure).

Fig. 3 illustrates how the CCBOM is constructed, interpreted and enacted within the team through sensemaking. The CCBOM introduces a new requirement into an already established competition

routine, causing ecological change. However, the requirement does not arrive with a fully settled meaning. To the best of my knowledge, official Formula Student sources do not frame the CCBOM explicitly as a climate mitigation measure and the rules leave teams considerable autonomy in how they interpret and implement it. Teams are largely responsible for deciding how the CCBOM should be approached and what significance it should have. “The sustainability bit was new. Nobody knew what [the CCBOM was about] or the extent of the work [needed].” (84H) Additionally, most members first heard about the CCBOM from someone else, meaning its purpose had already been interpreted before reaching them.

In the enactment stage in Lund Formula Student, members incorporate the CCBOM into routines already associated with the Bill of Materials. “I understood it to just be an addition to the regular BOM in which we just had to calculate the total carbon emissions of the set subsystem” (U8S). Since the Bill of Materials has historically functioned as a reporting and documentation object, the ‘costed and carbonised’ dimensions of the CCBOM, was largely absorbed into this pre-existing understanding. Members gain understanding of what the CCBOM requires while working with it and its meaning develops through ongoing updating.

The selection stage shows how members draw on particular cues to absorb the CCBOM into the team’s structure. Across the interviews, the top priorities were performance, cost, manufacturability, time and available resources. One respondent explained that the team tries to make the “fastest car from the means we have” (SOO). Similarly QQ6 stated that “there's like, a shared competitiveness throughout the team, and if that decision helps us to satisfy this competitiveness then it's a good decision.”

This performance orientation is closely connected to time pressure. Members do not only evaluate whether a technical solution is good, but whether it is good enough to be designed, manufactured, tested and integrated into the car within the available time. As HRU explained: “So it's always a balance of okay, how good do we need to make this? [...] Because if we don't have time to test that car in the summer, then it won't work either way.” (HRU)

When asked what counts as a good decision in their area of work, respondents often mentioned communication, workload and compromise. Good decisions were described as those that balance the quality of the outcome with the amount of work required from the team. As 84H stated “being conscious of what everyone is up to is very important [...] making sure that you're well informed about what is happening in the team is crucial because, if you're not, then I don't think anything that you decide would end up being super relevant.” Another interviewee similarly described good

decision-making as “finding a solution where no one gets overworked, but we still work coherently towards our team goals” (A0F). This suggests that organisational capacity is also an important condition shaping how new requirements are enacted. This interpretation is further shaped by identity and plausibility. The overarching goal of Lund Formula Student is building a fast and functional race car, while members develop as engineers. “People want to see the car go and people want to race” (C5X). Another participant states that “when you don't know what you're doing, then your priorities are just, like, trying to understand and I want to make this work. And, yeah, then other good engineering practices come later” (SOO).

Within this context, sustainability never appeared as a first-order or intuitive criterion for priorities or decision-making. At the same time participants did not reject sustainability, but rather subordinated it. One participant explained that “being sustainable is not our goal. Sustainable is something we would aim for if possible” (SOO) and “team focuses on designing something that is good, and then we find out how much carbon it is. We don't design it to be low carbon, because that's not our goal” (DG0).

Additionally, the CCBOM’s potential to shape sustainability-related understanding is weakened by its timing. Because the relevant subsystem is announced midway through the season, many design decisions have already been made or are difficult to reverse. As a result, the CCBOM is often enacted retrospectively. “I think it's not prevalent in the design, because the rules come out so late. So we can't, like, design having it in mind because we don't know which areas are going to be affected” (SOO). The CCBOM therefore becomes framed as part of competition work, engineering documentation or point-scoring. However, it does not manifest itself as something challenging dominant priorities or team identity.

The team’s interpretation of the CCBOM is shaped by retrospective cues from previous competition experience. Since Lund Formula Student scored “better than almost all of the teams in the world” (U8S) on the CCBOM last year, the existing approach was understood as successful and largely repeated in 2026. “I think the way we did it this year is similar to how they did it last year. And I think it worked well last year. So I think it was a natural continuation of an already proven concept” (S26). This helped retain the meaning of the CCBOM as a reporting requirement rather than as a design or decision-making tool: “It's a reporting tool. Well, because we manage, we have designed something, and then we take in people to do the CCBOM and no decisions are made based on it” (DG0). Once this interpretation is established, it feeds back into future enactment and selection, as members are more likely to notice cues that reinforce a performance and reporting-based understanding of the CCBOM. This is further supported by the team’s identity as a race-car engineering organisation.

5.3 CCBOM's Contribution to the Development of Sustainability Competencies within Lund Formula Student

The CCBOM contributed to the development of sustainability competencies among Lund Formula Student members in an uneven and partial way. It made sustainability more visible within the team and encouraged members to connect engineering work to carbon emissions, future industry expectations and the role of engineers in sustainability transitions. However, the tool did not strongly develop sustainability-oriented decision-making. Its educational value was limited by several barriers: carbon numbers were difficult to interpret without context, sustainability was understood in fragmented ways, members lacked prior theoretical knowledge and the CCBOM remained separated from everyday design practice.

Table 4. (see below) attempts to evaluate how the CCBOM developed each sustainability competency within the team. The strongest contribution was to the future-thinking competency, due to the broad agreement that the CCBOM would prepare members for future industry expectations. For example:

> I think it's a skill that in the future will be required more by industry, and just looking at the European Union, for example, they are speaking about carbon emissions tax. [...] So I think having people who can, in a practical environment, actually do these types of analysis will be a sought after skill [...] [and] will increase our chance of getting sponsors, and will be something sponsors ask of us. (A0F)

However, the CCBOM did not influence the future-thinking competency in terms of impacting decisions on a future Formula Student car, that is why I evaluated it as 'moderate' in Table 4.

The future-oriented awareness did not easily translate into other competencies. Regarding systems-thinking, members often recognised the CCBOM as sustainability-related, but struggled to explain how the carbon data should be interpreted or used. A participant explained that "I just don't think enough people are even aware of what that number means, and you don't have anything to put it into context. So it's just a number, and you're like, okay, good" (C5X). Similarly, U8S described: "like for me, it can just be a big number. [...] It's more or less just a surprise. I guess I don't really know how it impacts me, because I will still do this, even though it's a lot of emissions and stuff, but I do it anyway". These quotes suggest that the CCBOM made emissions visible, but carbon data remained abstract rather than actionable and visibility alone was not enough to develop a deeper systems understanding. Interviewee (A0F) explained this by saying:

> I think we would need to have more information in the team about how the industry actually does it, which I don't think the industry does it yet, so they don't know either. I think if the

> industry could tell us [...] [what to] prioritize [we would know what to do], but I don't think we can just tell the team to make a more sustainable car and lower carbon emissions.

A similar pattern appeared in relation to values-thinking. Sustainability was often explained through broad categories, such as feelings and past experiences, individual choices, continuity, environmental science, innovation, and above all it was understood through material efficiency, waste and reuse (see Appendix 2). However, when members were asked to explain what sustainability meant specifically within the team setting, it became harder to connect this general understanding to concrete practices. This lack of a shared and practical sustainability insight also explains why the CCBOM could increase awareness without becoming a decision-making tool. A participant said: “No, I think it might have shifted the team's focus a little bit to more sustainability, but nothing like decision making. Basically just making everyone a little bit more sustainability conscious” (HRU). This consciousness often remained difficult to translate into action: “I personally don't know how we would use that data” (SOO). Another interviewee summarised the issue more broadly: “environmental science, it's hard to see in the current scheme, where we would fit in a holistic environmental sustainability perspective within the organization” (LZK).

The values-thinking was reinforced by the team’s identity. A participant reflected that “but if we look at the overlap between race car interest and environmental [...] interest, I would think that overlap is pretty small. So [...] in the type of people we attract, we're not super aligned with this type of thinking” (LZK). Another interviewee expressed this distance clearly: “What I actually feel personally is it's just to take up time honestly. I mean, it's definitely a good thing to know about carbon emissions, I don't know exactly why [...]” (U8S). This weakens values-thinking because sustainability is not yet collectively translated into a shared internal purpose.

The development of the interpersonal competency was also limited, due to the fact that students lack the theoretical foundation for it, A0F stated that:

> I think one thing that also makes it hard to work with sustainability [...] [is that sustainability is not taught in a sufficient amount]. So if we were to implement sustainability [...] as some kind of core parameter, it would require teaching people a lot of theory in the beginning. [...] And my opinion is that the responsibility to teach sustainability to engineering students can't be just on us as a team, as the whole purpose is to help engineers turn theoretical knowledge into practical knowledge [...].

This points to a broader educational barrier of the CCBOM being introduced into a team expected to apply sustainability knowledge that many members had not developed. At the same time, the same

participant noted that sustainability integration cannot simply be solved by bringing in external expertise:

> And I think it's hard to be in a position where you need to implement change [...], which at a lot of industry companies would be the case where you need to teach maybe mechanical engineers or design engineers to think about sustainability when designing. And I think having an outside person who has never worked with design engineers and who don't understand that process come in and start dictating how they should design stuff without understanding the design culture or how a design workflow works [...] is a really hard ask [...].

Thus, among other things, interpersonal competency was constrained by the gap between sustainability knowledge and organisational practice.

Strategic thinking and integrated problem-solving were the weakest sustainability competencies developed. Strategic competence would require using the CCBOM to set priorities, compare alternatives and integrate carbon emissions data into design decisions. However, team values, workload, time pressure, weak guidance and distance from the CCBOM work limited this. The tool was appreciated, but did not yet offer a clear path to action. As A0F explained:

> I feel like how we approach competitions is a bit like how a lot of students at that age approach studying for their exams. You don't read the course plan and what the teacher says could come on the exam. You look at all the exams you can find, and then you see, what does the teacher actually put on the exam. [...] And I think for us, with cost, that's the same thing. [...]

Table 4. Evaluation of how the CCBOM developed each sustainability competency within Lund Formula Student (adapted from Brundiers et al., 2020, own table).

Competency	Strength	Explanation	Supporting quote
Futures-thinking	Moderate	The CCBOM developed future-oriented awareness by helping members see sustainability tools as relevant to future engineering work, regulation and industry expectations.	“The whole purpose of this project is to create better engineers. And engineers are those people that will hopefully work towards creating a better future for all, and that includes also a sustainable one, yeah, but I don't think the product in itself creates anything that's sustainable.” (QQ6)
Systems-thinking	Moderate	The CCBOM encouraged members to connect materials, manufacturing, carbon emissions, performance and design choices. However, these connections remained difficult to interpret because carbon numbers lacked context and were not clearly linked to design consequences.	“Showing people just how big their carbon footprint is, would be super beneficial […] But I think that the CCBOM is not the best at communicating that as it doesn’t really force you to put things into perspective.” (LZK)
Interpersonal	Moderate	The CCBOM required data collection across the team, but its work was separated from most members and weak knowledge-transfer. This limited collective learning and broader participation.	“This year, I thought I was going to be more involved with it, but I had so many other responsibilities that I had to drop it.” (HRU)
Values-thinking	Weak	The CCBOM signalled that sustainability matters, but it did not create a shared understanding of what sustainability should mean for the team or how it should be weighed against performance, cost and manufacturability.	“There are people who are very well intentioned and they want to be sustainable, but I don’t think that there’s a widespread understanding of how to make the team sustainable. [...] I want to be more sustainable. How do I actually do that? Who do I need to actually talk to, what things do I need to pay attention to?” (84H)

Integrated problem-solving	Weak	The CCBOM did not integrate systems analysis, future thinking, values reflection, collaboration and strategic action into a coherent process. It made sustainability visible but did not force members to develop solutions.	"If the industry could tell us what we should actually look out for to reduce our emissions in a feasible way […] then we could tell the team that, yes, this is what you should prioritize." (A0F)
Strategic-thinking	Absent	The CCBOM had potential to guide decisions, but in practice it was not used in design or decision-making.	"I personally don't know how we would use that data." (SOO)

6. Discussion

Organisational sustainability is increasingly framed as one of the most prominent system-level responses to environmental and social challenges, yet its implementation and impact often fails to create change (Nurani et al., 2025). Literature indicates that corporate sustainability initiatives frequently become decoupled from practice and align with weak sustainability implementation (Cepêda et al., 2025, Demastus and Landrum, 2024). The problem is therefore not only whether organisations adopt sustainability commitments, but also what they become in practice, what they should become to ensure strong sustainability implementation and how to bridge that gap (Redman et al., 2021). Hence, recent literature turns towards examining the micro-level, exploring how sustainability commitments are embraced through employees perceptions and behaviours (Bettker-Vasconcelos et al., 2025).

In this study I used sensemaking theory with institutional theory, to examine how the CCBOM was constructed, interpreted and enacted within Lund Formula Student and analyse how organisational conditions shape this process and its implications for education. The findings reveal a gap between the tool's intended purpose for sustainability learning and its outcome. The CCBOM is an example of how sustainability governance tools can be diluted, reinforce fragmented learning and performance-driven implementation, as they are shaped through existing routines, institutional pressures and organisational identities.

Shourkaei (2025) argues that in many cases the dominance of mainstream business logic constrains the possibility of strong sustainability. This case study supports this argument. Although the tool's value was recognised, it was largely interpreted through existing routines, organisational identities and institutional pressures, including performance, efficiency, cost, and scoring. In this context, competition points operated as the primary source of legitimacy just as profit does in corporations.

Focused on documentation and level of accuracy, rather than on achieving the lowest possible carbon footprint, the CCBOM centred on quantification and organisational control, rather than on substantive sustainability outcomes. To summarise, the tool became embedded as a form of weak sustainability rather than as an educational practice that could equip students to make more transformative sustainability decisions in their future professional roles.

6.1 Educational Intent does not Determine Practical Meaning

The world is in desperate need of professionals that can work with environmental and social challenges of the 21st century (Redman et al., 2021). A common response to this need is to call for more sustainability education (Nakad et al., 2024). This study supports this call, but also shows that the issue is more nuanced than simply placing emphasis on more 'active' educational content. By 'active' I mean the practical actions that target sustainability competencies, not just theoretical knowledge.

Sustainability governance tools must be understood within the broader educational environment in which they are taught and used. The educational significance of these tools lies not only in whether students can apply them correctly, but also what kinds of sustainability practices the tools make visible, usable and legitimate. This study finds that educational actions require careful attention to the forms of learning and professional practice they are likely to produce. In this case, the CCBOM only partly supported the development of sustainability competencies among students.

This finding aligns with broader sustainability education research. Lozano et al. (2017) points out that pedagogical approaches matter because different teaching methods develop different sustainability competencies and the same action can support different forms of learning depending on how it is encountered or embedded in strategy. Redman et al. (2021) show that assessing different sustainability competencies remains difficult precisely because these competencies involve combinations of knowledge, competencies, attitudes and applied judgement. More recent studies support this argument, suggesting that evaluation of sustainability competencies has expanded, but remains difficult to assess, especially in applied judgement (Nakad et al., 2024, Leal Filho et al., 2025, Valdes-Ramirez et al., 2024).

The findings of this study show that students learn through formal teaching but also pay close attention to what is rewarded, prioritised and normalised. The term 'hidden curriculum' helps explain this tension. Villanueva et al. (2018, p.1) define hidden curriculum as the "unwritten, unofficial, or unintended values, lessons, and perspectives that are present in academic settings and work environments." This is especially relevant, as it shows that students absorb implicit lessons

about what counts as legitimate engineering work, including which concerns are treated as central and which are treated as secondary. Additionally, Cech's (2014) work on engineering education argues that students' concerns for public welfare can decline when social and ethical responsibilities are positioned as external to 'real' technical work. The implication is that sustainability competencies within graduates leaving for their future careers must be developed to such a level that they ensure that governance tools are implemented at the design process early enough to shape decisions.

6.2 How Sustainability is Learned in the Present Shapes How it is Likely to be Enacted in the Future

Building on the previous point, literature suggests that when students learn to work with sustainability, they are not only doing it in the present, but they are also forming assumptions about where sustainability is placed in future professional practice. This aligns with research arguing that sustainability competencies in science, technology, engineering and mathematics (STEM) are important for lifelong learning and for helping future professionals understand the relationship between innovation and environmental, social and economic concerns (Valdes-Ramirez et al., 2024). This is important since many interviewees viewed the CCBOM as preparation for future engineering work. They grasped that the tool's purpose was to introduce best engineering practices, familiarise themselves with future industry expectations in which sustainability will become increasingly important.

This finding problematises the assumption that an experience of weak sustainability will naturally lead to it becoming a stronger version in the future. In other words, if the CCBOM is currently experienced as compliance-oriented reporting, it cannot be assumed that members will later reinterpret the same kind of practice as design or decision-making. Literature suggests that the way sustainability is encountered now may shape what members expect it to be in future professional contexts (Kucher et al., 2025). This argument is further supported by sensemaking and institutional theory, which together explain how a reporting-oriented understanding of sustainability can be carried forward. Sensemaking states that actors interpret new tasks through prior experience and familiar cues (Weick, 1995). Institutional theory outlines that formal organisational structures such as sustainability requirements can become institutionalised as legitimate practices while remaining decoupled from core work activities (Meyer and Rowan, 1977).

However, this carry-over from educational to professional environments can also have a positive effect. France et al. (2022) found that students who encountered sustainability topics in engineering courses were more likely to express career goals related to addressing those issues. Interestingly, a different study shows that recent engineering graduates may have both willingness and skills to

promote sustainability, while still lacking the workplace possibilities or power to take advantage of these capabilities (Vehmaa et al., 2018). Similarly, Karvinen et al. (2026) argue that engineering graduates are increasingly expected to already know how to work sustainability into their practices. The implication for this finding is that students may carry forward assumptions about where sustainability belongs and how it should be used and supported in professional practice.

6.3 Sustainability is Affirmed but Not Always Owned

A further point I would like to discuss is that in my research, students widely affirmed sustainability as important, but they struggled to translate it into role-specific responsibilities. The general support for sustainability actions rarely led to changes in how they approached their own work. This could mean that when framed as something that 'everyone' should care about, it may cause confusion and in practice become something that no one feels directly responsible for.

Research on corporate sustainability shows that organisations are more likely to act on sustainability responsibilities when they have been institutionalised. Institutionalised responsibility means that it has been integrated into the organisation, roles have clear responsibilities and actors know how these responsibilities fit into everyday work (Keil et al., 2025).

It is crucial to consider what choices are actually available within the actor's role. In the case of Lund Formula Student, a software manager does not choose carbon fiber, but may influence data management practices. A monocoque manager may influence resource choices, material use, reuse or waste. A sponsor may influence supplier information, packaging and sourcing. In this sense, responsibility should not be distributed uniformly or as moral expectations. Ownership emerges when employees understand their room for manoeuvre, what they can influence, where and how sustainability is relevant to their work and how they are expected to act in their position (Süßbauer et al., 2019).

Drawing on sensemaking theory, managers hold a special role because they influence not only workload and knowledge transfer, but also how members make sense of sustainability within the team. This point is reflected in Schaltegger et al.'s (2023) which argue that managers and employees play a vital role in advancing corporate sustainability since they hold the power to shape the organisational structures through which sustainability becomes actionable. This connects to Süßbauer et al. (2019), who emphasise that employees' everyday experience, within their own field, can generate practical knowledge valuable for sustainability transformation, but that this requires supportive organisational structures and culture.

6.4 Translation Through Locally Meaningful Criteria is Necessary but Insufficient

In this study, sustainability was best explained through criteria already embedded in engineering judgement, such as continuity, innovation, material efficiency, waste and reuse. This suggests that sustainability has a greater chance of being integrated into organisational strategy when it is framed through locally meaningful criteria and communicated in familiar language and, most of all, reward.

PwC's Global Sustainability Reporting Survey 2025 comes to a similar conclusion. Over the past decade, growing regulatory and stakeholder pressure to integrate sustainability into corporate strategy has caused many companies to discover a hidden value in sustainability reporting. Namely, companies that have implemented sustainability governance tools primarily for compliance reasons, uncovered a way they could more efficiently monitor excess use of energy and materials in the process of production (PwC, 2025b). This framing connects sustainability to the decision-making process in a way that organisational actors already recognised and accepted as relevant.

The recognition and acceptance is good because it provides a way for sustainability to enter organisational practices in which, otherwise, it would not. But unfortunately it is a form of weak sustainability. Bettker-Vasconcelos et al. (2025) found that weak implementation can initially create employee engagement and interest, but fails to sustain it due to the initiatives appearing inconsistent, symbolic, or disconnected from meaningful action. Therefore, weak sustainability can act as a 'seed for change' because it creates visibility, routines, learning and organisational capacity, but only if it allows actors to question and move beyond business-as-usual sustainability.

On the other hand, if these tools remain tied only to efficiency, performance and legitimacy they may instead lock organisations into weak sustainability. Many scholars support this point, critiquing weak sustainability as a pathway to diluting socio-ecological problems (Demastus and Landrum, 2024, Imbrogiano and Nichols, 2021, Shourkaei, 2025). Shourkaei (2025) highlights that this is evident in the business-case approach to sustainability, which justifies environmental and social action through economic benefit, captured in the claim "do well by doing good" (Falck and Heblich, 2007, p.247). This framing makes sustainability conditional on financial return and can obscure the need for more substantive change.

This study suggests that meaningful progress toward strong sustainability could depend not only on the design of governance tools, but also on how these tools are interpreted, communicated and justified by the actors responsible for implementing them. While literature does not present a uniform position on whether weak sustainability initiatives can support a transition toward strong sustainability, studies suggest that greater attention to the micro-level implementation of

sustainability requirements offers an important starting point. Postaire et al. (2024) show that attempts to manage strong sustainability through management control devices require ongoing interpretation of their purpose into practice, as well as deliberation on their short- and long-term consequences. Similarly, Apostol et al. (2021) highlight, in a business-to-business context, that sustainability communication can help connect sustainability with organisational practice, but only when actors actively interpret and negotiate what sustainability means in their specific context. Therefore, greater attention should be paid to the actors responsible for implementing sustainability governance tools. This includes examining what sustainability competencies they have and how they construct, enact and interpret sustainability requirements. Such attention could help identify why sustainability requirements are translated into practice in different ways. More effective sustainability governance requires clearer communication of purpose, role-specific training, interpretive support and organisational routines that help actors understand what sustainability means for their own decisions (Zaccone, 2025). However, further research is needed to better understand how these interpretive processes shape the movement from weak to stronger forms of sustainability integration.

7. Conclusion

This study highlights the importance of the human side of sustainability implementation and offers insights for policymakers, sustainability consultants, organisations and educators. Empirically, the study finds that: 1) The educational intent of sustainability requirements does not always determine their practical meaning, since such requirements enter organisational and learning environments through existing routines, identities, priorities, performance pressures and prior knowledge. 2) Students may carry forward assumptions about where sustainability belongs and how it should be used and supported in professional practice. It is therefore important that sustainability is introduced from the outset as part of decision-making, rather than as a secondary reporting task. 3) While sustainability is often affirmed as important, it is not always personally or organisationally owned. Organisations should therefore pay close attention to how they operationalise sustainability and create space for actors to develop and take responsibility for sustainability initiatives. 4) Translating sustainability through locally meaningful criteria can be an important entry point, but it is often insufficient on its own because it may reproduce weak sustainability implementation. To move toward stronger sustainability, sustainability requirements should be designed with attention to how they are likely to be constructed, interpreted and enacted in practice. An additional summary for Formula Student of the practical ideas resulting from this study can be viewed in Appendix 3.

8. References

Abo-Khalil, A. G. (2024). Integrating sustainability into higher education: Challenges and opportunities for universities worldwide. Heliyon, 10(9), Article e29946. https://doi.org/10.1016/j.heliyon.2024.e29946

Apostol, O., Mäkelä, M., Heikkilä, K., Höyssä, M., Kalliomäki, H., Jokinen, L., & Saari, J. (2021). Triggering sustainability communication in a B2B context: Combining action research and sensemaking. Accounting, Auditing & Accountability Journal. https://doi.org/10.1108/AAAJ-08-2019-4125

Awuah, B., Yazdifar, H., & Elbardan, H. (2024). Corporate reporting on the Sustainable Development Goals: A structured literature review and research agenda. Journal of Accounting & Organizational Change, 20(4), 617–646. https://doi.org/10.1108/JAOC-10-2022-0155

Benameur, K. B., Mostafa, M. M., Hassanein, A., Shariff, M. Z., & Al-Shattarat, W. (2024). Sustainability reporting scholarly research: A bibliometric review and a future research agenda. Management Review Quarterly, 74(2), 823–866. https://doi.org/10.1007/s11301-023-00319-7

Bettker Vasconcelos, C., Sanchez-Zeziaga, A., Henning, K., & van der Meer, Y. (2025). Evolving (dis)engagement: Analyzing employees' responses to sustainability initiatives through causal loop diagrams. Frontiers in Sustainability, 6, Article 1666622. https://doi.org/10.3389/frsus.2025.1666622

Beusch, P., Frisk, J. E., Rosén, M., & Dilla, W. N. (2022). Management control for sustainability: Towards integrated systems. Management Accounting Research, 54, Article 100777. https://doi.org/10.1016/j.mar.2021.100777

Bowen, H. R. (1953). Social responsibilities of the businessman. Harper & Brothers. https://ia601509.us.archive.org/20/items/in.ernet.dli.2015.126534/2015.126534.Social-Responsibilities-Of-The-Businessman.pdf

Braun, V., & Clarke, V. (2023). Thematic analysis. In H. Cooper, M. N. Coutanche, L. M. McMullen, A. T. Panter, D. Rindskopf, & K. J. Sher (Eds.), APA handbook of research methods in psychology: Vol. 2. Research designs: Quantitative, qualitative, neuropsychological, and biological (2nd ed., pp. 65–81). American Psychological Association. https://doi.org/10.1037/0000319-004

Brundiers, K., Barth, M., Cebrián, G., Cohen, M., Diaz, L., Doucette-Remington, S., Dripps, W., Habron, G., Harré, N., Jarchow, M., Losch, K., Michel, J., Mochizuki, Y., Rieckmann, M., Parnell, R., Walker, P., & Zint, M. (2021). Key competencies in sustainability in higher education—Toward an agreed-upon reference framework. Sustainability Science, 16, 13–29. https://doi.org/10.1007/s11625-020-00838-2

Carroll, A. B. (1999). Corporate social responsibility: Evolution of a definitional construct. Business & Society, 38(3), 268–295. https://doi.org/10.1177/000765039903800303

CDP. (n.d.). CDP: Turning transparency to action. Retrieved April 5, 2026, from https://www.cdp.net/en

Cech, E. A. (2014). Culture of disengagement in engineering education? Science, Technology, & Human Values, 39(1), 42–72. https://doi.org/10.1177/0162243913504305

Cepêda, C., Monteiro, A. P., & Aibar-Guzmán, B. (2025). Decoupling in sustainability reporting: A systematic literature review. Corporate Social Responsibility and Environmental Management, 32(3), 2988–3007. https://doi.org/10.1002/csr.3114

Commission Delegated Regulation (EU) 2023/2772 of 31 July 2023 supplementing Directive 2013/34/EU of the European Parliament and of the Council as regards sustainability reporting standards. (2023). EUR-Lex. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:02023R2772-20250101

Crick, R. D. (2008). Key competencies for education in a European context: Narratives of accountability or care. European Educational Research Journal, 7(3), 311–318. https://doi.org/10.2304/eerj.2008.7.3.311

Crutzen, N., & Herzig, C. (2013). A review of the empirical research in management control, strategy and sustainability. In L. Songini, A. Pistoni, & C. Herzig (Eds.), Accounting and control for sustainability (Vol. 26, pp. 165–195). Emerald Group Publishing Limited. https://doi.org/10.1108/S1479-3512(2013)0000026005

Demastus, J., & Landrum, N. E. (2024). Organizational sustainability schemes align with weak sustainability. Business Strategy and the Environment, 33(2), 707–725. https://doi.org/10.1002/bse.3511

Di Tullio, P., & Rea, M. A. (2025). Institutionalisation of sustainability in universities: Insights from strategic planning and sustainability reporting practices in Italian universities. Meditari Accountancy Research. https://doi.org/10.1108/MEDAR-05-2024-2467

Dickinson, E. (n.d.). Much madness is divinest sense. Bartleby. https://www.bartleby.com/lit-hub/complete-poems/life/xi-8/

DiMaggio, P. J., & Powell, W. W. (1983). The iron cage revisited: Institutional isomorphism and collective rationality in organizational fields. American Sociological Review, 48(2), 147–160. https://www.jstor.org/stable/2095101

EcoVadis. (n.d.). The global standard for resilient, sustainable supply chains. Retrieved April 17, 2026, from https://ecovadis.com/

Eitrem, A., Meidell, A., & Modell, S. (2024). The use of institutional theory in social and environmental accounting research: A critical review. Accounting and Business Research, 54(7), 775–810. https://doi.org/10.1080/00014788.2024.2328934

Elliott, R., Fischer, C. T., & Rennie, D. L. (1999). Evolving guidelines for publication of qualitative research studies in psychology and related fields. British Journal of Clinical Psychology, 38(3), 215–229. https://doi.org/10.1348/014466599162782

Epstein, M. J., Rejc Buhovac, A., & Yuthas, K. (2010, April). Implementing sustainability: The role of leadership and organizational culture. Strategic Finance, 91(10), 41–47.

www.proquest.com/scholarly-journals/implementing-sustainability-role-leadership/docview/229765119/se-2?accountid=12187

European Commission. (n.d.). Corporate sustainability reporting. Retrieved April 4, 2026, from https://finance.ec.europa.eu/financial-markets/company-reporting-and-auditing/company-reporting/corporate-sustainability-reporting_en

European Commission. (2022, July 26). Sustainable finance. https://ec.europa.eu/newsroom/fisma/items/754701/en

European Commission. (2023, July 31). The Commission adopts the European Sustainability Reporting Standards. https://finance.ec.europa.eu/news/commission-adopts-european-sustainability-reporting-standards-2023-07-31_en

Falck, O., & Heblich, S. (2007). Corporate social responsibility: Doing well by doing good. Business Horizons, 50(3), 247–254. https://doi.org/10.1016/j.bushor.2006.12.002

Feuls, M., Hernes, T., & Schultz, M. (2025). Putting distant futures into action: How actors sustain a course of action toward distant-future goals through path enactment. Academy of Management Journal, 68(2), 297–325. https://doi.org/10.5465/amj.2022.0257

Formula 1. (2026). 2026 regulations explained: All you need to know about F1's advanced regulations. https://www.formula1.com/en/latest/article/2026-regulations-explained-all-you-need-to-know-about-f1s-advanced.4h53Szn4Z3VsD6rGcR3LtU

Formula One World Championship Limited. (n.d.). Countdown to zero. Retrieved April 5, 2026, from https://corp.formula1.com/countdown-to-zero/

Formula Student Germany. (n.d.). Driving sustainability. Retrieved May 10, 2026, from https://www.formulastudent.de/fsg/about/driving-sustainability

France, J., Milovanovic, J., Shealy, T., & Godwin, A. (2022). Engineering students' agency beliefs and career goals to engage in sustainable development: Differences between first-year students

and seniors. International Journal of Sustainability in Higher Education, 23(7), 1580–1603. https://doi.org/10.1108/IJSHE-04-2021-0161

Frost, R. (2011, March). ISO 26000 on social responsibility: The essentials. ISO Focus+, 2(3), 10–13. https://iso26000.info/wp-content/uploads/2016/02/N011_-_ISOFocus_on_Soical_Responsibilty_Vol2_No3_March_2011_English.pdf

Gadomska-Lila, K., Sudolska, A., & Łapińska, J. (2024). The importance of green competencies in advancing organizational sustainability: The empirical perspective. Sustainable Development, 32(1), 1152–1169. https://doi.org/10.1002/sd.2729

Global Reporting Initiative. (n.d.). Who we are. Retrieved April 4, 2026, from https://www.globalreporting.org/about-gri/who-we-are

Gond, J.-P., Grubnic, S., Herzig, C., & Moon, J. (2012). Configuring management control systems: Theorizing the integration of strategy and sustainability. Management Accounting Research, 23(3), 205–223. https://doi.org/10.1016/j.mar.2012.06.003

Graduate Management Admission Council. (2024). Prospective students survey report 2024. https://www.gmac.com/market-intelligence-and-research/research-library/admissions-and-application-trends/2024-gmac-prospective-students-survey-summary-report

Greenhouse Gas Protocol. (n.d.). Corporate standard. https://ghgprotocol.org/corporate-standard

Halme, M., Rintamäki, J., Knudsen, J. S., Lankoski, L., & Kuisma, M. (2018). When is there a sustainability case for CSR? Pathways to environmental and social performance improvements. Business & Society, 59(6), 1181–1227. https://doi.org/10.1177/0007650318755648

IFRS Foundation. (n.d.). International Sustainability Standards Board. https://www.ifrs.org/groups/international-sustainability-standards-board/

Imbrogiano, J. (2021). Contingency in business sustainability research and in the sustainability service industry: A problematization and research agenda. Organization & Environment, 34(2), 298–322. https://doi.org/10.1177/1086026619897532

Imbrogiano, J., & Nichols, E. (2020). How to serve sustainability performance in businesses? An appetizing recipe to link practices to performance in business sustainability research. Business Strategy and the Environment, 30(4), 1610–1622. https://doi.org/10.1002/bse.2697

Institution of Mechanical Engineers. (n.d.-a). Formula Student. Retrieved April 5, 2026, from https://www.imeche.org/events/formula-student

Institution of Mechanical Engineers. (n.d.-b). The Formula Student challenge. Retrieved April 5, 2026, from https://www.imeche.org/events/formula-student/about-formula-student/the-challenge

Intergovernmental Panel on Climate Change. (2023). Summary for policymakers. In Climate change 2023: Synthesis report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change (pp. 1–34). https://doi.org/10.59327/IPCC/AR6-9789291691647.001

International Organization for Standardization. (n.d.). ISO 26000—Social responsibility. https://www.iso.org/iso-26000-social-responsibility.html

International Organization for Standardization. (2006a). ISO 14040:2006 environmental management—Life cycle assessment—Principles and framework. https://www.iso.org/standard/37456.html

International Organization for Standardization. (2006b). ISO 14044:2006 environmental management—Life cycle assessment—Requirements and guidelines. https://www.iso.org/standard/38498.html

International Organization for Standardization. (2018). ISO 14067:2018 greenhouse gases—Carbon footprint of products—Requirements and guidelines for quantification. https://www.iso.org/standard/71206.html

Jaramillo, P., Kahn Ribeiro, S., Newman, P., Dhar, S., Diemuodeke, O. E., Kajino, T., Lee, D. S., Nugroho, S. B., Ou, X., Hammer Strømman, A., & Whitehead, J. (2022). Transport. In P. R. Shukla, J. Skea, R. Slade, A. Al Khourdajie, R. van Diemen, D. McCollum, M. Pathak, S. Some, P. Vyas, R.

Fradera, M. Belkacemi, A. Hasija, G. Lisboa, S. Luz, & J. Malley (Eds.), Climate change 2022: Mitigation of climate change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change (pp. 1049–1150). Cambridge University Press. https://doi.org/10.1017/9781009157926.012

Karvinen, M., Sundman, J., Kaikko, A., & Keskinen, M. (2026). Working life relevance of sustainability-oriented engineering education and graduates' influencing possibilities: Insights from Finnish employers. European Journal of Engineering Education, 1–28. https://doi.org/10.1080/03043797.2026.2629871

Keil, M., Michaux, V., Ziefle, M., & Arning, K. (2025). Agents of sustainable change: The importance of leadership and responsibility in corporate sustainability. Frontiers in Sustainability, 5, Article 1490669. https://doi.org/10.3389/frsus.2024.1490669

Kucher, I., Hasling, K. M., & Ræbild, U. (2025). Sustainable design competences in action: Bridging educational and professional practices. In V. Clemente, G. Gomes, M. Reis, S. Félix, S. Ala, & D. Jones (Eds.), Learn X Design 2025. https://doi.org/10.21606/drslxd.2025.111

Kuh, G. D., Jankowski, N., Ikenberry, S. O., & Kinzie, J. L. (2014). Knowing what students know and can do: The current state of student learning outcomes assessment in U.S. colleges and universities. National Institute for Learning Outcomes Assessment. https://www.minotstateu.edu/Academic/_documents/assessment/Knowing-What-Students-Know-and-Can-Do.pdf

Leal Filho, W., Trevisan, L. V., Sivapalan, S., et al. (2025). Assessing the impacts of sustainability teaching at higher education institutions. Discover Sustainability, 6, Article 227. https://doi.org/10.1007/s43621-025-01024-z

Lozano, R., Merrill, M. Y., Sammalisto, K., Ceulemans, K., & Lozano, F. J. (2017). Connecting competences and pedagogical approaches for sustainable development in higher education: A literature review and framework proposal. Sustainability, 9(10), Article 1889. https://doi.org/10.3390/su9101889

Lund Formula Student. (n.d.). Lund Formula Student. Retrieved May 10, 2026, from https://lundformulastudent.se/

MacNeil, I., & Esser, I.-M. (2022). From a financial to an entity model of ESG. European Business Organization Law Review, 23, 9–45. https://doi.org/10.1007/s40804-021-00234-y

Meyer, J. W., & Rowan, B. (1977). Institutionalized organizations: Formal structure as myth and ceremony. American Journal of Sociology, 83(2), 340–363. https://doi.org/10.1086/226550

Mio, C., Panfilo, S., & Blundo, B. (2020). Sustainable development goals and the strategic role of business: A systematic literature review. Business Strategy and the Environment, 29, 3220–3245. https://doi.org/10.1002/bse.2568

Murga-Menoyo, M. Á. (2014). Learning for a sustainable economy: Teaching of green competencies in the university. Sustainability, 6(5), 2974–2992. https://doi.org/10.3390/su6052974

Nakad, M., Gardelle, L., & Abboud, R. J. (2024). A systematic review of the different methods assessing sustainability integration in engineering curricula. Sustainability, 16(11), Article 4549. https://doi.org/10.3390/su16114549

Nurani, M. D., Hardjono, R. K., Siscawati, M., et al. (2025). Exploring feedback structures to support systemic corporate sustainability transformation. Discover Sustainability, 6, Article 1329. https://doi.org/10.1007/s43621-025-02196-4

Paris Agreement. (2015). United Nations Framework Convention on Climate Change. https://unfccc.int/sites/default/files/resource/parisagreement_publication.pdf

Postaire, M., Jerman, L., & Alcouffe, S. (2024). “The seeds we grow will always need people to water them”: A study of strong sustainability management in an energy cooperative. Critical Perspectives on Accounting, 100, Article 102741. https://doi.org/10.1016/j.cpa.2024.102741

PwC. (2025a, March 20). PwC’s second annual state of decarbonization report: Essential ingredients for achieving your climate ambition. https://www.pwc.com/us/en/services/esg/library/decarbonization-strategic-plan.html

PwC. (2025b, October 3). PwC's global sustainability reporting survey 2025. https://www.pwc.nl/en/insights-and-publications/themes/sustainability/pwcs-global-sustainability-reporting-survey-2025.html

Rahman, M., Wahab, S. A., & Latiff, A. S. A. (2022). Definitions and concepts of organizational sustainability: A literature analysis. Society & Sustainability, 4(2), 21–32. https://doi.org/10.38157/ss.v4i2.496

Redman, A., Wiek, A., & Barth, M. (2021). Current practice of assessing students' sustainability competencies: A review of tools. Sustainability Science, 16, 117–135. https://doi.org/10.1007/s11625-020-00855-1

Rieckmann, M. (2012). Future-oriented higher education: Which key competencies should be fostered through university teaching and learning? Futures, 44(2), 127–135. https://doi.org/10.1016/j.futures.2011.09.005

Roberts, K. (2025). The 10 greatest innovations F1 has given the world. Formula 1. https://www.formula1.com/en/latest/article/the-10-greatest-innovations-f1-has-given-the-world.1fY8HvHkICzpj6s353iw82

Salmons, J. (2023, May 1). Participant observation. Sage Research Methods Community. https://researchmethodscommunity.sagepub.com/blog/131647

Schaltegger, S., Girschik, V., Trittin-Ulbrich, H., Weissbrod, I., & Daudigeos, T. (2023). Corporate change agents for sustainability: Transforming organizations from the inside out. Business Ethics, the Environment & Responsibility, 33(2), 145–156.

Science Based Targets Initiative. (n.d.). About us. https://sciencebasedtargets.org/about-us

Shourkaei, M. M. (2025). Going beyond the business case for sustainability: Main business-level shifts for pursuing strong sustainability. Journal of Cleaner Production, 518, Article 145905. https://doi.org/10.1016/j.jclepro.2025.145905

Sult, A., Wobst, J., & Lueg, R. (2023). The role of training in implementing corporate sustainability: A systematic literature review. Corporate Social Responsibility and Environmental Management, 31(1), 371–394. https://doi.org/10.1002/csr.2560

Süßbauer, E., Maas-Deipenbrock, R. M., Friedrich, S., Kreß-Ludwig, M., Langen, N., & Muster, V. (2019). Employee roles in sustainability transformation processes: A move away from expertise and towards experience-driven sustainability management. GAIA, 28(S1), 210–217. https://doi.org/10.14512/gaia.28.S1.7

Swalih, M. M., Ram, R., & Tew, E. (2024). Environmental management accounting for strategic decision-making: A systematic literature review. Business Strategy and the Environment, 33(7), 6335–6367. https://doi.org/10.1002/bse.3828

Tasdemir, C., & Gazo, R. (2020). Integrating sustainability into higher education curriculum through a transdisciplinary perspective. Journal of Cleaner Production, 265, Article 121759. https://doi.org/10.1016/j.jclepro.2020.121759

UNESCO. (n.d.). Education for sustainable development. Retrieved April 26, 2026, from https://www.unesco.org/en/sustainable-development/education

UNESCO. (2016). UNESCO Global Action Programme on Education for Sustainable Development: Information folder. https://unesdoc.unesco.org/ark:/48223/pf0000246270

UNESCO. (2020). Education for sustainable development: A roadmap. https://unesdoc.unesco.org/ark:/48223/pf0000374802

United Nations. (1992). Agenda 21: Results of the World Conference on Environment and Development. United Nations Conference on Environment and Development. https://www.un.org/esa/dsd/agenda21/Agenda%2021.pdf

United Nations General Assembly. (2015). Transforming our world: The 2030 Agenda for Sustainable Development (A/RES/70/1). United Nations. https://sdgs.un.org/2030agenda

Valdes-Ramirez, D., de Armas Jacomino, L., Monroy, R., & Zavala, G. (2024). Assessing sustainability competencies in contemporary STEM higher education: A data-driven analysis at Tecnologico

de Monterrey. Frontiers in Education, 9, Article 1415755. https://doi.org/10.3389/feduc.2024.1415755

Vehmaa, A., Karvinen, M., & Keskinen, M. (2018). Building a more sustainable society? A case study on the role of sustainable development in the education and early career of water and environmental engineers. Sustainability, 10(8), 2605–2623. https://doi.org/10.3390/su10082605

Villanueva, I., Carothers, T., Di Stefano, M., & Khan, M. T. H. (2018). “There is never a break”: The hidden curriculum of professionalization for engineering faculty. Education Sciences, 8(4), Article 157. https://doi.org/10.3390/educsci8040157

Weick, K. E. (1995). Sensemaking in organizations. Sage.

Weick, K. E. (2015). Karl E. Weick (1979), The social psychology of organizing, second edition [Review of the book The social psychology of organizing (2nd ed.), by K. E. Weick]. M@n@gement, 18(2), 189–193. https://doi.org/10.3917/mana.182.0189

Weick, K. E., Sutcliffe, K. M., & Obstfeld, D. (2005). Organizing and the process of sensemaking. Organization Science, 16(4), 409–421. https://doi.org/10.1287/orsc.1050.0133

Wiek, A., Bernstein, M. J., Foley, R. W., Cohen, M., Forrest, N., Kuzdas, C., Kay, B., & Withycombe Keeler, L. (2016). Operationalising competencies in higher education for sustainable development. In M. Barth, G. Michelsen, M. Rieckmann, & I. Thomas (Eds.), Handbook of higher education for sustainable development (pp. 241–260). Routledge. https://www.researchgate.net/publication/283295405

Wiek, A., Withycombe, L., & Redman, C. L. (2011). Key competencies in sustainability: A reference framework for academic program development. Sustainability Science, 6, 203–218. https://doi.org/10.1007/s11625-011-0132-6

World Commission on Environment and Development. (1987). Our common future. United Nations. https://digitallibrary.un.org/record/139811?v=pdf

World Economic Forum. (2025). The future of jobs report 2025. https://www.weforum.org/publications/the-future-of-jobs-report-2025/

Zaccone, M. C. (2025). Making different sense of corporate sustainability reporting directive: Emotion, identity and divergent professional pathways. Sustainability Accounting, Management and Policy Journal. https://doi.org/10.1108/SAMPJ-05-2025-0653

9. Appendix

Appendix 1. Interview guide

- **Professional role:**
  - Can you describe your role in the team this season and what you are mainly responsible for?
  - What kind of decisions do you typically make or are involved in?
    - Follow-up: Can you give me an example of such a decision?
  - When you think about building a car in an FS setting, what usually counts as a 'good decision' in your area?
    - Follow-up: Why is this a good decision? If you had to name it with one word, what criterion matters most that makes a good decision?
- **Sustainability**
  - What is sustainability for you?
  - In your opinion, does sustainability show up in the team in any way? How?
    - Follow-up: If participant confused, I say: In many teams, sustainability requirements are handled in different ways. In some cases, they mainly show up as documentation tasks. In others, they become part of technical discussions. And sometimes sustainability plays a completely different role, or isn't considered at all.

- Follow-up: Do you see sustainability considerations as something everyone in the team should engage with, or mainly something connected to a specific situation or role?

➢ Can you think of a way sustainability plays a role in your daily responsibilities?

❖ **CCBOM**

➢ Recently the competition introduced the Costed Carbonised Bill of Material. It's a part of the cost and manufacturing event, within the static disciplines. Have you heard about it?

- Follow-up: If yes: What did you understand it to be for? If participant confused, I say: How was the CCBOM positioned in the team that made it less visible to you?
- Follow-up: How has gathering the data been different for the CCBOM compared to your previous experience?
- Follow-up: In your opinion, does the CCBOM compare to the BOM?

➢ Do you feel like you're involved in the CCBOM process in any way?

- Follow-up: What emotion comes to mind when you think about it (the CCBOM)?
- Follow-up: What systems, or processes or competences were already in place when you found out you will have to start preparing the CCBOM, and what needed to be built from scratch?

➢ **In your view, what is the main purpose of the CCBOM?**

➢ If you had to decide, is it mainly for internal use or external use?

➢ Is it more of a reporting tool or decision making tool?

- Follow-up: Can you think of a concrete example where the CCBOM influenced (or did not influence) a decision?

- Is it (the CCBOM) worked on alongside the entire process of building a car throughout the year or at a specific stage?
- How does it (the CCBOM) relate to the team's core priorities?
- Looking ahead, do you think it (the CCBOM) could play a bigger role within the team in the future? In what way?
    - Follow-up: Do you think the CCBOM could help shape the LFS strategy, culture or competitive positioning? How?
- What kind of support or resources would make the biggest difference?
- Did the CCBOM change how you think about sustainability in the team?
- If insights about major costs and materials/car parts/processes that generate a disproportionately high amount of carbon emissions were documented and passed on to next year’s team members, do you think that could influence future design decisions?
- Would sustainability be something you would consider when getting a future job/ in what way?
- Is there anything you would like to add?

Appendix 2. Thematic Analysis Framework: Final Codes, Subthemes and Themes

Theme	Subtheme	Code
Team priorities	**External pressures**	Performance
		Cost
		Time
	Internal pressures	Compromise
		Communication
		Workload
CCBOM understanding	**Embedding the CCBOM into existing team routines**	CCBOM entering into the team
		CCBOM within team practice
		CCBOM understood as an extension of previous reporting
	Competition logic	Collective sensemaking
		Points as primary motivation
Education and future industry	**Best engineers**	CCBOM developing competencies
	Industry and regulation	It prepares students for future regulation and industry change
Emotions	**Negative emotions**	Burden annoyance dread
		Discomfort guilt anxiety
	Neutral emotions	Neutral emotions
	Positive emotions	Pride and respect
Knowledge transfer and continuity	**No internal strategy for sustainability**	Data is not converted into strategy
		Weak knowledge transfer for sustainability
		Confusion on what sustainability is in team setting
	Opportunities	Recognising the tools value
		Interest to create change
CCBOM vs team priorities	**External evaluation (judges)**	Teams follow judge signals more than rule intent

	CCBOM as reporting tool	Carbon reporting happens after design decisions
		Internal potential remains unrealised
		Documentation task
		CCBOM contributing to points
Team culture and identity	**No financial incentive value lies elsewhere**	No financial incentive
		Value lies elsewhere
	Team culture	Team values
		Sustainability vs team identity
Barriers for better integration	**Sustainability in the background**	Team values and structure as integration barriers
		People feel distant from CCBOM work
	Time and workload	Workload
		Limited time
	Knowledge and capability gaps	Stronger rules or incentives are needed
		Teams lack practical guidance and examples
	Financial barriers	Lack of finance for sustainability improvements
	Temporal barriers	CCBOM enters mainly during manufacturing
		CCBOM work is left until the end
Understanding sustainability	**Disengagement**	Carbon numbers feel abstract without context
	Role of sustainability	Understood through feelings and past experiences
		Understood through individual choices
		Understood through continuity
		Understood through environmental science
		Understood through material efficiency, waste and reuse
		Understood through innovation
		Sustainability in team context
Future job	**Relation to sustainability**	Pay most important but yes
		Pay most important do not care

Appendix 3. Summary for Formula Student of the Practical Ideas Resulting from this Study

The recommendations presented in this appendix are based on my own analysis and conclusions and should not be interpreted as representing the views or position of Lund Formula Student. They focus specifically on the environmental dimension of the CCBOM, as this is the area examined in this study. This does not imply that the cost or manufacturing dimensions are less important, but they fall outside the scope of this research.

Welcome!

The aim of this section is to explore how changes to the Formula Student CCBOM rules could make the environmental part more useful and practical for teams. I find the introduction of the CCBOM really exciting, because it opens the competition to students from new areas and shows that sustainability can be part of engineering, rather than something added to it afterwards!

This study suggests that rules do not only teach teams how to follow rules. They also shape what students understand as 'best engineering practices' and these ideas can follow them into their future careers. That is why it matters how sustainability is introduced from the beginning.

Formula Student is a high-impact learning environment. A rule change does not only change a score, it changes what students practise, what teams make visible and what industry sees as valuable in future engineers. Based on this, I prepared some practical recommendations for improving the environmental side of the CCBOM:

Make the purpose of the CCBOM clearer

In Formula Student's official communication (websites, social media, rules and handbooks), the CCBOM should be presented not as a carbon accounting form, but as a tool for sustainability governance and, in the bigger picture, climate mitigation.

A clearer objective could be: use the CCBOM to identify carbon hotspots and justify one real engineering decision that reduced or managed emissions.

This would make the purpose of the CCBOM more practical. Teams would not only submit a form with numbers, but also show how the numbers helped them think about design.

Add a mandatory 'CCBOM Design Decision' section

Each team could be asked to present one design decision influenced by cost-carbon analysis.

For example, they could explain:

- what design options they compared,
- what the cost and carbon differences were,
- what trade-offs existed between carbon, cost, mass, performance and manufacturability,
- why they chose their particular option.

This would make the CCBOM more similar to Engineering Design, where teams are expected to present and defend their engineering decisions. It would also make the environmental part more educational and harder to treat as only a spreadsheet task.

Create a short carbon and cost design defence

Building on the previous point, a practical option would be to include a short CCBOM discussion inside Cost and Manufacturing.

Suggested structure:

Part	**Content**
3-minute intro (as it is now)	Total cost, total CO_2e
Vehicle audit (as it is now)	Judges pick parts on the car and ask teams to locate them in the BOM and vice versa
Hotspot defence	Team explains why the largest emission sources are high and what alternatives were considered
Design trade-off	Team defends one real decision involving carbon and cost or mass or manufacturability or performance
Reflection	Team explains what it would improve next year

Keeps the existing judging structure, but makes the discussion more focused on design reasoning.

Standardise the CCBOM sheet and emission factors

If the goal is to connect emissions to design decisions, the rules should make this behaviour easier for teams. One option would be to reduce the time teams spend searching for emission factors by providing a standardised, basic emission factor library, so teams can focus more on understanding and justifying their design choices.

Suggested structure:

Data type	Suggested rule
Common materials	Use official default factors
Common processes	Use official default factors
Sponsor-specific data	Allowed if well documented
Unknown data	Use conservative default values
Deviations	Must be explained and justified

This would improve comparability between teams and reduce ‘source hunting’. Teams could still be rewarded for better evidence, but the main focus would move toward understanding and defending design decisions.

Keep the focus on calculation quality

Currently, teams are scored not on the ‘size’ of the CO_2 number, but on how reasonable and credible it is. I support this approach. The lowest carbon number should not become the main basis for scoring, because this could encourage teams to leave things out, rely on weak assumptions or benefit from narrow scope and system boundaries.

However, the final carbon result should still matter, because reducing emissions is part of the purpose of sustainability governance tools in professional practice.

A balanced scoring approach could include completeness of scope, quality of calculations, quality of sources, understanding of hotspots, quality of cost-carbon trade-off reasoning and the final emissions result, but with a minimal weighting.

This way, it would keep the carbon number visible, but would not let it dominate the judging.

Make best practices visible

The CCBOM should not disappear into judging files after the event. If good examples are made visible, other teams can learn from them.

Formula Student could publish anonymised insights after the competition, such as average CO_2e per system taken under account the given year, most common hotspots, common mistakes and best ‘carbon design decision’ case studies.

This would make sustainability learning visible across teams and help turn good practice into something others can copy and improve.