POLITECNICO
MILANO 1863

SCUOLA DI INGEGNERIA INDUSTRIALE
E DELL'INFORMAZIONE

How Sustainability Becomes Embedded in Universities: The Case Study of Cantieri della Sostenibilità

TESI DI LAUREA MAGISTRALE IN
MANAGEMENT ENGINEERING
INGEGNERIA GESTIONALE

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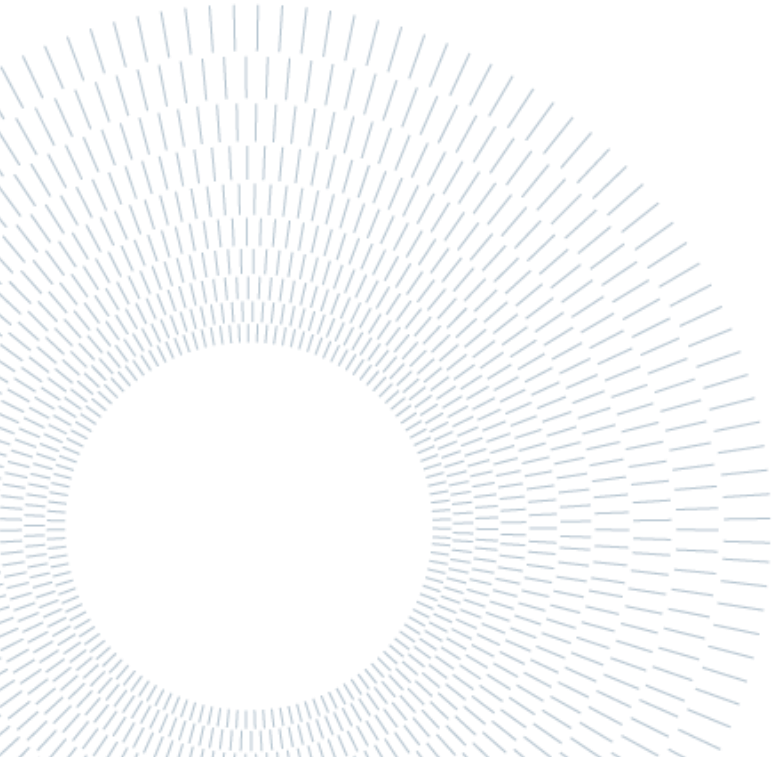
Academic Year: 2025-26



Abstract

Universities are increasingly expected to play a proactive role in advancing sustainable development. While much research has studied sustainability in higher education through curricular development and institutional strategies, less attention has been given to understanding how sustainability becomes embedded within university organizations. In particular, the internal mechanisms through which engagement and collective leadership support sustainability embedment remain underexplored.

This thesis addresses this gap by investigating the enabling factors of engagement and collective leadership for sustainability within university contexts. The study adopts a dual methodological approach. First, a benchmarking analysis of selected international universities is conducted to identify recurring patterns in sustainability embedment across governance, curriculum, operations, research, and outreach. Second, an in-depth case study of Politecnico di Milano is developed, focusing on the Cantieri della Sostenibilità initiative as a participatory structure for sustainability. The empirical analysis combines survey data, focus groups, and qualitative document analysis.

The findings show that sustainability embedment in universities depends on the interaction between four main dimensions: the cultural positioning of sustainability as a shared institutional value, distributed but structured leadership, organized engagement mechanisms that connect individual motivation to institutional processes, and the selective stabilization of practices over time. The Cantieri case shows that sustainability does not become embedded only through strategic declarations, but through organizational arrangements that connect governance, participation, and recurring practices. At the same time, though, embedment remains uneven across domains and continues to evolve.

Overall, this thesis shows that sustainability embedment should be understood as an organizational process. In doing so, it adds to existing research on sustainability in higher education and provides reflections that may support universities in strengthening their internal sustainability practices.

Key-words: Sustainability embedment, Higher education institutions, Distributed leadership, Organizational engagement, Routinization

Abstract in italiano

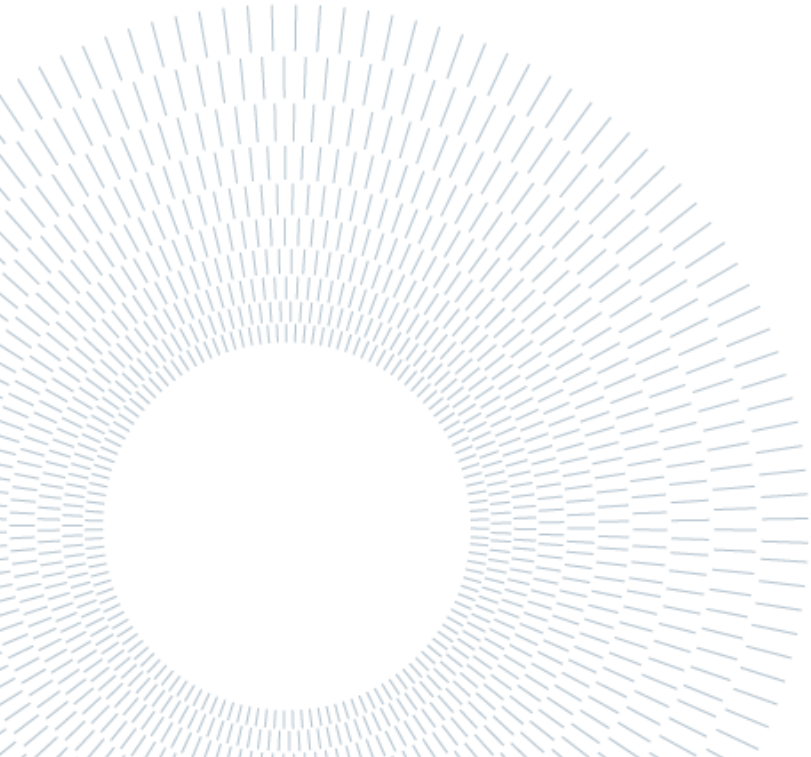
Le università sono sempre più chiamate a svolgere un ruolo attivo nella promozione dello sviluppo sostenibile. Sebbene la letteratura abbia analizzato ampiamente la sostenibilità nell'ambito dell'istruzione superiore in termini di innovazione dei percorsi formativi e strategie istituzionali, minore attenzione è stata dedicata a comprendere come la sostenibilità venga effettivamente integrata in modo strutturale all'interno delle università. In particolare, rimangono ancora poco approfonditi i meccanismi interni attraverso i quali il coinvolgimento delle persone e le forme di leadership collettiva contribuiscono a questo processo organizzativo.

Questa tesi affronta tale lacuna indagando i fattori abilitanti dell'engagement e della leadership collettiva per la sostenibilità nei contesti universitari. Lo studio adotta un doppio approccio metodologico. Da un lato viene condotta un'analisi di benchmarking su un gruppo selezionato di università internazionali con l'obiettivo di individuare le modalità più ricorrenti di integrazione della sostenibilità nei principali ambiti organizzativi: governance, didattica, attività operative nei campus, ricerca e relazioni con il territorio e ingaggio degli stakeholder. Dall'altro, viene sviluppato un caso studio approfondito sul Politecnico di Milano, con particolare attenzione ai Cantieri della Sostenibilità, intesi come struttura partecipativa finalizzata a favorire l'integrazione della sostenibilità all'interno dell'Ateneo. L'analisi empirica integra dati provenienti da survey, focus group e documentazione qualitativa.

I risultati mostrano che l'integrazione della sostenibilità nelle università dipende dall'interazione tra quattro dimensioni principali: il radicamento culturale della sostenibilità come valore istituzionale condiviso; una leadership distribuita ma al tempo stesso strutturata; meccanismi di engagement organizzati, capaci di collegare la motivazione individuale ai processi istituzionali; e la progressiva stabilizzazione di alcune pratiche nel tempo. Il caso dei Cantieri evidenzia come la sostenibilità non si consolidi solo attraverso dichiarazioni strategiche, ma attraverso assetti organizzativi che mettono in relazione governance, partecipazione e pratiche ricorrenti. Allo stesso tempo, l'integrazione rimane differenziata tra ambiti e continua ad evolversi nel tempo.

La tesi propone dunque di interpretare l'integrazione della sostenibilità come un processo organizzativo in continua trasformazione. In questo modo, contribuisce al dibattito sulla sostenibilità nell'istruzione superiore e offre spunti utili per le università che vogliono rafforzare e rendere più stabili le proprie pratiche interne in materia di sostenibilità.

Parole chiave: Integrazione della sostenibilità, Università, Leadership distribuita, Partecipazione organizzativa, Stabilizzazione delle pratiche



Contents

1 Introduction

1.1. Why Universities Play a Central Role in Addressing Sustainability Issues

Universities have always been places where knowledge is created and shared, but even more importantly, they are spaces where people learn how to take responsibility for the world around them. Their role as educators goes beyond technical training and increasingly involves shaping values, mindsets, and a sense of responsibility among students and staff. In this sense, academic institutions play a key role in enabling individuals to act as agents of positive change. To fulfil this role, universities continuously engage with innovation and knowledge renewal, seeking to generate value not only for their internal communities but also for society at large.

In the current context, marked by increasingly pressing environmental and social challenges, a growing number of organizations including companies, financial institutions, public administrations, and universities are recognizing the need to integrate sustainability into their strategies and everyday operations. This shift often entails a deeper cultural and organizational transformation, which may be driven by regulatory pressures, market expectations, or more intentional and value-driven commitments.

Universities particularly are increasingly called upon to assume a proactive role in advancing sustainable development by accelerating innovation and guiding it toward more sustainable and equitable futures. However, unlike private organizations, whose sustainability strategies are often shaped by market competition and regulatory compliance, universities operate according to different logics and missions. Understanding the specific organizational drivers that shape how universities engage with sustainability therefore requires closer examination.

1.2. Universities as Sustainability-Driven Organizations

Universities are increasingly developing initiatives and practices aimed at creating a shared commitment to sustainability within their organizations. This shared orientation is relevant not only for institutional reputation and positioning, but also for supporting a deeper cultural shift toward more sustainable ways of operating. In

this perspective, sustainability becomes intertwined with how universities define their mission, organize their activities, and engage with their communities.

Academic institutions adopt different approaches to sustainability, which take diverse organizational forms. Some focus on engaging stakeholders such as students, faculty, businesses, and policymakers in sustainability-related initiatives. Others emphasize the integration of sustainability into educational programs through courses, research projects, and extracurricular activities that promote environmental and social responsibility. In addition, some universities experiment with organizational models or structures dedicated to sustainability, which may operate as autonomous units or be integrated into existing academic and administrative systems. The specific configuration through which sustainability is embedded often reflects broader institutional priorities and values, and shapes how sustainability is translated into practice.

1.3. Research Gap

Over the past two decades, research on education for sustainability has expanded significantly. Many studies have explored how sustainability can be integrated into teaching and learning, often focusing on curriculum development, competences for sustainable development, and innovative pedagogies that support systemic and critical thinking [1], [2]. This stream of literature has helped position universities as protagonists in shaping the values and skills of future generations.

However, much of this research continues to describe universities primarily as educational providers more than as complex organizations with internal governance structures, leadership arrangements, and routinized practices. Teaching and research represent central pillars of university missions, but they do not fully explain how sustainability becomes embedded at the institutional level. Questions related to how initiatives are governed, how leadership is exercised in practice, and how activities reach operational stabilization remain comparatively underexplored [3], [4].

Within this broader gap, limited attention has been paid to the organizational processes through which sustainability is enacted. Engagement and collective leadership are frequently presented as important elements of sustainability transitions, yet they are rarely examined as mechanisms through which initiatives are coordinated, sustained, and routinized [5]. Existing case studies often privilege strategic intentions or observable outcomes, while offering less insight into how leadership is distributed, how engagement is organized, and how sustainability-related activities gradually evolve into stable routines. As a result, the organizational and relational foundations that support sustainability (leadership, participation, coordination, and routinization) remain insufficiently visible in the academic debate.

Specifically, some tensions need to be further explored by the existent literature. A first tension concerns the gap between strategic commitment and operational stabilization. Universities often adopt sustainability declarations and strategic plans, but they struggle to translate them into routinized and embedded practices within everyday organizational processes. This conflict reflects challenges of institutionalization and partial implementation in higher education contexts [3], [4].

A second tension emerges between intrinsic motivation and organizational structures. Sustainability initiatives frequently rely on the commitment and values of engaged individuals, but without supportive governance mechanisms and structural reinforcement, motivation alone may not ensure continuity over time [6], [7].

A third tension relates to distributed leadership and coordination. While collective and distributed leadership models are widely discussed as suitable for pluralistic organizations such as universities, their effectiveness depends on coordination mechanisms capable of generating alignment and shared direction [8], [9].

These tensions suggest that sustainability embedment cannot be conceived as a linear progression from strategy to action, but as a dynamic process that needs to be deepened.

This thesis addresses this gap by examining how sustainability becomes embedded within a university organization through the interaction of leadership, engagement, and routinization. Focusing on the Cantieri della Sostenibilità initiative at Politecnico di Milano, the study investigates how leadership extends beyond formal hierarchies, how engagement is structured and experienced by participants, and how sustainability-related practices gradually stabilize (or do not stabilize) within organizational processes. In doing so, the thesis contributes to a more grounded understanding of sustainability embedment in higher education institutions.

1.4. Research Question

The gaps identified in the literature point to the need for a deeper understanding of how sustainability is embedded not only through formal strategies or structural reforms, but also through the everyday actions of the people involved. While many universities have begun to integrate sustainability into teaching, research, and operational activities, less is known about how staff, students, faculty members, and administrative personnel engage with these goals in practice, and how leadership enacted, or contested, in this process.

Universities are complex and multi-layered organizational systems, where change does not emerge only from top-down decisions, but also from collaborative efforts and informal roles. In this context, engagement cannot be reduced to simple participation. Rather, it reflects how individuals perceive their role within the organization, whether

they feel included in decision-making processes, and how they connect their personal values and competencies with institutional sustainability ambitions.

Against this background, this thesis explores the following research question:

What are the enabling factors of engagement and collective leadership for sustainability within university organizational systems?

Although the question focuses on enabling factors, the analysis also considers the conditions that weaken or obstruct engagement and collective leadership over time. The study therefore considers sustainability embedment not only as a process of activation, but also as a process exposed to misalignment, and declining commitment over time.

The aim is to better understand the conditions that allow, or prevent, individuals to feel meaningfully involved in sustainability initiatives, and to contribute to shaping the institution from within. By focusing on the lived experiences of those involved in the Cantieri della Sostenibilità initiative at Politecnico di Milano, the research seeks to understand how engagement and shared leadership emerge in practice, and which factors support or hinder their effectiveness in real organizational contexts.

1.5. Structure of the Research

The thesis is structured into six chapters, each addressing a specific step of the research process. Chapter 1 introduces the topic and defines the research question, by discussing the role of universities in addressing sustainability, the existing gap in the literature concerning universities as organizations, and the limited attention devoted to the people and internal processes that shape how sustainability is implemented in practice.

Chapter 2 presents the theoretical framework of the study. It begins with a discussion of the culture of sustainability as a general framing perspective, and then focuses more specifically on the concepts of leadership, engagement, and routinization, which provide the main analytical lenses adopted in the research.

Chapter 3 explains the methodological approach, describing the research design, the data collection methods, and the analytical strategy used to interpret the empirical material.

Chapter 4 presents the empirical findings that emerged from the case study.

Chapter 5 discusses these results in light of the theoretical framework and reflects on their broader implications.

Finally, Chapter 6 draws the main conclusions and outlines possible directions for future research.

2 Literature background

2.1. Sustainability as a Core Value in Organizational Culture

The growing relevance of sustainability in organizational agendas has gradually shifted attention from isolated initiatives and actions mainly driven by compliance to broader questions related to values and organizational purpose. In this view, sustainability is not only treated as a strategic objective or an operational requirement, but it increasingly becomes part of the organization's culture. Organizational culture, understood as the set of shared assumptions and values that guide collective behavior, represents the context through which sustainability gains meaning and legitimacy within organizations [10], [11].

Research in organizational theory shows that culture influences how members understand what is important inside the organization, and this also affects how they respond to change [10], [12]. When sustainability becomes part of these shared meanings, it begins to influence everyday decisions and behaviors, shaping how people see their role within the organization and how they connect their work to broader societal goals [7], [13]. In this sense, sustainability contributes to defining organizational identity and purpose, and it gradually becomes integrated into ordinary practices.

Studies on sustainability and organizational values suggest that change is more likely to persist when sustainability is perceived as meaningful in itself and not only as a reaction to external pressures [14], [15]. Organizations that integrate sustainability into their core values tend to move beyond symbolic adoption and develop more coherent forms of change. This helps explain why organizations operating under similar regulatory or competitive conditions may follow different paths in embedding sustainability, since the difference often depends on how sustainability is interpreted and internalized within the organization [16], [17].

Within this perspective, sustainability is also described as a process of sense-making that helps members deal with complexity and competing demands [12], [18]. Through these processes, sustainability becomes connected to organizational identity and to shared narratives about who the organization is and what it stands for [19]. This dimension becomes particularly relevant in contexts where different expectations coexist, and coordination depends on a shared understanding of priorities.

When this cultural perspective is applied to universities, it becomes even more relevant. Universities are complex organizations with decentralized authority and strong professional autonomy, and they often include different institutional logics that coexist [20], [21]. In these settings, sustainability cannot be embedded only through formal mandates or central decisions but needs to be interpreted and enacted across different groups, including faculty members, administrative staff, students, and external actors. Viewing sustainability as a shared value helps explain how initiatives gain legitimacy and continuity in environments where hierarchical control is limited [4], [22].

Recent research on sustainability in higher education highlights this cultural dimension and shows that sustainability is described not only as a set of policies or projects, but as a commitment that influences teaching, research, governance, and everyday practices [23], [24]. The extent to which sustainability becomes embedded depends on whether it is recognized as part of the institution's mission and identity, and not simply treated as an additional concern [25], [26]. In this view, universities can be seen as institutions where sustainability contributes to shared interpretations that connect individual motivations with institutional goals [27], [28].

At the same time, embedding sustainability as a cultural value is not automatic and does not follow a linear path. Universities often face tensions between existing performance systems, disciplinary structures, and new sustainability ambitions, and these tensions may lead to fragmented initiatives or superficial adoption when sustainability is perceived as externally imposed [6], [29]. Understanding sustainability as a cultural process allows these dynamics to be interpreted as part of ongoing value negotiation within complex organizations [10], [30].

Overall, framing sustainability as a core value within organizational culture provides the foundation for understanding how sustainability change develops inside universities. Sustainability becomes durable not only through strategies or formal structures, but through how organizational members interpret it and integrate it into everyday practices [16], [31]. This perspective prepares the ground for the following sections, which focus on leadership, engagement, and routinization as mechanisms through which sustainability becomes more stable over time.

2.2. Leadership for Sustainability

As universities face growing societal expectations to respond to complex sustainability challenges, leadership has increasingly been recognized as an important driver of organizational change. In this context, leadership goes beyond formal authority and positional power and includes the processes through which direction and commitment are created within the organization [8], [9], [32]. Embedding sustainability in higher education institutions therefore requires leadership approaches that can adapt to institutional complexity and involve different actors.

Traditional models of leadership in higher education have often focused on individual and hierarchical figures, typically located in senior management roles [9], [33]. While these models may support strategic vision, they are less suited to sustainability, which crosses disciplinary and organizational boundaries. Universities are pluralistic organizations with dispersed authority and strong professional autonomy, and centralized control is often difficult to sustain over time [33]. In this context, leadership for sustainability shifts from individual authority to collective capacity developed across different groups.

An important contribution to this shift is offered by the direction, alignment, and commitment framework, which understands leadership as something that emerges from coordinated action and not as a quality possessed by a single leader [8]. From this perspective, leadership takes place when members create shared understanding and coordinate their efforts around common goals. This approach fits well with sustainability processes, where progress depends on the involvement and alignment of multiple actors.

For this reason, distributed leadership has become a relevant perspective in studies of higher education. It highlights the idea that leadership capacity is spread across different levels of the organization, including faculty members, administrative staff, students, and external stakeholders [34], [35], [36]. This view is consistent with academic norms of collegiality and participation, and it offers a way to deal with organizational complexity. At the same time, distributed leadership is not always stable, especially in environments where performance evaluation and accountability systems reinforce individual competition [9].

Relational perspectives add another dimension by describing leadership as something that develops through interaction and shared interpretations. Leadership is expressed through language and everyday communication, and not only through formal roles [37]. In sustainability contexts, this means that sustainability must be discussed, interpreted, and connected to shared values if it is to guide action in a meaningful way.

Empirical research on change processes in sectors such as healthcare and education shows that collective leadership often develops through negotiation and temporary agreements among actors with different interests [33]. These alignments are rarely permanent and tend to evolve over time as actors reinterpret goals and adjust their positions. Leadership, in this sense, involves continuous effort to maintain coordination and shared direction.

Within sustainability processes, leadership therefore operates more as a condition that enables action than as a tool of control. It supports participation and helps connect fragmented initiatives across the organization. Leadership becomes effective when it creates shared purpose and sustains commitment, especially in situations characterized by uncertainty [8], [9].

In sum, leadership for sustainability in universities can be understood as a collective and relational process that supports organizational learning and coordination. By encouraging participation and facilitating alignment, leadership creates the conditions under which engagement can grow and sustainability initiatives can become more stable over time.

2.3. Engagement for Sustainability

As universities increasingly integrate sustainability into their strategic agendas, engagement has become an important mechanism through which sustainability values are translated into collective action. Engagement goes beyond formal participation or simple compliance and involves relational and cognitive processes that allow individuals and groups to contribute actively to organizational change [38], [39], [40]. In higher education institutions, engagement represents one of the main ways through which sustainability becomes shared and socially embedded.

Engagement cannot be reduced to isolated activities or occasional initiatives. It develops through sustained interactions that support mutual learning and shared ownership of sustainability goals [41], [42]. For this reason, engagement operates across different areas of the university, including teaching, research, governance, and relations with external actors. Through practices such as service-learning and community-based research, universities experiment with forms of engagement that question traditional boundaries between academic and non-academic knowledge [42], [43].

This broader perspective presents sustainability as a social and organizational process, and not only as a technical or environmental issue. Engagement creates spaces where different forms of knowledge are recognized and discussed, allowing sustainability practices to become more inclusive and more connected to specific contexts [41], [44]. In this sense, engagement helps people make sense of sustainability in practice, since discussion and collaboration allow them to see how it connects to their work and responsibilities.

Universities are therefore increasingly seen as actors within wider societal systems, with responsibilities that extend beyond teaching and research [45], [46]. Through engagement processes, individuals can develop competences that are important for sustainability, such as systems thinking and collaborative problem solving [47], [48]. These competences are essential when dealing with complex sustainability challenges.

At the same time, engagement is not free from tensions. The literature highlights conflicts between civic missions and institutional systems that prioritize research outputs and performance indicators [40], [45]. Power imbalances between universities and external communities, as well as internal hierarchies among students, faculty, and administrative staff, may limit participation and reduce the impact of engagement

initiatives [39], [42]. For this reason, engagement often develops unevenly and depends on issues of recognition and access to decision-making processes.

Trust, continuity, and institutional support appear as important conditions for sustaining engagement over time. When engagement initiatives remain informal or depend only on individual motivation, they risk losing momentum. When they are supported by organizational structures and governance processes, they are more likely to persist and to generate shared responsibility [41], [43].

Several frameworks provide structured approaches to engagement. Community-based participatory research and service-learning emphasize collaboration and reciprocity, presenting engagement as a way to produce knowledge while also creating social impact [41], [42], [43]. These approaches respond to calls for universities to address complex problems through collaboration and dialogue, instead of relying only on disciplinary or centralized solutions [44].

Overall, engagement for sustainability represents a shift from passive involvement to active contribution. Through dialogue and sustained participation, individuals can move from being recipients of sustainability strategies to becoming contributors to organizational change [38], [40]. However, for engagement to produce lasting effects, it must be supported by organizational conditions that allow learning and coordination, which raises the question of how engaged practices become stabilized over time.

2.4. Routinization of Sustainability Practices

While leadership and engagement are important in initiating sustainability change, they are not enough to guarantee that it will last over time. For sustainability to move beyond isolated initiatives or voluntary efforts, it needs to become part of the everyday functioning of the organization through stable and repeated patterns of action. This process is commonly described as routinization and represents a key step in turning sustainability from an intention into an organizational capability [49], [50].

Organizational routines form the basis of coordinated action within complex institutions. Routines are not simply fixed procedures. They combine shared understandings of how activities should be carried out with their actual implementation in practice, and they evolve through repetition and adaptation [51], [52]. In this sense, routinization does not mean rigidity. It refers to the stabilization of practices that allow organizations to function consistently while still leaving room for learning and adjustment.

In sustainability contexts, routinization helps connect experimentation with long-term change. Many sustainability initiatives begin as projects or temporary efforts and often depend on individual commitment. When these initiatives are not integrated into organizational routines, they may remain peripheral or disappear when priorities

change [50], [53]. Embedding sustainability into routines allows organizations to preserve knowledge, coordinate action across units, and ensure continuity even when individual actors change.

This perspective is closely linked to the literature on dynamic capabilities. Capabilities develop through repeated actions that are gradually refined and stabilized into routines [50]. In sustainability processes, lessons learned from pilot initiatives and stakeholder involvement need to be reflected upon and incorporated into formal practices. Otherwise, sustainability risks remaining at an exploratory stage without becoming fully integrated into organizational processes [53], [54]. In this way, routinization supports the practical integration of sustainability within everyday operations.

Recent studies also connect routinization to the effectiveness of sustainability strategies. Sustainability becomes more consistent when it is integrated into core operational routines and governance processes, instead of being treated as a separate or additional activity [53], [54]. This integration strengthens coherence across the organization and reinforces sustainability as a legitimate reference point for decision-making.

Measurement and monitoring represent another important aspect of routinization. Sustainability practices become more stable when they are regularly assessed and reviewed through indicators and reporting systems. These mechanisms help maintain continuity over time and support learning and accountability [50], [53]. Without such systems, sustainability may remain dependent on informal efforts and individual motivation, which limits its organizational impact.

In participatory governance models, routinization does not necessarily take the form of rigid procedures. It may instead emerge through recurring decision cycles, structured feedback loops, systematic documentation of proposals and outcomes, and integration into budgeting planning. In such contexts, routinization becomes visible in the repetition of collective processes, the institutionalization of evaluation criteria, and when participatory spaces are consistently connected to formal governance structures. This perspective is particularly relevant for understanding how sustainability stabilizes within institutional initiatives characterized by shared leadership.

Routinization is also connected to organizational culture. When sustainability practices are repeated over time, they contribute to shaping shared expectations about appropriate behavior. At the same time, inconsistencies between stated sustainability values and everyday practices can reduce credibility and weaken engagement [54]. In this sense, routines play an important role in reinforcing or undermining cultural change.

It is important to note that routinization does not represent the final stage of transformation. Routines remain open to adaptation as organizations face new

challenges and contexts [51], [52]. Routinization therefore supports continuity, but it does not prevent change.

In universities, routinization presents specific challenges due to decentralized authority and strong professional autonomy. Sustainability routines rarely emerge only through formal mandates. They often develop through a combination of experimentation, shared leadership, and gradual formalization [9], [33]. In this sense, engagement and collective leadership create the conditions that allow sustainability practices to stabilize over time.

Overall, routinization represents the phase in which sustainability becomes part of ordinary organizational practice. Through the stabilization of roles, practices, and monitoring systems, sustainability can move from isolated initiatives toward more integrated and lasting forms of change. Understanding routinization is therefore essential to explain how universities can develop sustainability as a durable organizational capability.

3 Methodology

3.1. Methodological Approach

This research adopts a dual methodological design to investigate how sustainability is embedded within university organizational systems, with particular attention to leadership, engagement, and routinization. Given the exploratory nature of the research question and the focus on understanding how change develops over time, a qualitative approach combining different sources of data was considered the most appropriate way to capture both recurring patterns across institutions and in-depth organizational dynamics.

More specifically, the study combines (i) a benchmarking analysis based on secondary data and (ii) the collection of primary qualitative data within a single case study.

The benchmarking component aims to situate the case study within a wider institutional context. By examining publicly available documents, academic case studies, and institutional materials, this phase helps identify common dimensions through which sustainability is embedded at the organizational level. In this way, the Politecnico di Milano case is interpreted in relation to other institutions, which strengthens the credibility of the findings.

Alongside this comparative perspective, the collection of primary qualitative data focuses on how sustainability practices are enacted and sustained by organizational actors. In line with the theoretical framework, attention is given to engagement processes, shared leadership practices, and to how sustainability initiatives gradually become more stable over time. Qualitative methods are suitable for exploring these aspects because they allow participants to describe their motivations and perceptions in their own words.

This methodological approach is therefore consistent with the objective of understanding sustainability as an organizational process shaped by people and everyday practices. The following sections describe the two methodological components in more detail, starting with the benchmarking analysis based on secondary data.

3.2. Benchmarking Methodology

To assess the level of sustainability embedment across universities, a benchmarking analysis was conducted using a selection of internationally recognized higher education institutions as reference cases. The aim of the benchmarking is not to produce a ranking, but to develop a comparative understanding of how sustainability is embedded within different university organizational systems. The institutions included in the analysis were selected through a structured review of academic literature and institutional documents that explicitly describe how sustainability is addressed in each context. For this reason, the benchmarking relies on secondary data sources that provide qualitative insights into governance structures and sustainability-related practices.

The first step consisted of identifying a broader set of academic publications on sustainability in higher education. During this phase, some papers were excluded for three main reasons. First, publications in low-ranked or non-peer-reviewed outlets were excluded to ensure the reliability of the material. Second, studies focusing on private universities were not included, since their governance models differ from those of public institutions, which represent the focus of this research. Third, papers referring to institutions not included in widely recognized international rankings, such as the QS World University Rankings, were excluded in order to ensure that the selected cases are internationally visible and comparable.

The final benchmarking sample therefore consists of a selected group of peer-reviewed academic papers, each related to one university included in the analysis. These papers were retained because they provide sufficiently detailed descriptions of sustainability-related practices and governance arrangements. The objective of the benchmarking is not to be exhaustive, but to build a comparative sample that is conceptually coherent and empirically grounded.

Each case included in the benchmarking highlights a specific aspect of sustainability embedment, depending on the focus of the study. Some cases emphasize the integration of sustainability into curricula [55], others focus on sustainability in research practices [56], while others examine governance and organizational dimensions [57]. In several instances, the academic analysis reflects the institutional role assumed by the university in advancing sustainability. For example, universities described as societal testbeds often show strong attention to stakeholder engagement and community-oriented initiatives [58].

Based on this literature, a custom assessment framework was developed to support a structured comparison across institutions. Although unpublished, the framework is grounded in recurring themes identified in the literature and is aligned with the theoretical perspective of this research, which understands sustainability as an organizational phenomenon. The framework includes a set of macro-parameters

designed to capture both the strategic orientation and the operational integration of sustainability within universities.

The first macro-parameter, Vision & Perspective, assesses the temporal and strategic orientation of sustainability within the institution. It is scored on a scale from 0 to 2. A score of 0 indicates that sustainability is considered marginal or short-term. A score of 1 reflects partial integration, while a score of 2 corresponds to a long-term strategic vision in which sustainability is treated as a central organizational priority.

The second macro-parameter, Fragmentary vs. Holistic Approach, evaluates the extent to which sustainability is addressed across the main organizational areas. This parameter includes five dimensions: Curriculum & Learning, Research, Operations & Facilities, Governance & Policies, and Outreach. Each of these is scored from 0 to 2. A score of 0 indicates the absence of explicit sustainability-related actions, 1 reflects partial implementation, and 2 indicates a structured and coherent approach supported by concrete initiatives or organizational arrangements.

The third macro-parameter, Stakeholder Engagement, captures the level of involvement of both internal and external actors in sustainability-related activities. This dimension is assessed using the International Association for Public Participation (IAP2) spectrum, which ranges from Inform (1) to Empower (5). Engagement is evaluated separately for students, staff, faculty members, and the external community in order to distinguish different levels of participation within the institution.

The fourth macro-parameter, Impact Measurement Framework, examines the presence and development of mechanisms used to monitor sustainability-related outcomes. It is scored from 0 to 2 depending on whether measurement tools are absent, partially implemented, or fully integrated. The analysis considers instruments such as key performance indicators, sustainability reports, internal monitoring systems, and external assessment tools. The presence of multiple instruments contributes to a higher level of maturity in measurement practices.

Two additional macro-parameters, Governance Structure and Key Sustainability Initiatives, are assessed qualitatively. The governance dimension considers the organizational arrangements that support sustainability, including dedicated committees or coordinating bodies and the degree of strategic integration. The analysis of sustainability initiatives focuses on the main areas of action within each institution, such as awareness and education, campus operations, community engagement, research units, and policy-oriented projects. Particular attention is given to sustainability research units or hubs, as they represent relevant organizational models for comparison.

In addition to these parameters, a descriptive synthesis is provided for each university. This synthesis includes key aspects that highlight the most relevant features of the institutional approach to sustainability, followed by a concise overall assessment that summarizes strengths and potential areas for improvement.

The Table 1 below summarizes the parameters considered and the associated scoring logic, while the full benchmarking framework with the assessed universities can be found in Annex B.

Macro-Parameter	Sub-parameters	Scale	Scoring Criteria
Vision & Perspective	-	0–2	0 = short term 1 = medium term 2 = long-term strategic vision
Fragmentary vs Holistic Approach	Curriculum, Research, Operations, Governance, Outreach	0–2	0 = absent 1 = partial 2 = structured and implemented
Stakeholder Engagement	Students, Staff, Faculty, External Community	1–5 (IAP2)	1 = inform 2 = consult 3 = involve 4= involve 5 = Empower
Impact Measurement	KPIs, Reporting, Monitoring	0–2	0 = absent 1 = partial 2 = structured and implemented
Governance Structure	Boards, Committees, Integration	Qualitative	-
Key Sustainability Initiatives	Education, Operations, Research Units, Policy	Qualitative	-

Table 1: Structure of benchmarking framework

The scoring process followed an iterative approach. The initial version of the framework was tested on a first subset of universities in order to verify the clarity and applicability of each macro-parameter and sub-dimension. During this phase, some criteria were refined to improve internal coherence and comparability across cases. Once all universities had been assessed, a second round of review was conducted to ensure consistency in the attribution of scores and to adjust potential imbalances identified during the comparative analysis.

To limit subjective interpretation, the coding was based on multiple sources for each university whenever available, including the chosen reference paper, official university websites, sustainability reports, and institutional strategic documents. Consistent scores were attributed when explicit evidence supported the presence of structured practices, while conservative scoring criteria were applied when information was partial or ambiguous.

This iterative and prudent process was intended to ensure transparency and internal consistency, knowing that qualitative benchmarking inevitably involves partial interpretative judgment.

Quantitative scores, in fact, were calculated for the four macro-parameters to enable comparison across institutions: Vision & Perspective, Fragmentary vs. Holistic Approach, Stakeholder Engagement, and Impact Measurement Framework. For each of these dimensions, the final value was obtained by averaging the corresponding sub-scores. The qualitative parameters were used to support interpretation and contextual understanding.

It is important to clarify that the benchmarking framework is not validated against existing international sustainability rankings. The QS World University Rankings are referenced only for contextual purposes, in order to ensure that the selected universities are internationally recognized institutions. The comparison between benchmarking results and QS rankings is therefore descriptive and not analytical. The two approaches are based on different criteria: while QS rankings emphasize performance indicators and reputation, the framework developed in this research focuses on the internal organizational embedment of sustainability. Differences between the two are therefore expected and do not indicate inconsistencies.

3.3. The Cantieri della Sostenibilità Case Study

In response to the growing need to integrate sustainability into the core activities of higher education institutions, Politecnico di Milano launched the Cantieri della Sostenibilità as a strategic initiative aimed at promoting organizational change and improving how sustainability challenges are addressed within the university. The Cantieri function as working groups dedicated to the co-generation of ideas in key areas of sustainable development, including climate action, equity, digital innovation, waste reduction, mobility, and wellbeing (Figure 1: The 10 Cantieri della Sostenibilità The ideas developed within these groups can evolve into policy proposals, operational actions for campus improvement, or structured projects to be further developed at the institutional level.

WORKING GROUP NAME	GOAL
Accessibility	Gather expertise and professionalism on physical and digital accessibility, to initiate actions to map and remove physical and digital barriers in the University
Sustainable procurement	Discuss and generate ideas on policies and support tools to increase sustainability in procurement, reducing it where possible and raising awareness of the importance of sustainability as a key criterion in procurement choices
Behavioural change	Devise ways of involving the Politecnico community in disseminating new sustainable behaviour and lifestyles, when using space and resources
Sustainable mobility	Suggest policies and strategic actions to promote sustainable mobility in the University and region with environmental, social and economic benefits
Gender policies and inclusion	Promote gender equality and inclusion in University's activities, counteracting gender stereotypes and prejudices, promoting the empowerment of people and suggesting initiatives to include international students and staff
Food policy	Develop ideas to support a University food policy, encompassing its different aspects, including space and services, variety, supply, training, involvement, and reducing food waste
Energy saving	Discuss and generate ideas on policies, purchasing decisions, organisational changes and technical actions to reduce energy requirements, and inform and educate on the topic
Reuse of materials and waste management	Innovatively manage products and materials in the University, reducing waste throughout the life cycle by extending product life and reusing materials, promoting waste sorting, including experimental project for special waste categories
Digital sustainability	Generate ideas and suggestions to provide support for the Sustainability Plan through digital technologies, as transversal tools to implement the planned actions, with a synergic and coordinated approach
Sport and well-being in university life	Suggest ideas and solutions to improve the health and psychophysical wellbeing of the Politecnico community, exploring needs related to sport, welfare and social engagement

Figure 1: The 10 Cantieri della Sostenibilità

The Cantieri della Sostenibilità pursue two closely connected objectives. They aim to stimulate innovation around specific sustainability domains and, at the same time, to engage the university community in participatory processes that foster awareness and shared responsibility. The Cantieri do not usually implement projects. Their role is to develop structured and actionable proposals that are submitted to university leadership, which then evaluates their feasibility and potential integration into institutional strategies and operations.

The initiative of was launched in 2022 with the activation of five pilot Cantieri. These were conceived as working tables involving technical and administrative staff from departments, central administrative areas, and territorial campuses, together with representatives of the student community. During this initial phase, around 50 participants were involved. In 2022, the pilot Cantieri generated approximately 20 project proposals, and eight of them were implemented in 2023.

Building on this experience, the structure of the Cantieri was revised in 2023 to broaden participation and strengthen their integration within the university. The

number of participants increased significantly, and by 2024 their role was extended. Participants were no longer involved only in idea generation but also in supporting the early stages of implementation, working alongside university executives to translate selected proposals into operational initiatives.

Today, the Cantieri della Sostenibilità are formally integrated into the sustainability governance of the university and involve more than 200 participants, including faculty members, technical-administrative staff, and around 50 students.

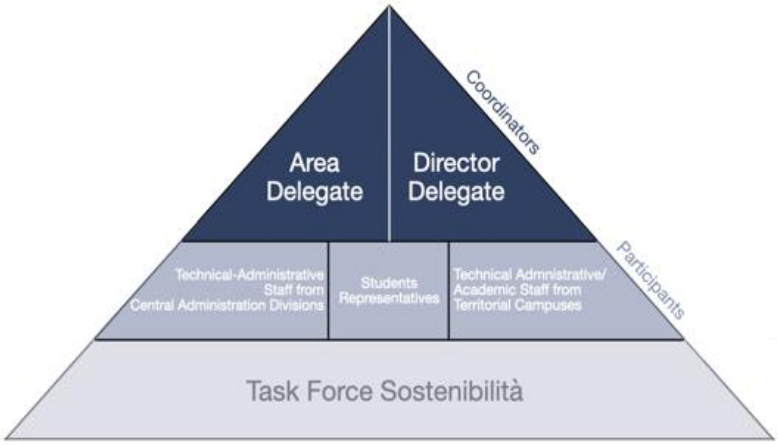


Figure 2: Cantieri governance structure

The governance structure of each Cantiere is exemplified by Figure 2. Every hub is co-led by two figures who reflect the academic [59] and administrative structure [60] of the institution: an academic delegate, usually a faculty member with a mandate related to sustainability, and a director-level representative from the central administration. This dual leadership reflects the broader organization of the university, where departments focus on teaching and research, while central administrative areas manage operational and service-related functions.

A coordinating role is carried out by the Sustainability Task Force, which operates within the central administration. The Task Force supports the Cantieri by facilitating communication across working groups and ensuring continuity over time. It also acts as a link between the Cantieri and the central sustainability governance body, the Sustainable Development and Societal Impact Coordination Round Table. The Table represents the executive-level coordination structure for sustainability and includes the Pro-Rector, Vice-Rectors with sustainability-related mandates, senior administrative leaders, and sustainability officers. While the Table holds formal

decision-making authority, the Cantieri contribute by submitting structured proposals for evaluation.

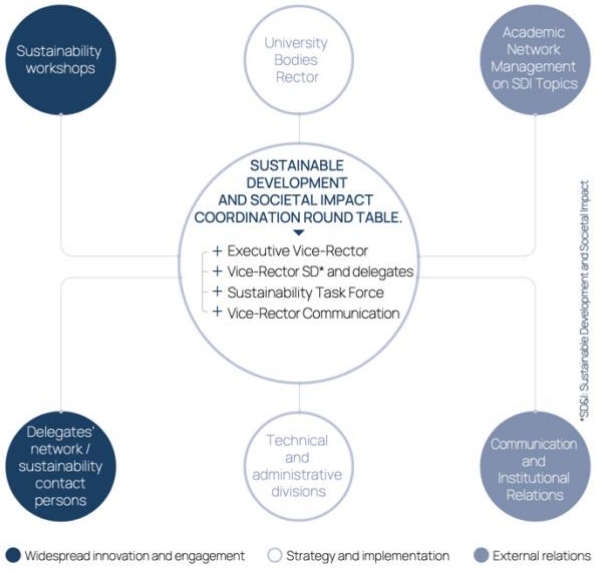


Figure 3: Sustainability strategy governance of Politecnico

The broader view of how Cantieri are integrated and interconnected to the Politecnico di Milano sustainability governance structure, taken from the Piano Strategico di Sostenibilità [61], is given by Figure 3. Specifically, between the three areas in which the sustainability strategy is structured, Cantieri are placed in the "Widespread innovation and engagement" intent.

In operational terms, the Cantieri work through a combination of plenary meetings and decentralized activities. Plenary meetings are usually held four to five times per year, while the periods in between are dedicated to work carried out within departments, administrative units, or territorial campuses. Each Cantiere designates one or two secretaries responsible for documentation and coordination with the Task Force. Twice a year, the Cantieri present their proposals to the Table: once in autumn, in line with the annual budgeting cycle, and once in spring, in relation to possible budget reallocations. Proposals can be presented at different stages of development, from fully defined projects ready for implementation to ideas that still require refinement or are temporarily not feasible, with clear justifications provided.

This structure allows the Cantieri to function as a coordination mechanism within the university. Participants represent their respective departments or administrative units and are expected not only to contribute to discussions but also to share information within their home structures. In this way, the Cantieri support idea generation while also facilitating the circulation of strategic priorities across the institution.

Between 2023 and 2025, the Cantieri generated a total of 102 ideas. Of these, 80 were transferred to the executive level for further evaluation, and 44 were implemented,

later consolidated into 35 structured projects. The remaining proposals were either revised within the Cantieri or closed due to feasibility constraints or changes in institutional priorities. The process is intentionally iterative: ideas are discussed, revised, and sometimes discontinued, with feedback provided at each stage. The emphasis is placed on maintaining a participatory process that supports learning over time, and not only on the immediate realization of individual initiatives.

Through this process, the Cantieri della Sostenibilità represent a participatory approach to sustainability governance within a complex university organization. By connecting different internal actors and creating structured pathways between idea generation and decision-making, the initiative contributes to integrating sustainability into everyday institutional practices.

3.4. Data Collection

The data collection strategy adopted in this research aims to capture the engagement and motivational dynamics connected to participation in the Cantieri della Sostenibilità. Particular attention is given to how individuals experience and interpret their involvement within the initiative. For this reason, a mixed-method approach was adopted, combining quantitative and qualitative data sources.

Primary data were collected through a survey and a series of qualitative focus groups. The survey allowed the collection of structured data on levels of engagement, motivation, perceived impact, and selected organizational aspects. It also included open-ended questions so that respondents could describe their experiences in their own words. In parallel, semi-structured focus groups were conducted to explore in more depth some of the themes that emerged from the survey, especially in relation to group dynamics, perceived barriers, and individual contributions.

The survey was distributed to both current and former participants of the Cantieri della Sostenibilità. The target group included students, PhD candidates, researchers, faculty members, and technical-administrative staff. A total of 107 complete and valid responses were collected and used for the quantitative analysis. In addition, 21 partially completed questionnaires were received. These were not included in the statistical analysis, but they were reviewed to extract qualitative elements and to support the interpretation of the main results.

To account for different participation trajectories, the survey was structured into two pathways. One pathway was addressed to individuals who had participated in the Cantieri in the past but were no longer active. This section explored the reasons for disengagement, perceived obstacles to continued participation, and retrospective evaluations of the initiative. Participants were also asked whether they would consider rejoining the Cantieri under different conditions.

The second pathway targeted participants who were currently active in one or more Cantieri. This section focused on motivations for ongoing involvement and on how participants perceived their role within the working group. Questions addressed aspects such as satisfaction, sense of contribution, and clarity of organizational processes. Open-ended questions invited respondents to reflect on possible improvements and future developments of the initiative.

The complete survey questionnaire is provided in Appendix A, while some methodological details are synthetised below in Table 3.

In addition to the survey, six focus groups were conducted using a semi-structured protocol. The sessions involved 18 participants whose gender and role is disclosed in Figure 4 and Figure 5. Although some sessions were smaller in size, they were carried out as mini focus groups, a recognized qualitative format that preserved the interactive nature of group discussion.

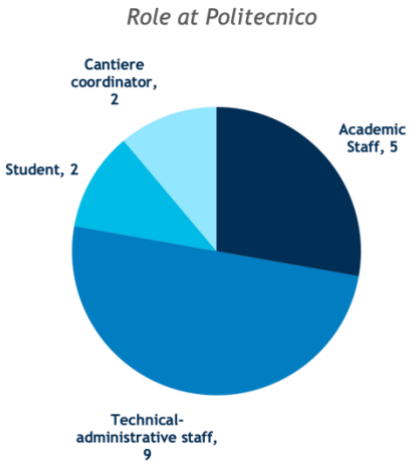


Figure 4: Role of focus group participants

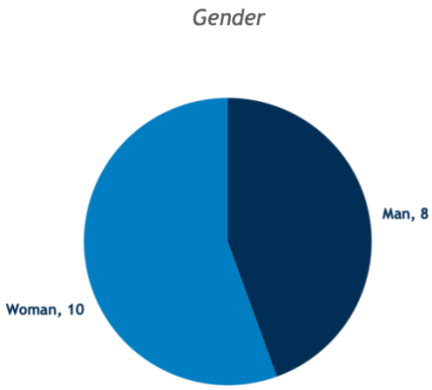


Figure 5: Gender of focus group participants

Focus group participants were selected to include individuals with different levels of motivation, both among those who appeared more engaged and those who seemed less involved. The aim was to interview two participants from each Cantiere, so as to gather perspectives from across the different groups. An effort was also made to include participants with different roles within the university, including students, technical-administrative staff, and professors or researchers. In addition, two coordinators were interviewed in order to capture the perspective of those responsible for leading and coordinating the Cantieri.

Participant n.	Focus Group n.	Cantiere rapresented	Interview Duration (min)
P1	FG1	Sport and well-being in university life	55
P2	FG1	Sustainable Procurement	55
P3	FG2	Sustainable Procurement	60
P4	FG2	Behavioural Change	60
P5	FG2	Behavioural Change	60
P6	FG3	Sustainable Mobility	60
P7	FG3	Digital Sustainability	60
P8	FG3	Sport and well-being in university life	60
P9	FG3	Reuse of materials and waste management	60
P10	FG4	Sustainable Mobility	60
P11	FG4	Gender policies and inclusion	60
P12	FG5	Digital Sustainability	65
P13	FG5	Food Policy	65
P14	FG5	Accessibility	65
P15	FG5	Food Policy	65
P16	FG6	Food Policy	45
P17	FG6	Energy Saving	45
P18	FG6	Sustainable Mobility	45

Table 2: Interviews details

As can be seen in Table 2 eventually a total of 18 participants took part, with group sizes ranging from two to five individuals. The focus groups were designed to complement the survey by exploring the main and most critical themes emerged from the survey analysis.

A shared protocol guided all sessions and was structured around the following main thematic areas: personal experience, motivation and engagement, organizational structure and perceived impact, future perspectives, and final reflections. This framework ensured a certain level of consistency across groups, while still allowing participants to focus on the aspects they considered most relevant to their own experience.

In practice, all focus groups addressed the main thematic areas, but the discussion was not conducted in a rigid or predefined order. Participants were free to move across topics and to emphasize issues that emerged as particularly significant, even if they were not explicitly listed in the original sequence.

Each focus group lasted between 45 and 65 minutes and was conducted with prior informed consent. All sessions were recorded, transcribed, and anonymized. The qualitative material was then analyzed using an interpretative approach aimed at identifying recurring themes and differences across participants.

The full structure and guiding questions of the semi-structured protocol are reported in Appendix A for transparency and reproducibility purposes.

In the following Table 3, instead, a synthesis of the data collection methodology and process is disclosed.

Phase 1 → Survey	
Sample	Number of participants involved: 250 Response rate: 73.6% (N=184) Valid complete responses: N=107
Data cleaning	Excluded blanks (N=10) Removed not valid responses (N=46) Kept incomplete responses for data validation (N=21)
Methodology of analysis	Quantitative data analysis with distributions and averages by answer Qualitative data analysis with clusters of themes by answer
Topics of investigation	Motivation (closed questions) Engagement (closed questions) Role and agency (open questions) Perception of the organization and project (open questions) Relationships and group dynamics (open questions) Obstacles and barriers (open questions) Perceived Impact (open questions) Possible improvements (open questions) Future outlook (open questions) Ideas and collaboration Tools (open questions)

Phase 2 → Focus Groups	
Sample	Number of participants invited I round: 24 Number of participants invited II round: 11 Response rate: 51,4% (N=18 interviewees) Number of focus groups: 6
Interviews structure and duration	Semi-structured protocol Between 45 and 65 minutes
Methodology of analysis	Qualitative analysis of the script by clustering main themes emerged for each topic of investigation

Topics of investigation	Participation and Engagement Governance and Processes Impact perceived Future Outlook

Table 3: Data Collection Synthesis

4 Findings

4.1. Benchmarking Results

The benchmarking analysis provides a comparative overview of how sustainability is embedded across a heterogeneous group of universities. The objective is not to produce a ranking, but to describe how sustainability practices are distributed across key organizational areas and how different institutional configurations emerge.

At an overall level, most universities show a strong strategic orientation toward sustainability, reflected in high scores for Vision & Perspective. In many cases, sustainability is framed as a long-term priority and is explicitly included in strategic plans, mission statements, or policy documents, as observed for institutions such as the University of British Columbia, the University of Toronto, and Qatar University [58], [62], [63]. Only a small number of cases display a weaker strategic positioning, suggesting that sustainability has largely moved beyond a marginal concern within the sample.

However, strategic commitment does not automatically correspond to uniform organizational integration. Clear differences emerge when examining how sustainability is embedded across the main domains: Curriculum & Learning, Research, Operations & Facilities, Governance & Policies, and Outreach.

Curriculum and Research show differentiated patterns. In some universities, sustainability is strongly integrated into educational programs and interdisciplinary teaching, as in the case of Jaume I University and Erasmus University Rotterdam [55], [64]. In other institutions, sustainability is more visible in research activities, often supported by dedicated centers or externally funded initiatives, as documented for Zhejiang University and the University of British Columbia [56], [58]. These two domains do not always develop at the same pace.

Operations & Facilities display significant variability. Some universities demonstrate advanced practices in infrastructure management and environmental monitoring, such as Qatar University, James Cook University, and the University of Toronto [62], [63], [65]. In other cases, operational initiatives are present but less systematically measured or coordinated.

Governance & Policies often appear as one of the more consolidated domains. Several universities have established sustainability-related boards, offices, or delegated roles

that provide coordination and strategic visibility. This is evident in cases such as the University of British Columbia, the University of Trieste, the University of Florence, and the University of Guadalajara [58], [66], [67], [68]. Nevertheless, the degree of integration between governance structures and everyday academic or administrative practices varies across institutions.

Outreach emerges as one of the least consolidated domains. While many universities report collaborations with local communities, municipalities, or external organizations, these activities are often organized through specific projects or temporary partnerships. Stable, institution-wide outreach strategies are less common. As a result, outreach activities tend to remain uneven and only partially integrated into long-term planning.

The analysis of the fragmentary versus holistic approach confirms this unevenness. In most universities, sustainability is more developed in one or two areas, most frequently governance and curriculum, while other domains remain less structured. Research integration often depends on disciplinary strengths or specific projects. Outreach and systematic impact measurement are among the least consistently developed dimensions.

Stakeholder engagement patterns reflect similar differences. Students and faculty members are generally the most involved groups, often through teaching and research initiatives. Engagement of technical-administrative staff varies more widely and is stronger where sustainability is closely connected to operational change, as in the cases of the University of Trieste and the University of Florence [66], [67]. Engagement with external actors is present in many institutions but is often project-based and not fully institutionalized [68], [69].

Impact measurement also shows differentiated development. Sustainability reporting and qualitative monitoring tools are relatively common among strategically oriented universities, including the University of British Columbia, the University of Toronto, and Erasmus University Rotterdam[58], [62], [64]. However, the systematic use of internal indicators and integrated monitoring systems is less consistent, with several institutions relying mainly on external reporting frameworks [3].

Finally, the analysis of key sustainability initiatives illustrates how strategic intentions are translated into concrete actions. Educational and awareness initiatives are widely observed, reflecting universities' traditional mission. Operational projects related to campus sustainability are also common, although their level of coordination differs. Dedicated sustainability research units or hubs are present in some universities but not across the entire sample. Policy-oriented initiatives are more frequent where governance structures are more developed.

The benchmarking results indicate therefore that sustainability embedment in universities is generally anchored at the strategic and governance level, while remaining uneven across operational, academic, and outreach domains. Formal

commitments and governance arrangements tend to be the most stable elements, but their implementation differ considerably depending on institutional priorities and organizational capacity. Sustainability embedment therefore appears as a selective and context-dependent process, characterized by varying levels of consolidation more than integrated institutional models.

This heterogeneous landscape provides an important interpretative lens for reading the Cantieri della Sostenibilità of Politecnico di Milano case. The selective patterns observed across the international sample, particularly in relation to outreach and impact measurement, anticipate dynamics that will also emerge within the Cantieri model. As shown in the following sections, Politecnico reflects a similar configuration: strong strategic anchoring and governance structure coexist with weaker stabilization in outreach practices and systematic monitoring mechanisms. The benchmarking analysis therefore helps placing the Cantieri experience within broader organizational trends in higher education.

4.2. Empirical Findings from the Cantieri Case Study

4.2.1. Survey Results

The survey was distributed to both current and former participants of the Cantieri della Sostenibilità. The target group included students, PhD candidates, researchers, faculty members, and technical-administrative staff. A total of 107 complete responses were collected and used for the quantitative analysis presented in this section. In addition, 21 partially completed questionnaires were received. Although these were not included in the statistical analysis, they were reviewed to identify recurring elements and to check the consistency of the overall patterns.

The sample shows a relatively balanced distribution across roles and gender. Respondents include 50 faculty members, researchers, or PhD candidates, 48 technical-administrative staff, and 9 students (Figure 6). The gender distribution is evenly split between 52 women and 52 men, with 3 respondents preferring not to answer (Figure 7). Regarding participation status, 91 respondents reported being currently involved in the Cantieri, while 16 indicated that they had participated in the past but were no longer active (Figure 8).

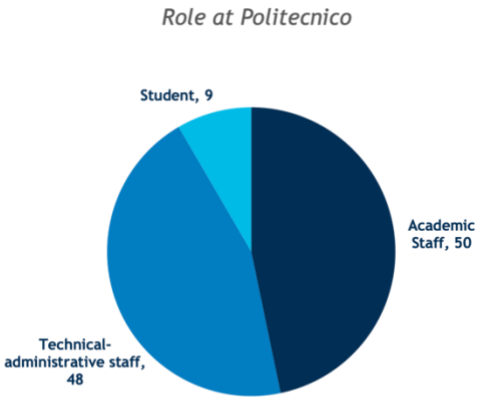


Figure 6: Role of survey participants

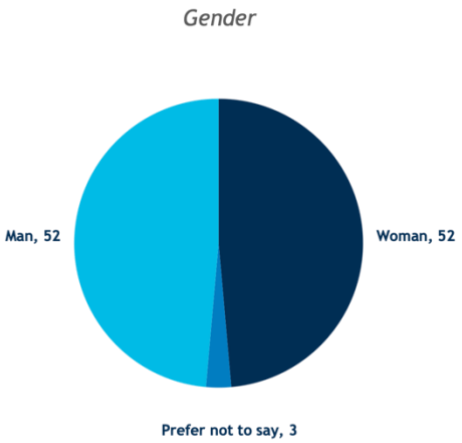


Figure 7: Gender of survey participants

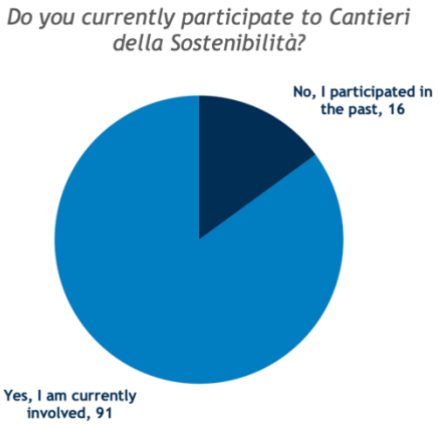


Figure 8: Current and former participants

Most respondents report having participated in the Cantieri for more than one year (Figure 9). This suggests that the results mainly reflect the perceptions of individuals who have had sufficient experience with the initiative to evaluate its functioning over time.

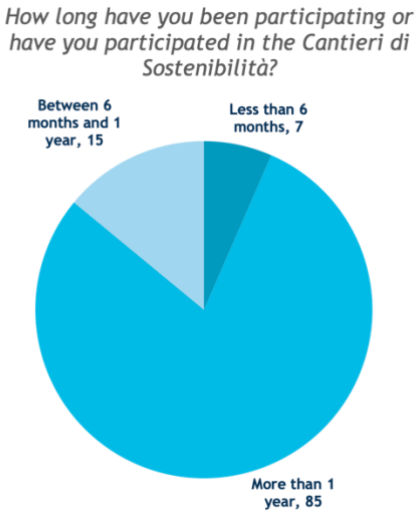


Figure 9: Duration of participation

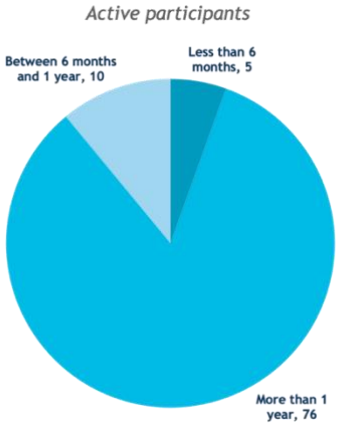


Figure 10: Active participants stay

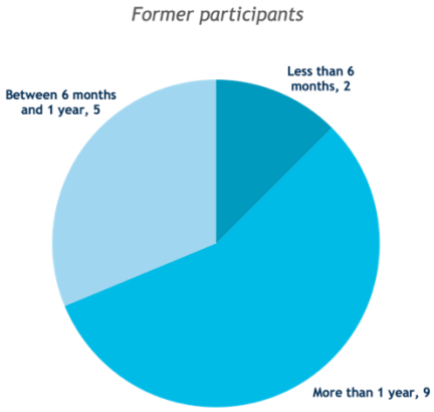


Figure 11: Former participants stay

Quantitative results from closed questions

Responses from active participants show a clear prevalence of intrinsic motivations. High scores are associated with contributing to the university, working on sustainability themes, and aligning with the values of the initiative. Many respondents report that participation feels useful and meaningful, and several indicate that it provides learning opportunities that can be applied beyond the Cantieri context.

Lower scores are associated with more external motivations, such as personal visibility, formal recognition, or participation requested by others. Overall, the quantitative results suggest that involvement in the Cantieri is mainly driven by internal commitment and perceived usefulness, and less by external incentives.

These patterns are consistent with theoretical perspectives that associate engagement with experiences of autonomy, competence, and relational belonging within

organizations. In particular, autonomy refers to the perceived possibility of exercising initiative and contributing to decision-making processes, a condition that has been linked to meaningful participation in organizational change [39], [40]. Competence emerges when individuals feel that their skills and expertise are recognized and effectively exploited, reinforcing their perception of contributing to collective goals [48]. Relational belonging, finally, reflects the perception of being part of a community where dialogue supports shared sensemaking and a common direction [33], [37]. The prevalence of intrinsic motivations in the survey data suggests that engagement within the Cantieri is sustained when these three dimensions are simultaneously present.

Below (Figure 12) the detailed results from the first set of quantitative questions of the survey can be seen.

"Indicate how much each statement represents why you participate (or have participated) in the Cantieri della Sostenibilità (answer using a scale of 1 to 5)"

Figura 12.1

Figura 12.2

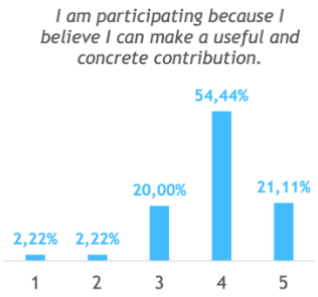


Figura 12.3

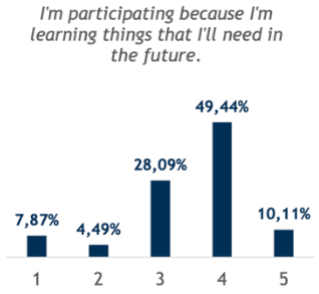


Figura 12.4

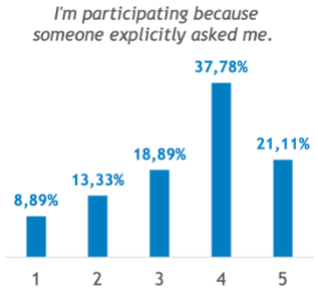
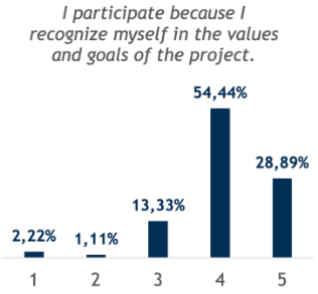


Figura 12.5



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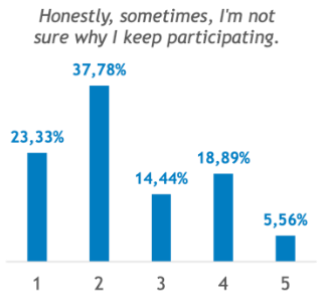

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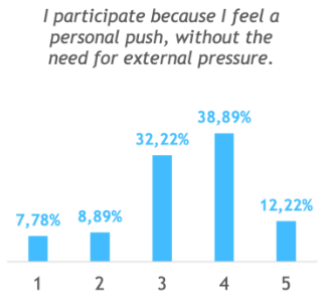

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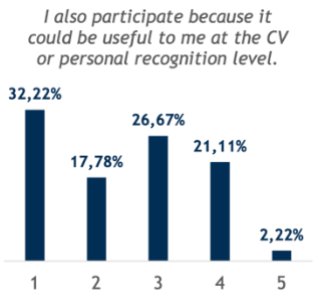


Figura 12.9

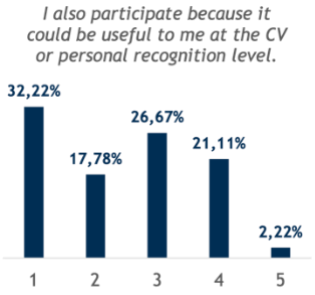


Figura 12.10

Figure 12: Closed questions exploring motivation

A second group of questions concerns the experience of participation while being active in the Cantieri. High scores are reported for motivation, satisfaction, and perceived contribution. Many respondents indicate feeling proud of the work carried out and perceive that they are contributing concretely to the institution. Indicators related to concentration and involvement are also generally positive.

However, items capturing more intense forms of engagement, such as losing track of time during activities, receive less consistent scores. This suggests that participation is generally meaningful and motivating, but not always characterized by very high levels of absorption.

Below (Figure 13) the detailed results from the second set of quantitative questions of the survey.

"Indicate how often you experience these situations while participating in the Cantieri della Sostenibilità (answer using a scale of 1 to 5)"

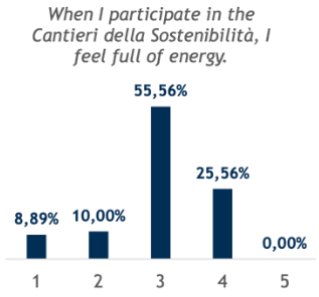


Figura 13.1

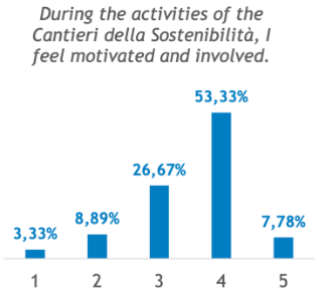


Figura 13.2

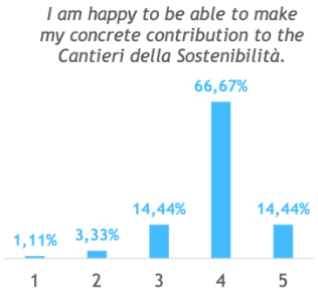


Figura 13.3

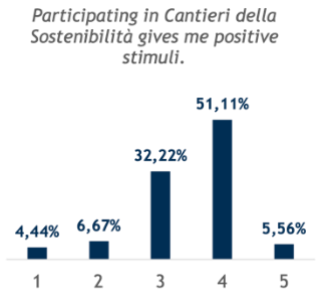
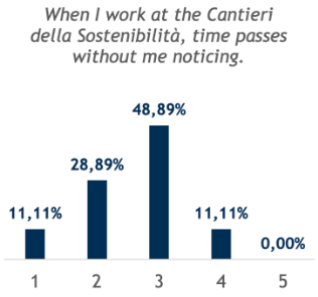


Figura 13.4

Figura 13.5



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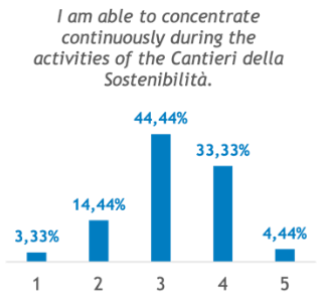

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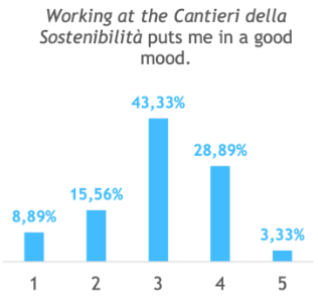

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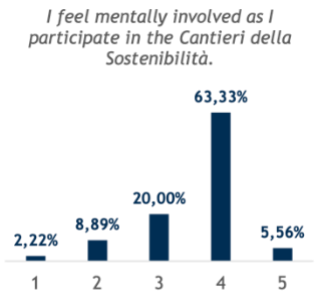

Figura 13.9

Figure 13: Closed questions exploring engagement

For past participants, responses are more moderate. Scores related to inclusion and listening tend to cluster around intermediate values, while perceptions of cohesion and impact are weaker. Organizational clarity is evaluated unevenly in this subgroup. Overall, past participants report a less positive experience compared to active respondents, particularly in relation to group cohesion and perceived effectiveness.

Below (Figure 14) the detailed results from the third set of quantitative questions of the survey dedicated to former participants.

"Aspects of the experience (answer using a scale of 1 to 5)"

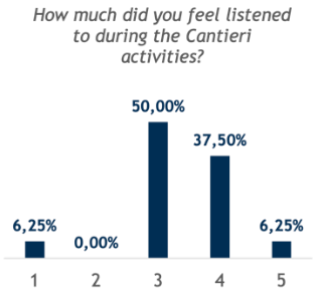

Figura 15.1

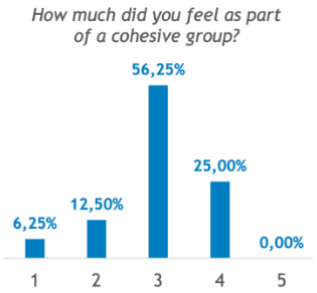

Figura 15.2

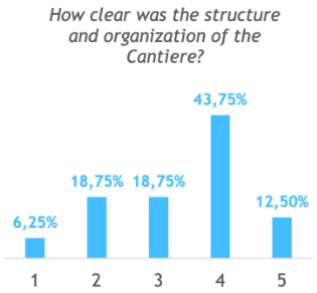

Figura 15.3

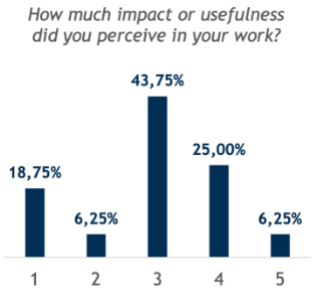

Figura .4

Figure 14: Closed questions to former participants

Qualitative results from open-ended questions

The open-ended responses offer further insight into the patterns observed in the quantitative results. Participants' answers were organized into recurring topics to identify the most common themes and motivations. This approach helps clarify how participants interpret their experience and provides a more structured view of the factors influencing engagement within the Cantieri. The following section presents the main themes emerging from the responses of active participants. Each cluster is described separately to illustrate the most frequent patterns and to show how engagement is experienced in practice.

Figure 15: I open question, active participants

As can be seen in **Error! Reference source not found.** the distribution of personal objectives shows that participants primarily join the Cantieri with the intention of contributing to the improvement of the university. This is the most frequently selected objective, indicating that the initiative is perceived as a space for concrete institutional impact. Personal recognition and motivation also emerge as relevant drivers, followed by learning and personal development. These results suggest that participants combine collective and individual goals when engaging in the Cantieri.

Inclusion and social values are mentioned less frequently, but they remain present as part of the broader motivation framework. Networking and collaboration are also visible, confirming that the Cantieri are seen as opportunities for interaction across roles and competencies. Only a very small number of respondents indicate the absence of personal objectives or focus on obstacles and constraints.

Participants perceive the Cantieri as a space with strong potential to generate value both for the institution and for themselves. At the same time, the prominence of recognition and motivation suggests that visible outcomes and acknowledgment of contributions play a central role in sustaining engagement over time.

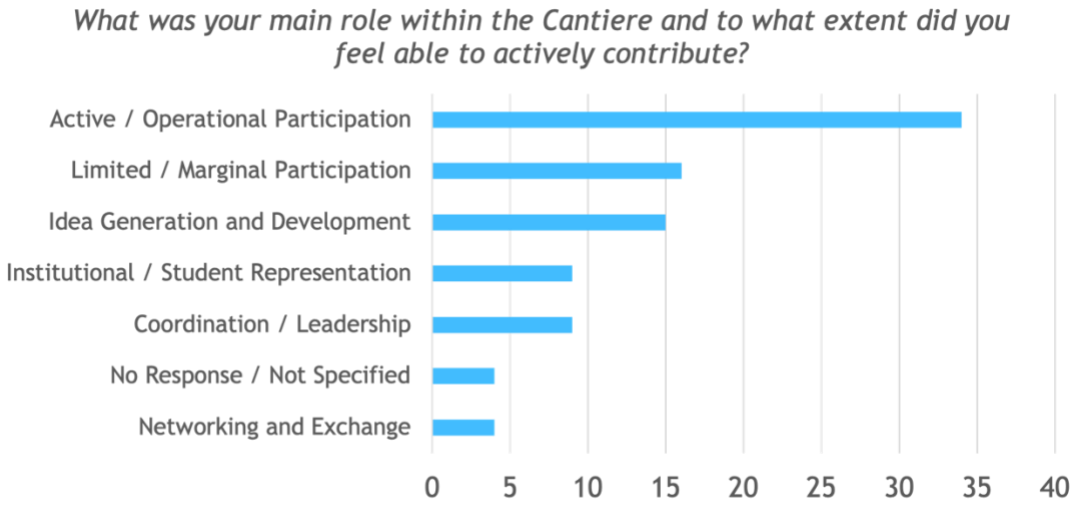

Figure 16: II open question, active participants

The distribution of responses (Figure 16) shows that most participants describe their role within the Cantieri as active and operational. This is the most frequent category, indicating that a substantial portion of respondents perceive themselves as directly involved in concrete activities and implementation processes. A smaller but still relevant group reports limited or marginal participation, suggesting that not all participants experience the same degree of involvement.

Idea generation and development also appear prominently, confirming that many participants see their role as propositional and creative. Institutional or student representation is mentioned with moderate frequency, reflecting the presence of representative functions within the Cantieri. Coordination or leadership roles are less common but still visible, indicating that a subset of participants assumes organizational or guiding responsibilities.

Networking and exchange are reported in a limited number of responses, while only a few participants provide no specific answer. Overall, the results indicate heterogeneous participation patterns, with a clear prevalence of active involvement alongside a non-negligible share of marginal experiences.

Figure 17: III open question, active participants

The responses (Figure 17) highlight both facilitating and critical elements in the organizational structure of the Cantieri. The most frequently mentioned facilitating factor concerns clear objectives and a well-defined structure. Many participants describe their Cantiere as functional when goals are explicit and responsibilities are understood. Inclusive processes and collaboration, particularly through sub-groups, are also recognized as positive elements, although mentioned less frequently.

Critical aspects are primarily related to coordination and leadership issues, followed by unclear or inconsistent objectives. Several respondents point to difficulties in maintaining continuity across meetings and in aligning roles with responsibilities. Problematic participation and limited innovation are also reported, indicating that in some contexts the organizational structure does not fully support creativity or active involvement.

A smaller portion of responses does not specify particular elements. Overall, the distribution of answers suggests that clarity of objectives and structural definition are perceived as central to the effective functioning of the Cantieri, while coordination and continuity remain areas where improvements are needed.

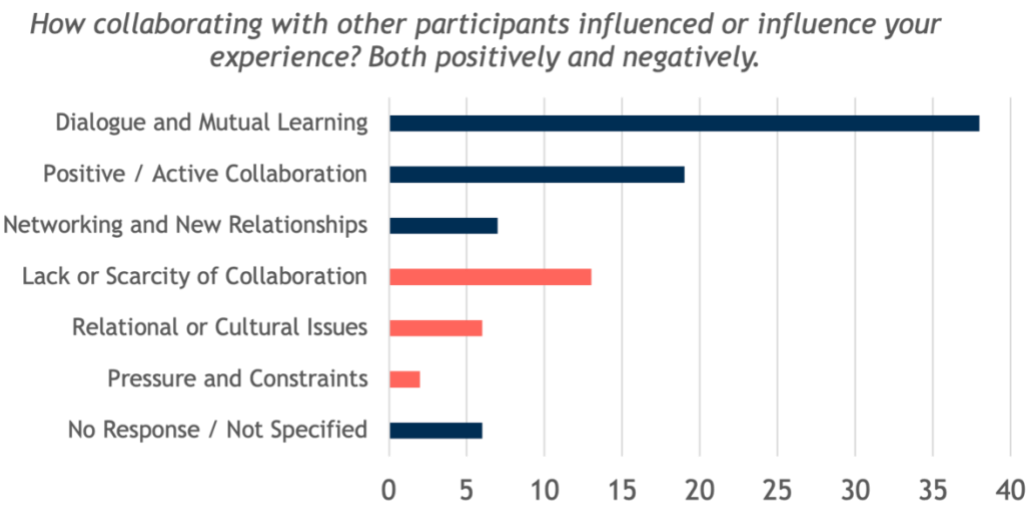

Figure 18: IV open question, active participants

The responses (Figure 18) show that collaboration is predominantly described in positive terms. The most frequently mentioned aspect concerns dialogue and mutual learning, indicating that interaction among participants is widely perceived as a source of exchange and knowledge sharing. Positive and active collaboration is also reported frequently, suggesting that many participants associate teamwork with increased motivation and improved quality of proposals. Networking and the development of new relationships are mentioned as additional positive elements, though less prominently.

At the same time, several critical aspects emerge. Some respondents report a lack or scarcity of collaboration, while others refer to relational or cultural issues that affect group dynamics. Pressure and constraints are mentioned less frequently but still indicate that workload, time limitations, or predefined objectives can negatively influence the collaborative experience. A small number of responses do not specify elements.

The distribution, finally, highlights the centrality of collaboration within the Cantieri experience, with positive interaction prevailing but accompanied by identifiable relational and structural challenges.

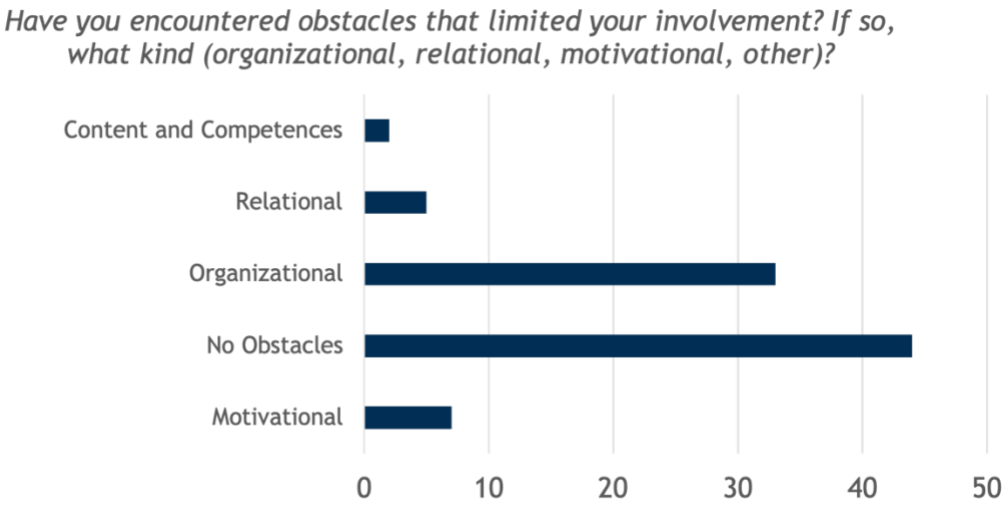

Figure 19: V open question, active participants

The responses (Figure 19) indicate that a substantial portion of participants report no significant obstacles limiting their involvement. At the same time, organizational obstacles emerge as the most frequently mentioned among those who experienced constraints. These relate primarily to time availability, coordination mechanisms, and clarity of processes.

Motivational and relational obstacles remain relevant even if they are reported less frequently. Some participants refer to reduced motivation over time or to difficulties in group dynamics that affected their level of participation. A smaller number of responses mention content-related issues or competences as limiting factors.

Overall, the distributions indicate that the obstacles limiting participation are predominantly organizational and structural rather than motivational. This finding is particularly relevant for the research question as it suggests that engagement in the Cantieri initiative is less constrained by individual attitudes and more by the design and stability of organizational processes.

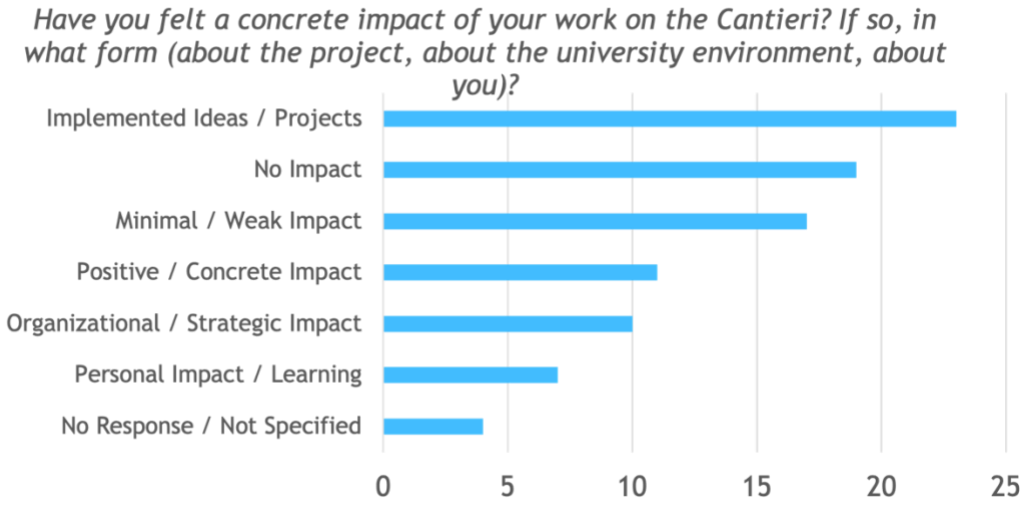

Figure 20: VI open question, active participants

The responses (Figure 20) reveal varied perceptions regarding the impact generated through participation in the Cantieri. The most frequently mentioned category refers to implemented ideas or projects, indicating that a substantial group of respondents associates their involvement with tangible outcomes. At the same time, a considerable number of participants report no impact or only minimal impact, suggesting that perceived effectiveness is not uniform across experiences.

Positive and concrete impact on specific projects is also reported, though less frequently than fully implemented initiatives. Organizational or strategic impact appears in a smaller number of responses, indicating that broader institutional effects are perceived but not dominant. Personal impact and learning are mentioned as additional outcomes, highlighting that some participants recognize individual-level benefits. A limited number of responses do not specify a clear form of impact.

Overall, the distribution indicates that while concrete implementation is the most visible form of impact, a significant share of participants experiences limited or unclear outcomes, pointing to uneven perceptions of effectiveness.

Figure 21: VII open question, active participants

The responses (Figure 21) indicate several conditions that participants consider necessary to increase their future involvement or improve the effectiveness of the Cantieri. The most frequently mentioned factor concerns the need for clearer objectives and concrete results, suggesting that participants expect visible outcomes and measurable progress. Tools and organizational improvements are also widely reported, highlighting the importance of structured processes and adequate support mechanisms.

Participation and inclusion appear as relevant conditions, indicating a demand for equitable involvement and transparent decision-making. Time availability and workload management are also mentioned with notable frequency, reflecting the need to make participation compatible with existing responsibilities. Recognition and incentives are present among the responses, though less prominently, while structure and governance adjustments are cited by a smaller share of participants. A limited number of responses refer to motivation and pressure-related aspects, and some do not specify particular conditions.

Overall, the distribution shows that clarity of objectives, organizational support, and visible results are perceived as central factors for sustaining participation and improving the effectiveness of the Cantieri.

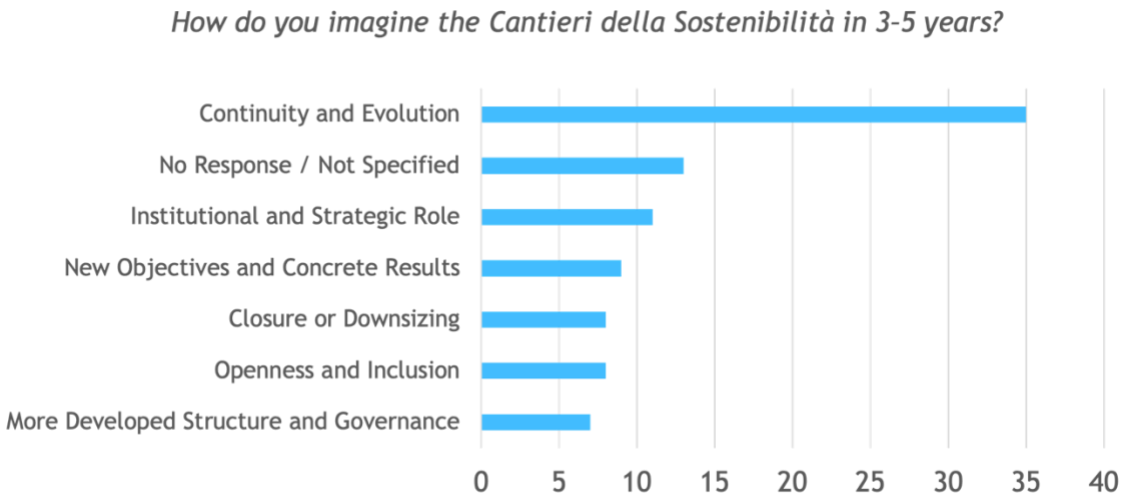

Figure 22: VIII open question, active participants

The responses (Figure 22) indicate that the most frequent expectation concerns continuity and evolution of the Cantieri over the next three to five years. Many participants envision the Cantieri as initiatives that should persist and develop further rather than be discontinued. A smaller group does not specify a clear outlook.

Institutional and strategic strengthening also appears among the responses, suggesting that some participants expect the Cantieri to assume a more defined role within university governance. References to new objectives and concrete results indicate a desire for clearer direction and measurable outcomes. A limited number of respondents mention closure or downsizing, showing that discontinuation is not a dominant expectation.

Openness and inclusion emerge as relevant elements for future development, while more developed governance structures are mentioned by a smaller share of participants.

Overall, the distribution shows that participants predominantly expect continuity and progressive consolidation of the Cantieri, with a stronger institutional role and clearer objectives over time.

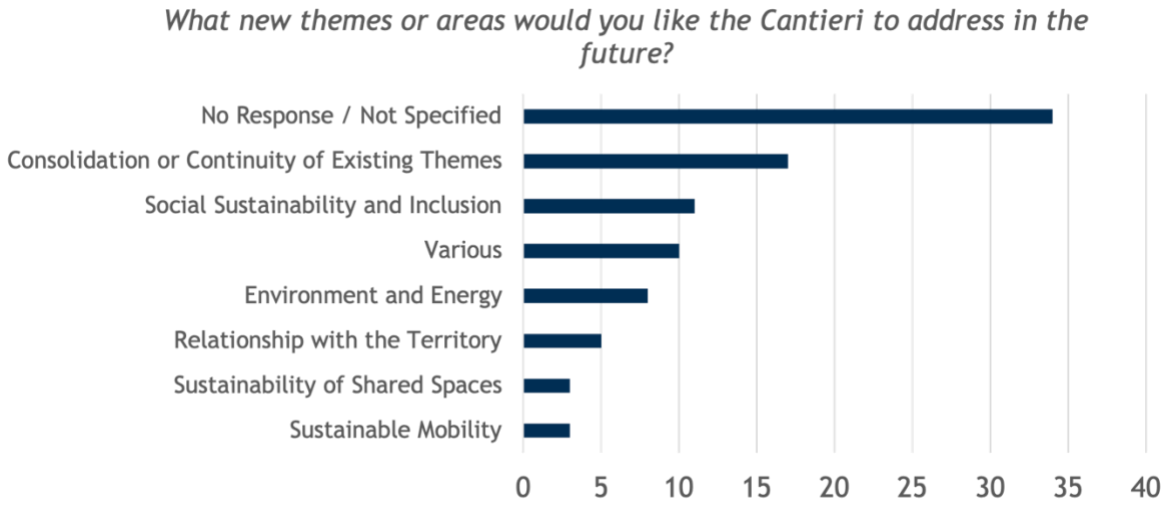

Figure 23: IX open question, active participants

The responses (Figure 23) indicate several thematic directions that participants consider relevant for the future development of the Cantieri. A significant share of respondents do not specify particular new themes. Among the explicit suggestions, consolidation or continuity of existing themes is frequently mentioned, suggesting that participants value stability and depth over constant expansion.

Social sustainability and inclusion also emerge as relevant areas of interest, followed by references to environment and energy. Various additional themes are mentioned, reflecting heterogeneous expectations. Relationship with the territory appears in a smaller number of responses, indicating an interest in strengthening external connections. Sustainable mobility and the sustainability of shared spaces are mentioned less frequently but remain present among the proposed directions.

Overall, the distribution suggests that participants prioritize strengthening and consolidating existing areas of work.

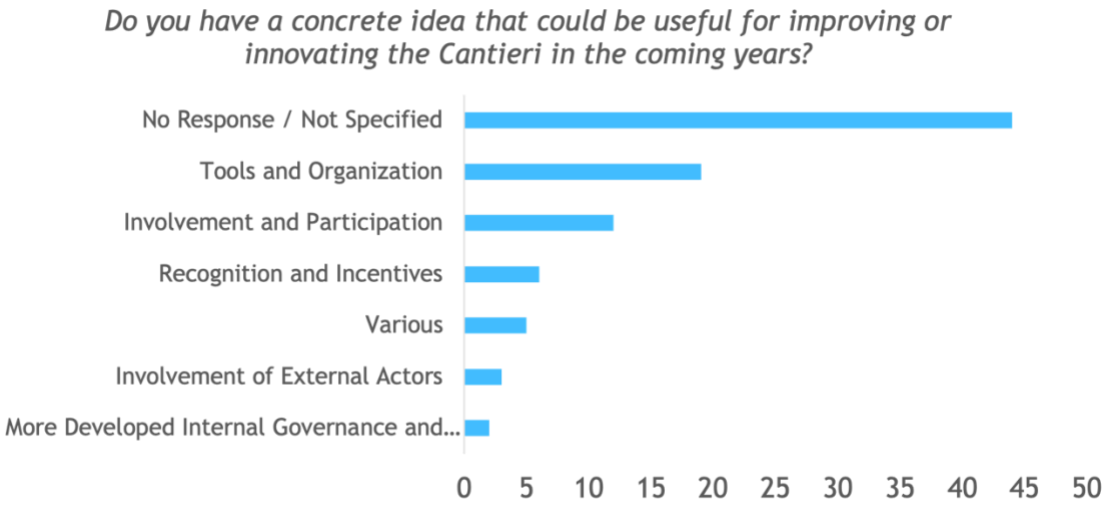

Figure 24: X open question, active participants

The responses (Figure 24) indicate a range of concrete ideas for improving or innovating the Cantieri in the coming years. A substantial portion of respondents do not specify a particular proposal. Among the articulated suggestions, tools and organizational improvements are most frequently mentioned, pointing to a perceived need for more structured processes and operational support.

Involvement and participation appear as relevant areas for enhancement, suggesting interest in broadening engagement and strengthening internal dynamics. Recognition and incentives are also cited, though less frequently, indicating the importance of valuing contributions. Some responses refer to the involvement of external actors, while a smaller number highlight the need for more developed internal governance structures. A limited share of answers falls into various additional proposals.

Overall, the distribution suggests that organizational strengthening and improved participation mechanisms are perceived as central levers for future innovation within the Cantieri.

The following section presents instead the responses of participants who are no longer active in the Cantieri. This group includes 16 respondents and therefore represents a smaller and more exploratory sample compared to the active participants. The analysis does not aim to draw general conclusions, but rather to identify recurring perceptions and possible patterns that may help explain reasons for disengagement.

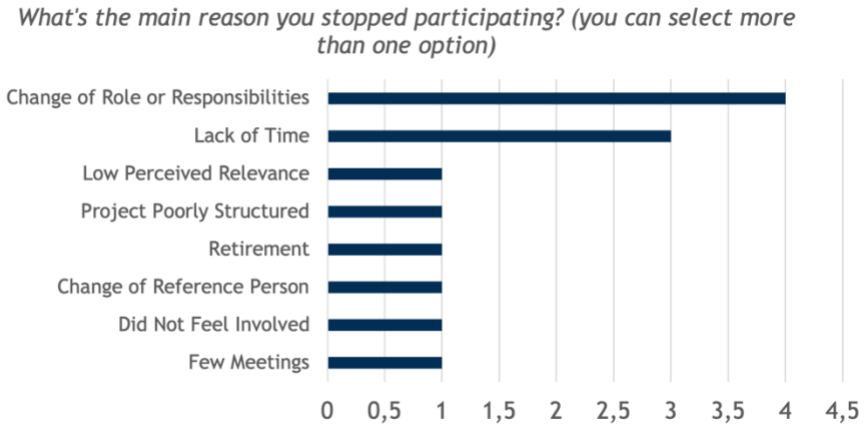

Figure 25: I choice question, former participants

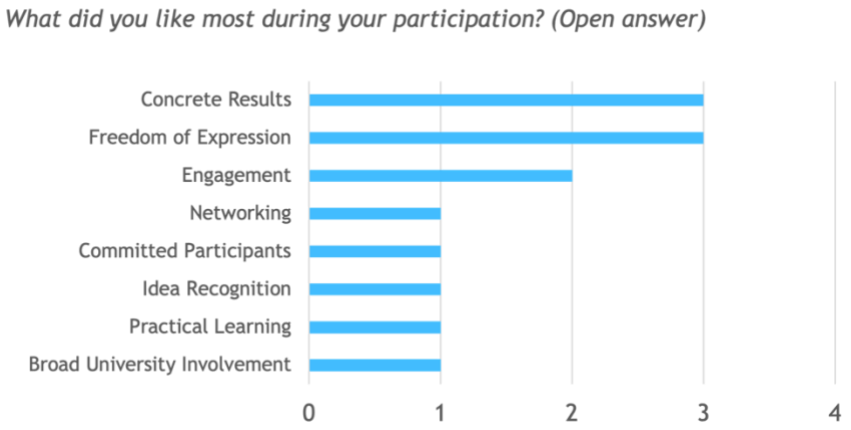

Figure 26: II open question, former participants

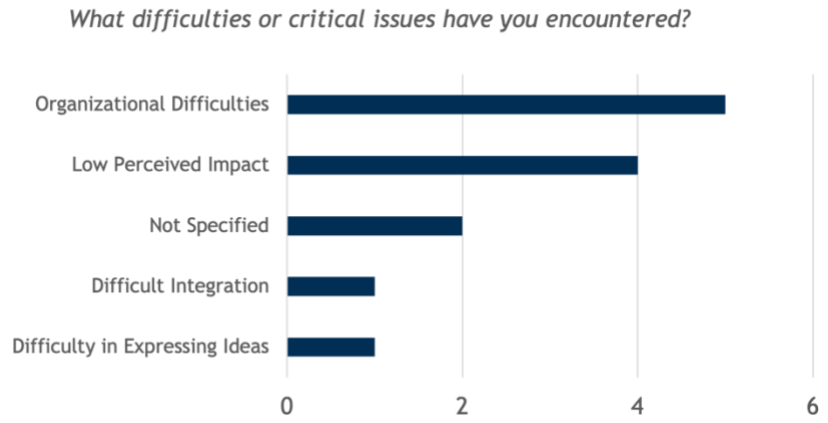

Figure 27: III open question, former participants

Figure 28: IV open question, former participants

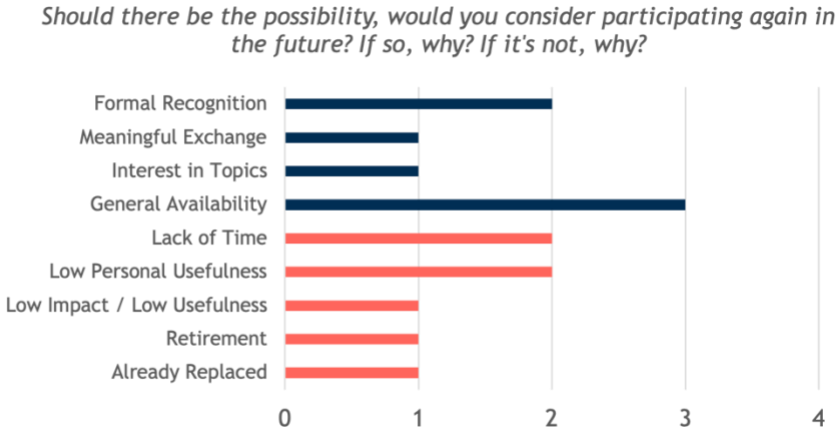

Figure 29: V open question, former participants

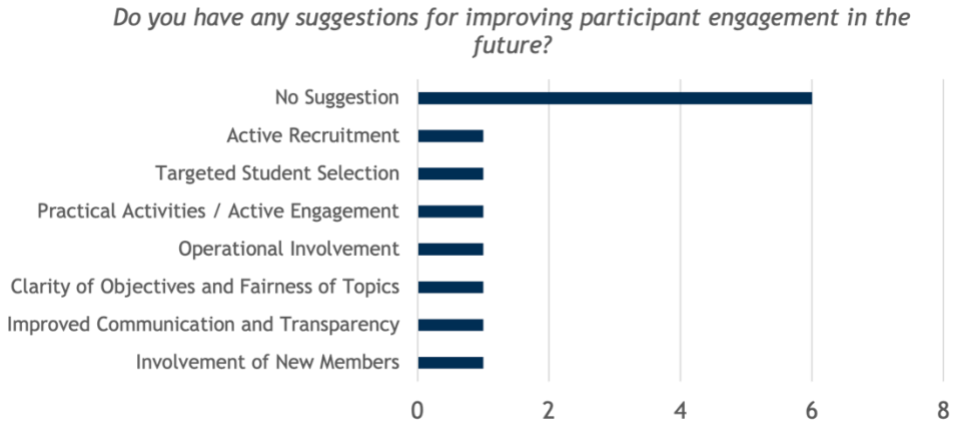

Figure 30: VI open question, former participants

The responses of participants who are no longer active offer a more nuanced view of the Cantieri experience. Overall, their accounts combine initial enthusiasm (Figure 26) with a gradual sense of dissatisfaction (Figure 27). Several respondents recall moments in which they felt listened to, but this is often followed by comments about weak group

cohesion, limited continuity, and difficulties in translating discussions into concrete actions (Figure 27).

Organizational aspects are mentioned frequently. Former participants refer to unclear objectives, a lack of follow-up between meetings, and fragmented communication. In many cases, the frustration does not seem to concern the sustainability themes themselves, but rather the difficulty in seeing ideas move forward and produce visible results. Some describe a progressive decline in motivation when proposals remained without feedback or when roles and responsibilities were not clearly defined (Figure 28, Figure 29).

When explaining why they stopped participating (Figure 25), practical reasons such as changes in professional role or limited time availability are common. At the same time, several responses point to more structural issues. Some participants felt that projects lacked sufficient structure or that their contribution was not fully acknowledged. Others mention that they struggled to see a clear link between their effort and the actual impact generated. In a few cases, respondents describe feeling marginal or not adequately involved in decision-making processes.

Despite these critical elements, the experience is not portrayed only in negative terms (Figure 26). Many former participants highlight positive aspects, particularly the opportunity to exchange ideas with colleagues from different areas of the university. Freedom of expression, networking, and exposure to diverse perspectives are often valued. Some also recognize that certain initiatives did lead to tangible results, even if these were not consistent over time.

When asked what might have encouraged them to continue (Figure 28), respondents refer mainly to greater clarity, more concrete outcomes, and more regular feedback. Some emphasize the need for better time management and more realistic expectations. Others point to the importance of recognition, both symbolic and institutional, as a way to acknowledge the time and effort invested.

Overall, the qualitative responses suggest that disengagement was rarely driven by a lack of interest in sustainability itself. On the contrary, many former participants continue to express commitment to the topics and themes addressed by the Cantieri. What appears more problematic is the gap between intrinsic motivation and the institutional mechanisms required to translate ideas into concrete and sustained action.

In several responses, it seems that the experience becomes frustrating not because sustainability loses relevance, but because proposals remain suspended, feedback is limited, and responsibilities are not clearly assigned. In this sense, disengagement reflects a misalignment between personal commitment and organizational capacity to stabilize and operationalize contributions. The presence of positive elements in many answers, in fact, indicates that the experience retains potential value, provided that coordination and continuity are strengthened.

4.2.2. Focus Group Results

The focus groups provide a deeper qualitative understanding of participants' experiences within the Cantieri. Through interactive discussion, participants were able to reflect collectively on engagement dynamics, organizational processes, perceived impact, and possible areas of improvement.

The findings presented below summarize the main recurring themes that emerged from the discussions. For reasons of confidentiality, individual quotations are not reported in full. However, under request, the anonymized transcripts of the focus groups can be made available for consultation under request by accessing the QR code in Annex A.3.

The following section offers a structured disclosure of the main topics and clusters identified during the analysis.

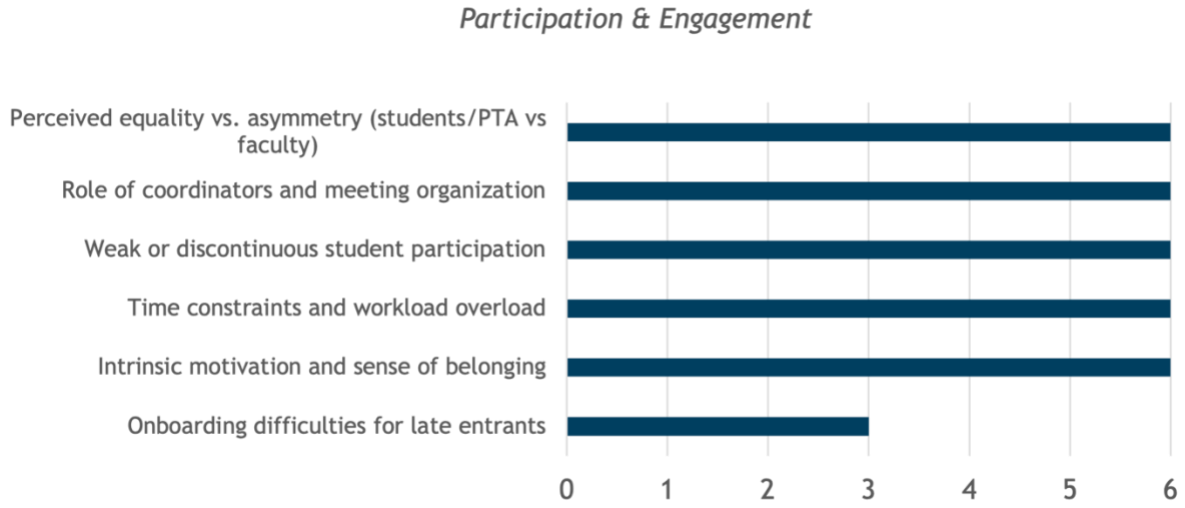

Figure 31: Participation & Engagement, focus groups

The focus group discussions show that participation and engagement (Figure 31) are at the core of the Cantieri experience. Participants often speak about strong intrinsic motivation and a sense of belonging as key reasons for staying involved. The Cantieri are generally described as open and collaborative spaces, where it is possible to exchange ideas across different areas and contribute in a meaningful way.

At the same time, some structural constraints clearly emerge. Time pressure and workload are mentioned frequently as factors that make participation more difficult. Differences between roles are also discussed. In particular, student participation is often described as more fragile or less continuous over time. Those who joined the Cantieri at a later stage report some difficulty in entering already established group dynamics and understanding previous decisions.

Coordination appears as another important element. Participants underline that regular meetings, clear documentation, and defined roles help maintain engagement. When the organizational structure is less clear or responsibilities are not well specified,

motivation tends to decline. Overall, the discussions suggest that participation remains strong when individuals feel informed, involved, and properly recognized within the group.

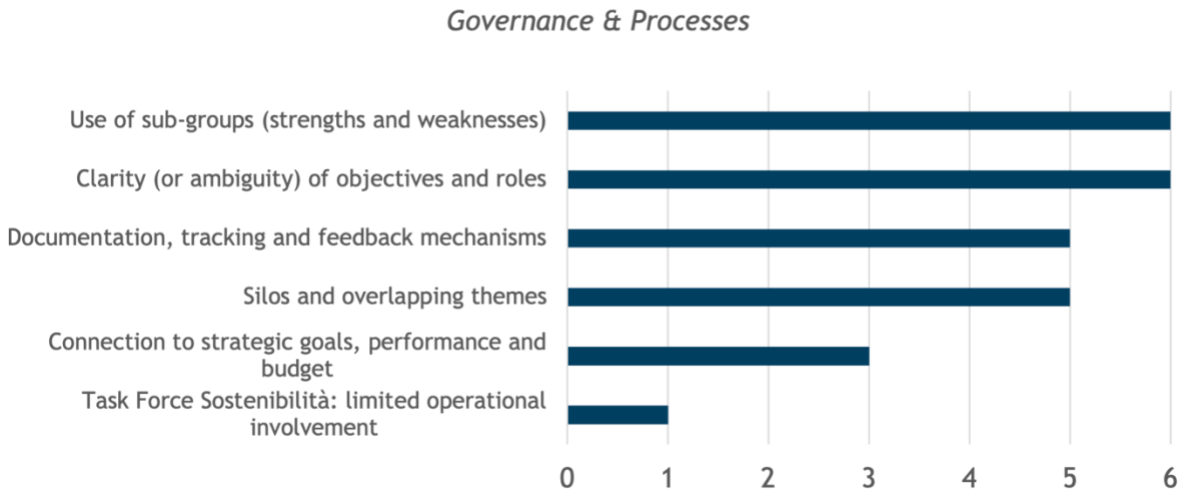

Figure 32: Governance & Processes, focus groups

The focus group discussions show that governance and internal processes (Figure 32) are experienced differently across the various Cantieri. Clear objectives and well-defined roles are often mentioned as key elements for the effective functioning of the groups. The use of sub-groups is generally viewed positively, especially when it helps to focus the work and distribute tasks more clearly.

At the same time, a number of structural weaknesses emerge. Some participants describe mandates as ambiguous and practices as inconsistent, with limited operational support. The existence of silos between Cantieri and the presence of overlapping themes are seen as obstacles to greater coherence. Documentation, tracking, and feedback mechanisms are not always systematic, which affects transparency and continuity over time. The link between the activities of the Cantieri and broader strategic goals or budget processes is recognized, but it is not always perceived as fully integrated.

The role of the Task Force is described mainly in strategic terms, with less involvement in day-to-day operational matters. As a result, coordinators often carry a significant responsibility in dealing with practical and organizational challenges.

Overall, the discussions suggest that governance and internal processes work better when objectives, coordination, and documentation are clearly defined. When these elements are weaker, fragmentation increases and consistency across Cantieri becomes more difficult to maintain.

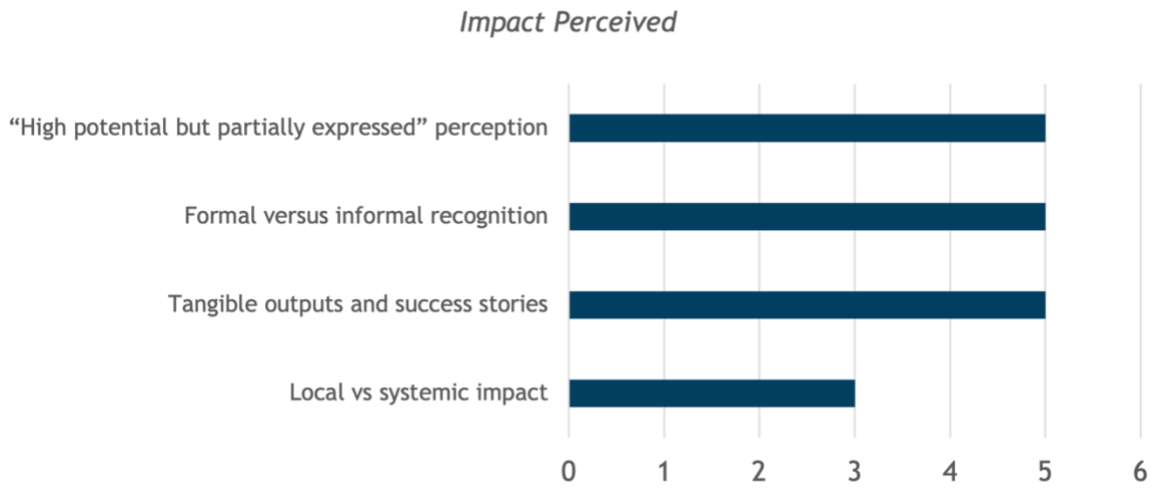

Figure 33: Impact Perceived, focus groups

The focus group discussions reveal different perceptions of the impact generated by the Cantieri (Figure 33). Many participants describe the initiative as having strong potential, even if this potential is not always fully realized in practice. Concrete examples are mentioned, including specific projects and visible improvements on campus. At the same time, several respondents observe that these results are not evenly distributed across all Cantieri.

Recognition emerges as a relevant factor in how impact is perceived. Some participants make a clear distinction between informal appreciation within the group and formal acknowledgment at the institutional level. The lack of clear recognition mechanisms is described as affecting motivation, especially among technical-administrative staff and students, who sometimes feel that their effort is not sufficiently visible.

Another theme concerns the difference between local and broader impact. Certain initiatives are considered effective within specific contexts or working groups, but their influence at a wider institutional level is less evident. As a result, perceptions of impact often fluctuate between individual experiences of success and a more cautious view of long-term, system-wide change.

Overall, the discussions suggest that the Cantieri generate meaningful outcomes, but in a way that remains uneven. Impact is visible in some areas, while in others it is limited by issues of consistency, follow-up, and institutional recognition.

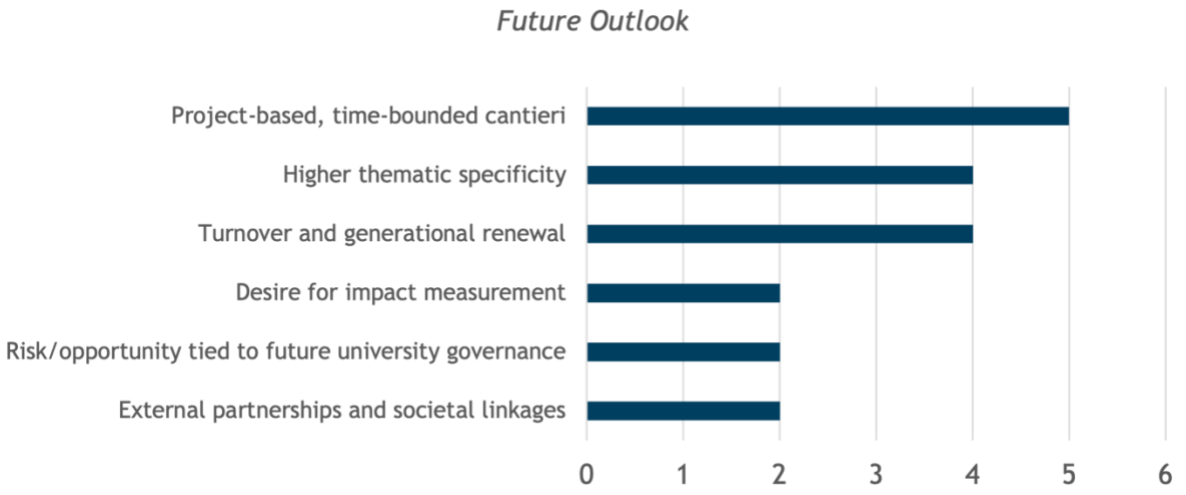

Figure 34: Future Outlook, focus groups

The focus group discussions also address the future development of the Cantieri (Figure 34). Many participants express a preference for more project-based and time-defined cycles, with clearer objectives and more explicit timelines. There is also interest in working on more specific thematic areas, so that activities can be more focused and less dispersed.

The issue of turnover and generational renewal is mentioned as well. Participants recognize the need to refresh participation over time and to involve new members, especially younger colleagues and students. Several respondents underline the importance of measuring impact in a more systematic way, while others stress the value of building stronger connections with external partners and actors beyond the university.

Some reflections concern the future governance of the Cantieri. Their long-term sustainability is seen as closely linked to how they are positioned within the broader university structure and leadership processes. In this sense, integration at the institutional level appears crucial for continuity.

Overall, the discussions point toward an expectation of evolution rather than transformation: a more structured and focused model, better connected to institutional processes, but still rooted in participation and collaboration.

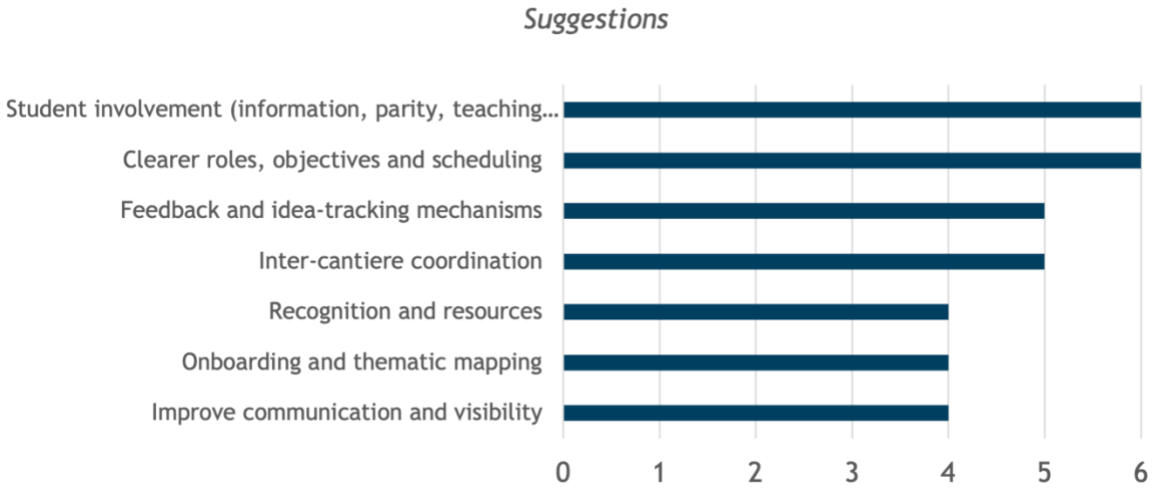

Figure 35: Suggestions, focus groups

The focus group discussions conclude with several practical suggestions aimed at improving how the Cantieri function (Figure 35). Participants often refer to the need for clearer roles, more defined objectives, and better structured scheduling. Stronger coordination across Cantieri is also emphasized, especially to reduce thematic overlaps and improve overall coherence.

Feedback and tracking mechanisms are repeatedly mentioned as important for ensuring continuity. Participants stress the value of more systematic follow-up on proposals and clearer communication about the status of ongoing initiatives. Improved onboarding processes and clearer thematic mapping are also seen as helpful tools to reduce confusion and support the integration of new members.

Recognition and resources emerge as additional concerns. Some participants highlight the importance of formally acknowledging contributions and ensuring access to adequate support tools. Student involvement is discussed in terms of visibility and inclusion, with suggestions to connect Cantieri topics more directly to teaching activities. Improving communication and making ongoing work more visible are also considered important steps for sustaining engagement.

Overall, the suggestions point in a similar direction: the need for a clearer structure, better coordination, and more consistent follow-up in order to strengthen the Cantieri over time.

4.3. Overall Assessment of the Politecnico Case

The combined analysis of benchmarking results, survey data, and focus group discussions offers an integrated view of how sustainability is embedded at Politecnico di Milano. Together, these sources help position the university within the broader comparative sample and make it possible to identify both structural strengths and areas where consolidation remains uneven.

From the benchmarking perspective, Politecnico shows a clear and consistent strategic orientation toward sustainability. Governance & Policies and Operations & Facilities appear as the most developed domains. Sustainability is integrated into strategic planning and supported by defined coordination structures. Initiatives related to mobility, waste management, energy efficiency, and digital sustainability are concrete and measurable, suggesting a relatively stable implementation capacity.

At the same time, embedment is less consistent in Curriculum, Research, and Outreach. Sustainability is present in courses and projects, but integration at program level is not yet fully systematic, and research activities are not organized within centralized sustainability hubs. Outreach initiatives exist, but they are often project-based rather than institutionally stabilized. This pattern is coherent with what emerges from the broader benchmarking analysis, where governance and operational domains tend to stabilize more quickly than academic or relational dimensions.

Survey and focus group findings provide a deeper understanding of the Cantieri model. Among active participants, engagement is generally described as meaningful and driven by intrinsic motivation. Collaboration, dialogue, and the possibility to contribute concretely are widely valued. However, recurring issues concern coordination, clarity of roles, continuity between meetings, and the visibility of outcomes. The contrast between active and former participants suggests that engagement weakens when institutional mechanisms fail to provide clarity, feedback, and stabilization.

Taken together, these findings support the Cantieri as representative of an advanced form of participatory governance within a university context. They successfully connect strategic orientation with distributed engagement and generation of concrete initiatives. At the same time, their routinization remains partial and inconsistent over time. Some hubs have developed relatively stable cycles of proposal, evaluation, and implementation, but others remain episodic or dependent on individual initiative. This hetherogeneous stabilization introduces structural fragility to some extent.

For these reasons, Politecnico can be contextualized as an institution that has moved beyond symbolic commitment and established a credible governance architecture for sustainability, yet is still in a transitional phase with regard to the full routinization of its participatory mechanisms. The Cantieri model demonstrates strong potential as a distributed and collective leadership configuration, but its long-term stability needs further integration into institutional routines.

5 Discussion

5.1. Discussion of Benchmarking Results

The benchmarking results provide a structured overview of how sustainability is embedded across universities. Two patterns clearly emerge: a broad convergence at the strategic level and significant variation in organizational implementation. Sustainability is widely recognized as an important institutional value, but the way it is translated into practice differs considerably across contexts.

A first relevant finding concerns the strong strategic positioning of sustainability in most institutions. High scores in Vision & Perspective indicate that sustainability is generally framed as a long-term priority and is formally integrated into strategic documents and mission statements [7], [10], [13]. However, the benchmarking also shows that formal recognition does not automatically lead to coherent implementation. In several cases, sustainability appears clearly articulated at the strategic level but less consistently integrated into everyday [16], [31].

This discrepancy becomes visible when examining the fragmentary versus holistic patterns. Universities rarely show uniform integration across curriculum, research, operations, governance, and outreach. Instead, sustainability tends to consolidate more strongly in specific areas while remaining less developed in others. Rather than progressing through a linear expansion across all domains, embedment often follows partial and iterative paths [70]. Fragmentation therefore appears as a recurrent feature of sustainability transitions in complex organizations.

Governance and policy frameworks often represent the most consolidated domain. Many institutions establish formal sustainability structures, delegated responsibilities, and strategic documents that provide visibility and coordination [15], [33]. At the same time, the results confirm that governance structures alone do not guarantee deep integration. When these formal arrangements remain weakly connected to operational routines, sustainability risks remaining centralized or symbolic. This dynamic is consistent with the literature on decoupling between formal policies and everyday practices [30], [71].

Stakeholder engagement also shows uneven development. Students and faculty members are generally more involved, particularly through teaching and research activities. Engagement of technical-administrative staff and external communities is more variable and often organized around specific projects. Engagement appears

stronger where sustainability aligns with existing professional roles, while it becomes more challenging when it requires redefinition of responsibilities or coordination across boundaries [39], [40].

Impact measurement represents another critical dimension. While sustainability reporting is relatively common, the systematic use of internal indicators and integrated monitoring systems is less consistent. This suggests that translating sustainability values into stable routines remains challenging. Measurement mechanisms are important because they support continuity and learning, yet their limited integration into decision-making processes indicates that sustainability often remains closer to strategic commitment than to fully routinized practice [50][52].

Overall, the benchmarking confirms that there is no single dominant model of sustainability embedment. Instead, sustainability develops through context-specific trajectories shaped by governance arrangements, institutional history, and organizational capacities. Rather than a linear progression, embedment appears as an ongoing process marked by partial consolidation and uneven development. This interpretation provides the basis for discussing the Politecnico case in greater depth.

5.2. Discussion of the Politecnico Case Study

The Politecnico di Milano case does not simply illustrate how sustainability develops within one institution. It provides insight into the conditions under which engagement and collective leadership can support the institutionalization of sustainability within a complex university organization. Interpreted in light of the theoretical framework, the findings suggest that sustainability embedment does not depend only on formal strategies or isolated initiatives. Instead, it emerges from the interaction between shared values, leadership forms, structured participation, and the gradual stabilization of practices over time [4], [69].

At the organizational level, sustainability at Politecnico is positioned as a central institutional value and reflected in strategic planning and governance structures. The long-term orientation embedded in the Piano Strategico di Sostenibilità creates a context in which sustainability is perceived as legitimate and institutionally supported. Organizational culture literature suggests that when sustainability is framed as a shared value rather than a formal obligation, it influences how members interpret priorities and reduces resistance to change [7], [10], [11]. The empirical evidence confirms this dynamic. Engagement within the Cantieri tends to be stronger when participants perceive coherence between their personal motivations and institutional direction. In this sense, cultural anchoring operates as a precondition for engagement.

Engagement, however, does not automatically translate into collective leadership. The findings show that distributed leadership within the Cantieri becomes viable only when participation is structured and supported. The Politecnico model combines formal roles, such as the Pro-Rector and the Sustainability Task Force, with participatory working groups. This hybrid configuration aligns with distributed and relational conceptions of leadership [8], [32], [33]. Collective leadership does not replace formal authority. It coexists with it. Formal coordination provides direction and legitimacy, while the Cantieri offer spaces in which commitment and creativity can be enacted through interaction.

The data also suggest that engagement and motivation are not secondary elements of this leadership model. They are foundational conditions. Survey and focus group results show that participation remains stable when individuals perceive agency, recognition and visible outcomes. When coordination weakens, roles become unclear and proposals do not lead to action, with the result that motivation declines. This confirms that distributed leadership cannot be sustained through openness alone. It requires organizational conditions that support meaningful contribution [39], [40]. Engagement therefore functions as both a driver and a stabilizer of collective leadership.

Over time, however, leadership and engagement are not sufficient for long-term embedment. Practices must become routinized. The Politecnico case shows disordered but visible processes of routinization. In operational domains such as mobility, waste management and digital sustainability, initiatives have been embedded into recurring procedures and decision cycles. Organizational routine theory suggests that stabilization occurs when practices are repeated, documented and integrated into formal systems [50], [52]. Where routinization occurs, sustainability becomes less dependent on individual initiative and more resilient to turnover.

At the same time, the findings reveal a process of selective routinization. Some Cantieri evolve into structured and recurring operational mechanisms, while others remain exploratory or advisory. This differentiation does not necessarily represent weakness. In pluralistic organizations, leadership and change processes often unfold unevenly across units [9], [33]. The coexistence of stabilized practices and flexible spaces for experimentation may be necessary to maintain adaptability. However, where routinization is absent, initiatives risk remaining episodic and dependent on individual commitment.

When positioned against the broader benchmarking results, Politecnico reflects a broader pattern observed in universities. Strong governance structures and strategic anchoring create favorable conditions for sustainability embedment, but academic integration, outreach and impact measurement remain less consolidated across

institutions [31], [69]. The Politecnico case confirms that sustainability embedment is not a binary state. It is a dynamic configuration shaped by trade-offs across domains [11], [16].

Taken together, the case suggests a broader answer to the research question. Engagement and collective leadership become enabling factors for sustainability when three conditions coexist. First, sustainability must be culturally legitimized within the organization. Second, participatory spaces must be structurally connected to formal governance. Third, selected practices must gradually become routinized to ensure continuity beyond individual commitment. Where these elements align, sustainability embedment can evolve from intention to institutional practice. Where they remain disconnected, sustainability risks fragmentation or symbolic adoption [30], [71].

5.3. The Process of Sustainability Embedment

The empirical findings allow the reconstruction of a dynamic process through which sustainability becomes embedded within a university organization. Data suggest an interdependent logic between engagement, leadership, and routinization, that are not conceived as separate dimentions.

The process begins with intrinsic motivation. Participants are initially driven by alignment with sustainability values, personal meaning, and a desire to contribute. In this sense, engagement can be considere the pre-condition under which sustainability can be embedded, but intrinsic motivation alone does not guarantee continuity.

As participation is granted, clarity and coordination become central. The data repeatedly show that when roles, objectives, and decision processes are well defined, engagement stabilizes. When coordination weakens or feedback is absent, motivation erodes. Engagement sustains collective leadership only when supported by clear organizational procedures.

If these conditions are met, participatory processes can generate collective alignment, enabling distributed leadership to operate effectively. Leadership in this context is not a replacement for formal authority, but a configuration in which strategic direction and participatory arenas reinforce each other.

The final step concerns selective routinization. When initiatives are integrated into recurring procedures, budgeting cycles, evaluation mechanisms, or monitoring systems, sustainability practices gain stability beyond individual commitment. Where routinization does not occur, initiatives remain episodic and vulnerable to turnover, workload pressures, or shifting priorities.

The overall logic process can therefore be summarized as follows: intrinsic motivation enables engagement, which is a necessary pre-condition;

structured coordination sustains distributed leadership; routinization stabilizes selected practices and transforms participation into institutional capacity.

At the same time, the data also reveal the reverse dynamic. When coordination mechanisms are weak and feedback loops are unclear, intrinsic motivation gradually detaches from institutional processes. In such cases, engagement declines and collective leadership becomes fragile. Sustainability embedment is therefore not a linear progression but a contingent process that depends on the alignment between motivation, leadership structures, and routinized practices.

This model clarifies the central contribution of the thesis: engagement is necessary but not sufficient. Participatory governance can generate innovation and commitment, but without structured mechanisms of translation into action and stabilization, it risks erosion over time.

6 Conclusions and Future Developments

6.1. Contribution to Theory and Practice

This thesis contributes to the literature on sustainability in higher education by focusing on how sustainability becomes embedded within university organizations. Instead of concentrating mainly on sustainability outcomes, reporting systems, or educational content, the study examines sustainability as an organizational process that develops over time through culture, leadership, engagement, and routinization. By combining benchmarking analysis with an in-depth case study, the research provides both conceptual reflections and practical insights on how universities translate sustainability commitments into more stable organizational practices.

From a theoretical perspective, the thesis advances the understanding of sustainability embedment as a dynamic process of institutionalization. While existing studies often emphasize strategic frameworks, curricula, or performance indicators, this research shows that sustainability becomes durable only when cultural alignment, leadership structures, participatory mechanisms, and routinized practices interact coherently.

A central theoretical contribution of the study is the demonstration that engagement, although essential, is not sufficient to guarantee sustainability embedment. The empirical findings indicate that high intrinsic motivation and participatory involvement can coexist with organizational fragility. In the absence of structured feedback mechanisms, decision cycles, and integration into formal governance processes, engagement risks weakening over time. Participatory models, therefore, require mechanisms of routinization to prevent motivational erosion and discontinuity.

The thesis also contributes to leadership research in pluralistic organizations. The case of Politecnico shows that distributed leadership can support sustainability only when it is connected to stable coordination structures. Formal roles and participatory arenas do not operate in opposition and their alignment is what enables collective leadership to function effectively. Without organizational anchoring, distributed leadership remains episodic and dependent on individual commitment.

A further contribution concerns the role of routinization. The findings highlight that sustainability practices do not stabilize automatically through repetition or goodwill.

Selective routinization understood as the integration of certain initiatives into recurring procedures, evaluation criteria, and budgeting cycles emerges as a necessary condition for long-term embedment. Where routinization remains partial, sustainability initiatives remain vulnerable to the declining of motivation over time.

In this sense the study reframes sustainability embedment not as the outcome of strategy alone, nor as the product of engagement alone, but as the result of the alignment between participation and structured organizational consolidation.

From a practical standpoint, the thesis suggests that universities seeking to strengthen sustainability should move beyond symbolic participation and isolated projects. Governance structures must combine strategic direction with participatory mechanisms, and these mechanisms must be supported by clear processes, feedback systems, and institutional integration. Engagement requires design, coordination, and recognition. Routinization requires intentional stabilization of selected practices without eliminating flexibility.

Overall, the study argues that sustainability embedment in universities depends on the structured interaction between leadership, engagement, and routinization. Engagement activates sustainability, leadership coordinates it, but routinization sustains it. By clarifying this relationship, the thesis offers a more precise understanding of how participatory sustainability models can evolve from motivated experimentation to durable institutional capability.

6.2. Recommendations for Cantieri della Sostenibilità

Building on the empirical findings and their interpretation, this section outlines a set of practical recommendations aimed at strengthening the role of the Cantieri della Sostenibilità as a central mechanism for sustainability embedment within Politecnico di Milano. These recommendations are not intended to standardize all Cantieri into a single model, but to support differentiated and complementary functions within the Cantieri structure, improving both effectiveness and continuity over time.

Differentiated Roles within the Cantieri

A first recommendation concerns the different roles that the Cantieri already seem to play in practice. The data show that some Cantieri are more active and generate a continuous flow of ideas, often managing to bring proposals to implementation. Others are less project-oriented and instead contribute by keeping sustainability themes visible within the university and by supporting coordination across units.

Instead of seeing these differences as a problem, they could be acknowledged openly as part of how the model works. Some Cantieri may function more as operational spaces, while others may have a more supportive or coordinating role. Clarifying these

differences could help define more realistic expectations and avoid evaluating all Cantieri using the same criteria.

Internal Organization and Coordination across Cantieri

A second area concerns coordination and internal organization. Survey and focus group results repeatedly highlight the need for clearer work cycles and more defined objectives. Participants often mention the importance of knowing what phase a project is in and what is expected from them.

Introducing clearer phases, such as idea development, feasibility discussion, implementation, and closure, could improve continuity. Meetings could also follow a more predictable rhythm, with clearer task allocation. At the same time, it is important to avoid placing the operational burden on a single person, which sometimes happens when the proposer of an idea becomes the only one responsible for carrying it forward.

Coordination across Cantieri also appears limited. Several participants noted that different Cantieri often work in parallel without fully exchanging information, even when topics overlap. Creating regular moments of exchange, especially in early stages of idea development, could help reduce duplication and encourage collaboration. A shared space where proposals and their status are visible to all Cantieri could also support this objective.

Feedback and Recognition

A third recommendation concerns feedback and recognition. Participants frequently report that motivation remains high when they can see what happens to the ideas they contribute. When proposals disappear without updates, engagement tends to weaken.

Providing clearer feedback, even when an idea is not implemented, would already represent an important step. Simple tools such as a shared tracking system indicating whether proposals are active, under evaluation, postponed, or closed could increase transparency.

Recognition also plays a role. Many participants express the need for greater visibility of the Cantieri's work. This does not necessarily require financial incentives. Institutional communication channels, certificates of participation, or acknowledgment within internal evaluation processes could already contribute to reinforcing commitment over time.

Strengthening Student Participation

Finally, the findings indicate the need to reinforce student participation. Although students are formally included, their involvement often remains fragile and inconsistent. Participation could be strengthened by increasing the visibility of the Cantieri within academic programs and by connecting involvement to curricular projects or thesis activities.

Both interviews and survey comments consistently underline that student participation brings energy and new perspectives to the model. Supporting this dimension could therefore contribute not only to inclusiveness, but also to innovation within the Cantieri.

Ultimately, these recommendations aim to strengthen the Cantieri della Sostenibilità as a flexible but more structured mechanism that can support sustainability embedment over time. Flexibility is one of the main strengths of the model, but there is also a need to introduce some selective routinization in specific processes. This is already happening in a few Cantieri that have active and proactive coordinators who provide regular feedback on ongoing activities, support the assignment of tasks and responsibilities, schedule meetings in advance, and share summaries of discussions with participants who could not attend.

This approach has proven effective in ensuring stability and continuity in the work carried out. At the same time, it is important that these forms of structure do not become too rigid since participants need to feel free to express ideas and should not feel constrained or overloaded with tasks that do not fit their role or availability.

6.3. Limitations of the Research

As with any empirical research, this study presents several limitations that should be acknowledged when interpreting its findings.

A first limitation concerns the case study focus. The Politecnico di Milano represents a rich and informative case for examining sustainability embedment, but the results cannot be statistically generalized. The case was selected because of its organizational complexity and the relative development of its sustainability governance. However, this choice means that the findings may not directly apply to universities with different governance structures, resource conditions, or levels of sustainability maturity.

A second limitation relates to the benchmarking analysis. Although it provided useful comparative insights, the number of universities included was limited and dependent on the availability of detailed documentation and academic studies. Moreover, the benchmarking framework developed for this research was not externally validated through inter-coder reliability testing or independent replication. While the coding process was iterative and supported by multiple sources, the framework remains an interpretative analytical tool constructed within the scope of this thesis. Future research could strengthen its robustness by applying it to a broader dataset and testing its reliability across different researchers and institutional contexts.

A third limitation concerns the use of self-reported data in the survey and focus groups. Participants' responses reflect personal perceptions and lived experiences rather than objective performance indicators. In addition, the survey relied on voluntary participation, which introduces a potential self-selection bias. Individuals who are more engaged, more motivated, or more interested in sustainability may have been more likely to respond. Furthermore, social desirability bias (the tendency of respondents to present themselves in a more positive or socially acceptable way) cannot be entirely excluded, particularly in questions related to motivation, engagement, and institutional commitment. Although triangulation between quantitative and qualitative data helped mitigate these risks, the findings should be interpreted as perception-based rather than as direct measures of organizational effectiveness.

Another limitation relates to the uneven participation of stakeholder groups. Although faculty members, technical-administrative staff, and students were involved, student participation remained relatively limited in both the survey and the focus groups. This imbalance may influence the representation of engagement dynamics, especially regarding generational perspectives and student integration within participatory governance models.

Finally, the internal heterogeneity of the Cantieri introduces analytical complexity. The Cantieri differ in thematic focus, level of activity, and degree of routinization. While this diversity represents an important empirical finding, it also makes direct comparison difficult and limits the possibility of drawing uniform conclusions about the model as a whole. A longitudinal design or additional comparative case studies would allow for a more precise understanding of how different Cantieri evolve and stabilize over time.

Overall, this study should be understood as an exploratory yet structured contribution to the literature on sustainability embedment in universities. The conceptual framework and empirical interpretations proposed here would benefit from broader empirical testing, external validation, and longitudinal observation in order to assess their stability and applicability across institutional contexts.

6.4. Future Research Directions

The findings of this thesis open up several possible directions for future research on sustainability embedment in higher education institutions, especially from an organizational and process-oriented perspective. By interpreting sustainability embedment as the result of the interaction between culture, leadership, engagement,

and routinization, this study points to areas that would benefit from further investigation.

A first direction concerns longitudinal research. Sustainability embedment develops over time, yet most studies, including this one, capture organizational dynamics at a specific moment. Future research could follow universities over a longer period in order to understand how sustainability initiatives evolve, stabilize, or decline. Such an approach would also allow researchers to examine how changes in leadership, governance arrangements, or institutional priorities affect the continuity of sustainability practices.

A second direction relates to comparative research. Expanding the analysis to a broader set of universities, possibly across different national contexts, would help clarify whether the patterns observed in this study are context-specific or more widely applicable. Comparative case studies could explore how different governance models, cultural environments, or regulatory frameworks shape sustainability embedment, particularly in relation to distributed leadership and selective routinization.

Finally, future research could further explore the relationship between internal organizational dynamics and external pressures. Universities increasingly operate in environments shaped by rankings, funding schemes, and policy frameworks related to sustainability. Understanding how these external factors interact with internal processes would contribute to a more complete picture of sustainability governance in higher education.

Overall, future research building on this work could deepen the understanding of sustainability embedment as an ongoing organizational process. By combining empirical investigation with comparative and longitudinal perspectives, further studies could support universities in designing virtuous sustainability initiatives.

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A Appendix A

A.1. Survey Protocol

Introduction

Dear Participant,

This questionnaire aims to better understand the levels of motivation and engagement of individuals participating in the Cantieri della Sostenibilità at Politecnico di Milano.

Your responses are anonymous and will be used exclusively for research and project improvement purposes. The questionnaire takes approximately 10–15 minutes to complete. We kindly ask you to answer sincerely.

All data will be analyzed in aggregated form and shared internally within the Cantieri.

Thank you for your contribution.

The Cantieri della Sostenibilità Team

Section 1 - General Information

Role at Politecnico di Milano

- Student
- Faculty / Researcher / PhD Candidate
- Technical-Administrative Staff (PTA)

Gender

- Woman
- Man
- Other
- Prefer not to answer

How long have you participated in the Cantieri della Sostenibilità?

- Less than 6 months
- Between 6 months and 1 year
- More than 1 year

Are you currently participating in the Cantieri?

- Yes, I am currently involved
- No, I participated in the past

Section 2 – Motivation

(For currently active participants)

Please indicate to what extent each statement represents your motivation for participating (1 = Strongly disagree, 5 = Strongly agree).

1. I participate because I would feel I am neglecting a responsibility if I did not.
2. I participate because I feel I "have to," more than because I truly want to.
3. I participate because I believe I can provide a useful and concrete contribution.
4. I participate because I am learning things that will also be useful for me in the future.
5. I participate because someone explicitly asked me to.
6. I participate because I identify with the values and objectives of the project.
7. Honestly, at times I am not sure why I continue to participate.
8. I participate because I feel a personal drive, without external pressure.
9. I participate because it may be useful for my CV or personal recognition.
10. I participate because I am genuinely interested in working on sustainability-related topics.

Scale:
1 – Strongly disagree
2 – Disagree
3 – Neutral
4 – Agree
5 – Strongly agree

Section 3 – Engagement Experience

(For currently active participants)

Please indicate how often you experience the following situations (1 = Strongly disagree, 5 = Strongly agree).

1. When I participate in the Cantieri, I feel energized.
2. During Cantieri activities, I feel motivated and engaged.
3. I am happy to be able to give my concrete contribution.
4. Participating in the Cantieri gives me positive stimulation.
5. I feel satisfaction and pride for what I do in the Cantieri.

6. When working in the Cantieri, time passes quickly.
7. I am able to concentrate continuously during Cantieri activities.
8. Working in the Cantieri puts me in a good mood.
9. I feel mentally involved when I participate in the Cantieri.

Scale:
1 – Strongly disagree
2 – Disagree
3 – Neutral
4 – Agree
5 – Strongly agree

Section 4 – Open Questions

(For currently active participants)

1. What are your main personal objectives in participating in the Cantieri?
2. What has been your main role within the Cantiere, and to what extent have you felt able to contribute actively?
3. How do you evaluate the organizational structure and clarity of objectives of your Cantiere? Please indicate facilitating or critical elements.
4. How has collaboration with other participants influenced your experience? Both positively and negatively.
5. Have you encountered obstacles that limited your engagement? If yes, of what type (organizational, relational, motivational, other)?
6. Have you perceived a concrete impact of your work in the Cantieri? If yes, in what form (project-level, university-level, personal)?
7. What conditions or changes could increase your willingness to participate in the future or improve the experience?
8. How do you imagine the Cantieri in 3–5 years?
9. What new themes or areas would you like the Cantieri to address in the future?
10. Do you have a concrete idea that could improve or innovate the Cantieri in the coming years?
11. Is there any additional comment you would like to share?

Section 5 – For Former Participants

Thank you for having participated in the Cantieri in the past. We would like to better understand your experience and the reasons for discontinuing your participation.

1. What is the main reason you stopped participating?

(You may select more than one option.)

- Lack of time
- Change in academic/professional role or responsibilities
- Low perceived relevance to my interests
- Organizational aspects not clear
- Relational issues or internal group dynamics
- Project perceived as poorly structured or ineffective
- I did not feel involved
- Other (please specify)

2. Please indicate your agreement with the following statements regarding your past experience:

1. I felt listened to during the activities of the Cantiere.
2. I felt part of a cohesive group.
3. The structure and organization of the Cantiere were clear.
4. I perceived impact or usefulness from my work.

Scale:
1 – Strongly disagree
2 – Disagree
3 – Neutral
4 – Agree
5 – Strongly agree

3. Open Questions

1. What did you appreciate most during your participation?
2. What difficulties or critical aspects did you encounter?
3. What would have helped you continue participating?
4. If there were the possibility, would you consider participating again in the future? Why or why not?
5. Do you have suggestions for improving participant engagement in the future?

A.2. Focus Group Semi-Structured Protocol

Introduction (5 min)

We are a research group at the Politecnico di Milano and, in agreement with the Vice-Rector for Sustainable Development and Impact, we are carrying out a study on how university organizational models are changing to address sustainability issues.

In particular, we are focusing on the model of the Cantieri della Sostenibilità of Politecnico, which for us represents a concrete and interesting case to analyze.

The aim of this meeting is to hold a small focus group, with 4 or 5 people, to understand together how effective the Cantieri model is and to delve deeper into some issues that emerged from the previous survey.

With your consent, we will record the conversation and then transcribe it later. All data will be processed anonymously and used exclusively for research purposes, therefore neither his name nor any of those mentioned will appear in the transcript.

At the end of the work, we will send you a copy of the results, so you can review them.

Personal experience in the Project (5 min)

- How long have you been participating in the Cantieri della Sostenibilità and in what roles?
- How did you enter or become part of the Cantieri?

Engagement and Motivation (10–15 min)

- Do you feel sufficiently involved in the activities of your Cantiere? Are there obstacles that make it more difficult to participate?
- How does collaboration and knowledge exchange work within your group? What do you think could improve them?
- With respect to the composition of the group: do the number and variety of people seem adequate to you?

Governance, Organizational Structure, and Processes (10–15 min)

- In your opinion, does the organizational structure of the Cantieri work? For example: the division into Cantieri, the ways in which PTA and PD interface with the Coordination Table, operational and executive responsibilities, or the role of the Sustainability Task Force?
- Do the ways in which ideas are developed and then implemented seem effective to you? How could they be improved?
- Do the objectives, processes and operating methods of your Cantiere seem clear and functional to you?

Perceived Impact and Future Outlook (5 min)

- Do you perceive an impact compared to the work you do in the Cantieri? How?

- Looking to the future, do you think that in the coming years the Cantieri will change a lot or will continue more or less in the current direction, with only a few small adjustments?
- In your opinion, which aspects should be maintained and which improved or transformed?

Closure (5 min)

- Is there any point we haven't touched on that you think is important to share or add?

A.3. Anonymized Script of Focus Groups

The focus group transcripts included in this appendix have been fully anonymized to protect participants' confidentiality. Personal names have been replaced with alphanumeric codes indicating the focus group and participant number (e.g., FG1_P1). References to specific individuals, departments, offices, or roles that could lead to indirect identification have been generalized.

Some contextual details that were not essential for the analysis have been simplified in order to reduce traceability, while keeping the original meaning and flow of the discussion intact. No substantive content has been removed. The transcripts remain faithful to the original exchanges, apart from minor linguistic adjustments such as the removal of filler words or repetitive expressions.

The QR code below brings to a One Drive folder where all the transcripts are accessible under request.

B Appendix B

B.1. Full Benchmarking Dataset

VALID UNIVERSITIES	University	Country	N. students	Paper	Journal	pdf	journal ranking	Website	Fragmentary / holistic approach (0-2): Vision & perspective		Curriculum & learning		Research		Operations & facilities		Governance & policies		Outreach		Stakeholders engagement (1-5): Students		Staff		Faculty		External community	
0	Politecnico di Milano	Italy	48000						[illegible]	2	[illegible]	1	[illegible]	1	[illegible]	2	[illegible]	2	[illegible]	1	[illegible]	3	[illegible]	3	[illegible]	3	[illegible]	2
1	Deakin University	Australia	50.800	Are university "living labs" able to deliver sustainable outcomes? A case-based appraisal of Deakin University, Australia	International Journal of Sustainability in Higher Education	[illegible]	SJR - Q1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2	Jaume I University	Spain	14.800	Integrated sustainability management and equality practices in universities: A case study of Jaume I University	International Journal of Sustainability in Higher Education	[illegible]	SJR - Q1	https://www.uji.es/	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
3	National Tsing Hua University (NTHU)	Taiwan	5.800	Internalizing Sustainability into Research Practices of Higher Education Institutions: Case of a Research University in Taiwan	Sustainability (Switzerland)	[illegible]	SJR - Q1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
4	Qatar University (QU)	Qatar	20.800	Universities of the Future as Catalysts for Change: Using the Sustainable Development Goals to Reframe Sustainability - Qatar University as a Case Study	book chapter published in 2023 as part of the "World Sustainability Series"	[illegible]	Springer (reliable publisher)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
5	University of British Columbia (UBC)	Canada	66.200	Next Generation Sustainability at The University of British Columbia: The University as Societal Test-Bed for Sustainability		[illegible]	Edward Elgar Publishing (reliable publisher)	https://www.ubc.ca/	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
6	University of Trieste (UniTS)	Italy	15.800	Italian Universities for Territorial Sustainable Development and Responsible Communities—The Case Study of the University of Trieste	Sustainability (Switzerland)	[illegible]	SJR - Q1		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
7	University of Cordoba	Spain	21.800	Universities that learn to tackle the challenges of sustainability: Case study of the university of cordoba (Spain)	Sustainability (Switzerland)	[illegible]	SJR - Q1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
8	Cardiff University	UK	30.800	Diffusion of sustainable development in universities' curricula: an empirical example from Cardiff University	Journal of Cleaner Production	[illegible]	SJR - Q1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Impact measurement framework (0-2)								Governance structure				Key sustainability initiatives					Descriptive summary	
KPIs		Sustainability report		External / independent rankings		Internal monitoring system		Sustainability board	Actors involved in addressing sustainability	Committees / sub units	Strategic integration	Awareness and education	Green campus and infrastructure	Community engagement	Sustainability research units / hubs	Policy and strategic projects	Important aspects	Bottom line = morale della favola
Internal tracking and idea scoring are in place (feasibility, coherence), but there is no public dashboard of indicators yet	1	Reporting through PSS and internal planning tools exists but no GRI-style consolidated report publicly released	1	Participates in UI GreenMetric but is not leading or highly visible in international SDG rankings	1	Internal mechanisms include feasibility evaluations, project lifecycles, and semiannual alignment with budgeting	2	Yes – SSI Coordination Table chaired by the Pro-Rector, with a Sustainability Task Force (TFS) and Cantieri governance	Pro-Rector, TFS, PTA and faculty members, Cantieri coordinators, and student associations	Yes – Cantieri are multi-actor thematic sub-units operating across departments and administration	Strong – Sustainability integrated into the PSS, budgeting processes, institutional governance, and HR structure	Moderate – Thematic campaigns and toolkits (e.g., energy, food waste, inclusive design) supported by Cantieri initiatives	Strong – Initiatives on mobility, waste, energy saving, and digital sustainability are widespread and documented	Partial – Interaction with city networks on specific themes (mobility, accessibility) but limited structured regional partnerships	Yes – Cantieri	Yes – Sustainability integrated into strategic planning (PSS), annual budgeting, and internal project evaluation cycles	(1) Cantieri della Sostenibilità structure enables cross-campus collaboration and innovation (2) Governance is solid, with embedded roles and coordination tables for sustainability (3) Strong operational focus: green mobility, digital sustainability, and waste reduction (4) Need to expand curricular integration and public visibility	Politecnico di Milano shows a robust governance-driven approach to sustainability with impactful initiatives and community engagement. Its Cantieri framework fosters institutional learning and innovation, though deeper curricular integration and external communication remain priorities.
Monitors carbon, procurement, and waste KPIs across campuses.	2	Annual Energy and Sustainability Reports issued since 2015.	2	Participates in ratings (e.g., Green Star); impact not fully benchmarked or communicated.	1	Integrated reporting system tracks progress; described as the "single source of truth for sustainability metrics."	2	No dedicated sustainability office yet, but plans are proposed.	Facilities, researchers, faculty, and sustainability team within specific projects.	Sustainability metrics are integrated, but no centralized council or working groups yet.	Sustainability initiatives are project-based; lacks formal cross-campus coordination.	Sustainability modules in certain courses; showcase awards for environmental education; minor presence in broader curriculum.	Real-time energy and resource monitoring, carbon emission reduction goals, zero water waste goal, Green Star-rated buildings.	Emphasis placed on potential impact, but current actions remain internal to campus.	Living labs across five campuses for sustainability innovation and testing.	Proposed establishment of a Sustainability Strategy Office, integrated performance tracking, sustainability embedded in university goals.	(1)Deakin's living lab initiatives span five campuses but lack a centralized governance structure (2)A proposed Sustainability Strategy Office would serve to coordinate and scale university-wide efforts (3)Reporting tools and data systems are strong, but strategic impact and community-level transfer still limited (4)Sustainability goals are ambitious (e.g., carbon neutrality, zero waste) but currently pursued through isolated, project-based efforts	Deakin has great infrastructure and initiative-level innovation, but lacks a systemic, strategic connection between these projects and the university's long-term sustainability goals
Indicators used internally; more formalized reporting needed for consistent benchmarking.	1	Published once (2017) according to GRI standard, but lacks commitment to periodic updates.	1	Cited as a highly ranked young university, but no formal inclusion in global sustainability rankings noted.	1	Internal Steering Committee monitors indicators; a sustainability awareness survey was launched in 2022.	1	Yes – includes the Sustainability Steering Committee, Equality Unit, Social Responsibility Committee, and Ethics Committee	Senate, Governing Council, students, equality and ethics unit members, vice-rectors for equality and sustainability	Equality Commission, Ethics Line Committee, Health & Environment Office, NGO "Isonomia Foundation"	Fully integrated into the Governance Action Plan and Social Responsibility Plan, aligned with Agenda 2030 and GRI principles	Mandatory sustainability in all degrees; training programs on equality and sustainability; educational campaigns.	Healthy Habitat COVID project, waste reduction, energy efficiency, new garden areas in planning.	Isonomia Foundation programs, municipal partnerships, campaigns against harassment and gender violence.	14 institutes; themes include environment, sustainable chemistry, gender, peace, development.	Equality Plan (2021–2025), Ethics Code, Social Responsibility Plan (RSUJI), Steering Committee oversight.	(1)One of the most structurally integrated equality and sustainability frameworks in Europe (2)Active equality-focused NGO (Isonomia) within the university leads regional empowerment and training programs (3)Despite structural maturity, communication strategy lacks central coordination and sustainability reporting remains ad hoc (4)Overlapping units (Equality Unit, Isonomia, Institute for Feminist and Gender Studies) may present organizational inefficiencies	Jaume I University presents one of the most institutionally integrated sustainability and equality models, combining top-down governance with grassroots programs. However, the lack of consistent sustainability reporting and decentralized communication dilute visibility and efficiency. Clear progress, but implementation impact could be better measured and optimized.
Carbon baseline and inventory in place; KPIs exist in principle but limited visibility in public reporting.	1	A comprehensive report exists (e.g., 2021), but publication is not yet consistent or institutionalized.	1	Participates in the Taiwan Corporate Sustainability Awards and other recognitions, but no evidence of THE Impact Rankings participation.	1	Dashboards and action plans are being developed for emissions tracking, but systems are still being implemented.	1	Yes – Sustainability Committee established; all 26 academic and admin units have assigned officers.	Faculty, unit officers, central administration; strong researcher involvement.	Sustainability Committee, Energy Conservation Office, student-involved Living Lab teams.	Sustainability goals are embedded in strategic planning and award systems, though faculty cite lack of incentives and top-down leadership in execution.	Faculty-driven public lectures and advocacy, but formal education lacks consistent curriculum-wide integration.	Green procurement policies (>98% of items meet environmental standards), carbon neutrality roadmap, and real-time monitoring dashboard under development.	Some outreach through faculty advocacy and student research, but no structured, university-wide programs.	Strong sustainability research culture in energy and environment; multidisciplinary projects promoted via SDGs framework.	Campus as Living Lab initiative, unit-specific sustainability planning, and ongoing development of carbon tracking systems.	(1)High-profile sustainability recognition in Taiwan with a proactive stance toward emissions reduction (2)Lacks centralized curricular and reward alignment to promote research or teaching in sustainability (3)Faculty members are self-motivated and active in sustainability research, often despite limited institutional support (4)University-wide commitment is present, but implementation remains fragmented, especially in teaching and student engagement	NTHU demonstrates strong faculty-driven sustainability research and commendable institutional goals like carbon neutrality by 2050. However, despite a formal committee structure and award-winning sustainability reporting, the internalization of sustainability across research, curriculum, governance, and student engagement is still fragmented and hampered by a lack of incentives and leadership-driven policy mandates.
SDG performance tracked via THE Impact Rankings and internal metrics; platform in development to standardize tracking.	2	Public reporting and dashboards exist; data tied to policy, operations, and rankings.	2	Ranked in THE Impact Rankings (Top 200 globally, Top 100 in several SDGs).	2	New SDG mapping platform being developed to centralize efforts and benchmark performance.	2	Yes – Coordinated through strategic offices and sustainability-focused centers.	Students, faculty, research centers, policy offices, and university administration.	Yes – Includes Center for Sustainable Development, Center for Law and Development, and others.	Strong – Sustainability is embedded in mission, academic reform, research priorities, and national alignment.	Broad efforts include SDG-integrated courses, public lecture series, and graduate attributes linked to global challenges.	Energy efficiency systems, sustainable waste management, resource policies, and zero-waste campus commitment.	Active collaboration with ministries, healthcare institutions, international NGOs, and schools; student-led local impact programs.	Yes – Multiple centers leading projects in SDGs 3, 4, 7, 11, 13, including climate mitigation and sustainable urban planning.	Yes – Institutional planning aligns with Qatar National Vision 2030, with strategic reforms across governance and education.	(1) QU embeds sustainability deeply in curriculum, research, operations, and institutional policy, with strong alignment to Qatar National Vision 2030 and SDG priorities (2) Faculty and students are actively involved in sustainability-related teaching, research, and community outreach, backed by specialized centers and government partnerships (3) Campus operations support zero-waste goals, renewable energy, and green procurement under a clear institutional policy framework (4) A digital SDG mapping platform is under development to centralize and monitor the university's sustainability performance across departments	Qatar University demonstrates a system-wide, policy-backed commitment to sustainability with broad SDG integration across teaching, research, and operations. Nationally aligned and internationally ranked, QU stands out for its proactive governance, faculty leadership, and student participation. To elevate its impact further, ensuring cohesion and long-term consistency across all units will be key to solidifying its role as a regional sustainability leader.
Performance is tracked through rigorous environmental and financial metrics, including lifecycle costing, carbon pricing, and emissions targets.	2	Transparent public reporting aligned with frameworks like STARS; monitoring systems in place for projects like CIRS and district energy.	2	STARS Gold rating, widely recognized leadership in campus sustainability and global climate performance.	2	Each major capital project (e.g., CIRS, biomass plant) includes detailed performance monitoring and impact evaluation mechanisms.	2	Yes – The UBC Sustainability Initiative (USI) operates under a Steering Committee with Vice Presidents and Deans, chaired by the Provost.	Faculty, students, operations teams, sustainability office, external partners (public/private/NGOs).	Yes – Teaching & Learning Office, Research & Partnerships Office, Operational Management, Communications.	Strong – Sustainability is embedded in strategic planning ("Place and Promise" plan), operations, curriculum, and research programs.	Extensive — public courses, cross-faculty collaborations, open-access tools, and interdisciplinary teaching fellowships.	Major projects like CIRS, smart grid retrofits, hot water district system, and bioenergy plant reflect deep infrastructural integration.	The "Agent of Change" model promotes joint learning and innovation with external actors on urban energy, planning, and policy development.	Yes – CIRS functions as both a building and a hub for sustainability research; other centers support behavioral and technical innovation.	Strong – Climate goals to reduce emissions 100% by 2050, mandatory carbon pricing compliance, and a commitment to regenerative sustainability.	(1) UBC positions itself as a living lab for regenerative sustainability, linking academic and operational systems to model net-positive futures (2) Sustainability is deeply institutionalized through leadership, governance structures, and interdisciplinary coordination across research, teaching, and infrastructure (3) Strategic projects like the CIRS building, biomass plant, and energy grid overhaul exemplify a campus-wide experimental platform with embedded learning mechanisms (4) The university's horizontal sustainability governance (via USI) cuts across vertical structures, fostering cultural change and embedding sustainability into institutional DNA	UBC stands out as a global leader in regenerative sustainability, integrating research, operations, and policy into a living lab model. Its challenge lies in maintaining coherence as it scales innovation across a complex institutional landscape.
Sustainability indicators aligned with RUS-GBS reporting standards are being used; continuous improvement areas have been identified through audits and internal reviews.	2	The Integrated Social Responsibility Report (since 2020) transparently presents UniTS' environmental, social, and governance efforts linked to SDGs.	2	The university does not report participation in global sustainability rankings, though it follows recognized national standards.	1	An internal performance framework and audit system are in place to guide improvements and track policy effectiveness.	2	Yes – Sustainability is overseen at the governance level, with the Rector's Delegate and working groups coordinating efforts across departments and in public-facing projects.	Faculty, administrative staff, researchers, students, and regional institutional partners.	Yes – Working groups operate within departments (e.g., Engineering and Architecture) to manage and implement sustainability-related initiatives.	Strong – Sustainability is embedded across planning, operations, and external partnerships. The Integrated Social Responsibility Report acts as a central accountability tool.	Student-facing campaigns (e.g., water conservation), cross-departmental training, and university-wide reporting raise awareness.	The Trieste Water Network installed 25 filtered water dispensers and supported public infrastructure upgrades, reducing plastic and promoting access.	Robust third mission efforts: urban regeneration (e.g., school-space redesign), inclusive design (e.g., accessibility planning), and territorial equity through spatial data and planning tools.	No standalone sustainability research hub, but several interdisciplinary research teams apply sustainability principles in public engagement projects.	Participation in INEST innovation ecosystem and regional spatial planning initiatives positions UniTS as a knowledge partner in territorial sustainability.	(1)UniTS actively integrates SDGs into its strategic vision and reporting, using national frameworks to structure institutional governance and performance evaluation (2) It plays a prominent role in regional sustainability, from accessibility planning and school regeneration to spatial equity research and public participation processes (3) Projects like the Trieste Water Network demonstrate how internal campus measures can ripple into public infrastructure improvements and behavioral change (4) While curricular integration and global rankings remain in early stages, UniTS leads in embedding sustainability through research application and third mission strategies	UniTS links governance and territory through SDG-aligned policies, civic partnerships, and applied research. Despite early-stage teaching integration, it shows strong momentum as a regional sustainability actor.
UCO uses the CRUE Sustainability Self-Diagnostic Tool (130 indicators), tracking performance over 20 years, showing progress from 7.1% in 2000 to 67.5% in 2019.	2	While annual environmental management reports exist, the paper does not mention a consolidated or public-facing sustainability report.	0	UCO does not report participation in global rankings such as THE Impact or UI GreenMetric.	0	A mature internal system for evaluation and planning is in place, including participatory audits, strategic milestones, and annual reports.	2	Yes – The Environmental Protection Service (SEPA) and Sustainability Office coordinate strategy, education, and management efforts.	Governance bodies, SEPA, Sustainability Office, faculty, and staff.	Yes – Dedicated departments like SEPA and units such as the Clover Programme function as sub-units.	Strong – Environmental sustainability is positioned as a strategic institutional axis; environmental norms and principles are embedded in planning documents.	The Clover Programme, participatory environmental action plans, and internal campaigns promote practical and reflective environmental learning.	Strong waste, energy, and water management systems are coordinated by SEPA; infrastructure is designed to reinforce visible environmental norms.	Limited – Some external alliances exist, but engagement is largely concentrated within the campus community.	Yes – SEPA doubles as a management and research hub with connections to education and publications.	Yes – The 2019-2022 Environmental Sustainability Plan and 20-year planning trajectory show deep institutional commitment.	(1) UCO's evolution toward sustainability spans two decades, grounded in organizational learning and strategic investment in environmental management (2) The university integrates management, education, and research via a scientific-technical hub (SEPA), fostering internal innovation and staff collaboration (3) Participatory initiatives such as the Environmental Action Plan and Clover Programme demonstrate bottom-up influence on policy and behavior (4) Despite internal maturity, UCO does not yet publish a formal sustainability report or participate in global rankings, limiting its external visibility	UCO has built a robust internal ecosystem for sustainability grounded in long-term planning, participatory learning, and strategic coordination. While it leads in institutional integration and performance tracking, its next steps should focus on external visibility, systematic curriculum reform, and broader stakeholder engagement to fully leverage its achievements.
Course-level audits using STAUNCH are performed, but no broader institutional performance indicators or longitudinal sustainability KPIs are cited	1	Cardiff University does not publish a consolidated sustainability report according to the information in the paper.	0	No mention of participation in international sustainability rankings (THE Impact, UI GreenMetric, etc.).	0	STAUNCH audits exist for curricula, but there is no full institutional monitoring system covering operations, research, or governance.	1	No – No mention of a centralized sustainability governance body beyond curricular mentions.	Primarily individual schools and a few pioneering faculty members; limited central coordination.	No – Decentralized, ad hoc efforts with no structural sub-units mentioned.	Weak to moderate – SD is recognized at the policy level, but implementation remains fragmented and largely dependent on individual initiative.	Curricular integration efforts through STAUNCH audits raise awareness among faculty and students.	Not discussed in the paper.	Not systematically developed.	Not mentioned.	Limited to policy language embedding SD; lacks concrete, operationalized strategic sustainability projects.	(1) Cardiff University recognizes sustainability in strategic documents but its implementation remains fragmented and localized in curricula (2) The STAUNCH audit revealed a tendency toward compartmentalization and siloed SD integration across schools rather than systemic change (3) Faculty champions play a role in advancing SD, but broader engagement across all departments is limited and slow (4) No dedicated governance bodies, operational initiatives, research centers, or external ranking participation were identified to strengthen sustainability impact	Cardiff University has made preliminary efforts to integrate sustainable development into teaching, but lacks systemic governance, operational action, and external benchmarking. Progress is driven by isolated champions rather than coordinated institutional transformation, leaving sustainability largely at the level of policy intent and scattered curricular inclusion.

VALID UNIVERSITIES	University	Country	N. students	Paper	Journal	pdf	journal ranking	Website
9	**University of the West of Scotland (UWS)**	UK	16.100	Sustainability and Stakeholder Awareness: A Case Study of a Scottish University	Sustainability (Switzerland)	file:///Users/user/Downloads/sustainability-13-04180-v2.pdf	SJR - Q1	https://www.uws.ac.uk/
10	**University of Florence**	Italy	50.000	The path toward a sustainable green university: The case of the University of Florence	Journal of Cleaner Production	https://pdf.sciencedirectassets.com/271750/1-s2.0-S0959652620X00308/1-s2.0-S0959652620333708/main.pdf?X-Amz-Security-Token=[illegible]	SJR - Q1	https://www.unifi.it
11	**University of Toronto**	Canada	97.000	Expanding Student Engagement in Sustainability	Sustainability journal (MDPI)	file:///Users/user/Downloads/sustainability-11-00530.pdf	SJR - Q1	https://sustainability.utoronto.ca/
12	**University of Liverpool**	United Kingdom	33.000	Liverpool Knowledge Quarter Sustainability Network: Case Study (2012, 2013)	Emerald Publishing	file:///Users/user/Downloads/Liverpool_knowledge_quarter_sustainability_network.pdf	SJR - Q1	https://www.liverpool.ac.uk/
13	**University of Salamanca**	Spain	30.000	Are We Training in Sustainability in Higher Education? Case Study: Education Degrees at the University of Salamanca	Sustainability journal (MDPI)	file:///Users/user/Downloads/Are_We_Training_in_Sustainability_in_Higher_Educat.pdf	SJR - Q1	https://www.usal.es/universidad
14	**University of Tübingen**	Germany	28.000	The Whole-Institution Approach at the University of Tübingen: Sustainable Development Set in Practice	Sustainability journal (MDPI)	file:///Users/user/Downloads/sustainability-12-00861-v2.pdf	SJR - Q2	https://uni-tuebingen.de/en/
15	**Zhejiang University (ZJU)**	China	65.000	The motivation and development impact of energy saving to sustainability in the construction of green campus: a case study of the Zhejiang University, China	Springer	file:///Users/user/Downloads/The_motivation_and_development_impact_of_energy_sa.pdf	SJR - Q1	https://www.zju.edu.cn/english/
16	**Erasmus University Rotterdam (EUR)**	Netherlands	33.000	Transforming universities: Mobilizing research and education for sustainability transitions at Erasmus University Rotterdam, The Netherlands	Springer Nature	https://link.springer.com/content/pdf/10.1007/[illegible].pdf	SJR - Q1	https://www.eur.nl/en
17	**University of Guadalajara**	Mexico	280.000	Towards the Implementation of Sustainable Development Goals at the University of Guadalajara, Mexico	Horizon Research Publishing (HRPUB).	file:///Users/user/Downloads/Towards_the_Implementation_of_Sustainable_Developm.pdf	Not ranked in Scopus (not Q1–Q4) but institutionally authored and highly detailed	https://www.udg.mx/en
18	**University of Beira Interior (UBI)**	Lisbon	8.500	Environmental Connection, Awareness, and Behaviors in University Students: An Exploratory Portuguese Study	Sustainability (MDPI)	file:///Users/user/Downloads/Environmental_Connection_Awareness_and_Behaviors_i.pdf	SJR - Q1	https://www.ubi.pt/en/
19	**Cairo University**	Egypt	260.000	Developing a Sustainable University Campus in Egypt: Cairo University as a Case Study (2023)	IOP Publishing	file:///Users/user/Downloads/Developing_a_Sustainable_University_Campus_in_Egypt.pdf	Part of the Scopus-indexed IOP Conference Series	https://cu.edu.eg/Home
20	**James Cook University (JCU)**	Australia	20.000	James Cook University's Holistic Response to the Sustainable Development Challenge	Springer - World Sustainability Series	file:///Users/user/Downloads/[illegible].pdf	Not ranked in Scopus (not Q1–Q4) but reputable journal	https://www.jcu.edu.au/

Fragmentary / holistic approach (0-3)

	University	Vision & perspective		Curriculum & learning		Research		Operations & facilities		Governance & policies		Outreach	
9	University of the West of Scotland (UWS)	UWS recognizes sustainability mainly through an economic and legal compliance lens. Sustainability is treated as a voluntary and operational exercise rather than a transformative core strategy	1	No evidence of systematic integration of sustainability into curricula or educational mission; sustainability education is almost absent.	0	No reference to sustainability-driven research initiatives or interdisciplinary hubs related to SDGs.	0	Energy reduction targets tied to carbon compliance laws exist, but little voluntary operational sustainability action beyond statutory obligations	1	Sustainability structures (like CUSP and a Sustainability Advisory Group) exist, but are poorly coordinated, underfunded, and not embedded into strategic leadership.	1	Limited outreach efforts; student union initiatives exist, but institutional-level external engagement on sustainability is almost absent.	1
10	University of Florence	Sustainability is fully integrated into the University's strategic vision under the current Rector, with structured initiatives across governance, operations, teaching, research, and community engagementUniversity of Florence.	3	The University offers specialized degrees, master's programs, and horizontal integration of SDGs into regular courses across several disciplines	2	Research projects on sustainability span multiple fields and are tracked via the "Flore" repository, although a centralized sustainability research strategy is still missing	2	Strong focus on green buildings, sustainable mobility initiatives (subsidized transport), energy savings projects, and waste reduction	2	A dedicated "Green Office" coordinates sustainability activities and reporting, integrated into the strategic governance structure	2	Initiatives like public lectures and participation in events (e.g., BRIGHT – European Researchers' Night) exist, but broader, deeper stakeholder engagement needs improvement	1
11	University of Toronto	The university commits to long-term sustainability through its Low-Carbon Action Plan and Climate Positive Campus goal, aiming for carbon neutrality and institutional transformation by 2050. These ambitions are backed by formal planning tools and multi-campus alignment.	3	U of T has mapped over 2,000 courses to the SDGs, with sustainability embedded across disciplines and supported by experiential programs like Community-Engaged Learning and Living Labs.	2	Interdisciplinary research centers and CECCS subgroups work on topics like decarbonization, climate justice, and urban design. Faculty clusters are structured to align with institutional and global sustainability priorities.	2	Campus-wide energy audits, net-zero buildings, real-time tracking, and sustainable procurement demonstrate deep integration of operational sustainability. Strategic targets guide infrastructure upgrades.	2	Governance is structured around the CECCS, which integrates students, faculty, and staff in subcommittees. Sustainability is institutionalized into capital planning, academic priorities, and reporting.	3	Community and civic engagement is central to U of T's strategy, with citywide sustainability partnerships and student-led impact initiatives shaping co-curricular programming.	2
12	University of Liverpool	The KQSN is embedded in Liverpool's strategic urban vision, aligning with the SDGs and local development plans through cross-sector partnerships. It seeks to scale transformation across healthcare, education, and civic actors through long-term institutional commitment.	2	Some sustainability themes emerge through awareness initiatives, workshops, and student-led campaigns, but no evidence of formal, curriculum-wide integration.	1	Anchored by applied sustainability research (e.g., circular economy, aquaponics, SDG impact), with knowledge transfer to SMEs and community groups.	2	Strong green operations focus: food composting, anaerobic digestion, rooftop aquaponics, sustainable procurement, and campus greening across member institutions.	2	Sustainability is embedded in local development strategies and within each institution's SDG plans. KQSN voluntarily reports to the city board and aligns with anchor institutional strategies.	2	Extensive partnerships with city councils, churches, NGOs, and the NHS; key projects (e.g., Micah, Sustainable Food Cities, Circular Economy Club) ensure deep urban engagement.	2
13	University of Salamanca	USAL has a sustained commitment to sustainability through participation in the CRUE-Sustainability network and its own initiatives like the Salamanca Declaration (2018), which affirms alignment with the 2030 Agenda and the integration of SDGs into its strategic direction.	2	Sustainability is included in transversal competencies in some degrees, notably in Education, but not uniformly across faculties. The EDINSOST project helped map integration, but systemic uptake is uneven.	1	USAL contributes to research on sustainability education through projects like EDINSOST, but lacks a visible, centralized sustainability research hub.	1	Sustainability principles are present in mission statements and policy documents, but the paper and website show no clear mention of green campus or infrastructure actions.	1	Sustainability is integrated into institutional policy through national networks (e.g., CRUE) and internal alignment with social responsibility strategies.	2	Strong international and Ibero-American engagement through events like the 2018 SDG Conference and active role in national sustainability education strategies.	2
14	University of Tübingen	The university presents a long-term institutional vision for sustainability, structured through its Sustainability Office and a "whole-institution approach". This includes climate goals, curriculum changes, and culture change, integrated into both strategic plans and university identity.	2	The university presents a long-term institutional vision for sustainability, structured through its Sustainability Office and a "whole-institution approach". This includes climate goals, curriculum changes, and culture change, integrated into both strategic plans and university identity.	2	The university promotes inter- and transdisciplinary sustainability research through dedicated programs and events such as "Sustainability Week". There's strong support for projects aligned with the SDGs.	2	Sustainability in campus operations (e.g., mobility, energy, procurement) is addressed through initiatives and working groups, but large-scale infrastructural transformation is still evolving.	1	A Sustainability Office was established in 2012 with a strategic mandate. The university senate adopted a comprehensive sustainability mission statement and sustainability is part of decision-making procedures.	2	Strong collaboration with the city of Tübingen and regional actors. The university plays an active role in the city's sustainability agenda and promotes social innovation and public engagement.	2
15	Zhejiang University (ZJU)	Sustainability is positioned as a long-term strategic goal, aligned with China's ecological civilization vision. The green campus model is seen as a long-lasting transformation agenda involving infrastructure, operations, and student behavior.	2	Environmental and energy-saving awareness is promoted among students, but SDGs or sustainability are not yet fully embedded across curricula.	1	ZJU leads research in green technologies, sustainable construction, and environmental management. Strong interdisciplinary collaboration is encouraged.	2	Extensive smart energy-saving systems, building-level controls, and emissions-reduction technologies are used. Real-time monitoring systems guide action.	2	The university implements top-down sustainability policies under national directives and campus-level plans for green development.	2	The paper shows focus on internal improvements; external engagement exists but is not central to the model.	1
16	Erasmus University Rotterdam (EUR)	EUR has embraced a long-term vision centered on sustainability transitions. The establishment of the DesignImpact Transition (DIT) platform and the integration of transition thinking into research and education indicate a strategic commitment extending well beyond 2030.	2	Sustainability is being integrated into educational programs (e.g., Erasmus School of Social and Behavioural Sciences), but not yet embedded university-wide. Progress is uneven across faculties.	1	Sustainability transitions are a core research theme, particularly through DRIFT and DIT. EUR is recognized for its systemic, impact-driven research aligned with SDGs.	2	Sustainable operations are evolving (e.g., CO_2 footprint reduction goals, sustainable catering), but comprehensive greening of infrastructure is still emerging.	1	Clear governance mechanisms include a Sustainability Program Board, dedicated sustainability managers, and faculty representatives. The DIT platform enhances strategic coherence.	2	EUR actively engages societal actors through co-creation, living labs, and partnerships in the Rotterdam region (e.g., Resilient Delta initiative).	2
17	University of Guadalajara	Sustainability is part of the institutional mission and has guided structural reforms for decades. The Sustainable University Program (since 2015) centralizes and aligns scattered past initiatives with SDG goals.	2	Sustainability principles are embedded across disciplines, including intercultural and inclusive education. A pilot course on ESD was created for professors.	2	Strong history of applied and interdisciplinary research (e.g., JIMA, turtle/crocodile conservation, SDG-aligned local research). Research indicators are being linked to SDGs.	2	Green energy transition program (PUFE), hybrid/electric vehicles, water footprint metrics, tree inventories, waste audits, and energy monitoring implemented.	2	The Sustainable University Program provides structured coordination; while not yet a fully autonomous office, governance is strategically aligned.	2	Extensive partnerships with NGOs, municipalities, and government. Regional campuses act as SDG nodes aligned with local environmental priorities.	2
18	University of Beira Interior (UBI)	UBI embeds sustainability in its long-term institutional strategy through education and research, aligned with SDGs and national policies.	2	Some courses and faculties integrate sustainability (e.g., Faculty of Human and Social Sciences), but systemic integration across programs is not yet evident.	1	Sustainability-related research is present (e.g., environmental psychology, behavioral change), but no centralized research center or SDG mapping yet.	1	Limited evidence of campus-level sustainability operations, such as green infrastructure, waste, or energy tracking.	0	General alignment with SDG discourse and Portuguese HEI sustainability efforts; however, no formalized governance unit is highlighted.	1	Some outreach through student projects and behavioral campaigns; broader strategic engagement with local or regional actors not documented.	1
19	Cairo University	Cairo University explicitly commits to long-term sustainability, aligning with Egypt Vision 2030, the UI GreenMetric framework, and sustainable campus transformation plans.	2	Environmental education is promoted through seminars and awareness programs, but formal curriculum-wide integration is not yet institutionalized.	1	Research on green energy, climate change, and waste management is being scaled; sustainability labs and related master's programs are being expanded.	2	Strong actions in energy saving (solar panels, LED lights), water conservation, and waste segregation. Smart infrastructure plans are being implemented.	2	Sustainability Office and GreenMetric Working Group operate under formal policy directives; environmental auditing is integrated into planning.	2	Partnerships and national engagement are noted, but community co-creation or external stakeholder empowerment is still limited.	1
20	James Cook University (JCU)	JCU's strategic intent emphasizes sustainability in tropical regions, embedding it in learning, research, and community impact. A dedicated sustainability vision (signed via the Talloires Declaration) guides planning and operations across the institution.	3	JCU offers a Bachelor of Sustainability with three majors (science, social science, business), strong transdisciplinary design, and practical learning integration. Sustainability is present in 25+ programs and integrated through the "Curriculum Refresh" initiative.	3	Multiple sustainability research centers exist, notably the Cairns Institute and TESS (Tropical Environmental and Sustainability Sciences), engaging in climate, Indigenous studies, biodiversity, governance, and more.	2	The TropEco program governs green initiatives: biofertilizer production, e-waste recycling, carbon-cutting district cooling systems, green buildings, and Second Life reuse programs. JCU also promotes campus-wide sustainability behaviors.	2	JCU has a two-tier governance model: the Sustainability Advisory Committee (SAC) and the Sustainability Action Group (SAG), with representation across stakeholders. They embed sustainability into planning, strategy, and performance indicators (LiFE Index).	2	JCU fosters external partnerships through events like the Annual Sustainability Fair and community-linked networks (e.g., Trop Futures for school teachers). Local governments and NGOs support projects like permaculture gardens and environmental restoration.	2

Stakeholders engagement (1-5)

	University	Students		Staff		Faculty		External community	
9	University of the West of Scotland (UWS)	The Student Union promotes awareness and behavior change projects, but institutional efforts to engage students on sustainability remain weak.	2	General staff awareness and involvement in sustainability initiatives is low; sustainability seen as peripheral rather than central to operations or teaching.	1	Few faculty initiatives on sustainability, and these mostly external to core curriculum or research planning.	1	No strategic partnerships with local communities or industries regarding sustainability reported.	1
10	University of Florence	Students are actively involved in sustainability courses and green mobility programs, but systematic engagement beyond participation remains limited.	3	Academic and administrative staff contribute through research, teaching, and operational projects, coordinated via the Green Office.	3	Faculty members lead curriculum development, research, and public communication efforts in sustainability areas.	4	Efforts exist (e.g., public events, community recycling programs), but a broader engagement strategy with external stakeholders is still needed	2
11	University of Toronto	Students are empowered through CECCS involvement, Living Lab pilots, and SDG project leadership, though governance roles could be expanded.	4	Staff contribute to the implementation of energy tracking, building retrofits, and co-lead CECCS subcommittees. Broader strategic leadership is still emerging.	3	Faculty play a core role in integrating sustainability into teaching, leading cross-cutting research groups, and contributing to CECCS governance.	4	The university collaborates with city partners, NGOs, and businesses to co-develop climate strategies and innovation projects with measurable impact.	4
12	University of Liverpool	Student-led sustainability campaigns, composting projects, eco-startups, and aquaponics initiatives are visible, but governance-level inclusion is limited.	3	Staff co-lead initiatives (food procurement, circular economy projects) and participate in network-wide best practice exchanges.	3	Academic staff contribute via research and cross-sector partnerships (e.g., aquaponics, FRED circular food system bid), though coordination is informal.	3	High-quality engagement with churches, local businesses, NGOs, and government institutions; projects like Micah and food redistribution schemes ensure deep societal involvement.	4
13	University of Salamanca	Students are recipients of sustainability-focused education, especially in teaching degrees, but there's little evidence of governance participation.	2	Faculty are engaged via curricular reform (e.g., EDINSOST) and educational projects, though engagement beyond education fields is unclear.	2	Faculty in Education are active leaders in SDG integration and research. Pedagogy faculty, in particular, achieved strong outcomes in integrating sustainability competencies.	3	The university hosts SDG-focused conferences, supports regional collaboration, and signed the Salamanca Declaration, promoting external engagement around sustainability.	3
14	University of Tübingen	Students are heavily involved through the Green Office, student working groups, and initiatives like the Sustainability Week.	4	Administrative staff participate in working groups and operational sustainability programs, though engagement varies by department.	3	Many faculty members actively participate in curriculum reform and sustainability governance. Teaching staff co-develop learning modules.	4	There are strategic collaborations with the city, NGOs, and civil society. Public events and joint city-university forums are held regularly.	4
15	Zhejiang University (ZJU)	Students are involved through behavioral change programs, awareness campaigns, and building use patterns, but not yet in strategic governance.	3	Administrative staff are included in building operations and energy management, with accountability tied to performance metrics.	3	Academic staff contribute via research and participation in the implementation of green solutions.	3	Some outreach to energy suppliers and external technology providers, but not fully collaborative or co-designed.	2
16	Erasmus University Rotterdam (EUR)	Students are increasingly engaged in education, events, and participatory projects, though representation in strategic governance remains limited.	3	Administrative staff and program managers are involved in implementation; sustainability managers exist across faculties.	3	Faculty play a driving role in research and the development of transdisciplinary, impact-oriented teaching. Many are embedded in DIT and DRIFT initiatives.	4	Strong partnerships with Rotterdam city, NGOs, and other universities through initiatives like Resilient Delta and living labs.	4
17	University of Guadalajara	Involved in SDG projects, environmental programs, mobility, intercultural activities, and social services.	3	Participated in sustainable procurement training, policy implementation, and infrastructure audits.	3	Drive curriculum reforms, lead research, and participate in applied community projects.	4	Strategic collaborations with state agencies, municipalities, and communities (e.g., Indigenous outreach, urban planning, ecosystem protection).	4
18	University of Beira Interior (UBI)	Students participate in sustainability-related surveys and behavioral programs but not in governance or curriculum design.	2	No formal or systemic staff engagement strategy is detailed.	1	Some faculty are active in sustainability research and teaching; involvement is individual rather than institutional.	2	Limited evidence of co-created sustainability activities with external stakeholders.	1
19	Cairo University	Informed and consulted through green clubs and awareness events, but not yet empowered in governance or planning.	2	Participates in trainings and workshops, especially around EMS (Environmental Management Systems) and awareness.	2	Faculty lead sustainability-related research and contribute to infrastructure planning and sustainability audits.	3	Outreach exists through events and national alignment (e.g., Egypt Vision 2030), but long-term co-design mechanisms are limited.	2
20	James Cook University (JCU)	Students are deeply involved in internships, clubs (e.g., Sustainability Club, Permaculture Society), the TropEco program, and co-creation of projects like Green Switch and edible gardens.	4	Staff contribute to research, operations, training, and project development. Staff pledges and internal green champions encourage personal responsibility for sustainability.	3	Faculty lead curriculum design, research strategy, and interdisciplinary centers. They co-supervise student internships and organize SDG-aligned activities across campuses.	4	Community engagement is well-structured through events, partnerships (e.g., Cairns Regional Council), and collaborative projects on food, education, and biodiversity. The university serves as a regional reference point for sustainability in northern Australia.	4

Impact measurement framework (0-2)								Governance structure				Key sustainability initiatives					Descriptive summary	
KPIs		Sustainability report		External / independent rankings		Internal monitoring system		Sustainability board	Actors involved in addressing sustainability	Committees / sub units	Strategic integration	Awareness and education	Green campus and infrastructure	Community engagement	Sustainability research units / hubs	Policy and strategic projects	Important aspects	Bottom line = morale della favola
No systematic internal KPIs or metrics for tracking sustainability performance beyond basic energy bills and transport surveys	0	No dedicated sustainability report or integrated public disclosure framework is mentioned.	0	University is listed in the "People and Planet" rankings but ranked poorly (119th to 122nd place), indicating weak external sustainability recognition	1	No cohesive internal system for sustainability auditing, monitoring, or feedback mechanisms.	0	Partial – CUSP and a Sustainability Advisory Group exist, but suffer from lack of authority, integration, and influence on university-wide strategy	Sustainability advisory staff, student union, and isolated staff members; limited buy-in from central leadership.	Partial – Structures exist but are poorly coordinated and underpowered.	Weak – Sustainability remains fragmented across units, lacking strategic integration into the university's governance or operational model.	Mainly driven by the Student Union; institutional efforts to raise sustainability literacy are minimal.	Energy saving measures tied to government carbon compliance exist, but no comprehensive green campus strategy.	Virtually absent beyond mandatory public services (health care, sports facilities); no sustainability-linked community projects highlighted.	None mentioned beyond the sustainability advisory group, which itself is focused on internal policy advice.	Lacking – No transformative or major policy initiatives around sustainability reported.	(1) Sustainability at UWS is mainly framed through economic survival and legal compliance rather than strategic transformation (2) Internal efforts are fragmented, with minimal coordination between advisory bodies and operational departments (3) The Student Union plays a more active role than the central administration in promoting awareness and small-scale sustainability projects (4) Lack of robust governance, monitoring tools, and stakeholder engagement limits UWS's credibility and effectiveness in its sustainability mission	UWS shows basic engagement with sustainability through energy and cost management but lacks strategic vision, institutional commitment, and systemic integration. Sustainability initiatives are fragmented, underreported, and poorly aligned with stakeholder engagement or global best practices, leaving much room for improvement.
Annual sustainability KPIs are integrated into strategic planning and reporting through measurable goals such as energy savings and waste reduction	2	A regular sustainability report is published following GRI Standards, linking activities explicitly to the SDGs since 2018	2	The University is listed in international rankings such as Times Higher Education Impact Rankings and the GRI database	2	The Green Office monitors sustainability activities, ensuring systematic internal reporting and planning integration.	2	Yes – A "Sustainable University" team led by a Pro-Rector for Sustainability and supported by the Green Office manages sustainability coordination	Rector's Office, Pro-Rectors, Green Office, faculty, administrative units, and students.	Yes – Specific committees and units (e.g., Green Office, Sustainable University Team) are operational.	Strong – Sustainability principles are embedded across all governance levels, strategic plans, and daily operations.	Broad programs include green labeling of curricula, participation in public awareness events, and online sustainability platforms.	Emphasis on green building construction, LED lighting, and waste minimization (e.g., water dispensers saving ~1.3 million bottles)	Public lectures ("Encounters with the Town"), BRIGHT program, and recycling points, although external community involvement could be enhanced.	No specific centralized unit yet, but a wide range of SDG-related research initiatives and EU-funded projects are underway.	Clear strategic plans for integrating sustainability into university operations, teaching, and external partnerships.	(1) The University of Florence has built a strong sustainability governance framework with a dedicated Green Office and embedded SDG principles into strategic planning (2) Academic integration is strong through multidisciplinary curricula and research, but a formal sustainability research strategy is still missing (3) Operational sustainability achievements include green mobility, green buildings, and energy-saving measures, though financial constraints slow down full implementation (4) Stakeholder and community engagement efforts are growing but require broader strategies to fully leverage external partnerships	The University of Florence shows a strong, comprehensive commitment to embedding sustainability across governance, teaching, research, and operations. Its integrated reporting system, strategic sustainability vision, and participation in global rankings position it as a leading example in Italy, though broader external engagement and full research coordination remain areas for future improvement.
Detailed metrics are tracked on emissions, procurement, waste, and building energy performance. Dashboards provide transparency across campuses.	2	Public-facing dashboards and reports (e.g., Low-Carbon Action Plan updates) are regularly published and aligned with international best practices.	2	The university participates in THE Impact Rankings and UI GreenMetric, with high scores in areas such as research and operations.	2	Progress is monitored through CECCS dashboards and project-level data that inform governance and reporting cycles.	2	Yes – CECCS chaired by leadership.	Students, faculty, operations, CECCS staff, and external advisors.	Yes – CECCS subcommittees on curriculum, living labs, and operations.	Strong – Sustainability embedded in academic priorities, capital projects, and campus master plans.	SDG mapping, interdisciplinary courses, and Living Lab experiential programs foster sustainability literacy across faculties.	Net-zero buildings, district energy systems, and waste audits support low-carbon infrastructure transitions.	CEL and co-curricular programs bridge students and community actors on urban climate justice and sustainability.	CECCS and research working groups coordinate sustainability scholarship on topics from biodiversity to decarbonization.	The Climate Positive Campus Strategy, Low-Carbon Action Plan, and academic planning guide systemic sustainability integration.	(1) U of T embeds sustainability across curriculum, research, governance, and infrastructure with long-term carbon neutrality goals (2) Faculty-led initiatives and CECCS subcommittees ensure strategic governance and interdisciplinary action (3) Students co-lead sustainability projects but are not yet fully empowered in university-wide decisions (4) Measurement and reporting practices are transparent, supporting progress monitoring and benchmarking	The University of Toronto exemplifies a comprehensive, governance-aligned approach to sustainability, marked by strong infrastructure initiatives, academic integration, and multi-stakeholder engagement. To move further, expanding student empowerment in governance and refining systemic cohesion will be key.
University of Liverpool and Royal Hospital use SDG-linked assessment tools (e.g., SDAT, EAUC Scorecard); KQSN tracks contributions to SDG 11 and others.	2	Institutions publish reports (e.g., Liverpool 2017–2018 SDG mapping; NHS SD plans), but a consolidated KQSN-wide report is still missing.	2	Individual members engage with rankings (UI GreenMetric, SDG tools), but KQSN as a network does not appear in global rankings.	1	EAUC's Sustainability Scorecard and NHS SDAT provide institutional tracking; cross-institution dashboard is under consideration but not yet implemented.	1	Yes – KQSN reports to the Knowledge Quarter Board and is co-chaired by sustainability leads from anchor institutions.	University and hospital sustainability professionals, city council, public health bodies, food systems experts, student unions.	Yes – Thematic sub-teams focus on food, circular economy, and sustainability training, though not formalized as standing committees.	Strong – SDGs embedded in institutional and city region strategies. Governance structures empower networked, cross-sector decision-making.	Student-led workshops, sustainability theatre, food security events, and inter-school competitions raise awareness.	Composting systems, aquaponics, circular food procurement, and smart waste management exemplify green campus transformation.	Micah programme, food redistribution, and public workshops embed sustainability in city life, emphasizing equity and inclusion.	While not centralized, research on low-carbon innovation and sustainable food is facilitated through collaboration (e.g., Eco-Innovatory).	SDG alignment in University of Liverpool's Estates Strategy and NHS SD Plans; KQSN supports green corridors, food strategy, and zero-waste planning.	(1) KQSN catalyzes deep cross-sector collaboration across universities, hospitals, and community actors. (2) Sustainability is strongly linked to health, equity, and food systems with active involvement of staff and students. (3) Green operations, innovation (aquaponics, composting), and community engagement are exemplary. (4) Formalization, curricular integration, and shared performance dashboards could enhance systemic impact.	KQSN is a rare example of a place-based, cross-sectoral sustainability network, with deep roots in community and health collaboration. While institutionally diverse, the alliance effectively fosters innovation and SDG action. Consolidating governance and building shared tracking tools will strengthen its growing reputation as a collaborative model for urban sustainability.
No quantitative SDG indicators are reported publicly; internal course assessments exist via EDINSOST, but not generalized across the institution.	1	No formal public sustainability report is mentioned in the paper or website.	0	No participation in THE Impact Rankings or UI GreenMetric reported.	0	Monitoring of learning outcomes exists for specific degrees via the EDINSOST sustainability map; broader performance tracking is not evidenced.	1	Not mentioned – involvement seems distributed via participation in national CRUE working groups.	Faculty in education degrees, researchers involved in EDINSOST, and national CRUE-Sustainability representatives.	Not explicitly mentioned. Participation occurs via academic project teams and research collaborations.	Moderate to Strong – Integrated into national strategy frameworks and the university's modernization goals, particularly in social responsibility and SDGs.	Integrated into educational degrees through sustainability competencies and the EDINSOST map. Awareness initiatives beyond these programs are not detailed.	No evidence found of energy, water, or infrastructure policies explicitly promoting sustainability.	Hosted the Ibero-American SDG Conference (2018); supports regional collaboration through CRUE and education-based outreach.	No formal hub, but ongoing research in pedagogy and educational sustainability through EDINSOST and faculty initiatives.	Aligned with CRUE's national sustainability education strategy and integrated into university modernization documents.	(1) Long-term alignment with 2030 Agenda via the Salamanca Declaration and national sustainability education strategies. (2) Education degrees have adopted strong sustainability learning outcomes; Pedagogy stands out for significant results. (3) Strong external engagement through CRUE and SDG events, but internal operational initiatives and KPIs are underdeveloped. (4) Research and monitoring are primarily tied to education; green infrastructure and wider curricular integration remain areas for growth.	The University of Salamanca has made significant contributions to sustainability education, especially in pedagogical fields, and aligns well with national strategies. However, the university's impact remains confined to certain faculties, and broader institutional integration—particularly in operations, monitoring, and infrastructure—has yet to materialize.
Some monitoring exists (e.g., emissions, energy), but a complete KPI framework or sustainability dashboard is not fully developed.	1	Reports and updates are shared on the website and through events, but no formal GRI-style or consolidated sustainability report is published.	1	Tübingen does not prominently feature in global sustainability rankings (e.g., THE Impact, UI GreenMetric), but participates in German-wide networks.	1	There is internal tracking and evaluation within projects and the Sustainability Office, but not a fully formalized institution-wide monitoring system.	1	Yes – Sustainability Office reports to the Rectorate; cross-sectional Sustainability Steering Committee involved.	Rectorate, Sustainability Office, student groups, faculty, city council.	Yes – Working groups on curriculum, energy, mobility, procurement, and culture.	Strong – Sustainability is part of university governance and the institutional development strategy.	Strong student-led initiatives (e.g., Sustainability Week), Green Office, workshops, and co-developed teaching formats.	Improvements in energy efficiency, mobility, and procurement; implementation still in progress for larger goals.	Strong ties to the city of Tübingen, collaborative events, and initiatives promoting social innovation and civic dialogue.	Several initiatives promote interdisciplinary research and SDG-aligned projects, including dedicated funding calls.	Sustainability integrated in the university strategy, with a formal mission and operational framework since 2012.	(1) A structured and long-standing commitment to sustainability since 2012, with integration into governance and academic mission. (2) Active student and faculty participation across governance, teaching, and operations through the Green Office and cross-actor working groups. (3) Close collaboration with the city of Tübingen as part of a territorial sustainability strategy. (4) Need for enhanced KPI use, external rankings participation, and infrastructural transformation.	The University of Tübingen offers a well-established, participatory model of sustainability, marked by strong governance, student engagement, and city partnerships. While strategic and cultural integration is high, its next steps include improved reporting, scaling infrastructure efforts, and aligning with international benchmarking tools.
ZJU uses quantitative indicators such as carbon emissions, electricity and water use, and building energy savings.	2	Reports are available in fragmented form (e.g., building performance), but not consolidated into a unified public sustainability report.	1	The university is included in GreenMetric and other ranking systems, but not prominently.	1	A robust, automated energy information system is operational, guiding real-time decisions and long-term planning.	2	Yes – Environmental efforts are coordinated by an administrative unit responsible for infrastructure and green campus projects.	Facilities office, energy management staff, researchers in environmental and engineering departments.	Yes – Operational teams manage and implement green campus solutions at the building level.	Strong – Sustainability is a pillar of campus planning and part of the university's response to national carbon neutrality policies.	Building-level campaigns and campus-wide awareness events promote low-carbon habits and energy saving.	Real-time energy monitoring systems, HVAC optimization, green building renovations, and solar panel installations.	Limited – Focus is primarily inward, with minor external partnership reporting.	Not formally labeled as sustainability hubs, but strong research centers exist on green architecture and energy systems.	Strong alignment with national goals and institutional policies to reduce carbon emissions and improve environmental performance.	(1) Zhejiang University is a national leader in smart green campus infrastructure, with strong implementation of energy-saving technology. (2) Operational governance and data-driven decision-making are mature, while curriculum-wide integration of sustainability remains limited. (3) Stakeholder engagement is driven mostly by behavioral change programs and research, but students and faculty are not structurally empowered in governance. (4) Sustainability is embedded in strategic planning and national policy alignment but lacks comprehensive external communication and unified reporting.	Zhejiang University showcases a highly technical and policy-driven model of sustainability integration, excelling in infrastructure, monitoring, and research. While internal systems are well developed, there is room to grow in curricular integration, stakeholder empowerment, and external visibility.
Quantitative metrics (e.g., CO_2 emissions, energy use) are monitored and linked to annual reports; tracked through a central sustainability dashboard.	2	EUR publishes a Sustainability Annual Report detailing progress and targets (e.g., 2022 report online).	2	Participates in UI GreenMetric, but sustainability rankings are not a strategic focus.	1	The Sustainability Program Board oversees internal monitoring, linking unit-level performance to institutional goals.	2	Yes – The Sustainability Program Board coordinates strategy, implementation, and faculty alignment.	Sustainability managers (per faculty), researchers (e.g., DRIFT, DIT), administrative leaders.	Yes – Sustainability coordinators per faculty, DRIFT and DIF serve as implementation and innovation hubs.	Strong – Sustainability is integrated into EUR's strategic plan via platforms like DIT, the Sustainability Strategy, and Resilient Delta.	Dedicated learning modules, student challenges (e.g., SDG Challenge), interdisciplinary SDG projects (e.g., "Move EUR").	Energy reduction efforts, sustainable catering, waste sorting stations, and CO_2 tracking platform.	EUR partners with local actors in living labs, hosts events with Rotterdam institutions, and co-develops regional strategies.	DRIFT and DIT are internationally recognized hubs for sustainability transitions and transformative research.	Sustainability Strategy 2021–2024, SDG Roadmap, Resilient Delta, and integration of sustainability into the EUR 2024 vision.	(1) Governance: EUR has a strong governance framework with cross-faculty sustainability managers, strategic boards, and integrated platforms like DIT. (2) Education & Research: While teaching integration is growing, EUR stands out in sustainability research, particularly in transitions and urban resilience. (3) Community Engagement: The university collaborates actively with local actors via initiatives like Resilient Delta and participatory living labs. (4) Operations & Reporting: Sustainability reporting and performance monitoring are transparent and improving, though full campus greening is still progressing.	Erasmus University Rotterdam shows a robust, transitions-focused model of sustainability grounded in long-term planning, stakeholder collaboration, and applied research. Its strength lies in governance innovation and external partnerships, while education and infrastructure still have room for broader institutional uptake.
Emission tracking, carbon neutrality goals, and SDG mapping exercises in progress.	2	Not formally published as a public-facing annual report, but strong internal documentation exists.	1	Participates in THE Impact Rankings and other metric-based surveys.	1	Campus-level indicator frameworks are under development, with energy/carbon budgets already used.	2	Yes – The Sustainable University Program coordinates across campuses.	University leadership, administrative offices, researchers, and campus sustainability teams.	Yes – Each regional campus focuses on a thematic SDG bundle with designated leadership and indicators.	Strong – Sustainability is integrated into strategic and operational planning, though decentralization remains a challenge for full cohesion.	Strong ESD integration, intercultural and inclusive education, tree and carbon literacy, and mobility programs.	Solar energy projects, hybrid fleets, campus energy monitoring, zero-waste efforts, water footprint analysis.	Long-term programs in conservation, urban regeneration, indigenous outreach, day care for student-parents.	Decentralized model; each campus leads thematic SDG research clusters (e.g., biodiversity, energy, land use).	Sustainable University Program (2015), Energy Transition Plan (2016), Inclusive University Program (2016).	(1) Governance: Coordinated through the Sustainable University Program and decentralized SDG bundles at campus level. (2) Curriculum: ESD integration underway, with faculty training and cross-campus piloting. (3) Research: Strong applied sustainability research and impact at the regional level. (4) Operations: Green infrastructure plans and carbon neutrality efforts signal long-term institutional alignment.	The University of Guadalajara demonstrates a bold, regionally rooted model of sustainability anchored in social responsibility, decentralized coordination, and strong stakeholder outreach. While cohesion across campuses is still evolving, its institutional commitment, operational reforms, and SDG-aligned educational strategies position it as a leading sustainability actor in Latin America.
No sustainability KPIs reported.	0	No dedicated sustainability report or dashboard identified.	0	UBI is not listed in THE Impact Rankings or UI GreenMetric.	0	No structured monitoring system for sustainability impact found.	0	No – No dedicated sustainability board or office identified.	Faculty researchers and some student groups, especially within Human and Social Sciences.	No – No evidence of institutional sub-committees or thematic [illegible] initiatives.	Moderate – Sustainability is embedded in certain faculties and individual research groups, but not yet structurally embedded across university governance.	Integration of environmental behavior and awareness concepts into student curricula and campus-wide campaigns.	No significant information; campus operations appear standard without explicit green policies.	Minimal; limited to research dissemination and student surveys on pro-environmental behaviors.	None formally identified; research is conducted within disciplinary teams.	Sustainability appears in discourse and research but lacks formalized institutional policy or external collaboration projects.	(1) UBI's Faculty of Human and Social Sciences promotes sustainability education through behavioral and environmental psychology. (2) Research is present but decentralized; no institutional hubs or SDG performance mapping. (3) Student engagement in surveys and awareness campaigns is documented, but lacks participatory governance. (4) No formal sustainability governance, report, or monitoring structure has been identified.	The University of Beira Interior shows promising academic interest in sustainability through its research and student-focused behavioral studies. However, institutional coordination, strategic governance, and operational implementation are still in early stages. A transition toward a more structured and monitored sustainability strategy would enhance its long-term impact.
KPIs tied to energy savings, carbon emissions, and green space tracking are reported as part of GreenMetric submissions.	2	Performance updates are published (e.g., in GreenMetric), but no consolidated annual sustainability report using GRI or equivalent.	1	Participates in UI GreenMetric, ranking #309 globally in 2022; also aligns with SDG indicators.	2	Internal audits and monitoring are ongoing, especially through the GreenMetric committee, though no public dashboard yet.	1	Yes – GreenMetric Working Group and Sustainability Office operate under university leadership.	Faculty members, environmental researchers, engineering departments, administrative offices, and university leadership.	Yes – Multiple internal committees, including Environmental Audit Committee and GreenMetric Technical Teams.	Strong – Sustainability principles are embedded in university policy, infrastructure planning, and Egypt Vision 2030 alignment.	Ongoing green campaigns, environmental lectures, recycling awareness sessions, and student clubs.	Solar panel installations, LED retrofitting, smart irrigation, waste segregation stations, and green building upgrades.	Some interaction with national programs and education campaigns, though not yet a co-creation model.	Active labs and departments conduct sustainability and energy efficiency research; new programs are under development.	Alignment with Egypt Vision 2030, UI GreenMetric performance tracking, and national higher education sustainability strategy.	(1) A formal Sustainability Office and GreenMetric governance framework support institutional accountability. (2) Strong achievements in green infrastructure, including solar energy, lighting, and waste systems. (3)Research and faculty engagement in sustainability is growing, though curriculum integration is still partial. (4) Cairo University is ranked internationally (UI GreenMetric), but lacks a unified public sustainability report.	Cairo University demonstrates a structured, infrastructure-focused approach to sustainability with clear national alignment. While operational actions and faculty-led research are strong, there is room to expand student engagement, curriculum integration, and community co-creation. It stands out in the region for its governance and green campus progress.
JCU uses the LiFE Index with 117 KPIs to benchmark and track sustainability across 16 domains. Action plans and performance evaluations are regularly conducted.	2	The paper references internal documentation and planning tools, but no publicly accessible, consolidated GRI-style report appears available.	1	JCU is a member of AASHE and applies external benchmarking (e.g., LiFE Index), but limited public visibility in global rankings like THE Impact or UI GreenMetric.	1	A structured system monitors project outcomes, KPIs, and strategy alignment. Data informs funding decisions and annual TropEco Awards.	2	SAC (advisory level) and SAG (implementation level) ensure multilevel governance with vertical and horizontal integration.	Vice-Chancellor, faculty, administration, students, sustainability officers, TropEco program leads, and external partners.	TropEco teams, student clubs, faculty working groups, and research centers like TESS operate as sub-units for implementation.	Sustainability is linked to JCU's "Grand Challenges Framework" and university-wide strategic intent, tying together teaching, research, community, and facilities.	Student engagement is cultivated through internships, sustainability pledges, clubs, workshops, and a student-led Sustainability Kitchen and newsletter.	Initiatives include the Cairns arboretum, district cooling, bio-fertilizer composting, e-waste recycling, and furniture repurposing schemes.	Events like the Sustainability Fair, regional educator networks, and co-created restoration projects showcase JCU's role as a civic sustainability actor.	The Cairns Institute and TESS drive multidisciplinary research on climate adaptation, Indigenous issues, governance, and biodiversity.	LiFE Index, annual planning cycles, and SAC/SAG coordination integrate sustainability into all levels of policy, budgeting, and performance.	(1) Governance: Dual-level structure (SAC + SAG) enables coordinated, participatory sustainability implementation across all university layers. (2) Curriculum: The Bachelor of Sustainability and embedded ESD modules foster place-based, action-oriented learning. (3) Research & Operations: The Cairns Institute and TropEco anchor JCU's sustainability culture through deep research practice integration. (4) Community: JCU connects local and regional actors through outreach, restoration projects, and permaculture initiatives.	James Cook University exemplifies a well-rounded, action-based sustainability model integrating curriculum, governance, research, and operations. Its use of KPIs, strategic frameworks, and student empowerment creates a culture of sustainability that bridges academia and community practice. JCU could further enhance its global recognition through formalized reporting and expanded ranking participation.

B.2. Benchmarking Ranking Scores

	University	Country	Vision & perspective	Fragmentary/holistic approach (0-2)	Stakeholders engagement (0-5)	Impact measurement framework (0-2)	Governance structure	Sustainability initiatives	Final scores
0	**Politecnico di Milano**	Italy	2	1,4	2,75	1,25	Structured governance with a Pro-Rector, coordination tables, and integrated Cantieri system.	Strong operational sustainability and governance; curricular and external outreach still evolving.	**7,4**
1	**Deakin University**	Australia	2	1,4	2,5	1,75	Lacks a central office; sustainability is tracked but not yet institutionally centralized.	Ambitious infrastructure and research-driven model; impact limited by internal focus.	**7,65**
2	**Jaume I University**	Spain	2	1,8	3,75	1	Multi-level governance integrates equality, ethics, and sustainability via dedicated committees.	Strong equality-led integration in curriculum and policy; outreach and reporting limited.	**8,55**
3	**National Tsing Hua University (NTHU)**	Taiwan	2	1,2	2,25	1	Sustainability Committee exists but suffers from weak integration and incentive structures.	Robust in research and operations; curriculum and engagement remain fragmented.	**6,45**
4	**Qatar University (QU)**	Qatar	2	2	3,25	2	Strong centralized leadership with policy offices and cross-sector centers driving SDG strategy.	Systemic SDG integration across education, research, and operations with regional leadership.	**9,25**
5	**University of British Columbia (UBC)**	Canada	2	2	4,25	2	High-level governance embedded in leadership; USI enables cross-campus sustainability integration.	World-class living lab model with full-spectrum integration and stakeholder innovation.	**10,25**
6	**University of Trieste (UniTS)**	Italy	2	1,8	3,5	1,75	Strong governance with Rector-led coordination and embedded SDG tracking in planning.	High territorial engagement and operations; curriculum and research centralization evolving.	**9,05**

	University	Country	Vision & perspective	Fragmentary/holistic approach (0-2)	Stakeholders engagement (0-5)	Impact measurement framework (0-2)	Governance structure	Sustainability initiatives	Final scores
7	**University of Cordoba**	Spain	2	1,6	2,75	1	Strong internal governance with SEPA at the core, but limited external visibility.	Mature operational systems; strong internal learning, but minimal external communication.	**7,35**
8	**Cardiff University**	UK	1	0,4	1,75	0,5	No centralized governance; sustainability led by individual faculty with little coordination.	Minimal implementation; isolated curricular audits and no operational or outreach strategy.	**3,65**
9	**University of the West of Scotland (UWS)**	UK	1	0,6	1,25	0,25	Advisory bodies exist but lack authority and strategic influence; governance is fragmented.	Fragmented and compliance-focused; low visibility in curriculum, research, and community.	**3,1**
10	**University of Florence**	Italy	2	1,8	3	2	Strong Pro-Rector-led governance with operational Green Office and embedded SDG strategy.	Strong campus operations and governance; research and community impact still expanding.	**8,8**
11	**University of Toronto**	Canada	2	2	3,75	2	Strong multi-campus governance led by the President's Advisory Committee on Environment, Climate Change and Sustainability. Sustainability Offices and Advisory Committees at each campus coordinate actions across academics, operations, and community outreach.	Advanced integration of sustainability in curriculum and research. U of T leads in climate action (net-zero by 2050), green building standards, and public reporting. Community engagement occurs via student-led projects, Living Labs, and local partnerships.	**9,75**
12	**University of Liverpool**	UK	2	1,8	3,25	1,5	Governance coordinated through the Sustainability Board chaired by senior leadership. Operational working groups support implementation, but academic and community integration are still developing.	Strong operational focus: climate action targets, waste management, and biodiversity strategy. Curriculum and research initiatives are growing, and the institution collaborates with the Liverpool City Region Sustainability Network.	**8,55**
13	**University of Salamanca**	Spain	2	1,4	2,5	0,5	Limited central governance on sustainability. Initiatives often led by individual departments or in collaboration with external entities. The university participates in national working groups but lacks a formal sustainability board.	Sustainability appears in the strategic plan with energy efficiency projects and green mobility actions, but broader curricular or research-based initiatives are less formalized.	**6,4**

	University	Country	Vision & perspective	Fragmentary/holistic approach (0-2)	Stakeholders engagement (0-5)	Impact measurement framework (0-2)	Governance structure	Sustainability initiatives	Final scores
14	**University of Tübingen**	Germany	2	1,8	3,75	1	Strategic governance driven by the Rectorate and Environmental Coordinating Office. Sustainability is embedded into institutional planning, with support from faculty committees.	Strong SDG-aligned initiatives across research, energy systems, and biodiversity. Participates in international networks and sustainability audits. Student and staff involvement in climate and inclusion projects is notable.	**8,55**
15	**Zhejiang University (ZJU)**	China	2	1,6	2,75	1,5	Sustainability management lies within the Office of Campus Development and affiliated research centers. Governance structures are formalized, but transparency and stakeholder participation are limited.	ZJU emphasizes smart campus design, carbon reduction, and eco-civilization education. Sustainability-themed MOOCs and interdisciplinary research hubs position it as a leader in China's green university agenda.	**7,85**
16	**Erasmus University Rotterdam (EUR)**	Netherlands	2	1,6	3,5	1,75	Sustainability governed by the Erasmus Sustainability Hub under the Strategy 2024 framework. Centralized coordination supported by faculty-specific sustainability coordinators.	EUR integrates sustainability in teaching and research across disciplines. Key focus areas include inclusive prosperity, circular economy, and student-led Living Labs. Sustainable campus initiatives (e.g., energy, mobility) are expanding.	**8,85**
17	**University of Guadalajara**	Mexico	2	2	3,5	1,5	Sustainability integrated into the university's development plan and managed through the Environmental Management Unit (UGEMA), which coordinates projects and policy across faculties.	Projects span energy, waste, biodiversity, and SDG-aligned teaching. The university organizes environmental festivals and community outreach campaigns, positioning itself as a sustainability driver in Latin America.	**9**
18	**University of Beira Interior (UBI)**	Lisbon	2	0,8	1,5	0	Governance around sustainability is informal and project-based. No central coordination unit or institutional leadership body is cited in either the paper or website. Efforts appear fragmented and often externally driven.	Awareness campaigns and isolated student projects are in place, but there is no evidence of systemic integration into operations, curriculum, or research. No tracking mechanisms or strategic plan for sustainability is publicly available.	**4,3**
19	**Cairo University**	(Egypt)	2	1,6	2,25	1,5	Formal sustainability governance through a dedicated Sustainability Office and GreenMetric Working Group under central leadership. Multiple technical committees support implementation, but student empowerment and cross-sector co-creation remain limited.	Strong focus on green campus operations (solar energy, energy efficiency, waste and water management) aligned with Egypt Vision 2030. Research activity is growing, but curriculum integration and community co-design are still developing.	**7,35**
20	**James Cook University (JCU)**	Australia	2	1,6	2,25	1,5	JCU features an Office of Sustainability and a dedicated Sustainability Advisory Committee. Governance is integrated across campuses (including Singapore), with reporting channels to senior leadership.	JCU implements a broad sustainability strategy including emissions targets, green buildings, and tropical ecosystem research. Initiatives in climate action and biodiversity are strong, though stakeholder engagement and curricular reach can still improve.	**7,35**

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Acknowledgments

A mamma e papà,

perchè mi avete insegnato la libertà per sognare, la spregiudicatezza per osare, e il senso del dovere per prendermi la responsabilità delle mie azioni.

A mia sorella Olivia,

perchè a salvarmi ci sei sempre stata, e so che ci sarai sempre.

A mio fratello Dario,

perché sappiamo tutto senza il bisogno di dirci nulla.

A tutta la mia famiglia, ai miei zii, ai miei cugini, ai miei nonni,

perchè sento le mie radici in ogni cosa che faccio.

Ad Anita e Cen,

perché siete parte di me.

A Leo, Marta, Cesco, Lele,

perchè attraversiamo questa avventura che è la vita tenendoci per mano.

A Baldo, Manne, Klint, Luzzi, Adi,

perchè per me siete e sarete sempre casa.

A Pietro, Greta, Edo, Gabri, Jiawei, Alex, Eli, Matte,

perchè siete stati i compagni di viaggio migliori che potessi desiderare.

A tutte e tutti voi, grazie.

Nella vita le persone vanno e vengono. Io spero che voi rimaniate.