

# Dynamic capabilities and sustainability-oriented innovations in higher education institutions: a case study

## *Capacidades dinâmicas e inovações orientadas à sustentabilidade em instituições de ensino superior: um estudo de caso*

Cláudia Fabiana Gohr<sup>1</sup> , Carlos Rodrigo de Souza Torres<sup>1</sup> , Walleci Gabeu Lira<sup>1</sup> 

<sup>1</sup> Universidade Federal da Paraíba – UFPB, João Pessoa, PB, Brasil. E-mail: claudiagohr@ct.ufpb.br; crst@academico.ufpb.br; walleci.lira@academico.ufpb.br

**How to cite:** Gohr, C. F., Torres, C. R. S., & Lira, W. G (2023). Dynamic capabilities and sustainability-oriented innovations in higher education institutions: a case study. *Gestão & Produção*, 30, e4223. <https://doi.org/10.1590/1806-9649-2023v30e4223>

**Abstract:** This paper aims to analyze the Dynamic Capabilities (DC) from their micro-foundations (sensing, seizing, and reconfiguration) that help in sustainability-oriented innovation (SOI) activities (organizational optimization, organizational transformation, and systems building) and that lead to the development of innovations in the context of higher education institutions (HEIs). This research has a descriptive and exploratory nature, developed through a case study in an HEI located in the northeast region of Brazil. The study was based on interviews with key sustainability managers within the institution and on research of institutional documents related to the subject. As a result, the existence of specific sensing, seizing, and reconfiguring microfoundations for HEIs that can enable SOI in the three levels of activities studied was verified, highlighting important relationships between them. This work contributes to the advancement of knowledge about SOI activities in HEIs by identifying the microfoundations that drive such activities and addressing a gap in studies on microfoundations of SOI dynamic capabilities and activities in higher education institutions. In practical terms, this article can serve as a basis for HEIs managers to understand what they need to do to drive SOI activities, especially in building systems for the development of innovations with social and economic impact for territories beyond institutional boundaries.

**Keywords:** Microfoundations; Dynamic Capabilities; Sustainability-Oriented Innovation; Higher Education Institutions.

**Resumo:** Este trabalho busca analisar as Capacidades Dinâmicas (CD) a partir de seus microfundamentos (*sensing, seizing e reconfiguring*) que auxiliam nas atividades de Inovação Orientada a Sustentabilidade (do inglês *sustainability-oriented innovation* - SOI) (otimização organizacional, transformação organizacional e construção de sistemas) para o desenvolvimento de inovações no contexto de Instituições de Ensino Superior (IES). Esta pesquisa possui natureza descritiva e exploratória, desenvolvida através de um estudo de caso em uma IES pública federal localizada na região nordeste do Brasil. O estudo baseou-se em entrevistas com gestores-chave de sustentabilidade na IES e na pesquisa em documentos institucionais sobre o tema. Verificou-se a existência de microfundamentos de detecção, captação e reconfiguração específicos para IES que podem habilitar SOI nos três níveis de atividades, ressaltando relações

Received Sept. 6, 2023 - Accepted Nov. 6, 2023

Financial support: None.



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importantes entre elas. Este trabalho contribui com o avanço do conhecimento sobre as atividades de SOI em IES, na identificação de microfundaamentos impulsionadores, abordando uma lacuna sobre microfundaamentos e atividades de SOI em IES. Em termos práticos, este artigo serve como base para gestores de IES compreenderem o que necessitam fazer para impulsionar as atividades de SOI, especialmente de construção de sistemas para o desenvolvimento de inovações com impacto social, ambiental e econômico para além das fronteiras institucionais.

**Palavras-chave:** Microfundaamentos; Capacidades Dinâmicas; Inovação Orientada a Sustentabilidade; Instituições de Ensino Superior.

## 1 Introduction

Sustainability issues have ceased to be marginal for companies and are becoming increasingly essential in the corporate environment (Beuter et al., 2019; Machado et al., 2022; Rezaee, 2018; van de Wetering et al., 2017). In this context, the ability to renew tangible and intangible assets is extremely relevant for business competitiveness in economic, environmental, and social terms (Beuter et al., 2019; Teece et al., 1997). Therefore, sustainability is regarded as one of the main drivers of innovation (Rodrigues et al., 2020).

In this sense, sustainability-oriented innovations (SOI) seek to generate environmental returns in addition to economic gains (Adams et al., 2016; Machado et al., 2022). Generating SOI requires gradual changes in philosophy, values and behaviors, changes in business resources and different levels of highly complex dynamic capabilities (DC) (Inigo & Albareda, 2019). DCs are also necessary for the adaptation and renewal of organizations in the face of new challenges that integrate innovation and sustainability at all levels (Souza & Takahashi, 2019; Teece et al., 1997).

HEIs (Higher Education Institutions) play a prominent role in promoting sustainability (Amaral et al., 2020; Casarejos et al., 2017) and are critical elements in the innovation process (Machado et al., 2022). HEIs are directly related to the generation and dissemination of knowledge in a dynamic way adopting inter- and transdisciplinarity, playing a leading role in their environment in the development of science, technology, and innovation (Berchin et al., 2021; Fischer et al., 2021; Machado et al., 2022; Romero Duque et al., 2018).

A search carried out in the *Web of Science* (WoS) database retrieved some works that aimed at understanding and applying DC, innovation, and sustainability in the context of HEIs. For example, Hayter & Cahoy (2018) presented a conceptual guide for fulfilling the social responsibilities of HEIs based on the DC approach. Machado et al. (2022) studied the relationship between innovation management and organizational sustainability focusing on a case study in a Brazilian HEI. Pangarso et al. (2020) analyzed aspects of DC for innovation and organizational ambidexterity that generate sustainable competitive advantage in HEIs. Romero Duque et al. (2018) suggested a qualitative DC measurement model for HEIs, presenting indicators aimed at innovation management. The latter, although it addresses DC for innovation, does not consider sustainability aspects in creating the analysis model.

None of the studies found in the database directly related DCs in HEIs that promote SOI activities. To fill this gap on identifying DCs aimed at SOI in HEIs, this work poses the following research question: how can DCs assist in SOI activities and lead to the development of innovations in the context of HEIs? To answer this question, the present paper aims to analyze DC based on microfoundations that assist in SOI activities (organizational optimization - OO, organizational transformation - OT, and

systems building - SB) as proposed by Adams et al. (2016) and that lead to the development of innovations in the context of HEIs. To this end, a framework integrates DC and SOI activities. It was applied through a case study in a Brazilian teaching, research and extension HEI in the Brazilian Northeast Region.

This paper contributes to improve the body of knowledge about innovation activities for sustainability in HEIs from the perspective of DC through the identification of microfoundations that drive SOI within these institutions and assist in a more efficient use of resources, environmental conservation, and improvement of the social environment (Inigo & Albareda, 2019; Rodrigues et al., 2020; Teece, 2007). In practical terms, this article helps HEI managers to understand which DC microfoundations enable sustainability-oriented innovations in HEI environments. Furthermore, it shows how interaction with stakeholders is relevant to developing proposals of social and economic impact for territories and beyond their borders, including issues of innovation and development of products and projects.

To achieve these objectives, this paper is structured as follows: after this introduction, Section 2 describes the main constructs (namely, SOI, DC and HEI) considering the scope of sustainable innovations. Then, Section 3 describes the methodological procedures that guided the empirical study. Section 4 presents the results, followed by a discussion (Section 5). Finally, Section 6 discusses the main conclusions, contributions, limitations, and opportunities for new research.

## **2 Literature review**

### **2.1 Sustainability-Oriented Innovation (SOI)**

The innovation process is permanent and cyclical. It implements ideas and seeks new products or processes that generate a competitive market advantage (Inigo & Albareda, 2019; Romero Duque et al., 2018). Innovation is a key dimension to explain the economic, social, and environmental development of companies (Inigo & Albareda, 2019; Romero Duque et al., 2018). Innovations may arise from spontaneous generation of an idea, method or technology, but also and mainly as a response to a specific problem based on opportunity analysis or an unexpected market movement (Rodrigues et al., 2020).

The emergence of significant long-term challenges, such as climate change, population aging, pollution, water and raw material scarcity, brought to light the need to relate innovation to sustainability (Beuter et al., 2019). A group of sustainability-driven innovations (SOIs) seek to make intentional changes to an organization's philosophy and values and its products or practices in order to meet a specific purpose of creating and realizing social activities, environmental values, and economic returns (Adams et al., 2016). Inigo & Albareda (2019) also report the transformational nature of SOI, which requires changes in the company's resources, promoting the emergence of different levels of complex DC.

Adams et al. (2016) highlight that SOI advances gradually in organizations, starting from responses to regulatory stimuli and growth, evolving to the increase in the organization's innovation capacity and large-scale radical changes in its systems. This evolution is classified into three levels (Figure 1), characterized as:

- (i) operational optimization (OO) activities, which are innovations converging from incremental and tool innovations to people-centric innovations;

- (ii) organizational transformation (OT) activities, which are part of an evolution towards sustainability practices that are more deeply incorporated into the company's culture; and
- (iii) system building (SB) activities, which are oriented to affect beyond the company's boundaries through engagement with various actors, such as NGOs, governments, and other stakeholders.

Therefore, an organization that wants to advance as a sustainable business must pay attention to SOI activities enabled by system-level DC, that is, activities that involve stakeholders in the microfoundations of detection, capture, and reconfiguration (Inigo & Albareda, 2019), this subject being discussed below.

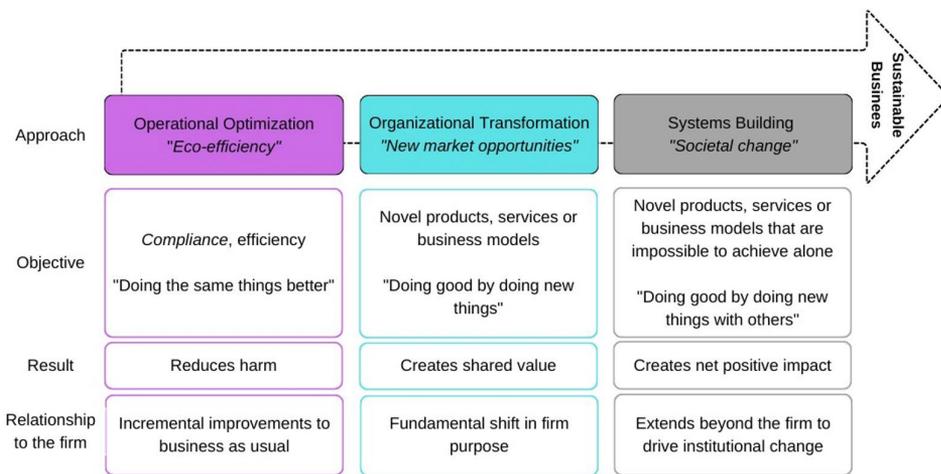


Figure 1. Categorization of SOIs. Adams et al. (2016, p. 185).

## 2.2 Dynamic Capabilities (DC) and SOI

An organization's DCs enable it to integrate, build, and reconfigure resources and skills to deal with rapidly changing environments (Teece, 2017). DCs can be oriented towards innovation (Romero Duque et al., 2018) and sustainability (Rodrigues et al., 2020). DCs in SOI are able to adapt, integrate, and reconfigure organizational skills, resources and functional competencies to respond to contemporary sustainability challenges (Adams et al., 2016; Teece, 2007).

Considering DCs in their microfoundations, Teece et al. (1997) and Teece (2007) define them as internal, individual and specific skills and competencies of an organization that give rise to the ability to adapt, innovate and reconfigure its resources in the face of a competitive environment. In this scenario, the authors present three dimensions of microfoundations: sensing, seizing, and reconfiguring. Sensing finds opportunities for improvement and innovation in a system. Seizing seeks the application of innovation opportunities generating sustainability. Finally, reconfiguring builds sustainability innovation networks in a cooperative and shared way. Each of these microfoundations develops concepts that relate to activities that must be adopted by organizations and that can be called second-order microfoundations, as Table 1 shows.

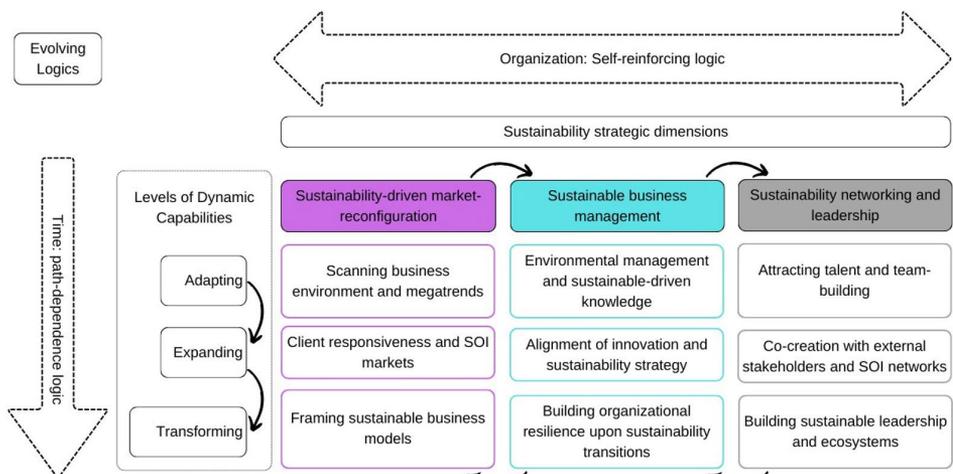
**Table 1.** 1<sup>st</sup> and 2<sup>nd</sup> order DC microfoundations.

| DC Microfoundation | Second Order Microfoundation (activity)                                             |
|--------------------|-------------------------------------------------------------------------------------|
| Sensing            | Monitoring the market, competitors, technologies, and trends                        |
|                    | Generation and development of ideas, knowledge, and expertise                       |
|                    | Identification of customers and their needs                                         |
|                    | Analysis of the potential environmental impact of products, processes, and services |
|                    | Collaboration Networks with stakeholders                                            |
| Seizing            | Data analysis, systematization, and sharing                                         |
|                    | Strategic planning                                                                  |
|                    | Governance and Business Model                                                       |
|                    | Collaboration to acquire new knowledge, skills, and resources                       |
|                    | Search for strategic partnerships                                                   |
| Reconfiguring      | Planning and management of human, material, and technological resources             |
|                    | Resource allocation in emerging businesses                                          |
|                    | Organizational restructuring capacity                                               |
|                    | Technological update and integration                                                |
|                    | Integration of knowledge between sectors or departments                             |
|                    | Adaptation and expansion of good practices observed internally and externally       |
|                    | Employees training                                                                  |

**Source:** Based on Chari et al. (2022) and Khan et al. (2020a, b).

The identification of a DC and its microfoundations are addressed in different contexts of sustainable innovations. For example, Mousavi & Bossink (2017) investigated which organizational and management capabilities companies can use to innovate for sustainability. van de Wetering et al. (2017) developed a theoretical model by which the combination of aspects of information technology, internal and external collaboration, and environmental factors of complexity can guide the emergence of sustainability-oriented innovations. Nagata et al. (2023) studied the effects of dynamic capabilities on sustainable environmental, social, and economic performance in the industrial context.

In this context, the work of Inigo & Albareda (2019) stands out. The authors conducted a theoretical study that proposes an evolutionary structure that guides DCs to SOI and directs assessments of organizations' maturity. Their work identifies three levels of complexity in the relationship between the DC for SOI (Figure 2):



**Figure 2.** Dynamic capabilities and SOI: levels and dimensions. Inigo & Albareda (2019, p. 345).

- (i) adaptation, which emerges first in most companies, through continuous improvement and adjustments, increasing individual skills, knowledge and organizational routines;
- (ii) expansion, which improves SOI processes for markets through innovative, clean technology and sustainability management processes and organizational learning processes in collaboration with stakeholders; and,
- (iii) transformation, which leads to the adoption of a sustainable business model, regenerating and reconfiguring SOI processes, creating social, economic and environmental values through advanced organizational learning with stakeholders, leadership strategies in sustainability, and resilience to the market.

When relating SOI activities with the microfoundations of DC, Inigo & Albareda (2019) presented an evolutionary logic that depends on the level of DC developed by the organization and reflects on SOI activities, starting from activities oriented towards operational improvement and reconfigurations of market towards systemic networking activities and leadership in innovation.

### **2.3 Innovations aimed at sustainability and dynamic capabilities in the context of HEIs: proposal for an integrative framework**

HEIs are in a macroeconomic context and must focus their efforts and capabilities towards innovation, prioritizing social and environmental issues even at the expense of economic aspects (Gunasekara, 2006). At the same time, HEIs need to reformulate their capital gains structures in the face of new challenges and social and economic changes (Rodríguez-Castro & Aparicio, 2021). In this context, the identification of actions that contribute to the recognition and application of DC in an organization is extremely important for its competitive survival at the operational, organizational, and systems levels (Adams et al., 2016; Khan et al., 2020a).

Romero Duque et al. (2018) proposed a model for evaluating specific capabilities for innovation in HEIs. The authors described five capabilities in (i) strategic administration management, (ii) learning, (iii) innovation management, (iv) resource management, and (v) relationship. Souza & Takahashi (2019) highlighted the efforts of HEIs in identifying market dynamics, reconfiguring their resources, and integrating and coordinating DC for learning. Pangarso et al. (2020) addressed the development of research in conjunction with the external community, the transfer of knowledge, and obtaining and requirement of certification of stakeholders as sources of innovation. Based on experiences found in the literature on HEIs, the analysis framework proposed here relates the microfoundations of sensing, seizing, and reconfiguring to SOI activities at the operational, organizational, and systemic levels in HEIs, as Table 2 shows.

In accordance with the above, studies related to HEIs highlight the lack of empirical analyses and methods that allow the recognition of DCs (Romero Duque et al., 2018) and the impacts of HEIs on the environment beyond its geographical limits based on DCs (Pangarso et al., 2020), of learning relationships, of organizational ambidexterity (Souza & Takahashi, 2019), and the identification of capabilities that align technical and management towards SOI (Machado et al., 2022). Thus, to analyze the DC microfoundations that are related to SOI within the context of HEIs, this study proposes an integrative framework (Figure 3) based on the innovation activities and the DC for SOI presented by Adams et al. (2016) and Inigo & Albareda (2019). It is worth highlighting that the activities presented in Figure 3 are extracted from the literature, as Table 2 shows.

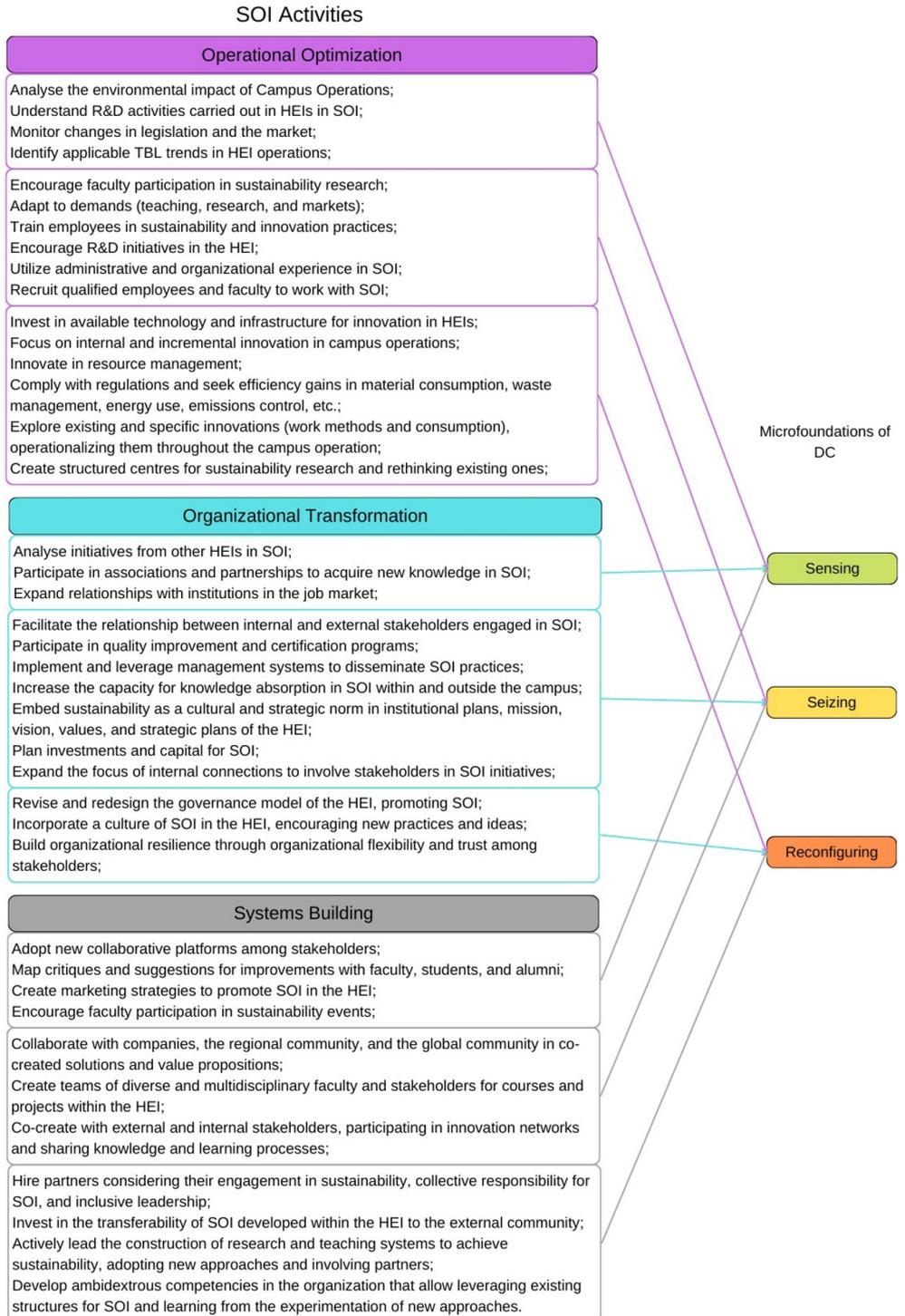
**Table 2.** Microfoundations of DC and SOI in the context of HEIs.

|         |                                                                                                                                                                                                                   | <b>SOI Activity 1: Operational Optimization</b>                                                                                                                                                                        | <b>Authors</b>                                                       |
|---------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------|
| Sensing |                                                                                                                                                                                                                   | Analyze the environmental impact of campus operations;                                                                                                                                                                 | Ávila et al. (2017)                                                  |
|         |                                                                                                                                                                                                                   | Understand R&D activities carried out in HEIs and what knowledge is generated in SOI activities                                                                                                                        | Romero Duque et al. (2018)                                           |
|         |                                                                                                                                                                                                                   | Monitoring changes in educational and market legislation                                                                                                                                                               | Souza & Takahashi (2019)                                             |
|         |                                                                                                                                                                                                                   | Identify TBL trends applicable to HEI operations through technological surveillance, new regulations, and markets                                                                                                      | Gunasekara (2006); Inigo & Albareda (2019); Souza & Takahashi (2019) |
|         |                                                                                                                                                                                                                   | <b>SOI Activity 2: Organizational Transformation</b>                                                                                                                                                                   | <b>Authors</b>                                                       |
|         |                                                                                                                                                                                                                   | Analyze initiatives of other HEIs in relation to SOI                                                                                                                                                                   | Souza & Takahashi (2019)                                             |
|         |                                                                                                                                                                                                                   | Participate in associations and partnerships to acquire new knowledge in sustainability                                                                                                                                | Inigo & Albareda (2019)                                              |
|         |                                                                                                                                                                                                                   | Expand the relationship with labor market institutions                                                                                                                                                                 | Romero Duque et al. (2018)                                           |
|         |                                                                                                                                                                                                                   | <b>SOI Activity 3: Systems Building</b>                                                                                                                                                                                | <b>Authors</b>                                                       |
|         |                                                                                                                                                                                                                   | Adopt new platforms for collaborative processes with various stakeholders, promoting networking with global research and teaching platforms                                                                            | Adams et al. (2016)                                                  |
| Seizing |                                                                                                                                                                                                                   | Relationship with teachers, students, and graduates to map out criticisms and suggestions for improvement                                                                                                              | Romero Duque et al. (2018); Souza & Takahashi (2019)                 |
|         |                                                                                                                                                                                                                   | Create marketing strategies aimed at disseminating sustainable innovations created by the HEI                                                                                                                          | Romero Duque et al. (2018); Souza & Takahashi (2019)                 |
|         |                                                                                                                                                                                                                   | Encourage the participation of researchers in conferences, seminars, and other events focused on sustainability                                                                                                        | Findler et al. (2018)                                                |
|         |                                                                                                                                                                                                                   | <b>SOI Activity 1: Operational Optimization</b>                                                                                                                                                                        | <b>Authors</b>                                                       |
|         |                                                                                                                                                                                                                   | Encouraging teacher training and participation in research for sustainability                                                                                                                                          | Gunasekara (2006); Romero Duque et al. (2018)                        |
|         |                                                                                                                                                                                                                   | Quickly adapt to market demands in relation to teaching, finding, and encouraging research in new sustainable market niches                                                                                            | (Inigo & Albareda, 2019)                                             |
|         |                                                                                                                                                                                                                   | Train employees in sustainability and innovation practices                                                                                                                                                             | Gunasekara (2006)                                                    |
|         |                                                                                                                                                                                                                   | Encourage R&D initiatives within the HEI                                                                                                                                                                               | Romero Duque et al. (2018)                                           |
|         |                                                                                                                                                                                                                   | Use administrative and organizational experience in SOI                                                                                                                                                                | Souza & Takahashi (2019)                                             |
|         |                                                                                                                                                                                                                   | Recruit employees and faculty qualified to work with SOI                                                                                                                                                               | Adams et al. (2016)                                                  |
| Seizing |                                                                                                                                                                                                                   | <b>SOI Activity 2: Organizational Transformation</b>                                                                                                                                                                   | <b>Authors</b>                                                       |
|         |                                                                                                                                                                                                                   | Facilitate relationships between internal and external stakeholders who work with sustainability                                                                                                                       | Adams et al. (2016)                                                  |
|         |                                                                                                                                                                                                                   | Participate in quality improvement and certification programs                                                                                                                                                          | Pangarso et al. (2020)                                               |
|         |                                                                                                                                                                                                                   | Implement and leverage management systems to disseminate sustainability-oriented practices                                                                                                                             | Inigo & Albareda (2019)                                              |
|         |                                                                                                                                                                                                                   | Increase the absorption capacity of sustainability knowledge on and off campus                                                                                                                                         | Inigo & Albareda (2019)                                              |
|         |                                                                                                                                                                                                                   | Adopt sustainability as a cultural norm and strategy, in the institutional development plan, and in the mission and values of the HEI. Existence of a specific strategy for sustainability that encourages innovation. | Adams et al. (2016); Gunasekara (2006); Inigo & Albareda (2019)      |
|         |                                                                                                                                                                                                                   | Plan investments and capital for sustainability innovation                                                                                                                                                             | Souza & Takahashi (2019)                                             |
|         |                                                                                                                                                                                                                   | Expand the focus of internal connections to include stakeholders in SOI initiatives                                                                                                                                    | Adams et al. (2016)                                                  |
|         |                                                                                                                                                                                                                   | <b>SOI Activity 3: Systems Building</b>                                                                                                                                                                                | <b>Authors</b>                                                       |
|         |                                                                                                                                                                                                                   | Collaborate in an expanded manner with companies and the regional and global community (city halls, cooperatives, NGOs, other HEIs), investing in solutions to generate co-created and new value propositions          | Adams et al. (2016); Souza & Takahashi (2019)                        |
|         | Form teams between professors and heterogeneous and multidisciplinary stakeholders within HEIs who care about sustainability in their research and projects.                                                      | Inigo & Albareda (2019)                                                                                                                                                                                                |                                                                      |
|         | Co-create with external and internal stakeholders, actively participating in innovation networks, acquiring and sharing knowledge and learning processes, and participating in projects with external cooperation | Inigo & Albareda (2019); Pangarso et al. (2020)                                                                                                                                                                        |                                                                      |

**Table 2.** Continued...

| <b>SOI Activity 1: Operational Optimization</b>                                                                                                                                                                     |                                                                                                                                                     | <b>Authors</b>                                  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------|
| <b>Reconfiguring</b>                                                                                                                                                                                                | <b>SOI Activity 1: Operational Optimization</b>                                                                                                     | <b>Authors</b>                                  |
|                                                                                                                                                                                                                     | Invest in technology and infrastructure available for innovation in HEIs                                                                            | Ávila et al. (2017); Romero Duque et al. (2018) |
|                                                                                                                                                                                                                     | Focus on internal and incremental innovation, applying them to campus operations                                                                    | Adams et al. (2016)                             |
|                                                                                                                                                                                                                     | Innovate in resource management                                                                                                                     | Ávila et al. (2017)                             |
|                                                                                                                                                                                                                     | Comply with regulations and seek efficiency gains in material consumption, waste management, energy use, emissions control, and other activities    | Adams et al. (2016)                             |
|                                                                                                                                                                                                                     | Explore existing and specific sustainability-oriented innovation capabilities (work and consumption methods), operationalizing them across campuses | Adams et al. (2016)                             |
|                                                                                                                                                                                                                     | Specialize groups of employees in sustainability within the campus structure                                                                        | Gunasekara (2006)                               |
|                                                                                                                                                                                                                     | Create structured centers for sustainability research and rethink existing ones                                                                     | Romero Duque et al. (2018)                      |
|                                                                                                                                                                                                                     | <b>SOI Activity 2: Organizational Transformation</b>                                                                                                | <b>Authors</b>                                  |
|                                                                                                                                                                                                                     | Review and redesign the HEI governance model taking SOI incentives into account                                                                     | Souza & Takahashi (2019)                        |
|                                                                                                                                                                                                                     | Incorporate SOI culture into the HEI and encourage SOI practices and ideas.                                                                         | Adams et al. (2016)                             |
|                                                                                                                                                                                                                     | Adopt new values, new innovation platforms, and new ideation practices within the HEI                                                               | Adams et al. (2016)                             |
|                                                                                                                                                                                                                     | Build organizational resilience through organizational flexibility and trust among stakeholders                                                     | Inigo & Albareda (2019)                         |
| <b>SOI Activity 3: Systems Building</b>                                                                                                                                                                             | <b>Authors</b>                                                                                                                                      |                                                 |
| Hire partners taking into account engagement in sustainability and develop collective responsibility for SOI with an inclusive leadership.                                                                          | Inigo & Albareda (2019)                                                                                                                             |                                                 |
| Invest in the transferability of innovation created within the HEI in collaboration with stakeholders, making it available to the external community.                                                               | Jones & Corral de Zubielqui (2017)                                                                                                                  |                                                 |
| Become an active leader in building research and teaching systems to achieve sustainability by adopting new approaches and include partners in diagnosing problems, building trust and promoting systematic change. | Adams et al. (2016); Inigo & Albareda (2019)                                                                                                        |                                                 |
| Develop ambidextrous skills in the organization that allow taking advantage of the existing structure for SOI, but also allowing learning by experimenting with new approaches.                                     | Adams et al. (2016); Jones & Corral de Zubielqui (2017)                                                                                             |                                                 |

The systematic literature review (SLR) conducted by Adams et al. (2016) highlights SOI as an emerging topic and as a way to meet environmental and social sustainability demands. Other authors, based on this SLR, identified SOI activities as fundamental for the development of sustainability-oriented innovations. Since then, several works have used such activities as theoretical and practical support to understand the importance of environmental and social sustainability as a driver of innovations (Inigo et al., 2017, 2020; Inigo & Albareda, 2019). This paper responds to recent calls to understand how DC microfoundations of sensing, seizing and reconfiguring might contribute to supporting and developing innovations focused on sustainable business models (Adams et al., 2016; Inigo et al., 2017, 2020; Inigo & Albareda, 2019), specifically in HEI (Pangarso et al., 2020).



**Figure 3.** DC and SOI integrative framework design in the context of HEIs.

### 3 Procedures for the case study

As it addresses an emerging theme (Adams et al., 2016; Inigo et al., 2017, 2020; Inigo & Albareda, 2019), this paper is exploratory in nature aiming the investigation of a new research topic and seeking possible generalizations and topics that might become research hypotheses or theories. It is also descriptive, as it records and analyzes data collected empirically without interference from researchers on the research object (Casula et al., 2021). In this context, the most appropriate methodological approach for this research is the case study. It consists of an in-depth investigation of a specific phenomenon in a real context where the boundaries between the phenomenon and the context are not well defined (Cauchick Miguel, 2007). Table 3 presents the steps for conducting the case study, explaining each step and the procedures involved.

**Table 3.** Conducting the Case Study.

| Step                                               | Procedure                                       | Action                                                                                       |
|----------------------------------------------------|-------------------------------------------------|----------------------------------------------------------------------------------------------|
| Definition of the conceptual-theoretical structure | Literature mapping                              | Exploratory review of the literature on microfoundations, DC, SOI, and SOI in HEIs.          |
|                                                    | Definition of a theoretical framework           | Integrative framework of DC and SOI in the context of HEIs.                                  |
|                                                    | Analysis Unit Selection                         | Single case study definition.                                                                |
| Case planning                                      | Definition of collection methods:               | Semi-structured interview guide divided into five sections (Figure 4).                       |
|                                                    |                                                 | Section 1 – Getting to know the interviewee and the SOI activities at the HEI (7 questions). |
|                                                    |                                                 | Section 2 – OO Activities (16 questions).                                                    |
|                                                    |                                                 | Section 3 – OT activities (12 questions).                                                    |
|                                                    |                                                 | Section 4 – SB Activities (10 questions).                                                    |
|                                                    | Section 5 – Final Considerations (4 questions). |                                                                                              |
|                                                    | Means of Research control                       | Triangulation of data with institutional documents.                                          |
| Data Collection                                    | Interviewee                                     | A manager at the Dean of Planning and Development.                                           |
|                                                    |                                                 | A manager at the Environmental Management Commission.                                        |
|                                                    | Document                                        | Institutional Development Plan.                                                              |
|                                                    |                                                 | Management Report.                                                                           |
|                                                    |                                                 | Sustainable Logistics Report.                                                                |
|                                                    |                                                 | Analyzing institutional pages on the internet.                                               |
| Analysis and reporting                             | Content analysis                                | Evaluation by researchers.                                                                   |
|                                                    |                                                 | Comparison of interviewees' answers.                                                         |
|                                                    |                                                 | Coding of interviews.                                                                        |
|                                                    |                                                 | Triangulation of data with institutional documents.                                          |
|                                                    |                                                 | Identifying microfoundations that enable SOI activities.                                     |

**Source:** Based on Cauchick Miguel (2007).

This paper conducts a single case study in a Brazilian HEI located in the Northeast region. The case study is adopted since this study intends to apply the conceptual-theoretical structure represented in Figure 3, which shows how DCs and their second-order microfoundations contribute to SOI activities. It is worth highlighting that Figure 3 compiles information from a literature field also related to HEIs, as Table 2 shows. Figure 3, in this sense, represents the theoretical framework used as the basis for the elaboration of data collection and analysis instruments.

The selected organization is an autonomous institution with a special teaching, research, and extension profile and related to the Ministry of Education. It operates since 1934 and currently is structured in four campuses. The accessibility selection criteria adopted were the following: being an institution that adopts sustainable

practices, having an area focused on environmental management, and being located in the northeast region. For the selected case, two administrative structures were the most relevant: (i) the Dean of Planning and Development, an auxiliary body of higher management directly related to the rector, with emphasis on the preparation and execution of the Institutional Development Plan (IDP) and management reports; and (ii) the Environmental Management Committee, created in 2013, with the aim of assisting the institution's rector in diagnosing and formulating strategies to address the institution's environmental liabilities and developing management programs. Therefore, to raise the most prominent microfoundations at the HEI, two people were selected for interview, as they are directly responsible for the management of these two structures and deal directly with issues of innovation and sustainability at a strategic and operational level. The first interviewee has worked at the HEI since 2002 and has directed all planning activities related to sustainability and innovation since 2016. The second interviewee joined the institution in 2008 and has coordinated all projects associated with campus sustainability developed by the HEI administration since 2013.

The main data collection instrument was a semi-structured interview with 49 questions and five sections, applied in July 2022. The questions were based on the integrative framework (Figure 3); each microfoundation identified was related to the SOI activities described during the interview (Figure 4). One of the interviews was carried out in person and lasted one hour and 33 minutes. The second was done via videoconference and lasted one hour and 23 minutes. All interviews were recorded and transcribed. In addition to interviews, consultations were made to documents cited by the interviewees with the aim of gathering more information on the subject and triangulating it with the testimony given during the interviews. It is a means of controlling the research and the reliability of the information provided. The documents consulted were the HEI Institutional Development Plan for the 2019-2023 triennium, the HEI 2018 Sustainable Logistics and Management Plan report, the 2022 Management Report and websites of the HEI.

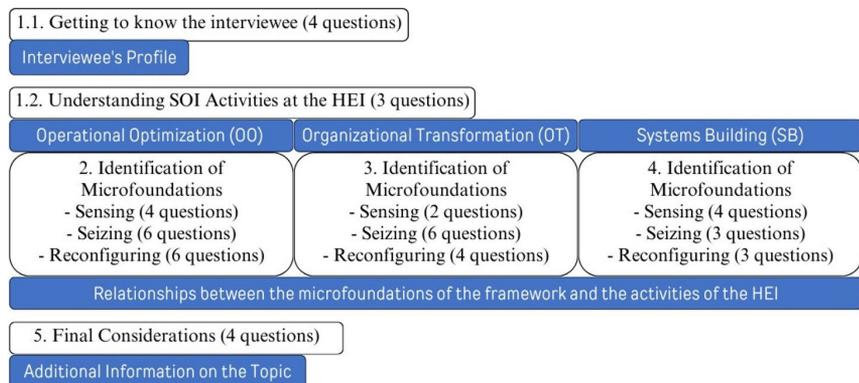


Figure 4. Interview application script.

After the interviews, the researchers analyzed the responses by comparing the interviewees' responses and the cited documents with the aim of expanding data triangulation, providing greater reliability and validity to the study and exhausting the information of the case. After carrying out the two interviews and analyzing the official HEI documentation on the topic, it was already possible to see convergence in the information. Furthermore, content analysis was used to analyze the information. Therefore, the analysis was conducted considering the steps proposed by Elo & Kyngäs (2008):

Initially, an (i) open coding was carried out, where each interview was analyzed individually and the SOI activities and microfoundations mentioned were identified freely. At this step, the initial characterization was based on the time they were mentioned in the semi-structured script and in institutional documents. Then, in (ii) coding, the SOI activities were grouped individually into Operational Optimization, Organizational Transformation, and Systems Construction (Table 4) according to the concepts of Adams et al. (2016) and considering the description interviewees provided. The interview script, based on the framework, allowed the activities to be well categorized according to the literature. Regarding microfoundations, the analysis was carried out taking into account the characterization of SOI activities the interviewees made and the concepts proposed by Teece (2007, 2017) and Inigo & Albareda (2019). Some microfoundations had to be recategorized, as they were cited within a broader context. However, the framework provided a solid basis for the immediate categorization of microfoundations into sensing, seizing, or reconfiguring.

The (iii) grouping of SOI activities was done by identifying similarities mentioned in both interviews and documents, which were grouped and divided into categories within each dimension, as presented in section 4.1. The same process was done for microfoundations, identifying similarities between interviews and grouping them. Also, the (iv) categorization of SOI activities and microfoundations was carried out taking into account the interviews and the theoretical framework and observing the consistency of information in the institutional documents cited during the interview. Finally, at the (v) abstraction step, an analysis of the relationship between the list of microfoundations created and the category of SOI activities was carried out based on the context in which the microfoundation was mentioned within the analysis framework. Several times, a microfoundation was cited in more than one group of activities, allowing highlighting some microfoundations that enable more than one group of SOI activities.

## 4 Results

There were 51 SOI activities in the dimensions OO (27), OT (14), and SB (10), as Table 4 shows. In OO, activities aimed at managing consumption and waste generated by campus operations through recycling, selective collection, recovery and disposal of materials stand out, in addition to activities to support teaching, research, development and innovation, infrastructure improvement, and administrative optimizations. In the OT dimension, sustainability-oriented activities focus on the formation of partnerships, development and application of management plans, risk control, transparency, governance and control, in addition to initiatives for the preservation of the local fauna and flora, expansion of accessibility, and access to the institution and social equity in the form of events, organizational transparency, and continued support for students with diverse needs. Finally, in the SB dimension, the institution focuses on activities directly related to the local community through the collection of electronic waste from the region, financial education courses, training and qualification for servers, training sessions open to the community, and interaction with local suppliers through prioritization in invitation to tenders and service contracts.

**Table 4.** SOI activities identified at the HEI.

|                               | SOI Activity                                                                                        |                                                                                         |
|-------------------------------|-----------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|
| Operational Optimization      | Recover broken computers                                                                            | Provide water and energy saving instructions to employees                               |
|                               | Collect used oil in HEI canteens                                                                    | Control warehouse stocks (monitor validity, exchange between warehouses in the sectors) |
|                               | Collect chemical and biological waste from laboratories                                             | Manage green areas (native forest conservation activities)                              |
|                               | Selectively collect waste generated on campus                                                       | Monitor and optimize the use of spaces inside the campus                                |
|                               | Compost rake leaves for fertilization                                                               | Create an electrical power substation                                                   |
|                               | Correctly dispose of waste from construction and renovation at the HEI                              | Monitor water leaks in sanitary facilities at the HEI                                   |
|                               | Perform reverse logistics of printing cartridges and toners and fluorescent lamps                   | Support new patents created within the campus                                           |
|                               | Dispose of electronic waste rationally                                                              | Assist in the accreditation of products and technologies developed at the University    |
|                               | Swap Fluorescent Lamps for LED                                                                      | Map initiatives and solutions being implemented in other HEIs                           |
|                               | Use mugs instead of disposable cups on campus                                                       | Map laboratories, teams, and innovation projects within the HEI                         |
|                               | Resize campus fleet usage by servers                                                                | Digitize administrative processes                                                       |
|                               | Provide buses on campus                                                                             | Promote hybrid meetings with employees from campuses in the countryside                 |
|                               | Avoid sending deans to distant meetings                                                             | Quarterly meetings of the deans' forum                                                  |
|                               | Install solar energy on the campus and invest in cleaner energy sources                             |                                                                                         |
| Organizational Transformation | Create a Laboratory Waste Management Plan                                                           | Monitor and control the environmental impact of actions on the campus                   |
|                               | Monitor and control consumption in actions on the campus                                            | Create a current risk management policy that considers environmental sustainability     |
|                               | Create a Conscious Consumption Program                                                              | Create a Civil Construction Waste Management Plan for the HEI                           |
|                               | Institutionalize actions to raise awareness of material consumption implemented on a specific basis | Prepare Institutional Development Plan and annual management reports                    |
|                               | Monitor the quality of life of the campus' fauna and flora                                          | Provide support to students with more "severe" needs                                    |
|                               | Install tactile floors at the university                                                            | Seek transparency and relevant indicators in plans and reports                          |
| Systems Building              | Improve access roads to the university in partnership with the local government                     | Plant native tree seedlings to recover degraded areas                                   |
|                               | Carry out events and campaigns to involve the community regarding sustainability                    | Make bids prioritizing micro and small entrepreneurs and sustainable companies          |
|                               | Collect electronic waste from the community surrounding the University                              | Provide Financial Education courses in partnership with the government                  |
|                               | Expand the use of the Management System implemented                                                 | Implement pilot projects at the University                                              |
|                               | Search for partner companies in the region for internships                                          | Promote the knowledge generated at the university to other institutions                 |
|                               | Provide training in sustainability for employees                                                    | Simplify administrative processes for internal and external users                       |

DC microfoundations were classified into the three dimensions of sensing, seizing and reconfiguring considering the SOI activities in the HEI studied, as Table 5 below shows.

**Table 5.** SOI microfoundations identified in HEI.

|                                                                                | Microfoundation                                                                                                       | No.                                                                        | Microfoundation                                                                                                  | No. |
|--------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------|-----|
| Sensing                                                                        | Internal control/audit and reporting by sector                                                                        | 1                                                                          | Real-time communication with the federal government                                                              | 7   |
|                                                                                | Opening of public notices for city halls and organized civil society entities seeking project demands                 | 2                                                                          | Environmental Impact Studies of campus activities                                                                | 8   |
|                                                                                | Teaching evaluation for teachers                                                                                      | 3                                                                          | Public HEI managers forums                                                                                       | 9   |
|                                                                                | Assessment and mapping skills to be developed by HEI technicians, with topics in Sustainability                       | 4                                                                          | Groups of public HEI managers on social networks                                                                 | 10  |
|                                                                                | Search for partners through Internship and Undergraduate Monitoring Coordination and course coordinators              | 5                                                                          | Mandatory disclosure of extension projects through social media                                                  | 11  |
|                                                                                | Co-creation of an integrated report based on information from other internal bodies                                   | 6                                                                          |                                                                                                                  |     |
| Seizing                                                                        | HEI International Cooperation Agency and dissemination of extension and research projects                             | 12                                                                         | Permanent Sustainability Body                                                                                    | 25  |
|                                                                                | Allocation of budget forecasts for long-term sustainability projects at the HEI                                       | 13                                                                         | Partnership with selective collection, reverse logistics, and hazardous waste disposal associations              | 26  |
|                                                                                | Allocation of funds for congresses, courses, and training                                                             | 14                                                                         | Partnership with public authorities in the execution of infrastructure projects                                  | 27  |
|                                                                                | Internal commission for monitoring changes to legislation                                                             | 15                                                                         | Partnership with other HEIs in the development of management systems                                             | 28  |
|                                                                                | Inclusion and Accessibility Committee                                                                                 | 16                                                                         | Partnership between external collaborators and professors in research projects and laboratories                  | 29  |
|                                                                                | Communication with external stakeholders regarding sustainable development through internal bodies                    | 17                                                                         | Participation of HEI in municipal and state committees                                                           | 30  |
|                                                                                | Coordination of Agreements and Contracts - Public and private partnerships                                            | 18                                                                         | Participation of teachers in Sustainability Committees                                                           | 31  |
|                                                                                | Creation of waste management, selective waste collection, and consumption assessment plans                            | 19                                                                         | Participation in sustainability rankings for HEIs                                                                | 32  |
|                                                                                | Event to promote internal campus sustainability activities                                                            | 20                                                                         | Prioritization of local micro and small entrepreneurs and inclusion of sustainability criteria in hiring         | 33  |
|                                                                                | Facilitating the participation of researchers in Training, Conferences, Seminars, and other events for sustainability | 21                                                                         | Relationship with other public bodies in sustainability for actions on and off campus                            | 34  |
|                                                                                | Encouraging the participation of professors and research groups on sustainability in global networks of universities  | 22                                                                         | Office of Deliberative Bodies of Superior Administration - monitors new regulations for HEIs that can emerge     | 35  |
|                                                                                | Investments in internal bodies (grants for projects with students, for example)                                       | 23                                                                         | Sustainability as a strategic norm in the Institutional Development Plan, mission, vision, and values of the HEI | 36  |
|                                                                                | Innovation seizing body for HEIs - Technological Innovation Agency                                                    | 24                                                                         | Use of georeferencing technology to monitor the use of spaces inside the campus                                  | 37  |
|                                                                                | Electronic platform for internal collaboration between centers                                                        | 38                                                                         | Extension programs based on regional social demands                                                              | 46  |
|                                                                                | Control of HEI technologies and intellectual property through the Innovation agency                                   | 39                                                                         | Network of warehouses in HEI sectors                                                                             | 47  |
|                                                                                | Education and training of HEI staff (training courses and awareness campaigns)                                        | 40                                                                         | Meetings of the Faculty Leadership Team of HEI Campus Directors to disseminate specific activities               | 48  |
|                                                                                | Meetings with the HEI and stakeholders involved in regional projects                                                  | 41                                                                         | Annual review of the governance model through a specific committee                                               | 49  |
|                                                                                | Feedback from central administration on the evolution of the HEI's sustainability goals                               | 42                                                                         | Annual review of reports, management and governance indicators, accountability etc.                              | 50  |
|                                                                                | Investments in maintaining installed high-standard laboratories and creating new ones                                 | 43                                                                         | Simplification of Administrative Processes                                                                       | 51  |
| Core, program or maintenance team for the recovery of HEI electronic equipment | 44                                                                                                                    | Transmission of information through circular letters in management systems | 52                                                                                                               |     |
| Partnerships between internal bodies in project implementation                 | 45                                                                                                                    |                                                                            |                                                                                                                  |     |

The detection microfoundations allow HEIs to identify opportunities for improvement and innovation within their structure and in the systems in which they are inserted from a green lens of analysis, anticipating standards and good practices (Inigo & Albareda, 2019; Teece, 2007, 2017). In this context, there were eleven detection microfoundations related to SOI activities (Table 5), mainly in the form of control, audit and internal processes and performance assessment of the HEI in sustainability activities.

Seizing microfoundations facilitate the application of SOI opportunities when they arise within the HEI or through stakeholders, organizational structures, partnerships, cultivation of non-economic values in business culture, control of management platforms, investments in innovation ecosystems, and management of internal collective decisions (Inigo & Albareda, 2019; Teece, 2007, 2017). In this context, there were 26 fundraising microfoundations associated with the SOI activities developed by the HEI (Table 5) in the actions of innovation and sustainability bodies within the campus, mainly in research and monitoring of SOI activities and outside of it through participation in projects and external bodies in public and private initiatives.

The microfoundations of reconfiguration for SOI activities in HEIs contribute to the construction of committed networks of innovation in sustainability, decentralizing good governance practices, sharing knowledge through co-specialization with stakeholders and knowledge management (Inigo & Albareda, 2019; Teece, 2007, 2017). In this context, there were 15 microfoundations (Table 5) and support collaboration networks in campus SOI activities in the simplification and review of processes, expansion of technology and mechanisms to facilitate the participation of external stakeholders.

## 5 Discussion

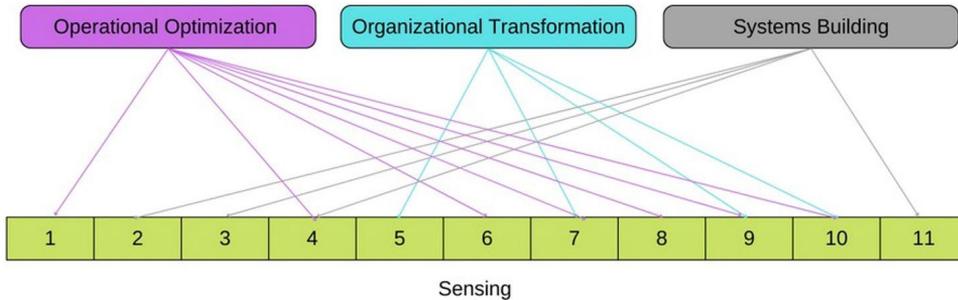
The microfoundations raised were grouped into SOI activity categories based on the integrative framework (Figure 3), allowing insights about microfoundations of sensing, seizing and reconfiguring associated with SOI activities in the institution studied (Table 6).

**Table 6.** Relationship between DC microfoundations and HEI SOI activities.

| SOI Activity 1: OO                          | Microfoundation*                                                       | Total of Relationships       |
|---------------------------------------------|------------------------------------------------------------------------|------------------------------|
| <b>Sensing</b>                              | 1; 4; 6; 7; 8; 9; 10                                                   | 7                            |
| <b>Seizing</b>                              | 14; 15; 16; 17; 18; 19; 20; 21; 22; 23; 24; 25; 27; 29; 34; 35; 36; 37 | 19                           |
| <b>Reconfiguring</b>                        | 38; 40; 43; 44; 45; 47; 48; 51; 52                                     | 9                            |
| <b>Total Microfoundations in OO for HEI</b> |                                                                        | <b>34</b>                    |
| SOI Activity 2: OT                          | Microfoundation                                                        | Total Relationships Observed |
| <b>Sensing</b>                              | 5; 7; 9; 10                                                            | 4                            |
| <b>Seizing</b>                              | 13; 16; 19; 24; 25; 26; 27; 28; 29; 30; 31; 32; 33; 34; 36             | 15                           |
| <b>Reconfiguring</b>                        | 41; 42; 47; 49; 50; 51; 52                                             | 7                            |
| <b>Total Microfoundations in OT for HEI</b> |                                                                        | <b>26</b>                    |
| SOI Activity 3: SB                          | Microfoundation                                                        | Total Relationships Observed |
| <b>Sensing</b>                              | 2; 3; 4; 11                                                            | 4                            |
| <b>Seizing</b>                              | 12; 21; 24; 27; 29                                                     | 5                            |
| <b>Reconfiguring</b>                        | 39; 46; 51                                                             | 3                            |
| <b>Total Microfoundations in SB for HEI</b> |                                                                        | <b>12</b>                    |

\*DC microfoundations are represented by the numbers listed in Table 5.

The analysis of the interaction between the microfoundations of sensing OO activities in HEIs (Figure 5) allows highlighting some relationships, especially the importance of internal control and audits in the institution's administrative sectors, generation of internal reports on activities developed, and mapping of risks and activity planning (1). They serve as the basis for the co-creation of the annual management report (6), allowing analysis of activities developed inside the HEI. In this sense, the execution of innovation reports provided by the institution's innovation capture body and the environmental sustainability reports (8) of the permanent sustainability body stand out.



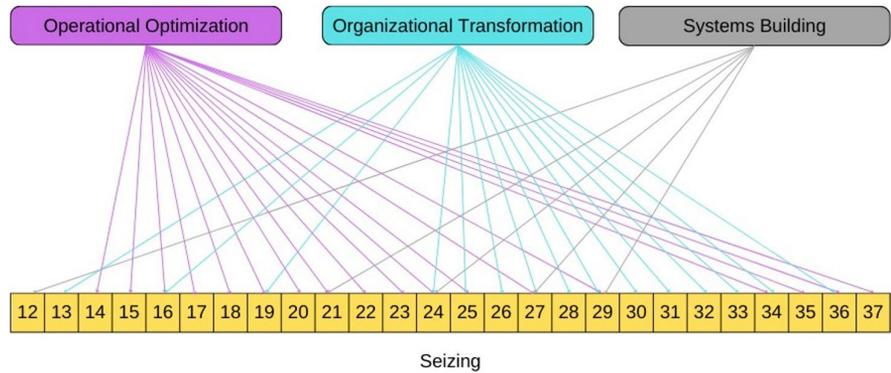
**Figure 5.** Microfoundations of sensing and SOI activities of HEIs. The numbers represent the microfoundations listed in Table 5.

The assessment and mapping of skills to be developed by HEI technicians in relation to sustainability (4) was listed as necessary in both OO and SB. Such an assessment allows for a survey of skills required by managers for their teams and, with this data, it is possible to plan training courses to be offered to employees, generating efficiency gains and expanding collaboration networks inside the institution. In this context, the evaluation of teachers regarding teaching (3) was cited as a sensing mechanism in the search for teaching improvements. However, there was no evaluation mechanism for teachers in relation to administration.

HEI maintains real-time communication with the federal government (7), scanning new long-term projects in infrastructure renewal and efficiency gains. At the same time, maintaining active contact in partnership with the federal government was considered an important mechanism in obtaining public resources to promote changes in organizational infrastructure. Likewise, the HEI also monitors actions developed by other HEIs through quarterly manager forum meetings (9) and an active, real-time network of contacts between HEI managers across the country (10). These fundamentals make it possible to detect new process optimization practices and efficiency gains, good governance practices, fiscal responsibility, and emerging organizational transparency.

The obligation to publicize extension project activities through social networks (11) was cited as important in creating marketing strategies for innovation actions. However, there is a need for more dissemination actions coordinated by the institution itself.

In relation to the seizing microfoundations most addressed in the context of HEI's SOI activities, Figure 6 highlights the nine most relevant microfoundations for the interface between SOI activities among the 26 listed.



**Figure 6.** Microfoundations of seizing and SOI activities in HEIs. The numbers represent the microfoundations listed in Table 5.

The creation of waste management, selective waste collection, and consumption assessment plans (19) allows monitoring resource consumption by the HEI, enabling the execution of reduction and optimization goals through actions that encourage a transition to a more sustainable organization. Facilitating the participation of researchers in training, conferences, seminars, and other events for sustainability (21), according to the demand of teachers and the budget, was cited as fundamental to the process of ideating new actions in OO through execution of projects and formation of partnerships relevant to the HEI. In addition to these, other key activities involve the allocation of funds for congresses, courses and training within the institutional budget, encouraging active participation of employees and teachers in institutional sustainability projects and training employees in innovation skills. Example are 5S training made available to HEI servers, the use of georeferencing technology in monitoring green areas and the use of spaces inside the campus.

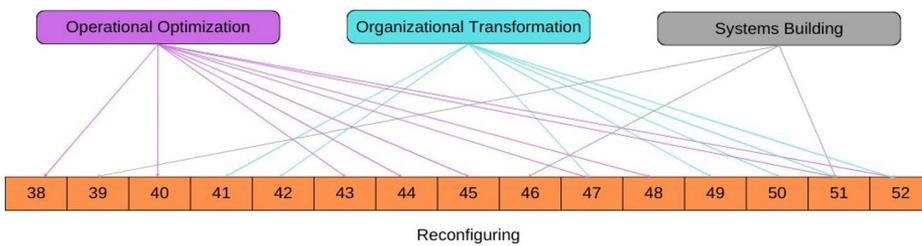
The creation of an innovation agency (24) was cited as a key facilitator in the process of SOI activities at the HEI in mapping, monitoring, and supporting innovation activities developed within the institution, in the search for partners and formalizing collaborations in innovation extension projects with teachers, laboratories and innovation centers, in addition to supporting the process of protecting intellectual property produced by the HEI.

The inclusion of sustainability as a cultural norm was also highlighted as relevant in facilitating SOI activities (36), as a global tool for monitoring management goals, accountability and transparency, and building a more sustainable organization. The creation of a permanent sustainability body (25) aimed to insert actions into the campus routine regarding the topic and promote sustainability as a cultural norm. Partnerships between external collaborators and professors in research projects and laboratories (29) were highlighted as a relevant source of resources for maintaining innovation activities within the institution. One of the most prominent actions to expand innovation actions in sustainability for the social sphere is the creation of an inclusion and accessibility committee (16), which carries out inclusion actions inside the campus by hiring caregivers and companions and mapping special needs regarding mobility and accessibility.

The public tender process is an important tool when hiring partners committed to sustainability. In this sense, advances in encouraging prioritization of micro and small entrepreneurs and local suppliers and the adoption of sustainability criteria (33) as soon as legally determined are ways to encourage a more sustainable ecosystem around the HEI.

The relationship with public and private bodies (34) allows activities on and off campus for reforestation, urban mobility, energy, social assistance, and other services for the community. For example, the HEI studied here maintains a partnership with the federal government for the implementation of photovoltaic panels and projects and services in the health area (27). It actively participates in Regional Committees, provides financial education courses for the community, acts as a collection point for e-waste to the community, and participates in local and global sustainability committees. Internally, the permanent sustainability body is responsible for this network creation process. Holding an internal event to publicize sustainability actions on HEI campuses (20) was cited as an important activity facilitated by the work of the permanent sustainability body.

Finally, Figure 7 shows the distribution of reconfiguring microfoundations within SOI activities of the HEI studied. Practically all microfoundations analyzed here are specific and were mentioned exclusively for each category of SOI activity, showing less maturity in relation to the other microfoundations. However, there are several positive experiences in each group of SOI activities. Digitization, simplification, and transparency of ongoing processes at the university for internal and external users (51) minimizes the risk of loss and diversion of documents. They are considered important for OO, OT and SB.



**Figure 7.** Microfoundations of reconfiguring and SOI activities of HEIs. The numbers represent the microfoundations listed in Table 5.

Despite the existence of several project partnerships, there was no formal platform for collaboration and mapping of these activities. Currently, the HEI management platform is being expanded in partnership with another institution aiming to provide more power for collaboration between internal bodies (38). In the context of OO, existing high-standard laboratories that receive investments in maintenance and expansion resulting from investments from the federal government or private companies were mentioned (43), mainly in the area of health and technology. Other examples are the creation of a center for the recovery of electronic equipment and reuse of parts (44), the provision of training courses for education and training of HEI employees (40), and an internal network of HEI warehouses (47) to promote efficiency gains in existing processes. The HEI governance model and the institutional management report are also reviewed annually by a specific committee (49) with the collaboration of internal bodies (50). The central administration also provides sectors with feedback on internal management reports and the evolution of HEIs' sustainability goals (42).

Exploring existing specific innovation actions and operationalizing them throughout the HEI is considered a major challenge. To this end, the HEI holds meetings of the Administrative Council of Campus Directors to disseminate specific activities (48). The interaction between internal sustainability bodies on different campuses also helps to spread activities throughout the institution (45). Institutional communication through circular letters (52) was also considered a tool for disseminating these activities.

Few microfoundations have been reported in SB activities. The most important among them is the control of intellectual property and protection of technologies by the innovation agency (39). During the interviews, the need to expand extension programs based on the social demands of the region (46) was highlighted. It could be achieved through the opening of public notices to city halls and organized civil society entities in search for relevant project demands (2).

In general, it is clear that the microfoundations identified in this study are focused on OO activities, campus operation activities, consumption reduction, and efficiency gains. As the work of Inigo & Albareda (2019) showed, sensing innovation activities tend to emerge and mature first within organizations. In the context of the HEI, 34 of the 52 microfoundations mentioned were directed at some level to the OO process, while only 12, for example, were marked as relevant in SB activities. In line with what that discussed by Ávila et al. (2017), most innovations are still concentrated in campus operations, especially in the generation and use of renewable energy. Likewise, one of the main challenges reported was the lack of administrative commitment and low community adherence.

The analysis of sensing microfoundations allows noting that real-time contact with the federal government and managers of other HEIs is of great relevance in SOI activities. Little attention is given to bodies other than public HEIs while identifying innovations. The mechanisms mentioned are focused on monitoring legislation, compliance with current regulations, and raising public resources. It is clear that specific partnerships can generate good financial and infrastructure returns for the institution, as Jones & Corral de Zubielqui (2017) proposed, requiring proactive detection mechanisms for partnerships with companies in research through the action of internal bodies operating in the interaction between internal and external stakeholders, especially teachers and companies (Machado et al., 2022).

Analyzing seizing microfoundations, they play a prominent role mainly in the form of performance of internal control, auditing, administrative bodies, and the promotion of innovation and sustainability. The formation of teams of employees in these structures is of fundamental importance to trigger changes within HEIs in a systematic manner, in both internal operations and actions at the organizational level, with emphasis on employee training and evaluation (Gunasekara, 2006). Partnerships with the private sector may also emerge from such decentralized structures, generating another important source of SOI in addition to the partnerships between the central administration and the government. Increasing the efficiency of these organizations and giving more visibility to initiatives inside them can be an important path towards a necessary response to the current scenario of decreasing resources from public sources (Rodríguez-Castro & Aparicio, 2021).

Most reported reconfiguring microfoundations are internal or organizational. In creating networks with society, the process of simplifying administrative processes and collaborations for regional projects stood out. It is clear that relationship activities are becoming increasingly important in the innovation environment and that HEIs need to instigate and maintain relevant relationships, thus creating a collaboration network (Romero Duque et al., 2018; Souza & Takahashi, 2019). Only the existence of meetings between the HEI and the stakeholders involved in regional projects was reported.

In practice, some SOI activities highlighted as important in the literature were not verified in practice or were highlighted as less relevant for HEIs. In all three dimensions, the process of hiring companies, employees and teachers was raised as an obscure point regarding engagement in SOI. In relation to the former, the HEI follows the public bidding process and cannot introduce obligations beyond what is provided for in the legislation, limiting hiring companies more engaged in innovation as a formal criterion. Regarding the latter two, there are no formal mechanisms that take SOI skills into account during the selection process.

## 6 Conclusion

It is possible to identify in the case study microfoundations associated with SOI activities in an HEI, highlighting important relationships between both dimensions. From the proposition of an integrative framework based on the literature on innovation, DC, and SOI activities, 52 specific microfoundations for HEIs were categorized and analyzed within the context of innovation activities for sustainability. In relation to sensing microfoundations, the highlights are the assessment and mapping of skills required for employees in sustainability, communication with the federal government, participation in manager forums, and a full-time network of contacts with managers of HEIs across the country as skills that can enable SOI activities in the three dimensions analyzed. OO activities exert a greater influence, especially in consumption and waste management and infrastructure improvement activities. They also assist in SB activities, mainly in the creation of internal networks, through evaluations and detection of points for improvement among employees. Sensing of innovation opportunities outside public HEIs are less explored, and the HEI is limited to supporting R&D activities through the dissemination of projects and the opening of public notices.

As for seizing microfoundations, a large part is related to internal bodies specialized in innovation, sustainability, and management activities. This dimension contains the largest number of microfoundations that relate to SOI activities in more than one dimension, generating a complex network of skills that allow enabling partnerships, investments, and actions on and off campus. There is a great impact of these microfoundations on OO and OT activities based on the work of internal bodies in executing internal management plans, collaborating for the creation of more transparent reports and indicators, and engaging in sustainability activities.

Among reconfiguring microfoundations, the creation of collaboration networks inside the campus stands out. It can allow efficiency gains in operations and promote good governance practices in addition to creating an internal cooperative environment. Simplifying administrative processes and expanding the digitization of administrative activities has a great OO and organizational potential, minimizing the risk of document loss and speeding up internal procedures. Investments in institutional communication and internal management platforms have the potential to expand actions developed on a specific basis through internal collaboration between physically distant bodies. In general, the reconfiguring microfoundations studied had specific applications, evidencing a lower level of coordination of the HEI in this dimension and with emphasis on OO activities through the creation of internal collaboration networks.

The research developed in this study also makes contributions in theoretical and practical/managerial terms. First, in theoretical terms, the development of the integrative framework relating microfoundations of DC with SOI activities performed within the context of HEIs is relevant for understanding the key aspects that allow the development of SOI in HEIs at operational, organizational, and systemic levels. Furthermore, this paper may encourage further research on the topic, shedding more light on the relationships between researchers and companies regarding innovation within HEIs, investigating the role of HEIs in promoting research aimed at innovation, and defining which improvements are needed to achieve greater maturity in relation to external collaboration networks. In terms of practical contributions, the results discussed here may be a parameter for other HEIs through important insights into the relationship between microfoundations and SOI activities, which can be of great value to managers seeking to promote such activities. This study may also provide a basis for identifying activities in HEIs that cannot be expanded due to legal and/or bureaucratic obstacles within the HEIs. It may also be a guiding path, with a greater emphasis on partnerships with private companies.

This research also has some limitations; and from them, opportunities for future studies may arise. First, a single case study does not allow the generalization of innovation activities in HEIs, especially in relation to the necessary microfoundations. Thus, future research can carry out multiple case studies in order to compare the results (between public and private HEIs, for example). Future research can also carry out surveys using the research categories described in Figure 3. Secondly, the framework itself must be reviewed and improved, inserting or grouping new SOI activities into subcategories that allow the identification of more specific microfoundations within HEIs. Furthermore, the interviews were conducted with directors of a strategic sector of the HEI administration and the permanent sustainability body, but interviews were not carried out with some bodies mentioned as important for a better understanding of the topic. As a result, fewer microfoundations, particularly sensing and reconfiguring, were observed, as activities within these bodies were not analyzed in more detail. Other case studies may improve this, including exploring the relationship between these bodies as several cases have been reported that may provide important mechanisms for innovation activities. Other studies can also improve relations between internal bodies and the construction of collaboration networks between stakeholders through the mediation of HEIs and their internal operating bodies. Finally, other studies can address the level of application of SOI activities reported by HEIs and the main challenges and facilitators in carrying out such activities.

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#### Authors contribution

Cláudia Fabiana Gohr was responsible for conceiving the idea and guiding the research. All authors worked on the conceptualization and theoretical-methodological approach. The theoretical review was conducted by Walleci Gabeu Lira and Carlos Rodrigo de Souza Torres and coordinated by Claudia Fabiana Gohr. Data collection was coordinated by Walleci Gabeu Lira. All authors participated in data analysis. All authors participated in the writing and final review of the manuscript.