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Think Twice to Achieve a Sustainable Project Management: From Ecological Sustainability towards the Sustainable Project Management Cube Model

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Abstract: This work aims at contributing to a new Sustainable Project Management (SPM) paradigm, focusing on the role of project managers as a key element. The contribution of this research has both practical and theoretical implications. It presents the first results of a project developed under the Erasmus+ program Think Twice, recommending a set of ecological practices to motivate and develop project managers' skills to adopt Sustainable Project Management. Subsequently, supported by a literature review and content analysis of the data collected for this project, an original conceptual model is presented: the Project Management Triple Sustainability Cube. This tool is intended to guide project managers on their journey to sustainability in project management, comprehensively and systematically. To this end, the tool outlines guidelines for adopting comprehensive practices according to the triple bottom line sustainability vectors (environmental, social, and economic) relating to people, processes, and innovative solutions (go/no digital) throughout the project life cycle.

1. Introduction

Smart Sustainable Development is a relevant concern nowadays. Planet Earth is under significant threat as a result of economic development since the first Industrial Revolution. Solutions to these problems which promote sustainability must be found among the organizations that have contributed to these results. Furthermore, a collaborative perspective should be promoted, so that together we may prevent the Earth's main threats, assuring a promising future for subsequent generations.

In a competitive and challenging market, organizations receive increasing support for novel projects, such as developing new products and new production processes by integrating emerging technologies, digitizing information, restructuring supply chains, achieving new markets, and entering new business areas. Thus, organizations face the challenge of implementing projects effectively and successfully but in a sustainable way. Success may not be measured only in terms of the results linked to the Iron Triangle criteria of budget, quality, and time. Additionally, it is necessary to include in the definition of project success an assessment of the impact on the furtherance of sustainable development goals (SDGs), including the three triple bottom line vectors (economic, environmental, and social) [1].

Thus, it is urgent to integrate sustainability as a criterion to achieve a smart project management process, promoting a change in thinking, moving from a predictive control approach focused on processes and deliverables to a more complex, flexible, and timely

approach to current challenges [2]. Other authors have defended this paradigm in project management, contributing to the management of environmental, social, and economic impacts [1,3,4]. Projects are instrumental in achieving sustainable solutions. Seeing sustainability as relevant in all project areas will ensure that environmental damage is minimized. Projects may seem to be provisional, but they may help organizations realize long-term investment objectives. Therefore, project management models are improved due to a balance between cost, schedule, and scope and trade-offs between the economic, social, and environmental factors involved in a project. Throughout this work, we will detail the advantages and usefulness of integrating sustainability in project management, namely:

- Facilitation of the assessment of the impact of project results on sustainable development goals (SDGs) [1];
- Betting on PM approaches more focused on current challenges [2];
- Focusing project managers on sustainable development concerns [5];
- Promoting benefits for stakeholders that include proactive stakeholder participation [6];
- Developing project management in a transparent, fair, and ethical way [7];
- Enhancing project deliverables with lesser environmental, social, and environmental impacts [6];
- Developing purchasing processes, project monitoring, and project risk management [8].

However, some constraints have been identified in the literature that may compromise the attainment of such goals. Some authors have observed that the integration of sustainability in temporary activities and organizations, such as projects, is rarely addressed [9]. Likewise, Eid [10] states that the main project management (PM) standards are not yet adequately aligned with sustainable development agendas.

The integration of new perspectives into PM increases its complexity, making it a more holistic management area and therefore less prone to standardization, requiring strong commitment from project managers [11]. As such, it is necessary to rethink the way projects have been developed, promoting this project management paradigm shift supported by the integration of sustainability into its processes. This transformation will encompass several areas of change, namely, rethinking project management criteria by adding to the traditional Iron Triangle (budget, quality, time) the economic, social, and environmental impacts (positive and negative) associated with the development of projects; moving from predictive and control-focused methods to approaches more focused on current challenges [2]; and shifting project managers' minds towards sustainable development concerns [5].

The new paradigm of project management is highly dependent on how committed project management professionals are to this challenge and on how much they want to assume the role of changemakers. Some authors [12,13] argue that the project manager has a vital role in the integration of sustainability in project management. Their intrinsic individual motivations, such as awareness about sustainability concerns, are crucial to achieving this objective.

Thus, the main research question put forward in this study is: "How to stimulate project managers' awareness and motivations for the systematic integration of sustainability into PM?" Accordingly, the main objectives of this research are the following: to contribute to the dissemination of practices and the development of skills to strengthen the motivation of project managers to implement Sustainable Project Management approaches; to identify and characterize the dimensions needed to frame the practices that must be implemented to integrate sustainability into PM; to propose a tool supporting the adoption of Sustainable Project Management comprehensively and systematically, developing a holistic approach.

To achieve these goals, this research presents the work under development as part of a European Project, Think Twice, involving all the authors and other partners. Its main objective is to raise awareness and develop skills for professionals involved in European projects, promoting the integration of environmental practices throughout the life cycle of project development.

Consequently, in the following section, this document presents the main theoretical foundations related to sustainability management and its integration into project management, highlighting the role of project managers in this process. The methodological procedures that support this research are described next. In Section 4, a description of the Think Twice project is presented, as well as the main results achieved so far. Finally, in the last section, we discuss the main contributions of the research and offer final reflections on the work, consider limitations, and indicate future lines of research.

2. Literature Review

2.1. Sustainable Development

The most widely used definition of sustainable development states that sustainable development is "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" [14].

The World Commission on Economic Development (WCED) indicated that sustainable development should simultaneously embrace economic, social, and environmental principles. Thus, the three axes of sustainable development are social (to ensure that all members of society have equal access to resources and opportunities), economic (a population's access to a certain minimum degree of satisfaction of their basic needs), and environmental (preventing human activity from degrading the environment) [14].

The United Nations (UN) and its member states, in 2015, launched the 2030 Agenda for Sustainable Development, supported by 17 Sustainable Development Goals (SDGs) [15]. This commitment was entitled "Transforming our world: the 2030 Agenda for Sustainable Development" to ensure the implementation of sustainable development principles by means of a collective effort to ensure the accountability and involvement of all member states. In addition to defining the SDGs, the 2030 Agenda also identified the resources needed for its implementation, such as financial resources, development technologies, and capacity building of local agents for sustainable development [16]. The 2030 Agenda aims to guide member states to develop inclusive, people-centered, and sustainable development strategies, strengthening sustainable development's social, economic, and environmental dimensions. Its implementation requires a more holistic, coherent, and integrated approach at the national, regional, and global level [17].

To achieve the essential SDGs, more effort is imperative regarding changing individual behaviour and adopting more sustainable production processes, avoiding the scarcity of natural resources on behalf of future generations, otherwise economic growth will increase global pressure, social exclusion, and inequality. Consequently, companies should seek to adopt sustainable production methods, to develop practices and technologies designed to transform materials into products through the consumption of smaller amounts of energy and non-renewable or toxic materials, reducing emissions and waste [18]. In this sense, it is pertinent to analyse how companies may manage sustainability from a corporate perspective.

2.2. Corporate Sustainable Management

Companies have a key role to play in the achievement of SDGs. For this, it is necessary to commit to corporate sustainability, making it an integral element of competitive advantage strategy.

A study developed by Kiron et al. [19] revealed that 90% of managers assume sustainability as a crucial factor in their business. However, only 60% of companies implement an integrated sustainability strategy in their organization. Considering these results, there is a need for more concrete guidance to allow companies to act strategically and successfully towards sustainable development [20]. Sustainable management practices help organizations to avoid risks and identify opportunities, pointing out a sustainability profile [21]. The integration of sustainability into business contexts was driven by the development of the Triple Bottom Line model, which gained popularity with Elkington [22]. This author concluded that responsible management encompasses three dimensions of sustainable development:

environmental, social, and economic. First, corporate sustainability management must be operationalized on principles of transparency and involvement of the main stakeholders, later translated into operations management.

Silva and Gouveia [23] present a conceptual model identifying the key elements of corporate sustainability management. They argue that sustainability management is based on a temporal concept, leading to reflection about the future. It is necessary to outline a long-term perspective supported by proactive management practices, mitigating risks and enhancing opportunities. An organization must understand its purpose from a systemic perspective, considering the set of relevant stakeholders and evaluating mutual impacts. They point out the concept of a permeable system where an organization must manage changes arising from an external context. They emphasize that leadership is crucial for the involvement of everyone in a culture oriented towards economic, social, and environmental sustainability objectives. Strategic management supporting sustainability should flow out to the organization's operations in four main stages: Involvement (targeting employees and other stakeholders); Execution (implementing actions at the tactical management level to improve economic, environmental, and social results); Monitoring (development of indicators to assess results); and Communication (reporting results to stakeholders, developing feedback mechanisms, and improving the results obtained).

To promote a strategy based on sustainability, organizations must look for complementary tools to support management, namely, the integration of sustainability in their management practices already implemented, such as the integration of sustainability in the processes of project management.

Labuschagne and Brent [24] present a definition of sustainability in business: "For the business enterprise, sustainable development means adopting business strategies and activities that meet the needs of the enterprise and its stakeholders today while protecting, sustaining, and enhancing the human and natural resources that will be needed in the future." In this context, for business, the challenge is to align operational processes with the main objectives of sustainable development, using practical tools to align business methodologies with the sustainability goals and life cycle management principles.

2.3. Sustainability in Project Management

One potential area for the implementation of sustainability is sustainable project management [25]. Sustainability has proved to be an emerging theme in PM knowledge, both in academia and the organizational field. In the academic sphere, most contributions have focused on understanding the impacts of the integration of sustainability in project management processes and practices [4,10,26]. At the organizational level, this effort has also been highlighted. For example, the IPMA Individual Competence Baseline® version 4 [27] has demonstrated the concern to integrate sustainability into management standards. Its latest edition clarifies the need to ensure that a project must comply with the principles and objectives of sustainability, and the project's impacts on the environment and society are also assessed. In addition, the ISO (International Organization for Standardization) in "ISO 21505:2017—Project, Program, and Portfolio Management", defines a set of guidelines for the governance of a project, namely: to improve accountability and transparency; engagement with stakeholders; reduce organizational risk; increase the likelihood of achieving sustainable results and respecting values; ethics and guiding principles [7].

As is often the case, emerging themes generate a wide range of concepts and perspectives which may not be properly aligned and may contribute to thematic confusion.

Thus, some efforts have been made to homogenize the concepts. Huemann and Silvius [6] describes Sustainable Project Management as "the planning, monitoring and controlling of project delivery and support processes, with consideration of the environmental, economic, and social aspects of the life cycle of the project's resources, processes, deliverables, and effects, aimed at realizing benefits for stakeholders and performed in a transparent, fair and ethical way that include proactive stakeholder participation." This definition may integrate two perspectives on the connection between sustainability and PM:

- "Sustainability by the project"—sustainability is considered in the specifications and design of the project outputs, considering the environmental, social, and environmental impacts of the project's deliverables.
- "Sustainability of the project"—sustainability is addressed in project management processes, such as identifying and involving stakeholders, purchasing processes, business case development, project monitoring, project risk management, and project team building.

Therefore, it is not sufficient to evaluate the sustainability of project deliverables; the project delivery process must also be sustainable [28]. Both elements are interrelated, as Sustainable Project Management (SPM) covers the life cycle of the project, focused on the sustainability of the outputs generated as well as on the integration of sustainability in the project management processes [24,29].

Klakegg [30] explains sustainable project management from a holistic perspective, including comprehensive criteria and planning that supports the flexibility of the project's delivery. For this, it is important to follow a bottom-line approach, including the relevant stakeholder expectations.

In the journey to embed sustainability in PM, several frameworks and practices have been developed. These contributions have emerged at the sectoral level, such as the framework developed by Corder, McLellan, and Green [31] in the mining industry or, as a more typical application, to assess social impacts on project life cycles [24].

Organizational maturity has been investigated in the integration of sustainability in PM [32]. Magano, Silva, and Martins [33] argue that this integration process should start with diagnosing PM maturity and thus identify the strengths and weaknesses that impact the development of sustainability practices throughout the management of a project. In harmony with this, other authors [34] have developed the local Government Project Management Maturity Model (LGPM3) framework.

2.4. Dimensions of Sustainable Project Management

As defended by several authors, sustainable project management should be implemented as a holistic package with different sustainability dimensions to create value through the project [25,35].

A systematic literature review of articles published from 1994 to 31 December 2018 was conducted, resulting in a total of 450 articles [36]. This analysis highlights the challenge of the integration of project management and sustainability from different perspectives. In this context, a five-dimensional approach emerged from the analysis. The dimensions are: corporate policies and practices; resource management; life cycle orientation; stakeholder engagement; and organizational learning.

Other authors [28] have also maintained that sustainability in PM can be analysed from different perspectives, such as product-related, process-related, organizational, and people perspectives. Additionally, companies must add sustainability into project management processes and shift from focusing on the Iron Triangle to wider effects [3]. Consequently, different dimensions of SPM can be identified and discussed, such as:

- Triple Bottom Line Dimension [22]

According to the literature, sustainability in PM covers multiple dimensions and meets the varying goals of different stakeholders [37]. Nevertheless, the empirical results review pointed out that, overall, the initiatives fail to meet the three dimensions of sustainability (economic, environmental, social), avoiding assessing the trade-offs between the dimensions [38]. Several of the sustainable initiative sets focus on the environmental dimension over the social and economic dimensions of sustainability [39]. The environmental area is more regulated than the social vector, and this consequently increases pressure to set and meet environmental goals before others [25].

- Project Development Life Cycle Dimension

As described by Labuschagne and Brent [24], enterprises that are successful in terms of project management adopt a simple and well-defined project management framework, with a staged approach for all projects which includes identifying all relevant information about major activities and deliverables for each project phase. In this context, for Sustainable Project Life Cycle Management it is necessary to know the life cycles involved in a project and their interactions. Moreover, the use of practical tools which include sustainability within evaluation processes may allow connections to be made between business methodologies and the principles of sustainability.

Therefore, the primary project phases are critical to introduce innovative solutions and increase the total value generated by the project [35,40]. In general, companies make some sustainability-related decisions quite early [41]. As also pointed out by Labuschagne and Brent [24], after considering the results of the project life cycle under the sustainability perspective, the stakeholders should define their priorities.

During the execution phase of a project, value activities may continue [40], information is updated, and decisions are made related to material choices, process steps, and resource consumption. There are several works on SPM dedicated to the initiation, design, and planning of project phases [39,42]. Still, restricting the focus of sustainable project management to these phases of projects is insufficient; the implementation and closing stages are critical for ensuring that the projects are developed in a sustainable way [25].

- Sustainability-oriented innovations dimension

Some authors [43] insist that value innovation should also take place regarding sustainability, as long as the innovative solutions are supported on all the dimensions of sustainability, economic, social, and environmental.

As innovations emerge with a significant role in framing sustainability in the project life cycle, sustainability-oriented innovations should be a driver to be covered in future research [25].

Sustainability concerns must be integrated into the innovation process to guide the development of innovations and guarantee that sustainability is taken into consideration [44].

2.5. The Pivotal Role of Project Managers in Sustainable Project Management—A New Paradigm

As mentioned in the previous sections, the integration of sustainability generates a new project management paradigm, leading to a shift in the mindsets of project managers towards sustainable development concerns. Thus, this paradigm depends on how project managers are committed to this challenge and how they may even assume the role of changemakers.

Project managers have a privileged role in implementing the key elements of sustainability management in their projects [32,45]. For this, their skills must also be targeted in line with awareness about sustainable development [46,47]. Therefore, the effort to integrate sustainability into PM depends on the behaviour and perceptions of project managers. The question that arises is how to boost project managers to commit to sustainability? Silvius [48] identified three main groups of stimulus patterns:

- Intrinsic motivations for project managers: these are related to the innate stimuli of each professional associated with their concerns for the planet, scarcity of resources, equal opportunities, social justice, and climate change. Sustainability is considered the "right thing", and therefore their motivations are not rewards, awards, or reputational gains. In this group, personal attitudes about sustainability predominate.
- Task-driven: in this category, the integration of sustainability in PM is pushed by the definition of sustainable requirements and objectives, such as contractual clauses with incentive policies to achieve these aims. Normative behaviours expected by others predominate.
- Pragmatic: these stimuli are very results-oriented, and therefore sustainability is integrated into PM when it adds value to project results. Sustainability is seen as an opportunity for the project.

Some researchers [12,13,29] have studied the incentives that lead project managers to integrate sustainability into their projects. In general, most of the managers surveyed reported that they incorporate sustainability into their activities due to their internal motivations as they believe that sustainability is a worthy pursuit. Thus, the results of these studies indicate that intrinsically motivating factors are the main incentives, rather than the other two sets of stimuli, as when the project manager has an intrinsic orientation towards sustainability, task-driven and pragmatic motivations have little significance. The research reinforces the importance of individual stimuli, as it concluded that these results do not depend on project typology, age, gender, or the type of industry in which the project is developed.

An essential factor for any initiative to integrate sustainability is training and education to develop skills, so this may be carried over to corporate strategies, action plans, and individual behaviour [49].

Considering these past results, efforts must be made to motivate project managers to develop their sensitivity to and awareness of sustainability. How, though, to develop this motivation in project managers for SPM?

To answer this question, this research builds on some preliminary results from a European project focused on fostering and developing awareness of sustainability concerns among project managers.

3. Methodology

This study follows a qualitative research methodology, resorting to several phases of data collection, analysis, and validation, and is aligned with the work developed in the Think Twice project funded by the Erasmus+ Program of the European Union. The study extended the preliminary data collection on good practices for environmental project management that was initiated as part of the Think Twice project and resorted to a narrative literature review and to subsequent phases of data collection and validation with experienced professionals in project management.

3.1. Approach and Context of the Study: Think Twice Project

The overarching goal of the project Think Twice is to stimulate project managers to "think twice" about the impact of everyday actions in the management of European projects (and not only) on the Earth's environment. The main outputs of Think Twice include the delivery of easily accessible and practical information about and tools for promoting ecological sustainability to project managers at diverse levels of experience. The project's specific objectives are increasing ecological sustainability in European projects, raising awareness about the possibilities of green project management, establishing good practices, and allowing project managers to make more conscious decisions with the environment in mind. The project brings together eight European partner organizations with extensive experience in project management: Wisamar (from Germany), a non-profit educational institute, acting in vocational, cultural, and adult education; the Association of Educational Services "OpenEurope" (from Spain), a non-profit organization that aims at involving educators, teachers, professors, students, and the whole community in carrying out projects and programs that seek a life-long learning process; p-consulting.gr (from Greece) an IT training and consulting company; Eurosuccess Consulting (from Cyprus), a company offering business services to support entrepreneurship and innovation; Taste Roots Co-operative Society (from Italy), devoted to the development of businesses in the primary sector and the sustainable development of territories; edEUcation Ltd. (from UK), based on education consultancy with expertise in working on international education programs; the Chamber of Commerce & Industry (from Slovenia), an independent voluntary organization representing all business sectors in Slovenia; and the University of Aveiro (from Portugal), a young Portuguese university, founded in 1973, with over 15,000 full-time students, including 15% international students.

To achieve the specific objectives, the project Think Twice comprises the development of two outputs:

- A Curated Treasury of good practices in ecologically sustainable project management pointing out ecologically sustainable solutions in all kinds of project management activities based on collected good practices (https://thinktwice.management/wp-content/treasure_chest, accessed on 7 November 2021);
- A Stress Test of current practice that leads to a personalized Learning Pathway, where project managers can test "How green is the management of my project?" and extend their knowledge, skills, and competences by following their individual, work-based, interactive learning pathway.

The work reported in this study builds extensively on the first stage of the work, namely, the development of a Curated Treasury of good practices for ecologically sustainable project management. The research team involved in this study collaborated in the project development and data collection activities and further extended this work, grounding it in the literature and developing conceptual dimensions to organize the sustainable good practices in project management and offering a contribution to knowledge in the project management field.

3.2. Data and Methods

The first step of the study was to carry out a narrative literature review to identify the key aspects of sustainable development and project management. The literature review goal was to give a holistic overview of sustainability in project management.

A first data collection phase followed, coinciding with the project fieldwork that took place in each of the partner countries of the Think Twice project. At this stage, good practices were identified and brought together by all partners. The research work included the conduction of several focus group meetings involving project partners, project managers, and the research team with the purpose of sorting and classifying the good practices, as well as developing examples for each of them in different managerial contexts. As such, the main methodological procedures to collect, validate, and build clusters of related good practices included: desk research, to gather a preliminary list of good practices and their descriptions; and the conduction of focus groups, brainstorming, and content data analysis. In addition, as the good practices list was achieved, an external analysis was performed to ensure the reliability of the data in which the practices were submitted to the evaluation of experts in project management and experienced respondents.

With the purpose of achieving the refinement and validation of the good practices list, the research team conducted a workshop, resorting to a hybrid model (integrating presential and online participants) in September 2021, inviting 62 project managers and representatives from project-based organizations as well as students in the field of ecological sustainability. This event was structured in two main moments, including (i) the familiarization of the participants with the ecological sustainability practices in project management that were collected under the scope of Think Twice, where scores were attributed to rate their importance and usefulness; and (ii) the collection of the participants' suggestions, thoughts, and practical examples of sustainability in project management, complementing and extending the preliminary list that was shared with them. To bring together the inputs collected from face-to-face and online participants, the workshop format used post-it notes to collect their contributions, while the inputs from online participants were gathered in an online board ("Jamboard") that was able to be shared in real-time with all, allowing for debate and refinement in the session.

After the workshop, the research team conducted an analysis of the collected inputs, supported by the Content Analysis methodology, which advocates the use of categories (or dimensions) often derived from theoretical foundations [50] or extracted from empirical data [51]. According to Bogdan and Biklen [52], the analysis involves working with the data, its organization (categories), the division into simple units of text (references), synthesis,

looking for patterns, discovering essential aspects that should be learned, and making decisions about what will be transmitted to others.

Since all authors are part of the project team, it is an intrinsic research strategy [53]. The research design is summarized in Figure 1, offering a guide to the successive phases of data collection, analysis, and results.
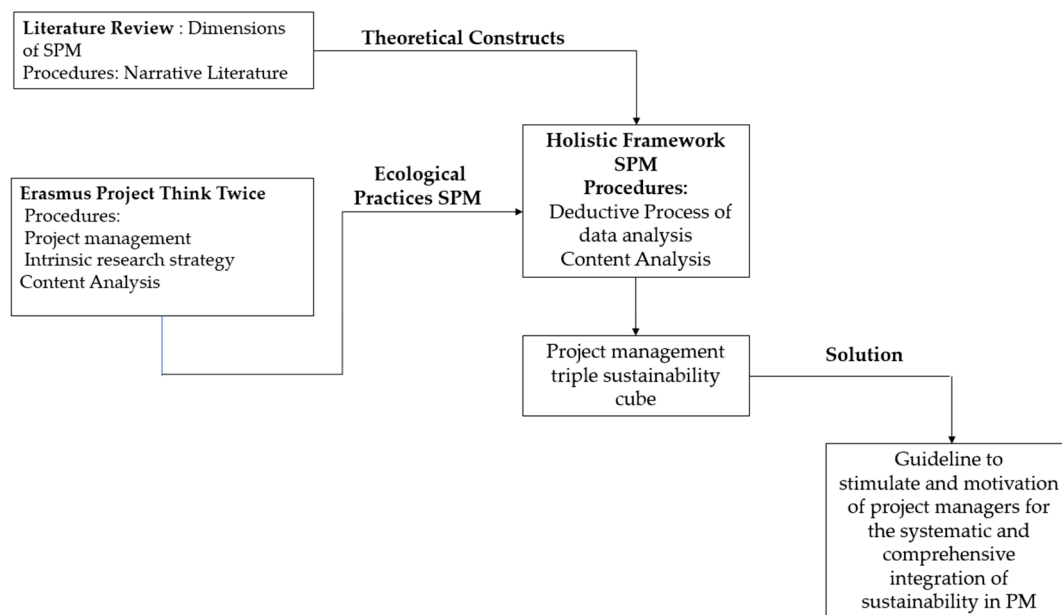

Figure 1. Article's research design methodology.

Overall, the research methodology of the study involved three main phases: (i) the collection of good practices, building on the literature review and desk research in the various countries of the Think Twice project, complemented by the subsequent collection of ratings and insights about the practices from external experts; (ii) the analysis of data concerning environmental good practices, leading to the identification of clusters and to a deductive process to identify dimensions; and (iii) the development of the triple sustainability cube conception.

3.3. Preliminary Analysis of Environmental Good Practices

The data analysis of the good practices list followed the prevalent recommendation of content analysis methods (with two levels): firstly, a vast list of recommendations was grouped to build a first level of categories accordingly—"Erasmus project development life cycle (PDLC)" with four phases: Management (PDLC-M), Implementation (PDLC-I), Dissemination (PDLC-D), and Evaluation (PDLC-E); subsequently, under each phase, the practices were grouped as a second level of categories—"Subject affinity." Eight families were defined in this level, namely, office organization, policies and standards, organizational culture, raising awareness among external stakeholders, digital, marketing, sustainable design, and transport mobility. All practices were assigned among these categories aiming to identify redundancies and grouping the recommendations into a final list of practices.

At that point, this final list was organized along the project development life cycle with 24 good practices relating to Management (PDLC-M), 12 good practices relating to Implementation (PDLC-I), 10 good practices relating to Dissemination (PDLC-D), and 8 good practices relating to Evaluation (PDLC-E), distributed among the following subcategories in each phase, as detailed in Table 1.

Table 1. Ecological sustainability project life cycle organization model.

		Project Development Life Cycle * PDLC
Management PDLC-M	Travel (3)	Footprint of transnational face-to-face meetings vs. online meetings Use terrestrial means of transport to arrive at transnational meetings Searching for synergies when travelling
	Building (6)	Reduction of organic waste and optimisation of heating costs and impact Installation of energy control system for buildings/apply sustainable solution for heating the workplace Use of smaller units of renewable energy compared to conventional energy production facilities Provide some alternative solutions, such as transformation of toilets with septic tanks into dry toilets, including recycling of brown, yellow, and grey water Use of free water/saving tap water
	Digital (2)	Cameras off during online meetings Impact of email attachments on energy consumption
	Tech (3)	Prolong the lifetime of a product and reduce your environmental footprint Choose products that allow you to prolong their lifetime and reduce your environmental footprint Preventing tech waste through cloud computing
	Office (9)	Choosing sustainable office supplies, minimising waste Sustainable or recycled office supplies Less printing, more energy efficient printers Using recycled paper Recyclable food packaging Creation of plant-based plastic products Reusing ink cartridges and toners Replacing plastic bottles with glass bottles Green procurement
	Other (1)	Use grants to fund investment in environmentally friendly practices
Implementation PDLC-I	Working at your PC (3)	Green search engines/ Work offline when possible Sharing printed documents: copy or scan?
	Transport/Commuting (3)	Carpooling Familiarise project managers with eco-friendly methods of movement (positive and negative aspects) Working from Home (online management solutions)
	Daily office routine (2)	Reduce water consumption at your workplace Zero-waste offices and coffee breaks
	Communication/awareness (3)	Raise awareness and make sustainability every employee's responsibility Nurturing a sustainable mindset Work and meet in nature-focused co-working spaces
	Other (1)	Tech Symbiosis—Upcycling tech for the implementation of training and digital competences-oriented activities
Dissemination PDLC-D	Multipliers (3)	Ecological sustainability of online multiplier events compared to physical events Sustainable catering Sustainable event management, starting with transfer to and from the event, accommodation, local transport to the venues, and materials
	Physical aspects (1)	Reduce waste impact on the environment by adopting upcycled/recycled "gadgets" for project dissemination purposes
	Digital (6)	Green databases are intended to provide information about companies whose activities, products, or services contribute to reducing negative environmental impacts Spring-clean your photograph folder Prefer "green" servers for websites, e-mail/use your digital marketing in a greener way Cooperation in grouping websites under one platform Reduce the environmental impact of online presence and raise awareness of websites' carbon footprints

Table 1. *Cont.*

		Project Development Life Cycle * PDLC
Evaluation Prcess PDLC-E	Evaluation Process (8)	Include sustainability-related questions in your evaluation Include environmental impact in your risk assessment plan Use online-based monitoring and evaluation questionnaires Use evaluation questions to inform sustainable exploitation plans Integrate sustainability criteria and measurable indicators into the quality assurance plan Circular economy and design thinking Measuring impact of a sustainably implemented project on beneficiaries' intended future behaviour Time banking in sharing economy

* More detail offered in the Think Twice Curated Treasury of good practices for ecologically sustainable project management can be found at https://thinktwice.management/toolbox, accessed on 7 November 2021.

The adoption of good ecologically sustainable practices may be taken at the individual or collective level during the conception and planning of the project. The use of good sustainable practices in project management may also be applied in the management of programs, institutions, organizations, people, and other entities requiring effective and efficient processes of production, marketing, distribution, and product or services delivery.

In this context, "ecological sustainability" is understood as the effort to get as close as possible to zero-impact activity to preserve the Earth from irreversible harmful human actions. The concept of good practices and their scope was clarified in an initial meeting with the entire project team. By "good practices" we mean any method, initiative, incentive, project, activity, norm, or standard that helps achieve ecological sustainability in project management. The scope is related to energy consumption, carbon emissions, recycling, waste, eco-alternatives, environmental compensations, and biodiversity. Then, each partner was responsible for collecting practices and registering them.

3.4. External Validation and Refinment of Good Practices List

Despite the extensive list of practices collected in the first phase and its coverage along the project lifecycle, the study resorted to a complementary source of data, i.e., the feedback from a more ample range of project managers, external to the Think Twice project, to assess the relevance of the practices identified and to add other missing perspectives and experiences. This was achieved with the conduction of a workshop as aforementioned to disseminate, refine, and validate the preliminary list of environmental good practices. The workshop allowed for the dissemination of the preliminary list of practices while raising awareness about green management and sustainable development and the implementation of projects, understanding the usefulness of the practices for the participants' daily work as project managers and collecting different perspectives of ecological project management.

It is interesting to note that the participants scored the practices presented in a very balanced way, since they recognized important practices in all phases of the project life cycle: four in the management phase, three in the implementation phase, three in the dissemination phase, and three in the evaluation phase. This result reinforces the adequacy of the project life cycle perspective proposed by the project team to classify the practices. These professionals considered as the most pertinent sustainability practices in the management phase: the conditions of the buildings where the project teams work, the commitment to green procurement, and work methods, such as preventing tech waste through cloud computing, less printing, and more energy-efficient printers. In the implementation phase, the focus was on working at home and co-working. In the dissemination phase, measures that reinforce the sustainability management of the events were highlighted. Finally, in the evaluation stage, risk management practices and the integration of sustainability indicators in the project's quality management plans are emphasised.

In addition, each participant was challenged to contribute additional practices. In summary, the suggestions collected included the following:

- Develop methods for assessing the ecological footprint of food services provided by companies.
- Invest in infrastructure development to promote travel by bicycle to the workplace.
- Promote and encourage sustainable practices through workshops and training for the project teams.
- Raise employee awareness so that sustainability is the responsibility of each person.
- Use suppliers' ecological footprints as an element in selection criteria.
- Encourage companies to disclose the environmental impacts of the project's main outputs.
- Promote the development of sustainable projects through available government funding programs.
- Define sustainability objectives upfront for any project (economic, social, environmental), together with the stakeholders.
- Develop a sustainability strategy and culture in project management.
- Develop and disseminate a code of conduct (fair trade) for all project stakeholders.
- Explore relationships with the local community throughout the project's development to take advantage of local infrastructure and promote the local economy.
- Risk management plan focusing on environmental, social, and economic impacts.
- Promote the linkage of project results with sustainable development goals (SDGs).

By analysing the contributions from the external expert's assessment, these professionals add a broader perspective to the integration of project management sustainability, bringing, not only environmental, but also social and economic aspects to the discussion.

4. Discussion and Conceptual Contribution

The challenges of the 21st century include combating the severe climate changes accelerated by human action in the Earth's ecosystem and adapting humanity to energy and digital transitions, leaving no one behind. For these reasons, sustainability is the keyword nowadays.

From the late 1960s, the ecological impact of human actions has been questioned, and nowadays its relevance to the fragility of the planet's sustainability is evident. Nevertheless, given the importance of this ecological aspect, several authors insisted that the sustainability concept should go wider and be made more comprehensive, including social and economic dimensions along with environmental factors. Therefore, one cannot act in relation to one aspect of this triple bottom line vector without influencing the others.

To respond to the current challenges, all the disciplines, all types of services, schools and academies, and rural and mechanical industries should acquire this triple global vision and adopt concrete measures, sometimes individually and sometimes as a group. The awareness of everybody's involvement is crucial to reach the desired end, and this awareness leads to changes in working processes and relational methods.

In the life cycle of product development and production, product managers have already been taking care of certain dimensions, including the ecological concerns, whether by limiting the use of certain types of raw materials, such as plastic, avoiding disposable materials, or offering alternatives for product destinations either by recycling the product or prepare it to act as a secondary raw material, ready for a new life. These actions widely adopted are not purely empirical but supported by the literature, for instance, the sustainability innovation cube of Hansen, Grosse-Dunker, and Reichwald [44] that adopts the triple bottom vectors approach to create a framework to evaluate sustainability-oriented innovations directed at encouraging product managers to act along the life cycle of a product, through manufacture, usage, and the end of the product's life.

This global and integrated vision should also be incorporated in the early stage of project management and be brought inside organizations' working methods, as supported by the literature state of the art outlined in Section 2.

To contribute to the introduction or extension of sustainability methods by project managers, the authors were deeply involved in the European Think Twice Erasmus + project, described in Section 3. This project intends to help promote the integration of

environmental sustainability actions in project management daily practices. The results obtained so far were compiled as a set of practices oriented towards environmental sustainability, designated as the Curated Treasury. This list will allow project managers to make more conscious decisions about the impact of their projects with a similar project life cycle (as presented previously in Table 1). In addition, these practices promote the motivation of project managers to develop their projects in a more sustainable approach.

The results are much more ambitious and not limited to an extensive list of good practices. This perspective leads project managers to the most suitable decision making considering the context of each project. Thus, one of the first steps to integrate sustainability into PM should be the analysis and selection of practices throughout the project life cycle, allowing the meeting of sustainability concerns in a customized and appropriate way to fit each project's scope, as conceptually presented in Table 2.

Table 2. Conceptual model of Think Twice's PDLC approach.

Sustainability Dimension	Project Development Life Cycle		
	PDLC Management	PDLC Implementation	PDLC Dissemination and Evaluation
Ecological	An extensive list of good practices, Table 1		

The PDLC approach avoids initial enthusiastic ecological intentions that will fade or be forgotten in the management and implementation phases. Adopting sustainable practices supporting the project's life cycle contributes to the integration of sustainability in PM, not only comprehensively but systematically.

With the Think Twice results, the project manager is challenged to commit all stakeholders to act in conformity to ecological sustainability along the project development life cycle. What about the other two triple bottom dimensions, though?

With this question in mind and with the project results as a starting point, the authors identify an opportunity to go beyond the ecological analysis achieved by the TT project. By applying the same methodology as before, the scope of the analysis was expanded towards the triple bottom line sustainability approach to complement the project manager's good practices.

The next section describes the conceptual model that led to a more extensive list of good practices for project managers where the other two sustainability dimensions were included. The three sustainability dimensions approach was called the project management triple sustainability cube (of good practices).

4.1. Conceptual Model to Assess Sustainability Dimensions in PM

The classification of sustainable practices catalogued by the project Think Twice could be an important contribution to stimulate the sensitivity and awareness of project managers, convincing them to adopt relevant attitudes towards sustainable goals in project development. However, it is limited to only one sustainability dimension, the ecological dimension.

To extend the range of the list of the TT's Curated Treasury of good practices towards the triple bottom line sustainability vision, the list was revisited and reorganized, and a conceptual model was built to reach this vision.

The first approach to the findings led to the emergence of a second dimension combining the ecological practices into families of related actions, named the variable dimension. Those variables are V01, Processes Green Indicators; V02, People and Systems; and V03, Go/No Go Digital or Innovation.

The group V01 corresponds to the ecological practices that are general to an organization and not specific to a given project. Instead, they are transversal actions or decisions that concern, not a specific project manager, but the organization that leads the project development.

Inside this category are actions such as those regarding workplace conditions or choices about team mobility and accommodation. An example of this kind of decision might be: How can the project manager choose the most environmentally friendly hotel for his international team to meet at?

Such V01 good practices should be seized by specific indicators and that's because they were labelled as PGI (Process Green Indicator)—Process Green Indicators. These indicators should be objective and measurable to support the PM's decision when adopting V01 practices in answering questions like: How can I compare different hotels concerning their ecological consciousness?

At this point, a new study area is identified for further research. Taking this example, one can suggest the creation of new accommodation green metrics, such as the ones used at home for appliance energy indicators A++, A+ . . . Hotels (or even transport methods, mutatis mutandis), then, could be labelled as (say) 4-star A++.

The group V02 corresponds to practices that refer to the impact of the actions of the team in the development of a certain project and how they affect the processes and systems that are used.

These can or cannot be generalized to the organization and are specific to the decision of the project manager along the PDLC. As an example of this group of practices, one can have, for example: Should I print all the intermediate reports or leave them in a repository and print only the final one?

Here, also, objectivity is imperative to decide among different options. Even though some of these decisions are common sense, they should be supported with the most objective indicators possible.

Finally, V03 concerns the specific project and includes all the practices that bias team decisions to use digital alternatives instead of physical solutions. This vector was named the Go/NoGo Digital dimension. This dimension may also be called digital innovation and is intended to guide project managers in choosing the border limits between the physical and the digital world.

These new classifications allow the development of a two-dimensional classification along the life cycle. Each one of the actions under the scope of the new variables V01, V02, and V03, can be equally adopted along the project's life cycle (Table 3).

Table 3. Two-dimensional classification aligning variables and project life cycle.

Sustainability Dimension	Project Development Life Cycle		
	PDLC Management	PDLC Implementation	PDLC Dissemination and Evaluation
Ecological	V01: Process Green Indicators		
	V02: Processes and System		
	V03: Go/NoGo Digital		

Note that at this point the four PDLC stages adopted in the Think Twice project were reduced to three, as the Dissemination and Evaluation phases were grouped.

So far, the exhaustive list of ecological good practices was reorganized along with a bidimensional conceptual model based on the project life cycle and a new family of variables described above.

The next step towards a complete list of good practices based on the holistic triple bottom line vectors of sustainability adds all three vectors to the developed conceptual model: the ecological sustainability vector (EcoS), the social sustainability vector (SocS), and the economic sustainability vector (EncS) (Table 4).

Table 4. The complete conceptual model for sustainable project management.

Sustainability Dimension	Project Development Life Cycle		
	Management (PDLC-M)	Implementation (PDLC-I)	Dissemination and Evaluation (PDLC-DE)
Ecological (EcoS)	V01: Process Green Indicators		
	V02: Processes and System		
	V03: Go/NoGo Digital		
Social (SocS)	V01: Process Green Indicators		
	V02: Processes and System		
	V03: Go/NoGo Digital		
Economic (EncS)	V01: Process Green Indicators		
	V02: Processes and System		
	V03: Go/NoGo Digital		

One can describe and number the scope of the observed dimensions in Table 5.

Table 5. The complete conceptual model number matrix.

Project Development Life Cycle			Variables			Triple Bottom Line Dimensions		
PDLC-M	PDLC-I	PDLC-DE	PGI	P&S	GNgD	EcoS	SocS	EncS
1	2	3	4	5	6	7	8	9

The introduction of the new vectors of sustainability dimensions requires the incorporation of an extended list of project management best practices concerning the social and the economic aspects of project development life cycle stages and variable dimensions. Subjects such as child labour, fair trade, or extremely low wages should be addressed at this time.

The complete conceptual model based on the three dimensions is now a 3D model in all the dimensions numbered above. This will allow the new Curated Treasury to be redistributed according to its target dimensions (Figure 2).

Figure 2. Correlation among the model dimensions, PDLC, variables, and sustainability.

To better picture the model and easily find the axis of action, the three conceptual dimensions are depicted in a 3D view that represents the Project Management Triple Sustainability Cube (Figure 3).
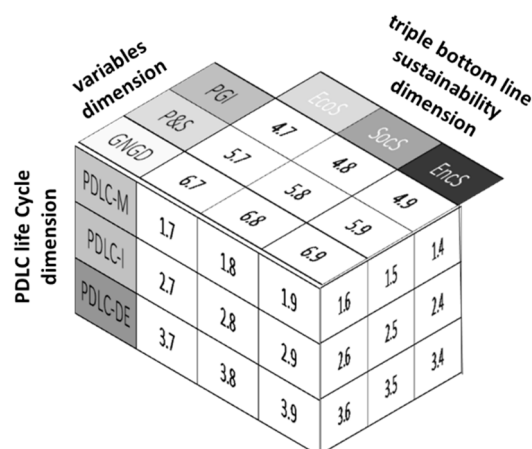

Figure 3. The project management triple sustainability cube of good practices.

The Project Management Triple Sustainability Cube model is a conceptual model that shows the transversality of three interrelated dimensions of sustainable project development along the project life cycle. It identifies 3 × 9 individual areas of sustainability procedures that may be adopted by project managers in each project development.

By adopting this methodology and achieving a group of 27 practices, each project manager could objectively identify the adoption of each group of best practices along each axis and at each stage of project implementation. By highlighting each of the 27 sustainability areas in which actions were taken in a certain project, project managers can improve and forecast improvement areas for current and subsequent projects.

The Project Management Triple Sustainability Cube outlines guidelines for adopting comprehensive practices in relation to the triple bottom line sustainability vectors (environmental, social, economic) concerning people, processes, and innovative solutions (go/no digital) along the project development life cycle to support the decision making of sustainability-concerned project managers.

4.2. The Detailed List of Practices

Finally, a complete list of several practice examples adopted in project management along all its dimensions is presented (Table 6), gathering the Think Twice ecological conclusions (Table 1) and the other dimensions' add-ons (Table 6).

This list is just a starting point and is open to new contributions. Some practices may be inserted in more than one area.

Table 6. List of project management practices to achieve sustainable project management.

Number	Description
1.4 (PDLC-M and PGI)	Environmental Management System (EMS)
1.5 (PDLC-M and P&S)	Installation of an energy control system for buildings (BEMS) Apply a sustainable solution for heating the workplace WC without a flush Adoption of urban renewable sources (O-wind turbines or photovoltaics) Adapt buildings for rainwater harvesting Modernise your IT department Recyclable food package: REFUCOAT Project Using recycled paper Reusing ink cartridges and toners Replacing plastic bottles with glass bottles Procuring external expertise and services Sustainable or recycled office supplies Lifetime extension of PCs (personal computers) and monitors Use grants to fund investment in an environmentally friendly practice Easily repairable and modular device Lifecycle cost analysis: available tools Cloud-based customer relationship management software in a subdomain The footprint of transnational face-to-face meetings vs. online meetings
1.6 (PDLC-M and GNGD)	Cameras off during online meetings Reducing email attachments to save energy consumption Preventing tech waste through cloud computing Circular economy and design thinking
1.7 (PDLC-M and EcoS)	Same as 1.4, 1.5, 1.6 and Initial stakeholder involvement to promote awareness of the ecologic sustainability strategy/culture in project development When selecting the projects to be developed, criteria relating to the potential social benefits to the local community are considered Initial team involvement to promote awareness of the ecological sustainability strategy/culture in project development In conception and design, consider the issues of sustainability of outputs (products and services) throughout the life cycle (development, use, and disposal) Comprehensive risk management plan for environmental impacts (use of natural resources, waste, energy consumption, biodiversity, etc.) Consider the environmental legislation and regulations applicable to the development of the project
1.8 (PDLC-M and SocS)	Initial stakeholder involvement to promote awareness of the social sustainability strategy/culture in project development When selecting the projects to be developed, criteria relating to the potential social benefit to the local community are considered Initial team involvement to promote awareness of the social sustainability strategy/culture in project development Comprehensive risk management plan for social impacts (health, safety, equal opportunities, non-discrimination) Relations with the local community (impacts, child labour, human rights, non-discrimination, Indigenous rights, forced labour) The project promotes the local economy and takes advantage of the local infrastructure to generate economic benefits (improvements in local infrastructure, namely energy sources, roads, communication, transport, education)
1.9 (PDLC-M and EncS)	Initial stakeholder involvement to promote awareness of the economical sustainability strategy/culture in project development When selecting the projects to be developed, criteria relating to the potential economic benefit to the local community are considered Initial team involvement to promote awareness of the economical sustainability strategy/culture in project development Frequent involvement of the client/financier in defining the scope and requirements, avoiding deep changes in deliveries that lead to a great waste of resources (material/human) Comprehensive risk management plan of economic impacts (job creation, training, education, local infrastructure, community services, etc.) The project promotes the local economy and takes advantage of the local infrastructure to generate economic benefits (improvements in local infrastructure, namely energy sources, roads, communication, transport, education)
2.4 (PDLC-I and PGI)	Nurturing sustainable mindset Zero-waste offices and coffee breaks

Table 6. *Cont.*

Number	Description
2.5 (PDLC-I and P&S)	Work and meet in nature-focused co-working spaces Reduce water consumption at the workplace Carpooling Non-motorised and public means of transport
2.6 (PDLC-I and GNGD)	Tech symbiosis—upcycling tech Online management solutions Green search engines Work offline Sharing printed documents: copy or scan?
2.7 (PDLC-I and EcoS)	Same as 2.4, 2.5, 2.6, and Selection of materials with a focus on project management sustainability (examples: reduction of resource use and waste production, recycling, impact reduction, and soil contamination) Examine the potential for air pollution in the proposed project management and the impact on local climate Development and sustainable or "green" purchasing practices of suppliers who adopt sustainable practices (fair-trade, business ethics—slave or child labour, environmental protection certification)
2.8 (PDLC-I and SocS)	Development of a business code of ethics (fair trade), relationship with competition and anti-crime policies, codes of conduct, technical and legal requirements, tax payments Check if there is a possibility of the project affecting cultural properties (set of material or immaterial (intangible) assets of the community, such as traditions, popular manifestations, and cults) The ability of project implementation to offer local employment opportunities
2.9 (PDLC-I and EncS)	Development of a business code of ethics (fair trade), relationship with competition and anti-crime policies, codes of conduct, technical and legal requirements, tax payments
3.4 (PDLC-DE and PGI)	Include sustainability-related questions in your evaluation Include environmental impact in your risk assessment plan Use evaluation questions to inform sustainable exploitation plans Integrate sustainability criteria and measurable indicators into the quality assurance plan Measure the impact of a sustainably implemented project on beneficiaries' intended future behaviour Development and sustainable or "green" purchasing practices of suppliers who adopt sustainable practices (fair-trade, business ethics—slave or child labour, environmental protection certification)
3.5 (PDLC-DE and P&S)	Prefer "green" servers for websites, e-mail, etc. Local networks against food waste Sustainable catering Sustainable event management Upcycled marketing items Use online-based monitoring and evaluation questionnaires Time banking in sharing economy
3.6 (PDLC-DE and GNGD)	Green supplier's database Spring-clean your photograph folder Use your digital marketing in a greener way Synergy in grouping websites under one platform Carbon neutral website Ecological sustainability of online multiplier events compared to physical events Use online monitoring and evaluation questionnaires
3.7 (PDLC-DE and EcoS)	Same as 3.4, 3.5, 3.6, and Promote the interconnection of project results with the 17 sustainable development goals (17 SDGs 2030) Definition of environmental performance indicators in project monitoring Integrate sustainability criteria and measurable ecological indicators into the quality assurance plan
3.8 (PDLC-DE and SoCS)	Definition of social performance indicators in project monitoring Integrate sustainability criteria and measurable social indicators into the quality assurance plan
3.9 (PDLC-DE and EncS)	Definition of economic performance indicators in project monitoring Integrate sustainability criteria and measurable economic indicators into the quality assurance plan
4.7 (PGI and EcoS)	Same as 1.4, 2.4, 3.4
4.8 (PGI and SocS)	The project promotes the local economy and takes advantage of the local infrastructure to generate economic benefits (improvements in local infrastructure, namely, energy sources, roads, communication, transport, education)
4.9 (PGI and EncS)	Green supplier's database Carbon neutral website Development of a business code of ethics (fair trade), relationship with competition and anti-crime policies, codes of conduct, technical and legal requirements, tax payments)

Table 6. *Cont.*

Number	Description
5.7 (P&S and EcoS)	Same as 1.5, 2.5, 3.5
5.8 (P&S and SocS)	The ability of project implementation to offer local employment opportunities
5.9 (P&S and EncS)	The project promotes the local economy and takes advantage of the local infrastructure to generate economic benefits (improvements in local infrastructure, namely, energy sources, roads, communication, transport, education)
6.7 (GNGD and EcoS)	Same as 1.6, 2.6, 3.6
6.8 (GNGD and SocS)	The project promotes the local economy and takes advantage of the local infrastructure to generate economic benefits (improvements in local infrastructure, namely, energy sources, roads, communication, transport, education)
6.9 (GNGD and EncS)	Green supplier's database Carbon neutral website

5. Conclusions

The research in this paper focuses on rethinking project management knowledge by promoting a new paradigm—sustainable project management. Despite the consensus on the relevance of integrating sustainability into project development (both in terms of outputs and management processes), some gaps were identified that have hampered this path as a result of the holistic approach and complex vision. To overcome these gaps, a strong commitment by the project managers is necessary. Thus, this research aimed to point out solutions to stimulate the awareness and motivation of project managers for the systematic and comprehensive integration of sustainability in PM.

To this end, the preliminary results of the Think Twice project disseminated a set of inspiring ecological practices that may help project managers to reflect on their current tasks and help them to make more sustainable decisions in project management. However, in addition to motivating project managers, this integration process must be comprehensive and systematic and extended to all the dimensions of the triple bottom sustainability approach. Consequently, a conceptual model, the Project Management Triple Sustainability Cube, was proposed. In this model, the comprehensive feature of the integration process is ensured by the following dimensions: Organization, Project and Innovation Variables, and the Triple Bottom Line, since it advocates that sustainability practices should be geared towards processes, people, and systems, implemented through innovative solutions with social, environmental, and economic impacts. The PDLC dimension leads to the systematization of the integration process, as it calls for the need to meet those practices in all project development phases.

One main original contribution of this conceptual cube is that it may grow indefinitely, listing, pioneering, and quantifying new areas of action towards a holistic Sustainable Project Management approach.

Notwithstanding the contributions mentioned above, there is a lack of counterpoint with quantified indicators to measure and prioritize the listed ecological choices. For example: How to measure and quantify the impact of deforestation to build enormous data centers to answer the cloud storage demand as the digital transition takes place? From the obtained results, it is possible to raise several relevant questions that should be answered in further research, such as:

- How to set an objective quantification for each one of the Cube practices? In most cases, it suggests a further technical-economic study per measure.
- How to identify or construct the vital indicator?
- How to define a scale to measure it?

- How to measure and compare the relevance of each one of the 27 groups of actions? What should be the unit of comparison? Should it be by area or by intercorrelation of dimensions?
- How to reach a measurement indicator of accomplishment per area and per project?

Thus, as a line of future research, there should be quantification for each aspect, defining the prioritization method, as project managers will frequently have to make choices and compromises.

The practices that have been identified are all relevant, as they contribute to the achievement of the SDGs set in the 2030 agenda, such as SDG7—renewable energies, SDG9—innovation and infrastructure industry, SDG11—sustainable cities and communities, SDG12—sustainable production and consumption, SDG13—climate action, SDG14—protecting marine life, and SDG17—partnerships for the implementation of the goals.

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