Towards Effective Business Sustainability: Unveiling the Role of Entrepreneurial Competencies in Project Management

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Abstract: Entrepreneurship has revolutionized business project management, introducing new strategies, tools, and needs that have transformed the way projects are carried out. One of the most significant aspects of this influence is the vision of sustainability, which has become a reference point and a management tool. Sustainability, derived from sustainable development, seeks to meet current needs without compromising the ability of future generations to do the same [1]. In response to the need to train competent professionals who support sustainable development in the business world, and to create frameworks for the development of competencies in educational institutions that provide the elements of sustainability (social, environmental, and economic) for countries like Colombia, this research focused on inquiring with a group of experts (university professors and entrepreneurs) about how entrepreneurial skills contribute to sustainability, their contributions, and the possible relationships as a system of entrepreneurial competencies. Preliminary results indicate that entrepreneurial competencies contribute significantly to the components of sustainability, but not in the same proportion and importance within the global sustainability model (social, environmental, and governance). It is expected that by understanding how these business competencies are identified, structured, and developed in universities, more coherent and contributory approaches to business sustainability can be modeled and managed.

Keywords: project management; sustainability; competencies; entrepreneurial competencies; effective business.

Hacia una sostenibilidad empresarial efectiva: desvelando el papel de las competencias empresariales en la gestión de proyectos

Resumen: El emprendimiento ha revolucionado la gestión de proyectos empresariales, introduciendo nuevas estrategias, herramientas y necesidades que han transformado la manera en que se llevan a cabo. Uno de los aspectos más significativos de esta influencia es la visión de la sostenibilidad, que se ha convertido en una referencia y un medio de gestión. La sostenibilidad, derivada del desarrollo sostenible, busca satisfacer las necesidades actuales sin comprometer la capacidad de las futuras generaciones para hacer lo mismo [1]. Ante la necesidad de formar profesionales competentes que apoyen el desarrollo sostenible en el mundo empresarial, y de crear marcos para el desarrollo de competencias en las instituciones educativas que brinden los elementos de sostenibilidad (social, ambiental y económico) para países como Colombia, esta investigación se enfocó en indagar con un grupo de expertos (profesores universitarios y emprendedores) sobre cómo las habilidades emprendedoras contribuyen a la sostenibilidad, sus aportaciones y las posibles relaciones como sistema de competencias emprendedoras. Los resultados preliminares indican que las competencias emprendedoras contribuyen significativamente a los componentes de la sostenibilidad, pero no en la misma proporción e importancia dentro del modelo global de sostenibilidad (social, medioambiental y de gobernanza). Se espera que al comprender cómo se identifican, estructuran y desarrollan estas competencias empresariales en las instituciones universitarias, se puedan modelar y gestionar enfoques más coherentes y contributivos a la sostenibilidad empresarial

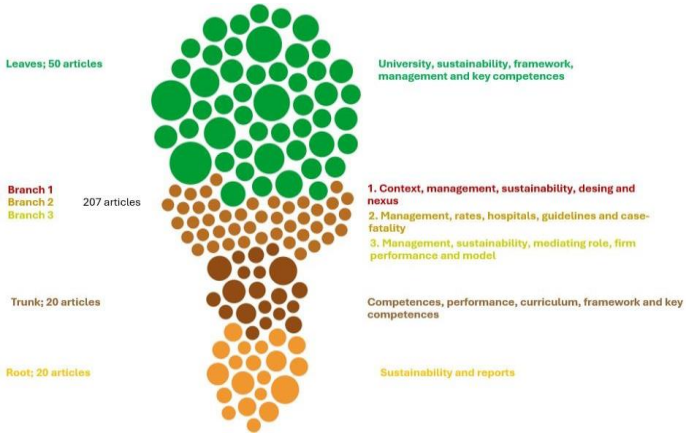
Palabras clave: gestión de proyectos; sostenibilidad; Competencias; competencias emprendedoras; negocio efectivo.

Introduction

Sustainability, a term widely accepted and defined in 1987 by the World Commission on Environment and Development (WCED) as "meeting the needs of the present without compromising the ability of future generations to meet their own needs" [1, p. 23], remains a critical issue across various sectors, including project management. In the business world, sustainable practices necessitate a comprehensive transformation encompassing products, services, business models, processes, policies, and resource mobilization [2]. Projects play a crucial role in implementing these changes, promoting sustainable development within organizations by addressing environmental, social, and economic concerns. This highlights the fundamental role projects play in sustainability, evident throughout their planning, organization, execution, management, and governance [2]. Project management professionals are vital in integrating sustainability principles and practices within project development and execution, ultimately contributing to a more sustainable future. However, project success requires more than simply incorporating sustainability objectives into traditional project management (PM) tools to track environmental impact. Project managers require the necessary skills to effectively lead project execution adhering to all three pillars of sustainability (environmental, social, and economic). Sustainability concepts must be integrated throughout the project life cycle, from planning and organization to execution, management, and governance [3]. Research in sustainability, project management, and competencies is experiencing significant growth and diversification, focusing on integrating these concepts for effective sustainable development. A bibliometric analysis using the Tree of Science tool and the Web of Science (WOS) database with keywords "sustainability," "project management," and "competencies," reveals 297 related articles. Figure 1 illustrates the hierarchy between keyword relationships, where articles are interconnected through roots, trunk, branches, and leaves.

Of the 297 articles, 70% concentrate in Branches 1, 2, and 3. The Leaves hold 17% (50 articles), the Trunk holds 7%, and the Roots hold the remaining 7% (20 articles). The Roots represent the most fundamental theme, sustainability, while the Trunk groups specific topics derived from sustainability, such as competences and performance. Branches 1, 2, and 3 represent sub-themes and dominant research areas related to management, sustainability, context and its nexus. Finally, the Leaves showcase a growing specialization in areas like universities, sustainability management frameworks, and key competences.

Figure 1. Hierarchy of relationship between sustainability, project management and competencies

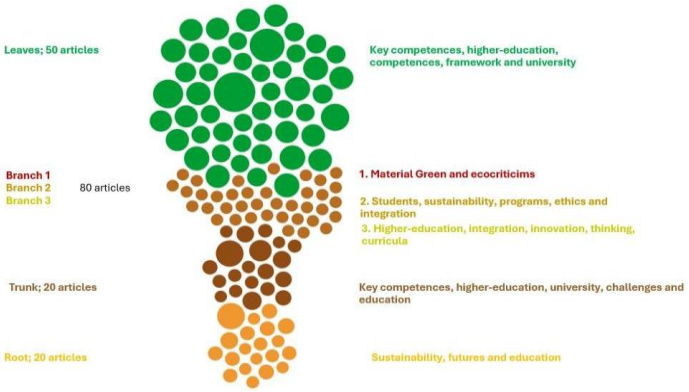


Source: ToS with data from WOS.

This bibliometric analysis using the Web of Science (WOS) database underscores the dynamism and significance of research on sustainability, project management, and competencies in achieving a more sustainable future. WOS was chosen due to its inclusion of indexed journals with high impact factors (Journal Citation Reports, JCR) and a vast collection of peer-reviewed publications from across the globe. The initial search targeted key publications related to the topic, encompassing keywords for sustainability, project management, and competencies. The results were then exported for interpretation using the Tree of Science (ToS) tool.

Expanding the analysis with ToS within WOS, and incorporating additional keywords like "entrepreneurial competencies" and "sustainability competencies," revealed a total of 170 relevant articles. Notably, "education" emerged as a prominent keyword throughout the entire tree structure (roots, trunk, branches, and leaves) – see Figure 2. The root keywords included "sustainability," "futures," and "education." The trunk grouped themes like "key competencies," "higher education," "university," "challenges," and "education." Branches 1, 2, and 3 (comprising 80 articles) concentrated on "students," "ethics," "programs," "integration," "higher education," "innovation," "thinking," "green curricula," and "materials." Finally, the leaves (with 50 articles) delved deeper into "key competencies," "higher education," "competencies," "framework," and "university.

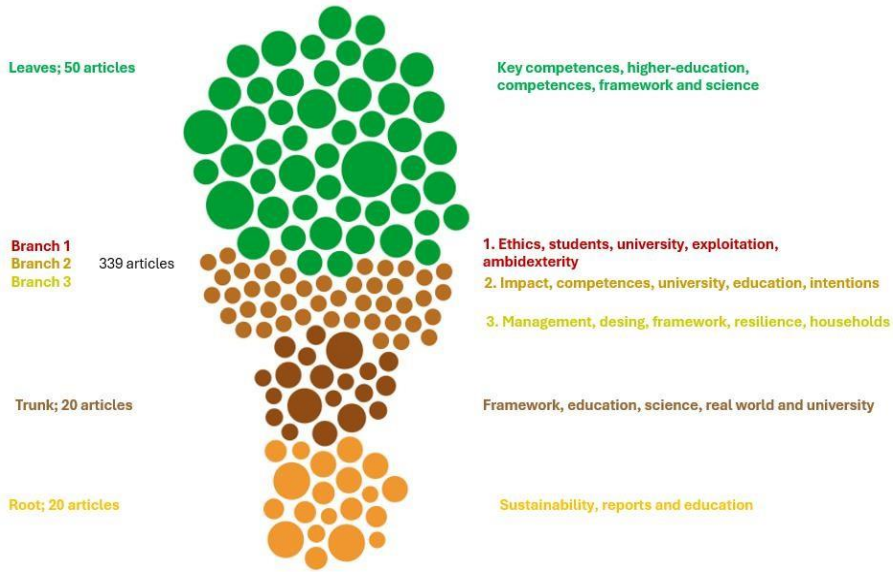
Figure 2. Relationship Hierarchy Between sustainability, project management, competencies, entrepreneurial competencies, and sustainability competencies.



Source: ToS with data from WOS.

This bibliometric analysis underscores the authors' and researchers' focus on education's role in a sustainable future (roots). Notably, a significant portion (8 articles) within branches 1, 2, and 3 explores how higher education prepares students with the necessary competencies to address sustainability challenges (trunk). These studies highlight practical strategies for incorporating sustainability into university education, focusing on key competencies (leaves). This suggests a growing emphasis on developing specific sustainability competencies within higher education. Consequently, exploring innovative teaching and learning approaches that integrate ethics, sustainability programs, and green curriculum materials becomes crucial. The analysis further emphasizes the rising importance of key competencies for sustainability, the need for innovation and critical thinking in higher education, and the integration of sustainability across all levels. These findings underscore the significance of promoting education for sustainability for educators, curriculum designers, and policymakers. Expanding the ToS analysis with additional keywords ("sustainability competencies" and "key competencies sustainability") yielded 429 related articles while maintaining the relationships visualized in Figures 1, 2, and 3. This broader analysis reinforces the research field exploring how higher education can equip students with key competencies to tackle sustainability challenges, particularly in project and company management. The focus areas within these articles emphasize ethics, impact, educational design, and real-world application (see Figure 3).

Figure 3. Relationship Hierarchy Between sustainability, project management, competencies, sustainability competencies and key competencies sustainability



Source: ToS with data from WOS.

Key Competencies for Sustainability

Success in sustainable project management hinges on a unique blend of business and entrepreneurial competencies. This combination equips individuals to effectively lead projects, balancing organizational objectives with social and environmental considerations.

Table 1. Entrepreneurial competencies

Entrepreneurial competencies	Definitions
Adaptability to change (V1)	The ability to quickly identify, understand, and respond to both internal and external changes affecting the organization's environment.
Strategic Vision (V2)	The ability to draw a clear and detailed map of the organization's desired future, guiding its path to sustainable success.
Continuous Industry and Market Learning (V3)	The ability to identify, understand, and anticipate the changing needs of customers and consumers, both domestic and international, driving innovation and long-term business success.
Mastery of Technical Topics (V4)	The possession, updating, and expert demonstration of specific knowledge and experience required for performance in a given role.
Continuous product learning (V5)	The deep and constantly evolving ability to understand, evaluate, and adapt the organization's products and services to meet customer needs, preferences, and requirements.
Productivity (V6)	The ability to set ambitious goals, implement effective strategies, and achieve outstanding results consistently, within established deadlines, and meeting the highest quality standards.
Results-oriented with quality (V7)	The ability to focus one's own efforts and those of others towards the consistent achievement of results that exceed expectations, always under the highest quality standards.
Planning & Organizing Skills (V8)	The ability to design and execute plans, setting clear goals, prioritizing actions, allocating resources, and defining deadlines effectively, leading to the achievement of strategic objectives.
Integrity (V9)	Adherence to moral principles, good manners and professional practices, manifesting a coherent and transparent conduct at all times, between what is said and what is done.
Temper and dynamism (V10)	The ability to combine serenity with determination, acting with firmness, enthusiasm, and perseverance, to conquer challenging goals, even in the face of adversity.
Driving People (V11)	The ability to delegate strategically, distribute responsibilities effectively and empower employees to achieve common goals, fostering a collaborative and motivating work environment.
Management and Achievement of Objectives (V12)	The ability to mobilize resources, control processes effectively and integrate activities synergistically, leading to the efficient and effective achievement of organizational objectives with high quality standards, fulfilling the organization's mission.
Leadership (V13)	The ability to identify, cultivate and enhance the innate talent of each employee, creating an inspiring and motivating environment that stimulates maximum individual performance and, consequently, collective success, allowing each person to reach their maximum potential and contribute in an exceptional way to the achievement of common goals.
Strategic Thinking (V14)	The ability to anticipate, analyze and understand the short, medium, and long- term impact of trends and changes in the environment on the organization, developing proactive and adaptable strategies that allow us to successfully navigate uncertainty and achieve sustainable success over time.
Public Relations (V15)	The ability to build and manage meaningful relationships with diverse stakeholders, including opinion leaders, media, communities, governments, and organizations, with the goal of positively influencing the perception and behavior of these audiences, generating a tangible impact on the success of the organization.

Teamwork (V16)	The ability to integrate individual strengths and perspectives into a harmonious whole, fostering collaboration between various departments and areas of the organization, with the aim of achieving common strategic objectives, generating a work environment that maximizes each member of the team.
Internal and external customer orientation (V17)	The ability to cultivate a culture of exceptional service, for both internal and external customers, anticipating their needs, understanding their expectations, and generating innovative and effective solutions that exceed their expectations, fostering long-lasting, mutually beneficial relationships that drive the organization's sustainable growth and success.
Effective Communication (V18)	The ability to establish strong and lasting bridges of communication, both verbal and non-verbal, between individuals, teams, and departments, with the goal of listening carefully, understanding each other's perspectives, and conveying information in a clear, concise, and timely manner, thus creating a transparent and effective communication flow that aligns efforts, fosters collaboration, resolve conflicts constructively and achieve organizational goals.
Decision Making (V19)	The ability to make sound strategic decisions in complex and dynamic environments. This capability involves the rigorous evaluation of various options, the consideration of internal and external factors, the estimation of risks and opportunities, and the selection of the optimal course of action that maximizes benefits and minimizes risks for the achievement of organizational goals.
Innovation & Creativity (V20)	The ability to challenge convention, conceive novel ideas and transform them into solutions that add value to the organization. This capability involves the constant exploration of new possibilities, the identification of hidden opportunities, the generation of original concepts and the effective implementation of innovative solutions that redefine products, processes, services and business models, driving growth and competitiveness.
Initiative – autonomy (V21)	The ability to anticipate future scenarios, identify emerging opportunities and issues, and make proactive and independent decisions to create value for the organization. This ability involves self-reliance to act without explicit instructions, taking responsibility for actions taken, and the ability to think differently.
Adaptability – flexibility (V22)	The ability to thrive in diverse and uncertain situations, adapting work styles, strategies, and behaviors to collaborate effectively with individuals or groups of different backgrounds, perspectives, and personalities. This ability involves
	the agility to adjust to new circumstances, the ability to learn from diverse experiences, and the willingness to work flexibly.
Perseverance in achieving goals (V23)	The ability to maintain unwavering focus and unwavering determination in pursuit of goals, even in the face of unexpected obstacles, challenges, and setbacks. This ability implies the tenacity to persist in the face of difficulties.
Taking Risks (V24)	The ability to proactively identify, analyze and manage potential risks, making calculated decisions and taking responsibility for the consequences with the aim of achieving strategic objectives and generating value for the organization.

Source: Own elaboration based on [4]–[33].

The identified trends and the current state of higher education learning regarding the integration of entrepreneurial skills, project management, and sustainability present significant challenges that demand comprehensive and efficient solutions. Building upon the bibliometric analysis conducted using the WOS database and the existing research, this study proposes the following research questions:

- Research Question 1 (RQ1): How can entrepreneurial competencies be effectively grouped or formalized in relation to the pillars of sustainability to enhance educational processes?
- Research Question 2 (RQ2): To what extent and in what ways do entrepreneurial skills contribute to achieving sustainability?
- Research Question 3 (RQ3): What are the contributions and potential relationships within an entrepreneurial skills system?

To address these questions and validate the findings of previous research on entrepreneurship competencies training and sustainability, a validation study based on key sustainability literature is proposed.

Methodology

A confirmatory factor analysis (CFA) was employed to investigate the research questions. This technique assessed the co-variation of variables defining the construct of "entrepreneurial competencies" in university student training and its relationship to the variables associated with the three pillars of sustainability outlined in the Brundtland Report[1] (social, economic, and environmental) as proposed by Barajas [34].

Pillar 1: Social: The focus on the well-being of individuals and communities translates into the promotion of equity, human rights, access to education and health, and decent employment, thus building a more just and equitable society.

Pillar 2: Economic: the ability of a person, company, or institution to maintain its long-term economic stability, ensuring the ability to generate sufficient income to cover its obligations and achieve its objectives.

Pillar 3: Environmental: Companies must consider the environmental impact of their activities and the associated risks, adopting sustainable practices to minimize their footprint on the planet and ensure their environmental responsibility.

To gain insights into competency training schemes for university students, with a particular focus on the importance of entrepreneurial competencies and their contribution to sustainability, a purposive sample of experts was consulted. This sample comprised seven professors with expertise in entrepreneurship education and eight entrepreneurs recognized for their commitment to sustainable practices. The profile of these experts was:

Teachers: University professor with more than 14 years of experience.- Knowledge of entrepreneurship and pedagogy processes - Face-to-face classes

Entrepreneurs: More than 10 years of experience - Role of Manager, CEO, or Owner - Training in administrative areas

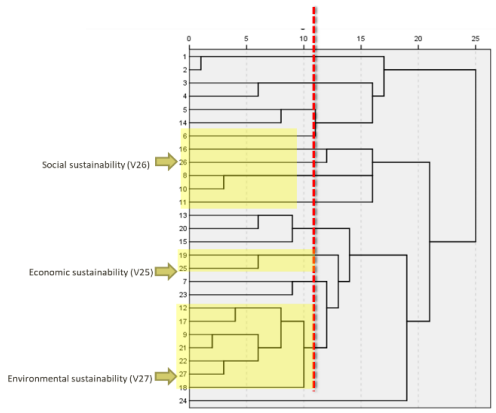
Following the administration of a survey instrument designed to capture data on the 27 competencies of interest, along with control questions and basic participant information, the collected data were tabulated and analyzed using SPSS v22 software. Notably, the instrument deliberately incorporated questions tailored to each of the three pillars of sustainability (social, economic, and environmental).

[1] It makes it possible to contrast a model built in advance, in which the researcher establishes *a priori* the total set of relationships between the elements that make it up.

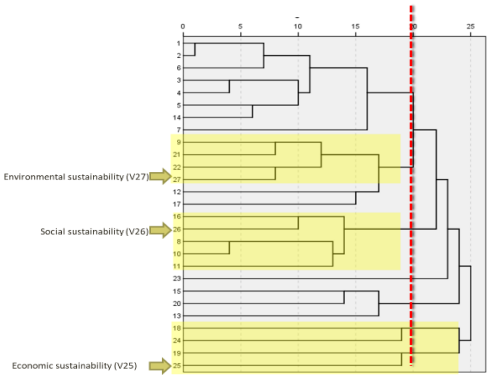
Results

As an initial exploration, a cluster analysis was conducted to examine the structure of the sustainability pillars and the grouping of entrepreneurial competencies. This analysis revealed that the representative competencies for each pillar formed distinct clusters, suggesting a lack of direct one-to-one correspondence between specific competencies and individual sustainability pillars. Multiple models were then tested to confirm the hypothesized three-factor structure (social, economic, environmental) of the sustainability pillars. Figure 4 visually depicts the identified clusters.

Figure 4. Classical conglomerates: dendrograms



Inter-Group Linkage, Euclidean Distance Squared-Cluster by Cases



Inter-Group Linkage, Euclidean Distance Squared-Cluster by Variables

Source: Own elaboration based on SPSS ® V22

Informed by the literature review and the preceding analyses, a confirmatory factor analysis (CFA) was employed to group the key entrepreneurial competencies for university student training around the three pillars of sustainability (social, economic, and environmental). The initial model explained 12.186% of the total variance, suggesting the presence of additional factors influencing the system beyond these three components. Table 2 details the distribution of the 27 variables across the proposed three factors.

Table 2. Rotated Component Matrix

Entrepreneurial competencies	Component		
	1	2	3
Productivity (V6)	,851	-,238	-,137
Mastery of technical issues (V4)	,776	-,081	-,033
Toughness and dynamism (V10)	,685	-,055	-,003
Public relations (V15)	,424	-,321	-,163
Risk-taking (V24)	,421	-,161	-,033
Social sustainability	,414	,172	-,211
Strategic thinking (V14)	,410	-,056	,034
Continuous learning about products (V5)	,267	,022	,071

Continuous learning of the industry and the market (V3)	,260	,179	-,146
Perseverance in achieving objectives (V23)	-,236	-,176	-,088
Teamwork (V16)	,192	,693	,027
Economic sustainability	-,123	,621	-,043
Leadership (V13)	-,006	,506	-,258
Effective communication (V18)	-,164	,495	,215
Integrity (V9)	,192	-,482	-,378
Decision-making (V19)	,179	,426	-,071
Adaptability – flexibility (V22)	-,337	-,409	-,011
Initiative – autonomy (V21)	,074	-,349	-,004
Adaptability to change (V1)	,018	-,199	,763
Environmental sustainability	,096	,108	,752
Planning and Organizational Capacity (V8)	-,152	-,053	,539
Management and achievement of objectives (V12)	,054	-,182	-,448
Strategic vision (V2)	,392	-,211	,429
Internal and external customer orientation (V17)	-,131	-,122	-,422
People management (V11)	,259	,285	,380
Orientation to quality results (V7)	,100	,252	-,325
Innovation and creativity (V20)	-,026	-,053	,074

Source: Own elaboration based on SPSS V22.

Taking the main entrepreneurial competencies of each component, they are established for each of the sustainability pillars:

Pilar 1: Social - *Productivity (V6)*0,851+ Mastery of technical issues (V4)*0,776+Toughness and dynamism (V10)*0,685+ Public relations (V15)*0,424+ Risk-taking (V24)*0,421 y* ***Social sustainability*****0,414 + err1.*

Pilar 2: Economic - *Teamwork (V16)*0.693+* ***Economic sustainability*****0.621+Leadership (V13)* Effective communication (V18)*0.495+ err2.*

Pilar 3: Medio Ambiental: *Adaptability to change (V1)*0.763+* ***Environmental sustainability*****0.752+ Planning and Organizational Capacity (V8)*0.539-Management and achievement of objectives (V12)*0.448+ err3.*

The confirmatory factor analysis (CFA) revealed that while each entrepreneurial competency generally loaded onto its corresponding sustainability pillar, its factor weight was not always the highest within that category. Notably, the first competency in each component exhibited a positive contribution to its respective pillar. These findings suggest that not all entrepreneurial competencies for university students can be trained in isolation. For instance, in the social pillar, the competency specifically targeting social sustainability benefits from being synergistically developed alongside competencies for process optimization, technical problem-solving, demanding situation management, stakeholder relationship building, and decision-making informed by socially sustainable practices. Notably, "productivity" emerged as the most representative competency within this pillar.

Similarly, pillar 2 (economic) encompassed not only the "economic sustainability score" competency but also competencies related to teamwork, effective communication, and sustainable economic practices. Here, "teamwork" emerged as the most prominent competency.

Finally, pillar 3 (environmental) integrated competencies that enable individuals and organizations to effectively adapt to change, promote environmental sustainability, and achieve goals. Consistent with this pillar's focus, "facilities to adapt to continuous change" surfaced as the most relevant competency.

Conclusions

University student training in project management should function as a holistic model, equipping graduates with the tools, knowledge, and entrepreneurial skills necessary to tackle complex project challenges. This necessitates a sustainable approach that integrates social, economic, and environmental considerations. As Kummitha [35] and Rosário [36] suggest, and as our research confirms, a holistic examination of key categories within sustainable business education is crucial to understand the interconnectedness of these issues. Sustainable entrepreneurship education is a rapidly evolving field generating innovative approaches, as evidenced by the Sustainable Development Goals (SDGs).

In the context of project management, integrating these three sustainability pillars with entrepreneurial skills is further enhanced by strategies like Green Project Management® or Sustainable Project Management. These methodologies combine methods, tools, and techniques to achieve project objectives while simultaneously considering the project's entire life cycle to ensure a net positive environmental impact and generate positive social and economic value.

This study underscores the need for higher education institutions offering project management programs to fully embrace sustainability, not as an add-on consideration, but as a core training strategy that seamlessly integrates entrepreneurial skills with practical knowledge. Additionally, akin to any competitive system, continuous improvement and ongoing updates are essential to ensure the relevance and effectiveness of this approach

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