EXPLORING SUSTAINABILITY AS AN EMERGING AXIS IN PROJECT MANAGEMENT: A SYSTEMATIC AND BIBLIOMETRIC REVIEW

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EXPLORANDO LA SOSTENIBILIDAD COMO EJE EMERGENTE EN LA GESTIÓN DE PROYECTOS; UNA REVISIÓN SISTEMÁTICA Y BIBLIOMÉTRICA

EXPLORANDO A SUSTENTABILIDADE COMO EIXO EMERGENTE NA GESTÃO DE PROJETOS: UMA REVISÃO SISTEMÁTICA E BIBLIOMÉTRICA

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ABSTRACT

Sustainability has gone from an abstract aspiration to a structural obligation in key sectors, such as project management. However, its full understanding is limited by the diversity of topics and the rapid pace of knowledge expansion. This study addresses this complexity through a systematic review of international scientific literature to identify trends, categories, and transformations driven by sustainability in project management. A bibliometric-narrative methodology was applied, based on the adapted PICO model, using Scopus for searching, PRISMA for refinement, and RStudio with Biblioshiny for analysis. The study of 765 documents allowed the thematic evolution to be segmented into three stages spanning from 2000 to March 2025, evidencing the consolidation of sustainability as a central axis, with transformations associated with technologies such as BIM and the circular economy, and their integration with governance and digitization. It is concluded that sustainability has ceased to be a peripheral approach and has become a structuring dimension of project management, opening up new avenues for research and action.

Keywords
sustainability, management, projects, systematic review

RESUMEN

La sostenibilidad ha pasado de ser una aspiración abstracta para convertirse en un imperativo estructural en sectores clave como la gestión de proyectos. Sin embargo, su comprensión integral se ve limitada por la diversidad temática y la expansión acelerada del conocimiento. Este estudio aborda dicha complejidad mediante una revisión sistemática de literatura científica internacional, con el fin de identificar tendencias, categorías y transformaciones impulsadas por la sostenibilidad en la gestión de proyectos. Se aplicó una metodología bibliométrica-narrativa, basada en el modelo PICO adaptado, con búsqueda en Scopus, depuración mediante PRISMA y análisis en RStudio con Biblioshiny. El estudio de 765 documentos permitió segmentar la evolución temática en tres etapas comprendidas entre el año 2000 y marzo de 2025, que evidenciaron la consolidación de la sostenibilidad como eje central, con transformaciones asociadas a tecnologías como BIM, economía circular y su integración con la gobernanza y la digitalización. Se concluye que la sostenibilidad ha dejado de ser un enfoque periférico para constituirse en una dimensión estructurante de la gestión de proyectos, abriendo nuevas rutas de investigación y acción.

Palabras clave
sostenibilidad, gestión de proyectos, revisión sistemática

RESUMO

A sustentabilidade deixou de ser uma aspiração abstrata para se tornar um imperativo estrutural em setores-chave, como a gestão de projetos. No entanto, sua compreensão integral é limitada pela diversidade temática e pela rápida expansão do conhecimento. Este estudo aborda essa complexidade por meio de uma revisão sistemática da literatura científica internacional, com o objetivo de identificar tendências, categorias e transformações impulsionadas pela sustentabilidade na gestão de projetos. Foi aplicada uma metodologia bibliométrica-narrativa, baseada no modelo PICO adaptado, com pesquisa no Scopus, depuração por meio do PRISMA e análise no RStudio com Biblioshiny. O estudo de 765 documentos permitiu segmentar a evolução temática em três etapas, entre o ano 2000 e março de 2025, que evidenciaram a consolidação da sustentabilidade como eixo central, com transformações associadas a tecnologias como BIM, economia circular e sua integração com a governança e a digitalização. Conclui-se que a sustentabilidade deixou de ser uma abordagem periférica para se tornar uma dimensão estruturante da gestão de projetos, abrindo novos caminhos de investigação e de ação.

Palavras-chave
sustentabilidade, gestão de projetos, revisão sistemática

INTRODUCTION

EVOLUTION OF THE CONCEPT OF SUSTAINABILITY

Sustainability has historically been conceived from multiple dimensions, starting with approaches focused on environmental conservation, such as those initially proposed by (Von Carlowitz, 2013) before evolving towards an integral vision that includes ecological, economic, and social aspects (Sarmiento Rojas et al., 2024). This conceptual transformation has addressed historical, technological, and political changes that have expanded the scope of sustainability beyond the rational use of resources, which incorporates principles of intergenerational equity, social justice, and participatory governance. Thus, the transition to sustainability requires not only renewable sources, but also advanced technologies that optimize the use of resources (Medina-Reyes et al., 2025).

COMPLEXITY AND INTERDISCIPLINARITY OF SUSTAINABILITY

Due to its complex and interdependent nature, sustainability requires interdisciplinary approaches capable of integrating ecological, economic, technological, and ethical factors (Gimenez et al., 2012). This has led to the development of tools such as life cycle analysis (Xue et al., 2021), circular economy (Niyommaneerat et al., 2023), dynamic simulation (Aderemi et al., 2022), and science co-produced with social actors (Mitchell et al., 2015), which make it possible to approach sustainability as an open, dynamic system. This occurs in the face of the undeniable effects of climate change, which not only affect natural systems and socio-economic sectors, but also generate political impacts and disproportionate effects on the most vulnerable (Intergovernmental Panel on Climate Change [IPCC], 2023). In this context, it is imperative that governments also address these challenges through adaptation and resilience policies, energy diversification, decentralization of generation, and demand management. In particular, energy efficiency is presented as a key line for mitigating and adapting to climate change (Galindo-Borbón et al., 2024).

PROJECT MANAGEMENT AS A VEHICLE FOR SUSTAINABILITY

In this context, project management has established itself as a strategic field for integrating sustainability, especially in sectors such as construction, where technical processes, organizational decisions, and environmental demands converge (Friedrich & Wehnert, 2025). This is how the so-called sustainable construction arises, which seeks to optimize resources in the design, planning, and operation of buildings to minimize environmental and community health impacts (Abdulai et al., 2024; Díaz-de-Valdés-Haase, 2014). Sustainable construction is achieved through strategies that emulate nature's creativity, as expressed in concepts such as biomimicry and biophilic design. These approaches integrate green technologies, sustainable materials, and energy-efficiency practices (Ibrahim & Al-Chaderchi, 2023), fundamental elements for ensuring human survival and for moving towards a sustainable habitat. Although at the beginning, sustainability in projects was mainly approached from a regulatory perspective, focused on fulfilling social and environmental responsibilities, its approach has evolved towards a more operational dimension, integrating technological innovation, digitalization processes, and multifaceted collaboration schemes (Kaewunruen & Lian, 2019; Kuhl et al., 2016). Diverse studies have shown that these practices not only improve operational efficiency but also strengthen the link between sustainability and business strategy, making them essential for the future of organizations (Gerner, 2019; Økland, 2015; Tjahjadi et al., 2023).

Despite this, its integration faces persistent challenges. Among them, institutional fragmentation (Hwang & Tan, 2012; Martinsuo & Geraldi, 2020), the limited incorporation of dynamic monitoring metrics (Martinez Lagunas & Nik-Bakht, 2024), and gaps in the social dimension (Det Udomsap & Hallinger, 2020) stand out. These obstacles have led to the need to overcome reductionist approaches through adaptive frameworks, such as system dynamics, multicriteria evaluation, or participatory governance models (Amorocho-Daza et al., 2024), which allow for a more coherent and systemic integration of sustainability into project practice.

Faced with this scenario, this research conducts a systematic review with thematic and bibliometric analyses of the literature published between 2000 and March 2025 to identify trends, thematic categories, and impact patterns of sustainability in project management. Based on the study of the most cited articles and the thematic evolution over time, the article seeks to explore how sustainability has ceased to be an accessory element and has become a structuring axis in project planning and evaluation, thereby promoting more equitable, regenerative, and long-term-oriented management.

METHODOLOGY

The research process employed a mixed-methods bibliometric approach. This uses bibliometric techniques and qualitative and quantitative analyses to collect, synthesize, and evaluate information from databases, and defines the stages of execution, as presented below.

Table 1. Inclusion and exclusion criteria. Source: Prepared by the authors.

Type	Criterion	Conditions
Inclusion	Year of publication	2000 to 2025[1]
	Type of document	Scientific articles and reviews
	Thematic area	Engineering, social sciences, business, and management
	Language	Without restriction
	Theme	Sustainability in project management
Exclusion	Type of document	Conference proceedings

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DEFINITION OF CONDITIONS

This systematic review was structured around the PICO model adapted to qualitative and management studies (Amir-Behghadami & Janati, 2020):

- P (Population/Context): Project management.
- I (Intervention): Sustainability.
- C (Comparison): Not applicable.
- O (Outcome): Changes, improvements, transformation of project management.

Keywords and representative synonyms of the main concepts that structure the review were defined to identify the relevant studies. This selection was based on a combination of conceptual analysis, preliminary literature review, and terms commonly used in research indexed in scientific databases such as Scopus. The final equation was:

("project manag*") AND (sustainab* OR "sustainable development") AND (change OR transformation OR evolution)

Inclusion and exclusion criteria were defined to ensure the quality, pertinence, and relevance of the studies selected for analysis, in accordance with best practices in systematic reviews (Table 1).

PROCESSING

The PRISMA method (Page et al., 2021) was used for the systematic review. This started by reviewing the Scopus database, chosen for its broad, multidisciplinary coverage and for facilitating bibliometric analysis in a rigorous and replicable way; duplications with other highly overlapping databases were avoided (Pranckutė, 2021). Then, the results were exported in BibTeX format, in which metadata verification was performed on the 777 recovered documents, leading to the exclusion of 12 records: 7 for incomplete information in the title or authors and 5 for duplicity. A final sample of 765 documents remained. The data processing included variables such as authors, journals, keywords, abstracts, and citations, by using the algorithms of the package, *Biblioshiny* in RStudio (Aria & Cuccurullo, 2017). In general, the analyses were oriented to:

- Thematic co-occurrences: Identify clusters of keywords and their relationships that reveal the central research themes.
- Scientific collaboration between countries: This shows the links of international co-authorship and the intensity of cooperation between nations.
- Number of publications per year: This represents the temporal evolution of scientific production in the analyzed period.
- Frequency of keywords: This indicates the most recurrent concepts in the corpus and their relative relevance.
- Action and impact categories: A framework that classifies how sustainability is implemented in projects and what effects they generate.

RESULTS AND DISCUSSION

The systematic review on sustainability in project management between 2000 and 2025 shows a constant evolution of the field, characterized by the strengthening of its empirical base, the consolidation of theoretical frameworks, and the sustained increase in academic interest. The analysis evidences an active scientific community, with high levels of collaboration among authors and significant international exchange, which demonstrates the topic's global and transversal character. The variety of keywords used reflects a growing diversity of approaches, tools, and sectors involved, as well as a progressive transition from normative approaches to practical applications. Overall,

Table 2. Summary of results. Source: Prepared by the authors.

Description	Results
Timeframe	2000 to 2025[1]
Sources (Journals, books, etc.)	408
Documents	765
Annual growth rate (%)	7.43
Average number of citations per document	22.82
The author's keywords	2634
Authors	2681
Co-authors per document	3.8
Percentage of international co-authorship (%)	28.89
Document type - Article	668
Document type - Review article	97

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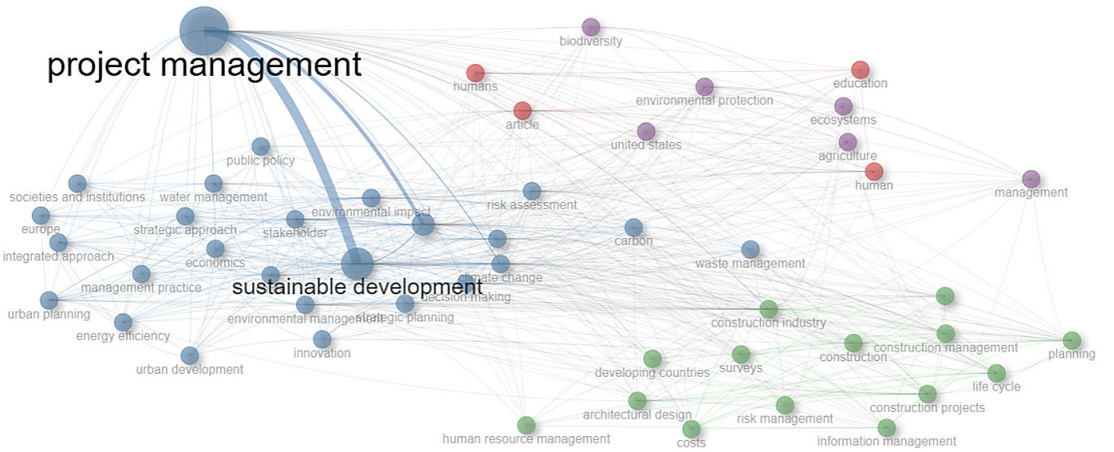

Figure 1. Network of co-occurrences. Source: Preparation by the Authors based on the results generated in Biblioshiny (Aria & Cuccurullo, 2017).

Figure 2. World map of scientific collaboration. Source: Preparation by the authors based on the results generated in Biblioshiny (Aria & Cuccurullo, 2017).

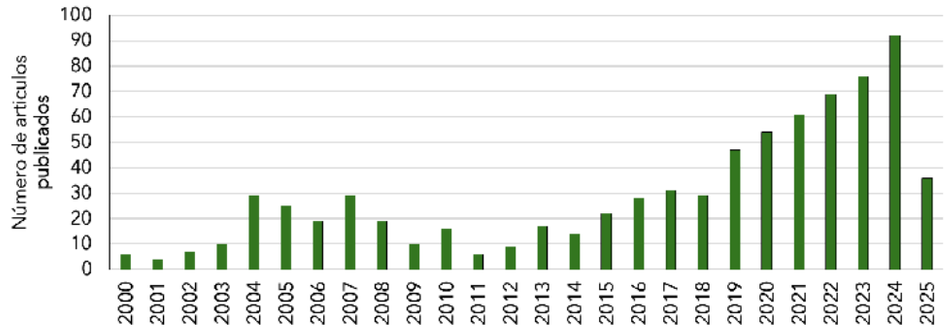

Figure 3. Number of articles published per year. Source: Prepared by the authors.

the results confirm that sustainability has ceased to be a peripheral concept and has become an articulating axis in project management (Table 2).

The network of co-occurrences in Figure 1 reveals four thematic clusters: blue, red, green, and purple. The interaction between the clusters reveals that scientific production does not operate in isolation, but as an interconnected system where governance and public policies (blue cluster) serve as an articulating axis, linking technical approaches to construction and life cycle (green cluster) with biodiversity and environmental protection goals (purple cluster). Finally, the red cluster, associated with education and human factors, functions as a knowledge-transfer bridge, facilitating the adoption of sustainable practices across different contexts. This network suggests that advancing the field depends on strengthening the connections among clusters to integrate metrics into project management and translate sustainability objectives into concrete planning and implementation actions.

In the geographical context analysis, country leaders are identified for each continent, namely those that exhibit the highest frequencies of scientific collaboration, as shown in Figure 2. In America, the United States stands out; in Europe, the United Kingdom; in Asia, China; in Oceania, Australia; and in Africa, South Africa.

The density of the links reveals a pattern of globalization in sustainability research, where transcontinental cooperation and the creation of multicenter networks are privileged. At the same time, significant geographical gaps are becoming evident, particularly in Latin America, large parts of Africa, and areas of Central Asia, where participation in collaboration networks is limited or incipient. These conditions may indicate inequalities in R&D investment, scientific infrastructure, and access to international financing, which represent opportunities to promote capacity-building, internationalization, and cooperation programs.

In particular, the quantitative distribution of publications per year shows a general trend of growth, although with some peaks and troughs in annual productivity. According to Figure 3, 2024 stands out as the year with the most significant scientific production, with a total of 92 publications, far surpassing the 4 produced in 2001.

The temporary distribution of publications justifies an analytical segmentation into three stages: 2000-2011 (initial phase), 2012-2018 (expansion phase), and 2019-2025 (consolidation and innovation phase). This segmentation makes it possible to interpret not only quantitative variations but also qualitative transitions in the ways of conceiving and implementing sustainability within the field of project management.

STAGE 1. 2000–2011

2000-2011 corresponds to an initial phase of thematic development in sustainability applied to project management, characterized by low scientific production (180 articles in total, with fewer than 30 per year) and a still-incipient structure. 560 keywords were identified with 667 occurrences, generated by 441 authors. The most common were *sustainable development* (16), *sustainability* (14), and *project management* (12), together with other topics of medium frequency, such as environment, education, urban planning, and climate change (2-5 appearances).

This group of multiple appearances accounts for approximately 23% of the total mentions (128 appearances), while the remaining 77% are unique terms, reflecting high thematic dispersion and a field in the process of consolidation. Figure 4 presents the count of keywords with more than 2 mentions within the articles published in the 2000-2011 period.

To identify the predominant dimensions in the study's most relevant topics, representative keywords from the

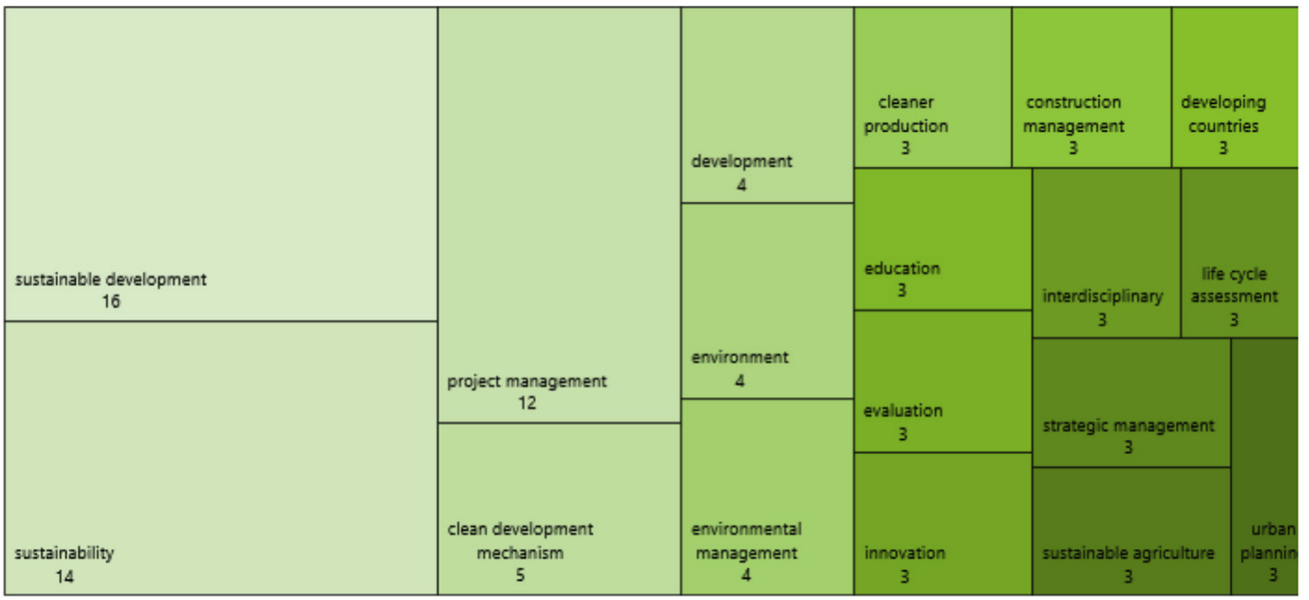

Figure 4. Frequency of keywords in articles (2000-2011). Source: Prepared by the authors.

period were categorized according to the triple baseline of sustainability: economic, social, and environmental, as shown in Figure 5. General terms were excluded, such *as* project management, development, evaluation, research, or innovation, as well as those words with a single appearance. This methodological refinement allows delimiting more significant trends.

The analysis of the 2000-2011 period reveals a clear orientation towards the environmental dimension of sustainability, with 43 mentions, compared to 18 for the economic dimension and 14 for the social dimension. The predominance of the environmental dimension in the 2000-2011 period is reflected in the frequency of terms such as *environment*, *climate change*, and *environmental impacts*, which evidences a narrative focused on the protection of the natural environment. This trend coincides with the literature of the time, which recognizes environmental sustainability as the foundation of the concept (United Nations [UN], 2007; Spangenberg, 2011), relegating the social and economic to complementary roles.

This approach was promoted by institutional and political milestones such as the Copenhagen Declaration (UN, 1995), the Kyoto Protocol (UN, 1998) , and the Millennium Development Goals (UN, 2000) , which promoted environmental and social criteria in project planning. The IPCC's key reports (Watson, 2001), such as the Stern Report (Stern, 2007) and publications such as *Towards a Green Economy* (UNEP, 2011) consolidated sustainability as a global priority, while tools such as GRI indicators, CSR frameworks, and the Climate Investment Fund facilitated its integration with concepts of value and accountability.

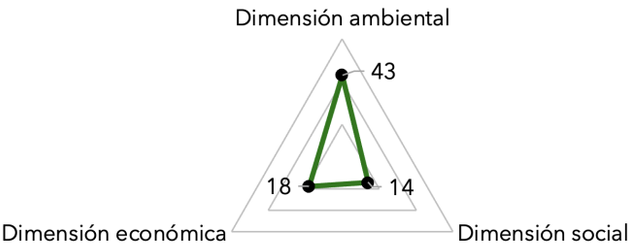

Figure 5. Frequency of keywords by sustainability dimensions approach (2000-2011). Source: Prepared by the authors.

In practice, this evolution was manifested in studies that translated these principles into concrete, high-impact projects. Some articles of the period were consolidated as pioneers in the field, with more than 200 citations and citation rates exceeding 30 per year, which evidenced their academic and practical relevance (Table 3).

Among the most relevant contributions of this period, the implementation of community energy projects based on trust and local governance (Walker et al., 2010); the integration of environmental standards into the industrial supply chain (Koplin et al., 2007); the redesign of maintenance as a life-cycle strategy (Takata et al., 2004), and the critical analysis of the CDM as a climate sustainability instrument (Sutter & Parreño, 2007) stand out.

These experiences constitute early evidence of how sustainability was operationalized both technically and organizationally. Thus, a typology of actions observed

Table 3. Primary academic referents (2000-2011). Source: Prepared by the authors.

Author	DOI	Total N° of citations	No. of citations per year
(Walker et al., 2010)	10.1016/j.enpol.2009.05.055	505	31.56
(Koplin et al., 2007)	10.1016/j.jclepro.2006.05.024	351	18.47
(Takata et al., 2004)	10.1016/s0007-8506(07)60033-x	306	13.91
(Spangenberg, 2011)	10.1017/s0376892911000270	290	19.33
(Sutter & Parreño, 2007)	10.1007/s10584-007-9269-9	271	14.26
(Cook et al., 2006)	10.1016/j.jclepro.2006.01.018	211	10.55

Table 4. Categories of action and impact of sustainability in projects (2000-2011). Source: Prepared by the authors.

Category	Impacts observed in project management
Implementation of sustainable technologies and solutions	Use of tools, technologies, maintenance processes, design, construction, or technical analysis (as a life cycle) to achieve sustainable goals.
Evaluation and adjustment of policies, mechanisms, and standards	Redesign of business structures, internal policies, and sustainability management models in productive sectors, through changes in the supply chain, services, or business practices.
Design and management of projects with sustainability criteria	Application of project management methodologies, strategic planning, evaluation, and certification (such as LEED or Green Globes), integrating sustainability as an operational criterion.

in the projects of the period is proposed, organized into three categories (Table 4), which show how sustainability ceased to be an abstract concept to be translated into technical, political, and strategic decisions.

These categories reflect the transition from a normative view of sustainability towards its practical application in project management. Thus, there are advances in the use of technologies, institutional frameworks, and sustainable standards for planning and executing initiatives. This change marks the beginning of an operational transformation that will be expanded upon in later stages.

STAGE 2 (2012 TO 2018)

The second period (2012-2018) is an expansion phase in the scientific production on sustainability in project management. 150 articles were published, with an annual growth rate of 21.53%, rising from 9 in 2012 to 31 in 2017. 531 authors participated, 600 keywords were recorded, and there were 708 mentions.

The semantic analysis reveals a field that is still in the process of diversification. 93% of keywords are recorded with a single occurrence, suggesting a broad thematic spectrum, but without terminological consolidation. The most common keywords were sustainability (20 mentions), project management (19), and sustainable development (9), indicating a general, not specific, conceptual positioning. The emerging thematic focus is evident in terms such as climate change (8), case study, construction, environmental management, and energy efficiency, each with 2 to 4 mentions. Figure 6 presents the count of keywords with more than 2 mentions within the articles published in the 2012-2018 period.

The categorization of keywords for the 2012-2018 period confirms the continuity of environmental predominance, with 31 mentions, compared to a lower representation of the social and economic dimensions, as presented in Figure 7. Terms such as *cleaner production*, *climate change*, *renewable energy*, and *environmental management* consolidate this thematic leadership, in line with the reactivation of the global environmental discourse promoted by Rio+20 (UN, 2012), which promoted the green economy and climate resilience.

The social dimension, although less prominent, was present through terms such as *participation, health care delivery,* and *transformational leadership*. This approach suggests an advance in recognizing the roles of communities, equity, and organizational culture in the success of sustainable projects. This is consistent with approaches such as those of Dempsey et al., (2011) and Walker et al., (2010) that highlight the importance of community commitment in sustainable initiatives.

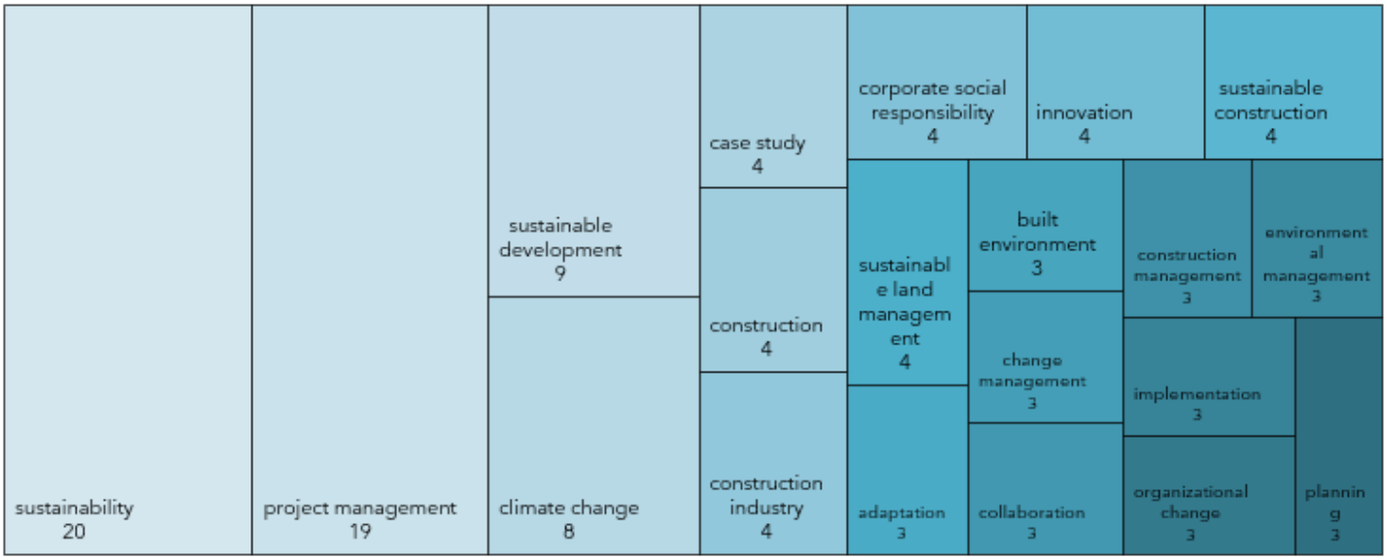

Figure 6. Frequency of keywords in articles (2012 – 2018). Source: Prepared by the authors.

In contrast, the economic dimension remained marginal. Its low frequency suggests a still limited integration of financial tools with sustainability criteria. This trend reflects the aftermath of the global financial crisis of 2008-2011, after which many organizations prioritized sustainable practices from approaches of risk reduction, regulatory compliance, and operational efficiency, instead of seeing it as a source of integral economic value (Det Udomsap & Hallinger, 2020; Jacob, 2012).

Although tools such as ISO 14001, LEED, and GRI reports were widely adopted, their emphasis on environmental and technical-operational metrics limited the full integration of economic and social sustainability into project planning. However, significant progress was made in innovative methodologies, organizational models, and citizen participation. This is shown in the most-cited studies of the period (Table 5), which explored topics such as green building management, urban co-design, and transdisciplinary frameworks to evaluate projects from a more integrated perspective.

These experiences reveal technical, organizational, and social transformations, which make it possible to consolidate a typology of key actions that explain how sustainability has been operationally integrated into diverse project contexts for the period studied, as outlined in Table 6.

This period shows an evolution towards a more applied, integrated approach to sustainability in project management. The five categories identified show how the social dimension acquires greater prominence and is articulated with environmental efforts. In contrast, the economic dimension is being incorporated in a transversal way through evaluation, certification,

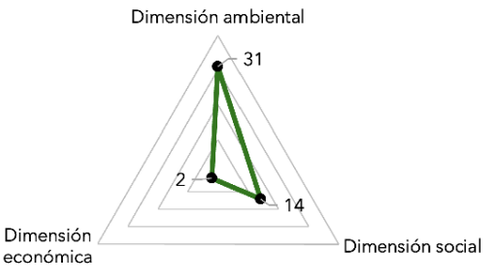

Figure 7. Frequency of keywords by sustainability dimensions approach (2012-2018). Source: Prepared by the authors.

and planning tools. Altogether, this stage marks the transition from conceptual frameworks to consolidated institutional practices, which prepare the ground for technological innovation and structural integration that will characterize the next phase (2019-2025).

THIRD STAGE (2019-2025)

Between 2019 and 2025, project management in sustainability reached an academic consolidation phase, marked by growing scientific interest and greater thematic specialization. The analysis of keywords with more than five appearances showed a maturity of the field, where central terms such as *project management* (86 mentions), *sustainability (85) and sustainable development (32),* as well as emerging sectoral foci such as *construction management (17), climate change (15), circular economy (13) and innovation (11),* stand out. The other terms and the number of mentions in articles are presented in Figure 8.

Table 5. Primary academic referents (2012-2018). Source: Prepared by the authors.

Author	Doi	Total N° of citations	No. of citations per year
(Hwang & Tan, 2012)	10.1002/sd.492	382	27.29
(Trencher et al., 2014)	10.1016/j.gloenvcha.2014.06.009	171	14.25
(Mitchell et al., 2015)	10.1016/j.futures.2014.10.007	167	15.18
(Hong et al., 2015)	10.1016/j.apenergy.2015.06.043	154	14.00
(Arıoğlu Akan et al., 2017)	10.1016/j.jclepro.2017.07.225	153	17.00
(Zhang et al., 2014)	10.1016/j.ijproman.2013.01.009	151	12.58

Table 6. Categories of action and impact of sustainability in projects (2012-2018). Source: Prepared by the authors.

Category	Impacts observed in project management
Transformation of management and governance frameworks	Development of specific frameworks for sustainable construction, improvement in institutional coordination, promotion of transformational leadership, and systemic thinking
Education and training for sustainability	Strengthening competencies in leadership, change management, social participation, and environmental awareness
Adaptation of sustainable infrastructure and technologies	Reduction of emissions, improvement in energy efficiency, maintenance strategies, and sustainable retrofitting
Public participation and social appropriation	Greater legitimacy, contextual adaptation of projects, strengthening of local capacities, and social cohesion
Sustainability assessment and monitoring instruments	Introduction of dynamic models, use of environmental indicators, integration of multicriteria analysis for decision making

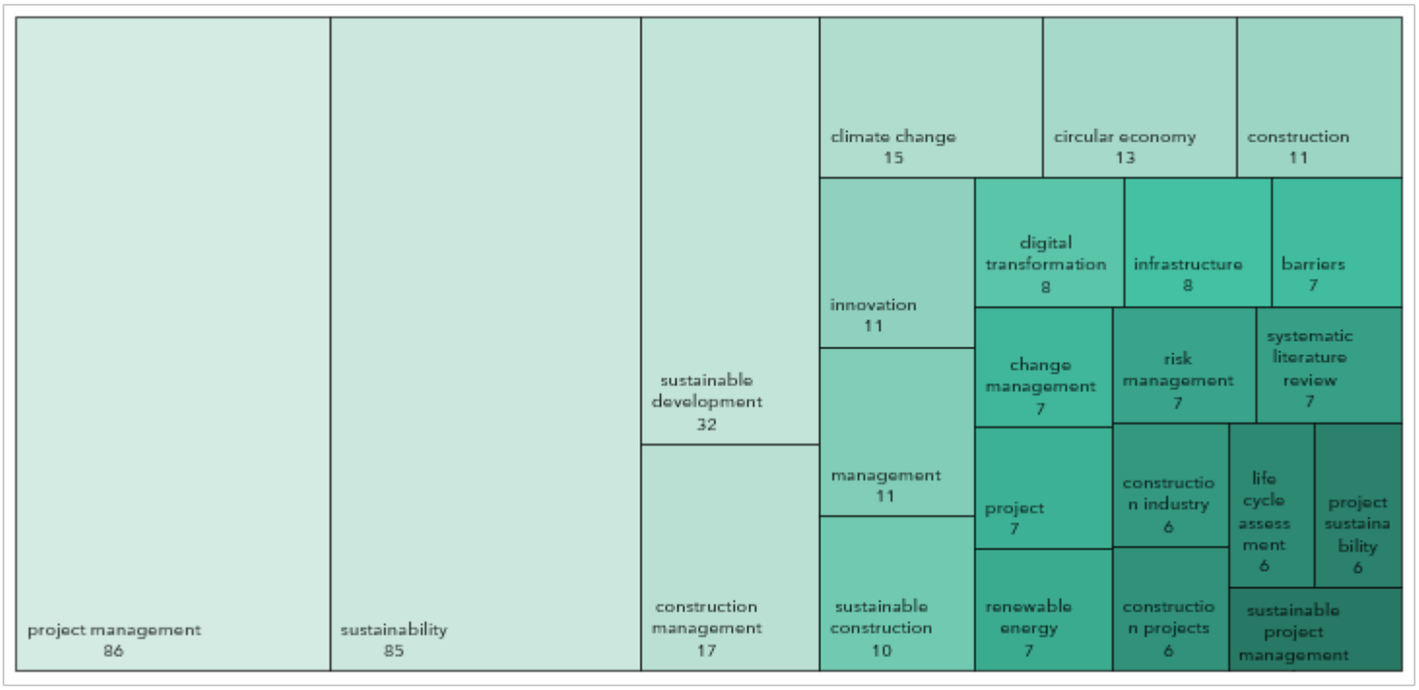

Figure 8. Frequency of keywords in articles (2019-2025). Source: Prepared by the authors.

In general, only 14% of keywords have appearances in multiple articles, while the remaining 86% comprise single-appearance terms. The classification of 14% of the sample along the dimensions of sustainability to evidence the approach to the topic is presented in Figure 9.

The economic dimension (223 mentions) exceeds the environmental (137) and the social (107) dimensions. It gains prominence through the active integration of sustainability across sectors such as construction, industry, logistics, and information technology, where it is perceived as a motor of efficiency and competitiveness. In particular, the construction sector reflects this transition through concepts such as construction management and infrastructure, which show a shift towards more sustainable and technologically advanced models. A practical approach supports this change, focusing on efficiency, traceability, and technologies such as digital twins and intelligent systems, which enable project management under a life-cycle logic, thereby optimizing costs, times, and results (Kaewunruen & Lian, 2019; Lima et al., 2021). The support of this approach is evident through the most cited studies of the period (Table 7).

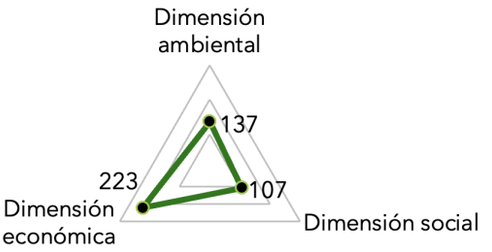

Figure 9. Frequency of keywords by sustainability dimensions approach (2019-2025). Source: Prepared by the authors.

During this period, project management, particularly in the construction sector, was positioned as an integrating framework for technological, financial, organizational, and environmental solutions. The integration of tools such as BIM, digital twins, IoT, and artificial intelligence has allowed the optimization of the project life cycle by improving efficiency, safety, and sustainability. As

Table 7. Main academic referents (2019-2025). Source: Prepared by the authors.

Author	DOI	Total N° of citations	No. of citations per year
(Shepherd et al., 2020)	10.1002/jsfa.9346	225	27.29
(Pauleit et al., 2019)	10.1016/j.ufug.2018.10.006	220	14.25
(Lima et al., 2021)	10.1016/j.jclepro.2020.125730	217	15.18
(Kaewunruen & Lian, 2019)	10.1016/j.jclepro.2019.04.156	209	14.00
(Det Udomsap & Hallinger, 2020)	10.1016/j.jclepro.2020.120073	162	17.00
(Shooshtarian et al., 2022)	10.1016/j.spc.2021.11.032	130	12.58

Table 8. Categories of action and impact of sustainability in projects (2012-2018). Source: Prepared by the authors.

General category	Impacts observed in project management
Digitalization and data-based management	Incorporation of BIM, digital twins, GIS, and analysis systems to improve efficiency, traceability, and decision-making.
Circular economy and resource efficiency	Waste reduction, material reuse, and infrastructure life-cycle planning to minimize impacts.
Resilient and sustainable infrastructure	Design and implementation of projects with a focus on adaptability, environmental conservation, and risk mitigation.
Institutional and political transformation	Adjustments in regulations, public policies, incentives, and governance frameworks aimed at sectoral sustainability.
Education, skills, and social participation	Strengthening of competencies in sustainability, leadership, citizen participation, and co-creation between actors.

a result, five impact categories are identified that synthesize how sustainability has been integrated into project management practice (Table 8).

In general, over the last two decades, project management has evolved significantly, with sustainability becoming an operational and strategic principle. This change has made it possible to integrate economic efficiency, social justice, and environmental integrity through emerging technologies and collaborative approaches. Between 2000 and 2024, we moved from an environmental and technical approach to a more comprehensive practice, based on institutional innovation, digitalization, and social participation, that redefined how we plan and implement projects.

In the most recent stage, sustainability is articulated with digital transformation and the circular economy, by incorporating technologies such as BIM, digital twins, and IoT systems as essential tools to anticipate impacts, optimize resources, and build resilience from the early stages of projects. This sophistication has made sustainability an indispensable operational framework, with tools such as multicriteria analysis and life cycle management fully integrated into decision-making. In addition, the analysis by dimensions reveals a growing functional interdependence: the economic is not positioned as a barrier, but as an enabler of sustainable strategies and the generation of shared value. The social dimension, on the other hand, is gaining strength through the recognition of social capital, education, and organizational culture as key factors in the legitimacy and success of projects.

The language of sustainability has become more precise, its instruments more robust, and its application environments more diverse. It is no longer a question of an inspiring ideal, but of a technical, political, and organizational structure that shapes the viability and relevance of projects in contexts marked by resource scarcity, the pressure for equity, and growing systemic risks. It has ceased to be a normative aspiration; it has become a structural foundation that transforms the way projects are conceived, managed, and evaluated. This integration represents not only a methodological advance but also a strategic requirement in the face of the challenges of the 21st century.

CONCLUSIONS

The findings of this research confirm that sustainability has ceased to be an ethical-normative principle and has consolidated itself as a structural axis in project management, especially in the construction sector. Over the period from 2000 to March 2025, three stages of evolution are evident: from an initial environmental approach with thematic dispersion, towards a more complex integration that articulates digital technologies, institutional frameworks, adaptive governance, and citizen participation.

This transformation has generated key impacts in several strategic areas. Digitalization and the intensive use of data have strengthened the capacity for monitoring, anticipation, and decision-making. The circular economy and resource efficiency have promoted more sustainable and regenerative processes. Resilient infrastructure has made it possible to face climate and urban challenges with more adaptive solutions. Likewise, institutional, regulatory, and political changes have given rise to new forms of governance and evaluation. At the same time, training, capacity development, and social participation have become essential pillars for the legitimacy and sustainability of projects.

Despite the observed progress, sustainability remains unevenly integrated. The environmental dimension remains the most developed, while the social and economic dimensions require a more solid and balanced articulation. The current challenge is to move beyond a technical vision of sustainability towards a structural approach, in which economic value, social justice, and environmental conservation are understood as codependent elements. This transition requires interdisciplinary frameworks, systemic analysis, and adaptive governance mechanisms with a territorial approach and multi-stakeholder participation.

Finally, the analysis of cooperation between countries shows that leading nations such as the United States, China, the United Kingdom, South Africa, and Australia concentrate scientific production and account for most international connections, while regions of Africa and Latin America have less representation. This pattern suggests that to achieve truly comprehensive and equitable sustainability, it is necessary to strengthen international scientific cooperation, promote networks, and facilitate the transfer of knowledge to countries with lower production capacities, thus balancing the capacity to generate sustainable solutions across diverse contexts.

In conclusion, project management can no longer be considered outside the realm of sustainability. It must stop being a decorative complement and become an operational, strategic, and measurable principle. The real challenge is not to incorporate sustainability as a label, but to use it as a basis for redesigning project processes, structures, and objectives. Only in this way will it be possible to respond to contemporary complexity with viable, equitable, and regenerative solutions.

LIMITATIONS

Given the complexity of the topic addressed and the rigor applied in the study design, it is important to recognize certain methodological limitations that may influence the interpretation of the results. The Scopus database was used exclusively, selected for its broad multidisciplinary coverage. However, excluding other sources, such as Web of Science, SpringerLink, or Taylor & Francis, as well as local databases, such as Latin American ones, may limit the representativeness of the analyzed corpus. Similarly, the analysis period from 2000 to March 2025, although it allows us to observe contemporary trends, it excludes earlier studies that could offer valuable historical context on the conceptual evolution of sustainability in project management. These limitations do not invalidate the findings, but they do invite caution in interpreting them and consider future research that broadens the spectrum of analysis.

CONTRIBUTION OF AUTHORS CRediT

Conceptualization, J.A.S.R, J.J.A, F.D.G.P, E.L.B.Q, ; Data curation, J.J.A; Formal analysis, F.D.G.P, J.J.A, E.L.B.Q; Acquisition of J.A.S.R funding; Research, J.A.S.R, F.D.G.P, E.L.B.Q; Methodology, E.L.B.Q; Project management, J.A. S.R; Resources, J.A.S.R; Software. F.D.G.P, J.J.A; Supervision, J.A.S.R; Validation, E.L.B.Q; Visualization, D.M.G.A; Writing - original draft, J.J.A, E.L.B.Q; Writing - revision and editing, F.D.G.P, E.L.B.Q.

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