IT Governance and Corporate Sustainability: Decision Frameworks for Digital Transformation Aligned with GRI Standards

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Abstract

Digital transformation represents a fundamental opportunity for organizations to incorporate sustainability criteria into their strategic decisions. In this context, IT governance and management frameworks—such as COBIT, ITIL, CMMI, and Six Sigma—provide structures to guide technology projects aligned with economic, environmental, and social objectives. This article presents a Systematic Literature Review (SLR) that analyzed 61 primary studies selected from 126 initial records. The research work was based on the Kitchenham methodology and the PRISMA 2020 statement; to identify how these technological governance and management frameworks act as facilitators in the adoption of sustainability indicators under GRI Standards. The results reveal a clear association between cost reduction and increased productivity within the economic dimension; waste reduction reflects progress in the environmental dimension; and the improvement of quality and value delivered to stakeholders aligns with the social dimension. In conclusion, sustainability is not an abstract concept, but a measurable result of mature process management; which allows organizations to make informed strategic decisions and communicate their performance in a comprehensive manner.

Keywords: Sustainable development, decision-making, digital transformation, technology governance and management frameworks.

1. Introduction

Globally, the development of sustainability indicators is driven by various international organizations. The Global Reporting Initiative (GRI) stands out as one of the leading entities in defining best practices for disclosing economic, environmental, and social impacts. The GRI Standards are structured into three conceptual series: universal, applicable to any type of organization; sector, oriented toward particular industries; and topic, focused on specific sustainability impacts (such as economic, environmental, and social aspects). Adopting these standards aims to guide organizations toward a sustainable development model [1].

Alongside these efforts, the United Nations (UN) periodically publishes reports on the Sustainable Development Goals (SDGs). There is a direct correspondence between the SDGs and sustainability indicators; as the latter function as metrics to quantify progress toward the goals proposed by the 2030 Agenda. In this context, the SDGs establish strategic objectives, while the indicators facilitate their operational quantification. For example, within the framework of SDG 7 (Affordable and Clean Energy), economic indicators are identified, such as the cost of renewable energy per unit of production; environmental indicators, such as the percentage of energy consumed from renewable sources; and social indicators, such as the number of people with access to affordable energy services [2].

Within the context of sustainable development, the role of economic indicators has evolved to assess long-term financial viability in alignment with resource efficiency and value creation. Their current objective is to reflect organizational capacity to generate prosperity while safeguarding natural and social capital. This approach expands the scope of traditional financial metrics by incorporating key aspects such as resource productivity and the internalization of external costs (such as carbon taxes); thus, facilitating a comprehensive economic evaluation [3].

In parallel to the economic dimension, environmental indicators quantify the interaction between organizational activities and the natural environment. Their primary function is to provide a technical basis for assessing ecosystem integrity, pressure on natural resources, and ecological resilience. These indicators allow for measuring progress toward conservation goals and the mitigation of impacts such as pollution, soil degradation, or biodiversity loss; acting as support instruments for the development of environmental policies backed by empirical data and real-world measurements [3].

Finally, regarding the social dimension, indicators are defined as measurement variables designed to assess human well-being, equity, cohesion, and quality of life. These instruments complement traditional statistical records by allowing for the evaluation of organizational performance and the impact of its operations on communities. Likewise, these indicators facilitate the analysis of inequality, vulnerability, and social justice; encompassing operational domains such as access to basic services, labor conditions, safety, and civic participation [3].

Sustainability indicators are classified into three pillars: economic (organizational governance, competitive advantage, among others), environmental (such as carbon footprint, waste management), and social (including human rights, labor conditions). These indicators allow for continuous monitoring of organizational performance, facilitate strategic decision-making for sustainable practices, identify areas for improvement, and serve as communication tools for stakeholders. Within the framework of this analysis, metrics aligned with GRI and UN definitions are classified as standardized indicators.

On the other hand, there are organizational or proprietary indicators, developed internally by the institution for operational efficiency and the achievement of specific goals. These are considered indirect, as their contribution to sustainability arises as a consequence of reaching primary objectives focused on efficiency and cost reduction, which are achieved through the optimization of IT governance within the economic pillar [3]. From this perspective, the main difference lies in the fact that while an indicator aligned with GRI standards measures direct global impacts (such as greenhouse gas emissions derived from electricity consumption in data centers), an organizational indicator quantifies internal technical efficiency (such as the percentage of server virtualization or the uptime of critical IT services). This latter approach indirectly impacts the economic dimension by optimizing operational costs and reducing organizational energy consumption.

From the perspective of technology governance and management, reference frameworks such as COBIT, ITIL, CMMI, and Six Sigma operate as tools that support sustainability and strategic development. The generation of organizational value (understood as the realization of benefits through cost and risk optimization) depends on a high level of digitalization, efficient processes, and innovation. This has led organizations to rely increasingly on IT infrastructure for their survival and growth [4]. For the purposes of this research, these tools and the methodological approaches identified in the literature are defined generally under the term IT frameworks.

COBIT (Control Objectives for Information and Related Technology) is an organizational IT framework that encompasses the technology used by the organization to achieve its objectives. The structure of this framework is based on the differentiation between governance and management [4]. Governance evaluates stakeholder needs, determines objectives, establishes direction through decision-making, and monitors compliance. Meanwhile, management plans, builds, executes, and monitors activities in alignment with that direction to achieve organizational goals [4], [5].

ITIL (Information Technology Infrastructure Library) is a widely recognized best-practice framework for technological services. Its main purpose is to guide organizations in creating value from their technical capabilities and in consolidating an effective digital transformation. Since modern services are linked to technological development, institutions benefit from optimizing their IT service management capabilities, ensuring that environment opportunities and new methodologies are adopted optimally [6].

CMMI (Capability Maturity Model Integration) is a set of process improvement models applicable to software engineering, systems, and other operational sectors. It was developed to unify various quality models and serves as a global benchmark for evaluating organizations. Its central purpose is to measure an institution's maturity through its processes, categorizing them into five sequential levels: initial, managed, defined, quantitatively managed, and optimized. The implementation of CMMI generates concrete benefits such as cost reduction, increased productivity, and improved quality of organizational processes [7].

Six Sigma is a data-driven quality management methodology that seeks to improve processes and products by identifying and eliminating the causes of defects. Its primary purpose is to reduce variability to approach an optimal quality level, maintaining a focus on delivering value to the customer, user, or beneficiary. Furthermore, this approach supports managerial decision-making through statistical analysis, orienting processes toward a maximum threshold of 3.4 defects per million opportunities (which is equivalent to six standard deviations) and utilizing a defined role structure (known as belts) for project participants [8].

This work constitutes an extended and specialized version of the preliminary study titled: "Global Implementation of IT Governance and Management Frameworks: Success Cases, Challenges, and Key Factors" [9]. Unlike the previous research, which focused on identifying adoption patterns and operational challenges of COBIT, ITIL, CMMI, and Six Sigma on a global scale, this article delves into the capacity of these frameworks to act as facilitators of organizational sustainability, linking their adoption to specific dimensions (economic, environmental, and social) and metrics for organizational evaluation.

Consequently, considering the methodological particularities of the aforementioned IT frameworks, this study analyzes how they guide the integration of sustainability indicators into digital transformation projects. Therefore, this research seeks to answer the following question: How does the implementation of IT frameworks act as a facilitator for the adoption and compliance of sustainability indicators in the context of organizational digital transformation? Likewise, the impact generated by such implementations and the recommendations derived from the case studies are examined, demonstrating the strategic role of these frameworks in the adoption of sustainability.

2. Materials and Methods

This study is conducted through a Systematic Literature Review (SLR), a structured process whose purpose is to detect, construct, and justify scientific knowledge regarding the object of study. Detection is aimed at identifying research, theories, and background information directly linked to the stated problem; construction allows for the formulation of a theoretical perspective grounded in existing evidence; while justification provides the academic support that connects current research with previous knowledge. In summary, this methodology allows for an understanding of the advances, trends, and the current state of knowledge in a discipline, optimizing research effort and consistently situating the study within the current academic context [10].

Initially, the search process is based on the guidelines of the methodology proposed by Kitchenham (2007) for conducting systematic literature reviews. This approach, which originated in the field of software engineering and is applicable to various technical disciplines, provides a rigorous, scientific, and reproducible method for synthesizing evidence. The methodology is structured into three main phases: planning, execution, and reporting. The planning phase involves the specification of research questions, the development of the review protocol, and its validation. Execution (conduct review) encompasses the identification of relevant research, the selection of primary studies, quality assessment, the extraction of required data, and the synthesis of information. Finally, the report includes writing the review document and its validation [11].

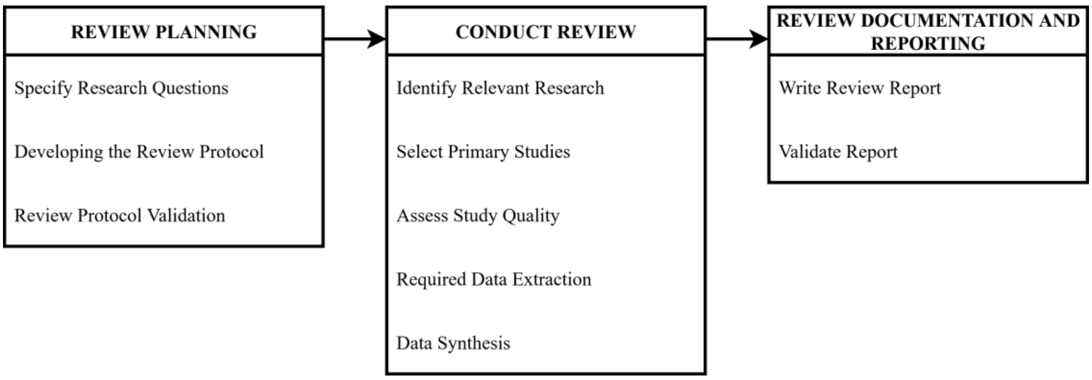

Fig. 1. Methodological flow of the Systematic Literature Review. Adaptation of the Kitchenham (2007) method [11], illustrating the sequential phases of planning, execution, and reporting applied to the selection and identification of IT governance frameworks.

Subsequently, an internet literature search was conducted to define the IT frameworks most frequently associated with digital transformation projects. The results can be observed in Figure 2.

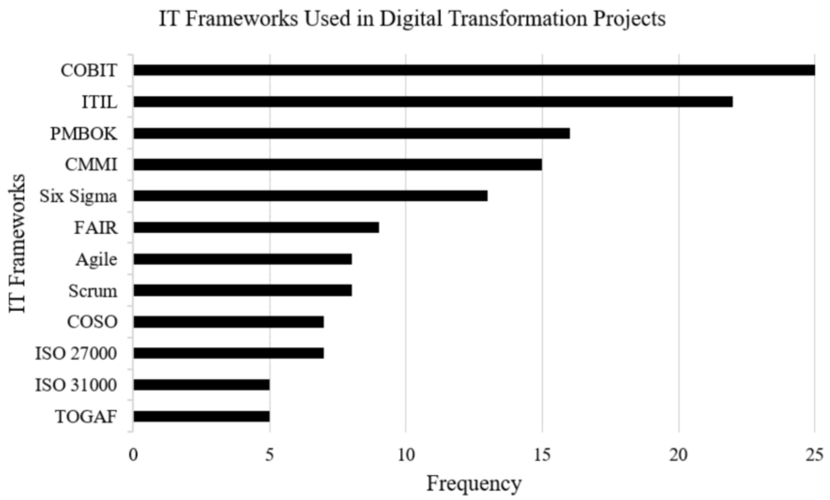

Fig. 2. IT frameworks used in digital transformation projects. Frequency distribution showing the governance and management frameworks identified in the literature, which can be adopted to structure technological initiatives in organizations.

The frequency of the IT frameworks presented in Figure 2 was obtained through an initial identification phase of technical and academic literature. To ensure data representativeness and reproducibility, a systematic search was conducted exclusively in the IEEE Xplore and Google Scholar databases, yielding an initial total of 126 records (28 from IEEE Xplore and 98 from Google Scholar). The exact and literal Boolean search query used was: "Digital Transformation" AND "IT Frameworks" AND "Sustainable development". The methodological significance of this frequency distribution lies in establishing a quantitative filter within the state of the art, which shows the level of adoption and empirical backing of each IT framework in the scientific community.

Observing the results in Figure 2, the IT frameworks used in digital transformation projects are COBIT, ITIL, PMBOK, CMMI, Six Sigma, FAIR, Agile, Scrum, COSO, ISO 27000, ISO 31000, and TOGAF. However, for the purposes of this study, only COBIT, ITIL, CMMI, and Six Sigma were selected. This decision was based on their relevance and higher frequency of use within the analyzed context.

The exclusion of the remaining IT frameworks was based on specific technical criteria: PMBOK was not selected because it is a general project management standard and not an approach specialized in IT governance or strategic management. FAIR was excluded as it focuses exclusively on the quantification of financial and cybersecurity risks [12]; Agile was not chosen because it is an incremental delivery philosophy, and Scrum was discarded for being a framework derived from that philosophy [13]. Likewise, COSO was excluded as it is not specifically oriented toward digital transformation projects, while the ISO standards (ISO 27000 and ISO 31000) were discarded because they represent compliance, security, and risk standards rather than procedural frameworks. Finally, TOGAF was discarded as it showed one of the lowest frequencies of use in the review conducted.

However, it is important to clarify that this delimitation responds strictly to the methodological scope of this research. In real organizational environments, the excluded frameworks and indicators (such as FAIR for financial risk management [12], Agile methodologies for incremental software development delivery [13], or ISO standards for regulatory compliance [5]) are not mutually exclusive. On the contrary, academic literature demonstrates that they possess a level of complementarity and can coexist synergistically, functioning harmoniously alongside the IT frameworks selected for this study (COBIT, ITIL, CMMI, and Six Sigma) to strengthen digital transformation initiatives.

As part of the systematic selection process, the primary consideration was to collect research that would ensure methodological rigor, data precision, and the validity of the conclusions. This final screening process was formally operationalized by applying the following eligibility criteria:

1. Demonstrate the implementation of specific IT frameworks (individual or combined).
2. Report results or impacts derived from their application in digital transformation projects.
3. Incorporate sustainability indicators, whether standardized or organization-specific.
4. Present evidence on how the application of IT frameworks, through the aforementioned digital transformation initiatives, contributed to integrating sustainability into the organization.
5. Correspond to verified quality, peer-reviewed scientific articles published from the year 2010 onwards.
6. Be written exclusively in the English language.

The exclusion criteria applied were:

1. Be opinion pieces, editorials, or studies lacking primary empirical evidence.
2. Present only theoretical compilations on IT frameworks without the validation of an implemented digital transformation project.

From the articles subject to analysis, the following parameters were selected for data extraction:

- Author and year of publication.
- Country or region where the study was conducted.
- Type of digital transformation project undertaken by the organization.
- Specific IT framework applied.
- Sustainability results or impacts on the organization as a result of said technological implementation.
- Organizational conclusions regarding the relationship between the adoption of these frameworks and sustainability indicators.

This information was systematized into a data extraction matrix, which allowed for a comparative analysis and the synthesis of the findings presented in the subsequent sections.

To ensure scientific rigor in the identification and analysis of the literature, the methodological design of this study represents a technical evolution regarding the protocol used in the preliminary work [9] (originally based on Kitchenham, 2004). By adopting the updated guidelines of Kitchenham (2007), more robust data synthesis processes were incorporated, which allowed for a systematic, in-depth evaluation of technological impacts oriented toward the sustainable development of organizations.

In order to operationalize Kitchenham's execution phase and provide full transparency to the selection process, the PRISMA 2020 statement [14] was integrated. As detailed in the workflow in Figure 3, this standard allowed for the systematic management of the selection process through the identification, screening, eligibility, and inclusion phases. This step-by-step audit technically justified the filtering of the 126 initial records down to a final sample of 61 high-impact primary studies, ensuring the traceability and reproducibility of the selection.

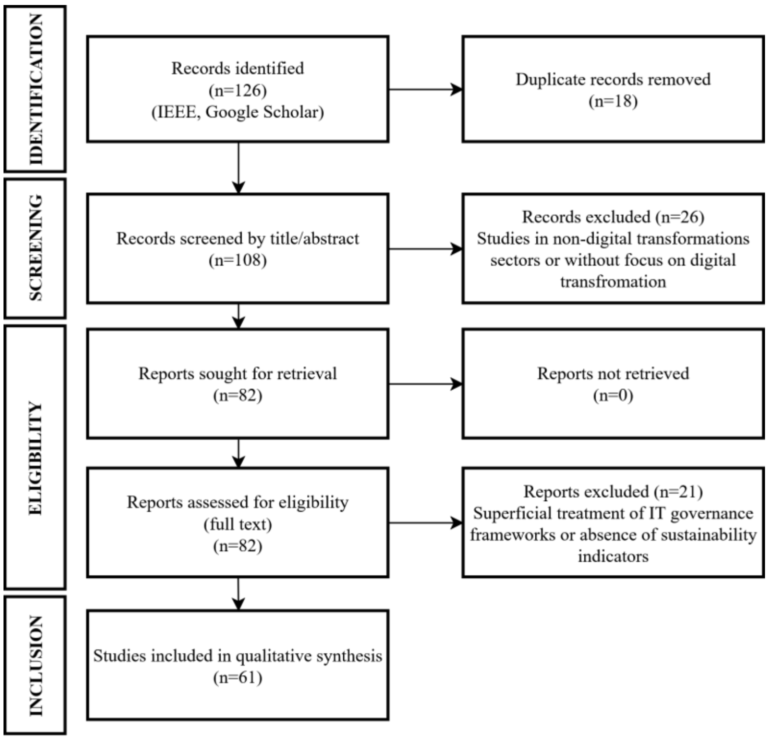

Fig. 3. Article selection flow based on the PRISMA 2020 statement. Adaptation of Page et al. (2021) [14], illustrating the identification, screening, eligibility, and inclusion stages of the analyzed studies.

3. Results and Discussion

3.1 Relationship between Digital Transformation Projects and IT Frameworks

The results obtained in this specialized analysis significantly expand upon the findings presented in the preliminary study [9]. While the previous research established the global distribution and general characterization of IT frameworks, the current data suggest that their adoption is being driven by the strategic need to report sustainability metrics. Unlike the macro perspective on successes and challenges from the previous study, the core value of this research lies in the identification and categorization of a detailed set of indicators directly linked to digital transformation projects. This approach allows for the complementing of the implementation patterns previously analyzed, structuring an evidence base aimed at optimizing organizational decision-making.

In terms of geographical scope, the results demonstrate widespread adoption of IT frameworks, implemented in countries such as Germany, Saudi Arabia, Australia, Austria, Belgium, Brazil, Canada, China, Colombia, Costa Rica, Denmark, Egypt, the United Arab Emirates, Slovakia, Spain, the United States, Finland, India, Indonesia, Iraq, Iran, Italy, Kosovo, Lithuania, Malaysia, Morocco, the Netherlands, Pakistan, Portugal, the United Kingdom, Singapore, Switzerland, Taiwan, and Tunisia.

Furthermore, it was evidenced that the analyzed IT frameworks (COBIT, ITIL, CMMI, and Six Sigma) were implemented in organizations through various digital transformation projects. For the interpretation of Table I, it should be noted that the unit of measurement corresponds to the frequency of occurrence of each framework within the selected literature; therefore, since some studies simultaneously integrate more than one IT framework, the total impact per category represents the horizontal sum of these occurrences and not the net number of articles.

Table I: Types of digital transformation projects where the analyzed IT frameworks were applied

DIGITAL TRANSFORMATION PROJECT	FREQUENCY (FRAMEWORK)				TOTAL
	COBIT	ITIL	CMMI	Six Sigma	
Process Optimization	6	0	13	14	33
Process Operationalization	3	0	4	4	11
IT Service Management in Healthcare, Education, and Organizational Sectors	2	3	0	0	5
IT Service Optimization	0	5	0	0	5
Organizational Learning - Knowledge Absorption	0	0	0	2	2
Critical Success Factors (CSF) Analysis	1	0	0	0	1
Satellite Crop Analysis	0	0	0	1	1
Organizational Process Reengineering	0	0	1	0	1
IS Development for IT Service Management	0	1	0	0	1
Accounting Standardization for Organizational Activity Planning	0	1	0	0	1
IT Governance Strategy Enhancement	1	0	0	0	1
Project Management and the need for Sustainability Integration	1	0	0	0	1
Document Management	0	0	1	0	1
Implementation of Sustainable Practices in the Supply Chain	0	0	0	1	1
IT Performance Measurement	0	0	1	0	1
Development of a Model for Project Selection and Decision-Making Improvement	1	0	0	0	1
Quality Cost Rationalization	0	0	0	1	1
Green Sustainability Improvement	0	0	0	1	1
Quality Management System	0	0	0	1	1

As evidenced in Table I, the data analysis reveals that the literature is strongly concentrated in the realm of projects related to Process Optimization, where the highest frequency is recorded with 33 mentions, supported by representative studies such as [8], [15], [16], [17]. This category reveals a multidisciplinary approach supported by the simultaneous application of frameworks such as Six Sigma, CMMI, and COBIT, as documented in [16], [18], [19]. In second place are projects related to Process Operationalization with a total of 11 records, which present a balanced distribution between CMMI, Six Sigma, and COBIT, as detailed in [19], [20], [21]. Following this, two categories focused on technological services stand out with 5 mentions each: IT Service Management (in the health, education, and organizational sectors), whose distribution is supported by works such as [22], [23], [24], and IT Service Optimization, led entirely by ITIL, with significant case studies in [25], [26]. Finally, 2 projects encompassing Organizational Learning – Knowledge Absorption were identified, where the Six Sigma framework was applied [17].

Additionally, the digital transformation projects that record a single occurrence in the selected literature are presented. These include Critical Success Factors (CSF) Analysis, as described in [27]; Satellite Crop Analysis, as documented in [28]; Organizational Process Reengineering, as observed in [29]; IS Development for IT Service Management, as detailed in [30]; Accounting Standardization for Organizational Activity Planning, as indicated in [31]; and IT Governance Strategy Enhancement, as referred to in [32]. Likewise, Project Management and the need for Sustainability Integration, as exposed in [23], were identified; Document Management, as pointed out in [33];

Implementation of Sustainable Practices in the Supply Chain, as shown in [19]; IT Performance Measurement, as evidenced in [34]; Development of a Model for Project Selection and Decision-Making Improvement, as stated in [35]; Quality Cost Rationalization, as described in [36]; and, finally, Green Sustainability Improvement and Quality Management System, as indicated in [35].

3.2 IT Frameworks as Facilitators for the Incorporation of Sustainability Indicators

The theory of IT frameworks indicates that their primary function is to support organizational decision-making. This section demonstrates how their adoption generates concrete data that are transformed into key sustainability indicators for strategic management.

Table II: Most common sustainability indicators after the implementation of IT frameworks for organizational decision-making

ECONOMIC INDICATORS	**FREQUENCY**
Productivity and Efficiency Improvement	43
Cost Reduction and Savings	41
Profitability and Financial Impact	25
Risk Management	23
Value Management	7
ENVIRONMENTAL INDICATORS	**FREQUENCY**
Waste Reduction and Minimization	7
Environmental Management and Standards Alignment	4
"Green IT" Initiatives	1
SOCIAL INDICATORS	**FREQUENCY**
Customer/User Satisfaction	25
Institutional and Life Cycle Sustainability	7
Employee Satisfaction and Morale	5
Educational Quality Improvement	2
ORGANIZATIONAL INDICATORS	**FREQUENCY**
IT Governance Improvement	35
Service Quality Improvement	34
Maturity Level and Framework Adoption	32
Sigma Level	25
Implementation Success Factors	20
Goal Achievement / Objective Compliance	18
Innovation and Organizational Learning	6

For the development of Table II, a list of both standardized (economic, environmental, and social) and organization-specific sustainability indicators was generated. Their frequency was calculated to verify how COBIT, ITIL, CMMI, and Six Sigma support the incorporation of these indicators into digital transformation projects, which ultimately improves organizational decision-making.

In Economic Indicators, Productivity and Efficiency Improvement shows the highest frequency, being cited by 43 articles, as shown in [8], [15], [21], [24]; this indicates that organizations are focused on optimizing operations and obtaining maximum performance from their human, financial, or technological resources. Among the Environmental Indicators, Waste Reduction and Minimization has the highest occurrence, appearing in 7 articles, as evidenced in [19], [33], [37], which means that organizations are adopting a life cycle approach in their operations, concerning themselves not only with the final product but also with the environmental impact of the production process. Regarding the Social Indicators, Customer/User Satisfaction is the most common, mentioned in 25 articles, as documented in [24], [30], which implies that organizations consider their users and stakeholders as key components and recognize their importance for long-term success. Finally, among the Organizational Indicators, IT Governance Improvement is the most popular, cited by 35 articles, as observed in [31], [33], [36], [38]; this reveals an important trend: organizations view the effective management of their technology not just as a support function, but as a strategic factor for sustainability and long-term value creation.

The correspondence between the analyzed IT frameworks and the incorporation of these indicators into digital transformation projects is evidenced by the way each IT framework structures organizational governance. For example, the adoption of COBIT acts as a direct bridge toward organizational and economic indicators, because its focus on strategic alignment compels organizations to define clear value and risk management metrics before initiating any technological initiative [4], [31]. For its part, the implementation of ITIL systematically introduces Customer/User Satisfaction and Service Quality Improvement indicators within digital transformation, by transforming operational processes into managed services with measurable service level agreements (SLAs) [6], [22], [39]. In the case of Six Sigma and CMMI, their focus on process optimization and maturity directly drives indicators such as Sigma Level and Productivity and Efficiency Improvement, providing the necessary best practices for digitalization projects to reduce variability and operational waste [7], [17], [29], [40]. Through these mechanisms, IT frameworks not only regulate technology but also institutionalize sustainability indicators as mandatory success criteria in organizational decision-making.

From a practical perspective, the findings of this analysis provide a roadmap for sustainability managers and organizational decision-makers. By understanding which IT frameworks drive specific sustainability indicators, those responsible for these areas can collaborate directly with technology departments to prioritize digital transformation initiatives that not only generate operational value but also accelerate the achievement of economic, environmental, and social objectives. For example, sustainability management can use these results to promote the incorporation of COBIT or ITIL best practices as key criteria in the design of new information systems, thus ensuring that data collection regarding resource efficiency and Customer/User Satisfaction is automated from the root of the operational process. By providing this strategic understanding to decision-makers, the present study shows that IT governance facilitates the transformation of technological data into rigorous and auditable sustainability reports [24].

3.3 Sustainable Impact: Economic, Environmental, and Social

In this study, results or impacts were also analyzed as evidence of the relationship between theory and practice, examining how an operational result translates into sustainability indicators. For the construction of Table III, the relationship between operational results and impacts and sustainability indicators was defined through conceptual mapping and semantic aggregation, grouping literature findings under functional affinity criteria [11]. A direct alignment is established when the practical result is the cause or evident reflection of the indicator; for example, the occurrence of Quality Improvement directly and immediately impacts the Customer/User Satisfaction indicator. In this context, the organization of the data reveals the integration of three essential factors: IT frameworks (COBIT, ITIL, CMMI, and Six Sigma) act as methodological vehicles, digital transformation projects operate as the field of practical application, and sustainability indicators constitute the measurable result upon which informed decision-making is based.

Table III: Most common results and impacts in relation to sustainability indicators

SUSTAINABILITY INDICATORS	RESULTS-IMPACTS	FREQUENCY
ECONOMIC INDICATORS		
Cost reduction and savings	Productivity and efficiency improvement	43
Cost reduction and savings	Cost reduction	37
Profitability and financial impact	Profitability and financial impact	26
Multiple Economic Indicators	Other Economic Impacts (Risk management, Financial savings, Reliability improvement, On-time delivery, Delivery flexibility improvement)	31
ENVIRONMENTAL INDICATORS		
Waste reduction and minimization	Waste and scrap reduction	9
Environmental management and alignment with standards	Health, Safety, and Environment (HSE)	2
Green IT initiatives	Carbon footprint reduction	1
Environmental management and alignment with standards	Access to environmental certifications	1
SOCIAL INDICATORS		
Customer/user satisfaction	Quality improvement	22
Customer/user satisfaction	Customer/user satisfaction	17
Institutional and life cycle sustainability	Long-term viability and sustainability	16
Employee satisfaction and morale	Employee satisfaction	3
ORGANIZATIONAL INDICATORS		
IT governance improvement	Governance improvement	25
Goal achievement	Strategic alignment	24
Implementation success factors	Service quality improvement	21
Multiple Organizational Indicators	Other Organizational Impacts (Project management improvement, Maturity level, Innovation and organizational learning, Information control, Business competitiveness, Sigma level, Statistical process control)	60

For Table III, a list of results and impacts found in the analyzed organizations was generated, and their frequency was calculated to verify how an operational result serves as tangible evidence of sustainability. Within the economic dimension, the discussion focuses on the three leading impacts that concentrate the most attention in the literature. First, Productivity and efficiency improvement stands out as the most reported result with 43 articles, as shown in [8], [15], [16], [24]; followed by Cost reduction, which obtains 37 mentions, as evidenced in [22], [35], [36], with both elements aligning with the Cost reduction and savings indicator. Third, Profitability and financial impact is positioned directly in 26 articles, as documented in [21], [41], [42]. Finally, the impacts of lower frequency were consolidated under the general category Other Economic Impacts with a cumulative total of 31 occurrences, associated with studies such as [37], [43], [44], [45]; acting as a secondary support block that complements overall financial performance without diverting the focus from the primary economic indicators.

In the environmental dimension, literature shows a concentration on a single primary impact. Waste and scrap reduction stands out as the dominant result with 9 articles, aligning directly with the Waste reduction and minimization indicator [19], [37]. The remaining environmental impacts show lower frequency in the analyzed organizations; Health, Safety, and Environment (HSE) records 2 mentions, as shown in articles [33], [36], while Carbon footprint reduction obtains a single occurrence linked to Green IT initiatives. Finally, Access to environmental certifications closes the dimension with one mention, linked to the Environmental management and alignment with standards indicator [1].

In the social dimension, firstly, Quality improvement stands out as the most reported impact with 22 articles, as evidenced in [46], [47]; followed by Customer/user satisfaction with 17 mentions; both results align with the Customer/user satisfaction indicator. Third, the impact of Long-term viability and sustainability accumulates 16 articles, as shown in [48], [49]; directly linking to the Institutional and life cycle sustainability indicator. Finally, Employee satisfaction closes this dimension with a frequency of 3 articles, as documented in [50], under the Employee satisfaction and morale indicator.

In the organizational or organization-specific indicators, the discussion focuses on the three leading impacts with the highest frequencies. First, Governance improvement stands out with 25 articles, as shown in [4], [5], [51], aligning directly with the IT governance improvement indicator. Second, Strategic alignment records 24 mentions, as observed in [52], [53], linking to the Goal achievement indicator. Third, Service quality improvement has 21 articles, as documented in [22], [30], [54], associated with the Implementation success factors indicator. Finally, to optimize the analysis, the remaining lower-frequency impacts—which include project management improvement, maturity level, innovation and organizational learning, information control, business competitiveness, Sigma level, and statistical process control—were consolidated under the general category Other Organizational Impacts, accumulating a total of 60 occurrences linked to studies such as [32], [36], [55], which serve as an operational support block without diverting attention from the three primary organizational pillars.

3.4 Strategic Guidelines for Sustainability Decision-Making

This section consolidates the lessons learned from the analyzed articles, providing a set of strategic guidelines for institutional and organizational leaders. Methodologically, these do not represent isolated theoretical statements but rather are derived directly from the qualitative analysis and triangulation of organizational conclusions regarding success factors, implementation barriers, and operational failures reported in the selected empirical studies.

To articulate these findings with organizational management, the information was structured hierarchically into five strategic domains: Strategy and leadership, Implementation and operation, People and skills, Technology and measurement, and Sustainability and future. Thus, the frequency of each lesson learned presented in Table IV reflects the recurrence with which empirical studies identify a specific action as a priority for institutional sustainability. For example, the high concentration of evidence in the guideline Using an IT governance framework such as COBIT to align technology with business objectives (29 mentions) [4], [5], [51] allows for the inference of a key finding in the literature: the impact of technology on sustainability is not an isolated event, but a result directly proportional to the level of governance and strategic alignment applied. These guidelines seek to provide decision-makers with the necessary knowledge to understand governance in a deep, measurable, and effective manner for the long term.

Table IV: Strategic guidelines for sustainability decision-making

STRATEGY AND LEADERSHIP	FREQUENCY
1. Aligning the improvement initiative with organizational strategy and business objectives	22
2. Top management commitment and leadership	15
3. Continually evaluating and improving IT governance	13
IMPLEMENTATION AND OPERATION	
4. Integrating multiple methodological frameworks for holistic management	23
5. Utilizing maturity models to assess the level of process and framework adoption	13
6. Adapting methodologies and frameworks to the specific context and organizational needs	10
PEOPLE AND SKILLS	
7. Improving staff training and competence in applied methodologies	12
8. Involving all employees and properly managing cultural change	10
9. Having project leaders with managerial skills	7
TECHNOLOGY AND MEASUREMENT	
10. Using an IT governance framework such as COBIT to align technology with business objectives	29
11. Measuring performance with quantifiable indicators and relevant performance metrics	13
12. Conducting IT audits in accordance with established frameworks	5
SUSTAINABILITY AND FUTURE	
13. Focusing on long-term viability and business results	7

14.	Integrating process improvement with sustainability factors (environmental, social and economic)	6
15.	Linking the methodology with the environmental management system	2

In Table IV, the discussion within the Strategy and leadership category focuses on three strategic guidelines. First, Aligning the improvement initiative with organizational strategy and business objectives stands out with support from 22 articles, among which the contributions of [16], [39] stand out; this indicates that for the success of a digital transformation project, a clear purpose and strategic backing that unify operational efforts are indispensable. Second, Top management commitment and leadership records 15 mentions, as evidenced in works such as [27], [56], which demonstrates that the active involvement of management is the critical factor for ensuring continuous sponsorship of initiatives and mitigating resistance to institutional change. Third, Continually evaluating and improving IT governance accounts for 13 articles, as shown in [4], [5], [51]; this trend indicates that the sustainability of these frameworks requires periodic audits and adjustments to justify long-term technological investment in the face of changing organizational dynamics.

For the Implementation and operation category, the leading strategic guidelines reflect an eminently practical approach. First, Integrating multiple methodological frameworks for holistic management stands out, a trend supported by 23 articles, among which the studies of [5], [26] stand out; this demonstrates that, whenever possible, organizations do not adhere to a single method to achieve a complete transformation, as isolated structures (such as COBIT or Six Sigma) fail to simultaneously cover all the strategic and operational layers required for sustainability. This is complemented, secondly and thirdly, by Utilizing maturity models to assess the level of process and framework adoption with 13 articles, as evidenced in works such as [7], [22]; and Adapting methodologies and frameworks to the specific context and organizational needs with 10 articles, as shown in [40], [52]; these guidelines suggest that operational effectiveness does not lie in the rigid replication of a standard, but in its customization and gradual instrumentation according to institutional capabilities.

Regarding the People and skills category, the literature analysis demonstrates that the human factor acts as the essential engine of change. The guideline focused on Improving staff training and competence in applied methodologies leads to this domain with support from 12 articles, as highlighted in research such as [6]; this evidences that formal transfer of technical knowledge is vital to avoid the abandonment of new workflows. Subsequently, Involving all employees and properly managing cultural change accumulates 10 mentions, as evidenced in works such as [16], [57]; addressing the need to mitigate psychological resistance and align institutional culture with operational transformation. Finally, Having project leaders with managerial skills records 7 articles, a trend observed in studies such as [27], [57]; which denotes that sustainable success does not depend solely on technical expertise, but on managerial capabilities that ensure conflict resolution, negotiation, and the articulation of multidisciplinary teams.

In the Technology and measurement category, the guideline with the highest frequency consists of Using an IT governance framework such as COBIT to align technology with business objectives, a trend supported by 29 articles, among which the studies of [58], [59] stand out. For this governance structure to translate into measurable results, the literature demonstrates that it requires indispensable technical and instrumental support. This explains why, in second and third place within this domain, priority is given to Measuring performance with quantifiable indicators and relevant performance metrics with 13 articles, as evidenced in works such as [34], [60]; followed by Conducting IT audits in accordance with established frameworks with 5 articles, which confirms a complete cycle of control, evaluation, and operational transparency, as observed in [61].

Finally, the Sustainability and future category is articulated under three strategic guidelines oriented toward institutional viability. The main guideline focuses on Focusing on long-term viability and business results, an approach supported by 7 articles, among which the study [41] stands out; this demonstrates that technological transformations should not seek only immediate operational efficiencies, but strategic returns that guarantee the permanence of the organization over time. This is followed by Integrating process improvement with sustainability factors (environmental, social and economic) with 6 articles, as evidenced in works such as [3], [19]; a trend that determines that the optimization of IT processes is a direct enabler of global organizational responsibility. Lastly, Linking the methodology with the environmental management system records 2 articles, which highlight an incipient but crucial effort in current literature to materialize these theoretical guidelines into formal operational and instrumental tools within the organizational structure, as suggested in [33].

4. Conclusions

In response to the central question of this research regarding how IT frameworks facilitate sustainability in the context of digital transformation, the findings of this study demonstrate that these frameworks act as facilitators of organizational sustainability through a three-stage sequential process: first, they optimize operational and internal efficiency (through variables such as productivity, waste management, and quality improvement); second, they systematize and standardize technical, operational, and management information flows; and third, they transform that data into measurable sustainability metrics and indicators under economic, environmental, social, and organizational dimensions. This conversion of operational data into management indicators provides top management with the basis for informed and proactive strategic decision-making. Consequently, more than mere technical control tools, IT frameworks emerge as integrating platforms that, within the framework of digital transformation, drive governance, competitiveness, and the creation of long-term sustainable value.

On the other hand, digital transformation oriented towards organizational sustainability does not manifest itself as dispersed, isolated technological initiatives, but is concentrated in the optimization and operationalization of internal processes. In this regard, the data in Table I evidences a division of methodological labor: while IT frameworks such as Six Sigma and CMMI dominate the landscape of operational efficiency and process control, structures such as COBIT, by their nature, consolidate themselves as the overarching umbrella of global governance.

Upon analyzing the results of Table II, a marked asymmetry is observed in the prioritization of sustainability dimensions following the implementation of IT frameworks. While the economic dimension and the improvement of organizational governance concentrate most of the attention, the environmental dimension remains at an emerging stage. This behavior suggests that organizations tend to interpret sustainability under a predominantly financial and operational logic, rather than adopting a systemic and integrated vision of its three dimensions. In this sense, while the economic sphere prioritizes productivity and efficiency, the environmental category is linked to waste reduction, the social dimension to quality improvement, and the organizational component to the strengthening of IT governance, consolidating themselves as the main impact of the implementation of these frameworks.

The data presented in Table III allow for identifying a clear correspondence between sustainability indicators and observed impacts. It is highlighted that each dimension manifests itself through specific results: economically, cost management is linked to productivity improvement; environmentally, waste reduction is the tangible result of minimizing waste; socially, quality improvement translates into greater user satisfaction; and organizationally, IT governance is directly associated with institutional governance. Together, these results evidence that the impact of sustainability is not uniform but is articulated through specific operational results according to the prioritized dimension.

Likewise, the evidence regarding key recommendations suggests, in line with Table IV, that the transformative success of IT frameworks tends to be consolidated through the articulation of five guidelines: aligning the improvement initiative with organizational objectives; integrating multiple methodological frameworks for holistic management; strengthening staff training and competence; ensuring governance through formalized structures (such as COBIT); and focusing on long-term viability. Taken together, these findings indicate that the strategic value of these structures lies in transitioning from isolated technical adoption toward an integrated and conscious application, oriented toward the creation of sustainable value.

Finally, it is necessary to acknowledge the limitations inherent in this study, circumscribed by the methodological scope of a systematic review based on indexed literature and the exclusion criteria applied. Based on these boundaries and considering the nature of this extended article, clear lines are identified for the continuation of this research agenda. First, academia must transition from documentary synthesis toward empirical validation through case studies that evaluate the applicability of the proposed integration model in real organizational environments. Second, given the marked asymmetry detected in the prioritization of sustainability dimensions, it is fundamental to advance toward the design of adapted governance models that integrate IT frameworks with environmental and social dimensions (currently more relegated in the literature), using GRI Standards as a reference.

References

[1] Global Reporting Initiative, "GRI 1_Fundamentos." GRI, 2020. [Online]. Available: https://www.globalreporting.org/pdf.ashx?id=12361

[2] Organización de Naciones Unidas ONU, "Informe de Objetivos de Desarrollo Sostenible 2023," 2024. [Online]. Available: https://unstats.un.org/sdgs/report/2023/The-Sustainable-Development-Goals-Report-2023_Spanish.pdf

[3] Junta de Andalucia, "Indicadores de Sostenibilidad y Medio Ambiente," España, 2006. [Online]. Available: https://www.juntadeandalucia.es/medioambiente/portal/web/rediam/indicadores-de-sostenibilidad-y-medio-ambiente

[4] ISACA, "Marco de Referencia COBIT 2019, Introducción y Metodología." ISACA, 2014. [Online]. Available: https://www.isaca.org/resources/it-governance-framework-isaca-cobit

[5] R. Almeida, R. Lourinho, M. M. da Silva, and R. Pereira, "A model for assessing COBIT 5 and ISO 27001 simultaneously," presented at the 2018 IEEE 20th Conference on Business Informatics (CBI), IEEE, 2018, pp.

60–69. doi: 10.1109/CBI.2018.00018
[6] ITIL Foundation, “ITIL 4.” 2014. [Online]. Available: https://www.axelos.com/certifications/itil-service-management
[7] R. Morales-Fernández, J. A. Brito-Rojas, and J. A. V. Marcial, “CAPABILITY MATURITY MODEL INTEGRATION (CMMI),” vol. 2, 2014, doi: 10.1201/9781420052848.ch3.
[8] J. Antony, “Readiness factors for the Lean Six Sigma journey in the higher education sector,” *Int. J. Product. Perform. Manag.*, vol. 63, no. 2, pp. 257–264, 2014. doi: 10.1108/IJPPM-01-2013-0006
[9] S. Arcos, H. Roa, and S. Alvaro, “Global Implementation of IT Governance and Management Frameworks: Success Cases, Challenges, and Key Factors,” *In Proc. Conferencia Latinoamericana de Informática (CLEI 2025)*, p. In press, 2025.
[10] R. Hernández, “Metodología de la Investigación,” Primera edición., México: McGraw Hill Education, 2014. [Online]. Available: https://www.uca.ac.cr/wp-content/uploads/2017/10/Investigacion.pdf
[11] Kitchenham Barbara, “Guidelines for performing Systematic Literature Reviews in Software Engineering,” Department of Computer Science University of Durham, UK, EBSE Technical Report EBSE-2007-01, Jul. 2007. [Online]. Available: https://www.elsevier.com/__data/promis_misc/525444systematicreviewsguide.pdf
[12] FAIR Institute, “FAIR, Análisis de Factores de Riesgo de Información,” Washington, DC, USA, 2024. [Online]. Available: https://www.fairinstitute.org/what-is-fair
[13] Cohn M, *Agile Estimating and Planning*. Prentice Hall, 2006. [Online]. Available: https://spawn-queue.acm.org/doi/10.1145/1142031.1142049
[14] M. J. Page, J. E. McKenzie, P. M. Bossuyt, I. Boutron, T. C. Hoffmann, C. D. Mulrow, L. Shamseer, J. M. Tetzlaff, E. Akl, S. E. Brennan, R. Chou, J. Glanville, J. M. Grimshaw, A. Hróbjartsson, A. Lalu, T. Li, E. W. Loder, E. Mayo-Wilson, S. McDonald, L. A. McGuinness, L. A. Stewart, J. Thomas, A. C. Tricco, A. C. Welch, P. Whiting, and J. E. Moher, "The PRISMA 2020 statement: an updated guideline for reporting systematic reviews," *BMJ*, vol. 372, p. n71, Mar. 2021.
[15] A. Brun, “Critical success factors of Six Sigma implementations in Italian companies,” *Int. J. Prod. Econ.*, vol. 131, no. 1, pp. 158–164, 2011.
[16] L. G. Gutiérrez, O. F. Bustinza, and V. B. Molina, “Six sigma, absorptive capacity and organisational learning orientation,” *Int. J. Prod. Res.*, vol. 50, no. 3, pp. 661–675, 2012. doi: 10.1080/00207543.2011.564667
[17] C. A. Escobar, D. Macias, M. McGovern, M. Hernandez-de-Menendez, and R. Morales-Menendez, “Quality 4.0–an evolution of Six Sigma DMAIC,” *Int. J. Lean Six Sigma*, vol. 13, no. 6, pp. 1200–1238, 2022. doi: 10.1108/IJLSS-11-2020-0205
[18] H. M. Alfaraj and S. Qin, “Operationalising CMMI: integrating CMMI and CoBIT perspective,” *J. Eng. Des. Technol.*, vol. 9, no. 3, pp. 323–335, 2011. doi: 10.1108/17260531111175057
[19] A. Cherrafi, S. Elfezazi, K. Govindan, J. A. Garza-Reyes, K. Benhida, and A. Mokhlis, “A framework for the integration of Green and Lean Six Sigma for superior sustainability performance,” *Int. J. Prod. Res.*, vol. 55, no. 15, pp. 4481–4515, 2017. doi: 10.1080/00207543.2016.1266018
[20] J. J. S. Peña, E. F. Vicente, and A. M. Ocaña, “ITIL, COBIT and EFQM: can they work together?,” *Int. J. Comb. Optim. Probl. Inform.*, vol. 4, no. 1, pp. 54–64, 2013. [Online]. Available: http://ijcopi.org/ojs/index.php/ijcopi/article/view/72
[21] R. Rohini and J. Mallikarjun, “Six Sigma: improving the quality of operation theatre,” *Procedia-Soc. Behav. Sci.*, vol. 25, pp. 273–280, 2011. doi: 10.1016/j.sbspro.2011.10.547
[22] A. Lahtela, M. Jäntti, and J. Kaukola, “Implementing an ITIL-based IT service management measurement system,” presented at the 2010 Fourth International Conference on Digital Society, IEEE, 2010, pp. 249–254. doi: 10.1109/ICDS.2010.49
[23] A. A. Pantigozo, H. V. Huerta, E. O. T. Jiménez, K. V. R. Zevallos, and R. M. Solis, “Impacto Del Modelo De Madurez En La Sostenibilidad De La Gestión De Proyectos Impact Of The Maturity Model On The Sustainability Of Project Management,” vol. 12, no. 02, 2021, [Online]. Available: https://hdl.handle.net/20.500.12952/3745
[24] A. Chakraborty and T. K. Chuan, “An empirical analysis on Six Sigma implementation in service organisations,” *Int. J. Lean Six Sigma*, vol. 4, no. 2, pp. 141–170, 2013. doi: 10.1108/20401461311319329
[25] K. Youssfi, J. Boutahar, and S. Elghazi, “A Tool Design of Cobit Roadmap Implementation,” *Int. J. Adv. Comput. Sci. Appl.*, vol. 5, no. 7, 2014. doi: 10.14569/IJACSA.2014.050720
[26] D. N. L. Armendáriz, “Modelo de gestión de los servicios de tecnología de información basado en COBIT, ITIL e ISO/IEC 27000,” Universidad de las Fuerzas Armadas ESPE, Sangolquí, Ecuador, 2020. [Online]. Available: http://repositorio.espe.edu.ec/handle/21000/22093
[27] G. Manville, R. Greatbanks, R. Krishnasamy, and D. W. Parker, “Critical success factors for Lean Six Sigma programmes: a view from middle management,” *Int. J. Qual. Reliab. Manag.*, vol. 29, no. 1, pp. 7–20, 2012. doi: 10.1108/02656711211190855
[28] R. Yandri, D. N. Utama, and A. Zahra, “Evaluation model for the implementation of information technology service management using fuzzy ITIL,” *Procedia Comput. Sci.*, vol. 157, pp. 290–297, 2019. doi: 10.1016/j.procs.2019.08.169
[29] A. N. Abdel-Hamid and A. E. Hamouda, “Lean CMMI: An iterative and incremental approach to CMMI-

based process improvement," presented at the 2015 Agile Conference, IEEE, 2015, pp. 65–70. doi: 10.1109/Agile.2015.17

[30] M. Talla, "An Implementation of ITIL Guidelines for IT Support Process in a Service Organization," *Int. J. Inf. Electron. Eng.*, 2013, doi: 10.7763/IJIEE.2013.V3.329.

[31] M. Rubino and F. Vitolla, "Internal control over financial reporting: opportunities using the COBIT framework," *Manag. Audit. J.*, vol. 29, no. 8, pp. 736–771, 2014. doi: 10.1108/MAJ-03-2014-1016

[32] L. Al Omari, P. Barnes, and G. Pitman, "Optimising COBIT 5 for IT governance: examples from the public sector," presented at the Proceedings of the ATISR 2012: 2nd International Conference on Applied and Theoretical Information Systems Research, Academy of Taiwan Information Systems Research (ATISR), 2012, pp. 1–13. [Online]. Available: https://eprints.qut.edu.au/53544/

[33] M. C. Machado, F. Hourneaux, and F. A. Sobral, "Sustainability in Information Technology: An analysis of the aspects considered in the model Cobit," *JISTEM-J. Inf. Syst. Technol. Manag.*, vol. 14, pp. 88–110, 2017. doi: 10.4301/S1807-17752017000100005

[34] J. F. Andry and H. Hartono, "Performance Measurement of IT Based on COBIT Assessment: A Case Study," *J. Sist. Inf. Indones.*, vol. 2, no. 1, 2017. doi: 10.29003/jsii.v2i1.77

[35] R. K. Padhy and S. Sahu, "A Real Option based Six Sigma project evaluation and selection model," *Int. J. Proj. Manag.*, vol. 29, no. 8, pp. 1091–1102, 2011. doi: 10.1016/j.ijproman.2011.02.006

[36] R. Yanamandra and H. M. Alzoubi, "Empirical investigation of mediating role of six sigma approach in rationalizing the COQ in service organizations," *Oper. Supply Chain Manag. Int. J.*, vol. 15, no. 1, pp. 122–135, 2022. doi: 10.31387/oscm0480332

[37] S. Karthi, S. Devadasan, and R. Murugesh, "Integration of Lean Six-Sigma with ISO 9001: 2008 standard," *Int. J. Lean Six Sigma*, vol. 2, no. 4, pp. 309–331, 2011. doi: 10.1108/20401461111183724

[38] M. Zhang, W. Wang, T. N. Goh, and Z. He, "Comprehensive Six Sigma application: a case study," *Prod. Plan. Control*, vol. 26, no. 3, pp. 219–234, 2015. doi: 10.1080/09537287.2014.891058

[39] T. R. Eikebrokk and J. Iden, "Strategising IT service management through ITIL implementation: model and empirical test," *Total Qual. Manag. Bus. Excell.*, vol. 28, no. 3–4, pp. 238–265, 2017. doi: 10.1080/14783363.2015.1075873

[40] D. Proença and J. Borbinha, "Formalizing ISO/IEC 15504-5 and SEI CMMI v1. 3–Enabling automatic inference of maturity and capability levels," *Comput. Stand. Interfaces*, vol. 60, pp. 13–25, 2018. doi: 10.1016/j.csi.2018.04.004

[41] A. Ansari, D. Lockwood, E. Thies, B. Modarress, and J. Nino, "Application of Six-Sigma in finance: a case study," *J. Case Res. Bus. Econ.*, vol. 3, p. 1, 2011. [Online]. Available: https://www.aabri.com/manuscripts/10636.pdf

[42] Q. A. Al-Fatlawi, D. S. Al Farttoosi, and A. H. Almagtome, "Accounting information security and it governance under cobit 5 framework: A case study," *Webology*, vol. 18, no. Special Issue on Information Retrieval and Web Search, pp. 294–310, 2021. [Online]. Available: https://www.webology.org/abstract.php?id=1033

[43] O. M. Bañuelos, A. A. Ponce, E. M. Calleros, A. S. Cárdenas, and H. M. M. Zacarías, "Análisis de la transformación digital como estrategia en la entrega de valor a las organizaciones bajo ámbitos clusterizados Analysis of digital transformation as a strategy in the delivery of value to organizations under clustered areas," 2022, doi: 10.32671/terc.v9i1.234.

[44] M. M. AlShamy, E. Elfakharany, and M. A. ElAziem, "Information technology service management (ITSM) implementation methodology based on information technology infrastructure library ver. 3 (ITIL V3)," *Int. J. Bus. Res. Manag. IJBRM*, vol. 3, no. 3, pp. 113–132, 2012. [Online]. Available: https://www.cscjournals.org/library/manuscriptinfo.php?mc=IJBRM-165

[45] Universidad Fidélitas and F. I. Hidalgo-Arguedas, "Propuesta de alternativas de solución para la transformación digital y estructuración de una mesa de servicio según ITIL para la empresa Adventure Pals, S.A.," *Rev. Fidél.*, vol. 6, no. 2, Jul. 2025, doi: 10.46450/revistafidelitas.v6i2.127.

[46] A. Pasquini and E. Galiè, "COBIT 5 and the Process Capability Model. Improvements Provided for IT Governance Process," *Proc. FIKUSZ*, vol. 13, pp. 67–76, 2013. [Online]. Available: https://kgk.uni-obuda.hu/sites/default/files/06_Pasquini_Galie.pdf

[47] K. Prabu, J. Makesh, K. N. Raj, S. Devadasan, and R. Murugesh, "Six Sigma implementation through DMAIC: a case study," *Int. J. Process Manag. Benchmarking*, vol. 3, no. 3, pp. 386–400, 2013. doi: 10.1504/IJPMB.2013.057726

[48] V. Serrano, A. Tereso, P. Ribeiro, and M. Brito, "Standardization of processes applying CMMI best practices," presented at the Advances in Information Systems and Technologies, Springer, 2013, pp. 455–467. doi: 10.1007/978-3-642-36981-0_42

[49] J. De Mast, B. A. Lameijer, K. Linderman, and A. Van de Ven, "Exploring the process of management system implementation: a case of Six Sigma," *Int. J. Oper. Prod. Manag.*, vol. 42, no. 13, pp. 1–24, 2022. doi: 10.1108/IJOPM-01-2022-0056

[50] K. D. Prasad, K. V. Subbaiah, and G. Padmavathi, "Application of Six Sigma methodology in an engineering educational institution," *Int. J. Emerg. Sci.*, vol. 2, no. 2, pp. 210–221, 2012. [Online]. Available:

https://www.researchgate.net/publication/267381283

[51] S. Fernandez, M. Imanullah, M. Y. Fathoni, and P. Pahrizal, "Utilization of the COBIT 2019 framework to identify the level of governance in internet services," *J. Infotel*, vol. 14, no. 3, pp. 188–195, 2022, doi: 10.20895/infotel.v14i3.791.

[52] Y. Bartens, S. De Haes, Y. Lamoen, F. Schulte, and S. Voss, "On the way to a minimum baseline in IT governance: Using expert views for selective implementation of COBIT 5," presented at the 2015 48th Hawaii International Conference on System Sciences, IEEE, 2015, pp. 4554–4563. doi: 10.1109/HICSS.2015.543

[53] A. Gerl, M. von der Heyde, R. Groß, R. Seck, and L. Watkowski, "Applying cobit 2019 to it governance in higher education," *Inform. 2020*, 2021. doi: 10.18420/inf2020_118

[54] M. Marrone, F. Gacenga, A. Cater-Steel, and L. Kolbe, "IT service management: A cross-national study of ITIL adoption," *Commun. Assoc. Inf. Syst.*, vol. 34, no. 1, p. 49, 2014. doi: 10.17705/1CAIS.03449

[55] R. Sheikhpour and N. Modiri, "An approach to map COBIT processes to ISO/IEC 27001 information security management controls," *Int. J. Secur. Its Appl.*, vol. 6, no. 2, pp. 13–28, 2012. [Online]. Available: https://gvpress.com/journals/IJSIA/vol6_no2/2.pdf

[56] N. Ahmad, N. Tarek Amer, F. Qutaifan, and A. Alhilali, "Technology adoption model and a road map to successful implementation of ITIL," *J. Enterp. Inf. Manag.*, vol. 26, no. 5, pp. 553–576, 2013. doi: 10.1108/JEIM-10-2012-0074

[57] T. Goh, "Six triumphs and six tragedies of Six Sigma," *Qual. Eng.*, vol. 22, no. 4, pp. 299–305, 2010. doi: 10.1080/08982112.2010.495096

[58] W. Gunawan, E. P. Kalensun, and A. N. Fajar, "Applying COBIT 5 in higher education," presented at the IOP Conference Series: Materials Science and Engineering, IOP Publishing, 2018, p. 012108. doi: 10.1088/1757-899X/420/1/012108

[59] A. Mutiara, E. Prasetyo, and C. Widya, "Analyzing cobit 5 it audit framework implementation using ahp methodology," *JOIV Int. J. Inform. Vis.*, vol. 1, no. 2, pp. 33–39, 2017. doi: 10.30630/joiv.1.2.22

[60] A. Hoerbst, W. O. Hackl, R. Blomer, and E. Ammenwerth, "The status of IT service management in health care-ITIL® in selected European countries," *BMC Med. Inform. Decis. Mak.*, vol. 11, pp. 1–12, 2011. doi: 10.1186/1472-6947-11-76

[61] G. A. T. Krisanthi, I. M. Sukarsa, and I. P. A. Bayupati, "Governance audit of application procurement using COBIT framework," *J. Theor. Appl. Inf. Technol.*, vol. 59, no. 2, pp. 342–351, 2014. [Online]. Available: http://www.jatit.org/volumes/Vol59No2/13Vol59No2.pdf