






## Article

# The Design of a Strategic Platform for the Smart Supervision of Public Expenditure for Colombia in the Context of Society 5.0

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**Abstract:** The overarching vision of Society 5.0 seeks to integrate technology to enhance quality of life and address social issues, with the primary goal of creating human-centered communities, which nowadays represent the inhabitants of smart cities. In this context, this work addresses the design of a modular strategic platform for the smart supervision of public expenditure, to be used by the Directorate of Information, Analysis, and Immediate Reaction (DIARI) of the General Comptroller of the Republic (CGR) of Colombia as a significant contribution towards the country's transition into Society 5.0. The design was performed by conducting a detailed literature review on fiscal control; performing a comprehensive analysis of the legal, organizational, and technological aspects of the country and the CGR; and developing six functional modules focused on topics such as continuous learning, strategic decision making, distinctive value, strategic achievements, capacity building, and organization, within a three-year implementation plan, through a participatory approach. This plan aims to integrate the platform to enable real-time monitoring, early detection of irregularities, and increased transparency in the management of data and public resources; since the start of the operation of the strategic platform in 2024, the DIARI increased the number of alerts generated by 29% over a three-month period with respect to the year 2023. The strategic platform for the DIARI of the CGR is useful for smart cities and the transition into Society 5.0 since it ensures efficient public expenditure management, enhancing transparency and citizen empowerment through modern technologies, data analytics, and active participation in governance processes.

**Keywords:** digital transformation; smart government; public expenditure; fiscal control; Society 5.0



**Citation:** Restrepo-Carmona, J.A.; Zuluaga, J.C.; Flórez, D.A.; Gómez, M.S.; Londoño, L.; Gómez, G.; Villamil, R.M.; Morales, O.; Hurtado, Á.M.; Escobar, C.A.; et al. The Design of a Strategic Platform for the Smart Supervision of Public Expenditure for Colombia in the Context of Society 5.0. *Urban Sci.* **2024**, *8*, 117. <https://doi.org/10.3390/urbansci8030117>

Academic Editor: Luis Hernández-Callejo

Received: 2 May 2024

Revised: 9 August 2024

Accepted: 13 August 2024

Published: 16 August 2024



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## 1. Introduction

Continuous global population growth, as reported by the United Nations [1], has led to a growing need for citizen participation in the supervision of public institutions [2]. This growing demand for active involvement in the control and monitoring of public resources and policies has been intensified in the era of Industry 4.0 and rapid technological development [3]. Consequently, there has also been an increase in the need to search for innovative solutions and digital systems that enable more effective, transparent, and agile state supervision, in order to meet the demands of an increasingly connected and informed society [4].

The supervision of public resource execution has generated a significant transformation in the face of “Fiscal Openness” [5], moving towards the use of smart tools and technologies. Today, such processes are highly dependent on manual methods and bureaucratic processes in several countries, limiting efficiency and accuracy in fiscal control. However, with the presence of modern data analysis tools (e.g., artificial intelligence and automation), more detailed supervision could be achieved. Such tools allow for (i) quasi real-time monitoring, (ii) early detection of irregularities, and (iii) comprehensive data analysis, which leads to optimizing the management of public resources and ensuring greater transparency and accountability in the use of government funds as reported in [6–8]. This shift towards the implementation of smart technologies has significantly strengthened supervision capacity, facilitating more effective fiscal control adapted to the demands of an increasingly technology-oriented and citizen-centered society, namely, Society 5.0.

The transition from Industry 4.0 to Society 5.0 has resulted in a significant change in the management of public spending. Society 5.0 focuses on the complete integration of technology to address social challenges and improve quality of life, in an approach known as human-centricity [9–11], while Industry 4.0 focuses primarily on automation and the integration of technologies in industrial processes [12]. In line with this, Society 5.0 (a futuristic concept that advocates integrating technology into every aspect of daily life to improve quality of life) will benefit society by facilitating faster anomaly detection, better decision making, and greater ability to anticipate and prevent issues with the use of public funds [11,13].

The progression towards intelligent platforms in public expenditure control has proven to be key for governmental financial supervision. Solutions powered by innovative technologies can provide a more precise monitoring of state resources, thereby strengthening flexibility, transparency, efficiency, and public trust in the management of public funds [14–16]. In this regard, one can find recent works that state that expenditure audits, which use better information, benefit fiscal transparency [7]. This quality information can be used by audit institutions through social networks to communicate with stakeholders more efficiently by reaching larger audiences [4]. Nguyen and Luong [17] conducted a study that highlighted the potential of increased expenditure control in reducing public debt, particularly in transition economies. This highlights the importance of public policies to strengthen independent fiscal institutions for the benefit of society [18].

The use of modern technologies has been reported to be useful within several sectors to supervise the execution of resources at different levels. For instance, Barateiro et al. [19] reported the use of blockchain in the oil and gas industry to perform fiscal measurement, which refers to the appropriate measurement for taxation and royalty calculation according to regulations published by official entities. On a wider and hierarchically superior level, Saeed [20] proposed a dynamic control system to regulate taxation and market operations for fiat money-based economies. More recently, Li and Li [21] provided key points around the government’s efforts to promote scientific and technological innovation while enhancing local fiscal decentralization through digital inclusion for an improved quality of economic development. However, some authors have also addressed some ethical and legal implications [22,23] of the use of modern technologies supported by artificial intelligence. Finally, the use of modern technologies requires a cultural change that will encounter resistance in aging parts of societies.

The aforementioned cultural change is occurring nowadays through the use of technologies in a society where citizens’ interest in science and public participation has increasingly embraced the perspectives of social sciences and humanities, recognizing their vital role in addressing complex societal issues [24,25]. In this regard, Anthony [26] stated that citizen engagement is a key driver toward achieving an equitable community. Such structural changes for community and urban development are being supported by digital platforms in the information age, where digitalization and networking are crucial for promoting economic growth in cities [27]. There is an increasing need for transparency of processes and a corresponding demand from citizens to participate in shaping them [28]. This partici-

pation has been facilitated by the modernization of public administration through emerging technologies, leading to the concept of smart public governance at local (smart city) and national (smart government) levels [29].

Research on platforms, systems, planning, and challenges in fiscal control is highly relevant for understanding development and progress in the formulation of digital transformation platforms for developing countries [17]. However, the results of the search and review process revealed that, in the regional context of this research, there has not been a consolidated presence of such a platform for smart fiscal control in Colombia that allows for not only processing large information volumes through modern Industry 4.0 technologies but also the generation of high-quality information for decision making and the engagement of citizens in the supervision of the execution of public resources. In this scenario, this paper addresses the proposal for the design of a strategic platform for the Directorate of Information, Analysis, and Immediate Reaction (DIARI) of the General Comptroller of the Republic of Colombia, as a complementary approach related to smart city strategies, to address the challenges of its digital transformation and technological modernization process.

Within the advantages of the proposed platform, one can find the following: adaptability and modularity, scalability and future-proofing, enhanced change management, interdisciplinary collaboration, and technological innovation. The key benefits of implementing this platform over a three-year period are expected to be improved transparency and accountability, enhanced citizen engagement, a benchmark for digital transformation, and support for smart cities and Society 5.0. Additionally, budgetary benefits comprise cost-effective implementation, optimized resource allocation, reduced risk of financial mismanagement, efficient use of infrastructure investments, and long-term savings through modernization. Since the start of the operation of the strategic platform in 2024, in an initial period of three months, the DIARI increased the number of alerts by 29%, compared to 2023. Such a strategic platform can also be implemented in other countries that are working to implement smart government processes by using the proposed methodology in the context of Society 5.0.

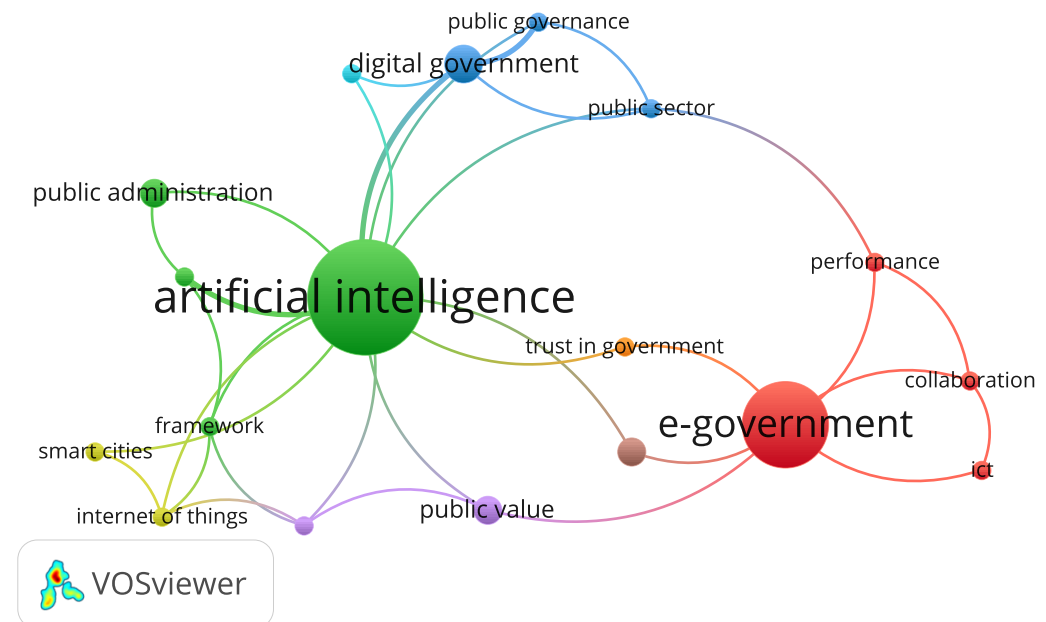
The organization of the paper is as follows. In Section 2, we provide the analysis of a systematic literature review that was performed; then, Section 3 contains the definition of the steps required to design the strategic platform; then, Section 4 shows the results with the architecture and the implementation plan; Section 5 contains the discussion; and finally, conclusions are presented in Section 6.

## 2. Literature Review

In the context of this research, an analysis of repositories, reports, and multidisciplinary scientific publications from recognized sources such as Science Direct and Scopus was performed. The aim was to identify and examine similar projects implemented in the region. This exploration focused on studies, platforms, and initiatives related to the intelligent supervision of public investment in the world and then in Latin American countries with a specific focus on the Colombian context. To better understand the context and seek references, a review of the scientific literature was conducted (from 2010 to 2024), focusing on the following key concepts: “digital transformation in the public sector”, “emerging strategy”, “strategic platform”, “fiscal control”, “public expenditure”, “smart supervision”, and the crucial concept of “society 5.0” [30], among others. In this search, 276 references were integrated into a database to perform a co-occurrence analysis of keywords (Figure 1).

As can be seen in Figure 1, the main nodes of the co-occurrence description are artificial intelligence, e-government, digital government, public administration, and public value. On a minor scale, one can identify smart cities, the Internet of Things, collaboration, performance, public governance, the public sector, and trust in government. This verifies that the integration of these concepts offers a comprehensive and updated view of the historical, technological, and prospective landscape related to the supervision of public spending, the implementation of new technologies in the public sector, and strategic

advancements driving civilizations and governments toward the new revolution of Industry 5.0 [3]. This review of the literature enables the identification of good practices, lessons learned, and potential opportunities for adaptation or improvement for the implementation of the proposed strategic platform for Colombia within the framework of Society 5.0.



**Figure 1.** Literature review: co-occurrence analysis of keywords (from 2010 to 2024). Performed with VOSviewer 1.6.20.

In regional and national contexts, some research and projects focused on governance security models have been identified in the Office of the Comptroller General of the Republic of Colombia, commonly known as the “Contraloría General de la República (CGR)”, which is an independent entity of the Colombian state responsible for supervising and controlling the management of public resources in Colombia. The CGR is an independent body whose mission is related to ensuring transparency, efficiency, and accountability in the use of public funds in Colombia through fiscal control, which, in addition to being subsequent and selective, can be exercised preventively and concomitantly [31]. An example is the study by García-Valencia [32], “Information Security Governance Model for the General Comptroller’s Office of the Republic of Colombia”. It addresses how this Colombian entity began the digital transformation in response to the emerging needs of users to perform procedures online, and a growing interest in establishing and improving digital security, both for users and in data and information management [33]. Furthermore, Pinilla-Cárdenas [34] presented a work related to the challenges the entity faces in combating corruption, “Fiscal Control Challenges to combat corruption in Colombia”, highlighting the key financial aspects of the entity and the mechanisms for the prevention of corruption in such institutions and countries.

In parallel, some works focused on strategy and development plans for the implementation of emerging technologies and public management of the CGR have been found. Márquez-Alzate et al. [35] presented the “Strategic Plan 2020–2021” by the General Comptroller of Quindío, focusing on fiscal surveillance and continuous auditing. Abadia-Benitez [36] proposed the “Departmental Comptroller’s Strategic Plan of Valle del Cauca 2020–2021 Version II”, for the Department of Valle del Cauca, to implement improvements in areas such as the use of technologies in the region. Erazo-Montenegro [37] worked on the “Institutional Strategic Plan 2020–2023: Transforming Fiscal Control”, for the CGR, to strengthen institutional capacity. More recently, Castro [38] developed the “Institutional Strategic Plan Fiscal Control Our Social Commitment” for the Department of Casanare, as a strategic plan for the period 2022–2025.



As a significant point in the literature review and in relation to the research mentioned above, it was concluded that in Colombia there is a limited presence of research in the area of creation and design of digital platforms for innovation and digital transformation. This significantly indicates that the design of the strategic platform represents an innovative opportunity and improvement for the field of fiscal control and can contribute to significant technological advances in Colombia, positioning the country as a prominent reference at the global level in Society 5.0. The absence of similar initiatives suggests a gap in the implementation of specific solutions in the field of smart cities and smart government, particularly at the national level. Therefore, current research represents an opportunity to bridge this gap by introducing an innovative strategic platform proposal for smart fiscal control. The design of such a platform is based on the following definitions:

- A strategic platform is an assembly of technologies, tools, resources, and processes [39] that is based on the emerging strategy's foundations [40]. It acts as a centralized framework that facilitates data management, decision making, and the implementation of actions aligned with an organization's strategic objectives. Designing such a platform provides a solid foundation for process optimization, continuous innovation, and adaptability to environmental changes, essential for any entity [41].
- Fiscal control comprises a set of actions, regulations, mechanisms, and procedures whose main objective is to oversee, verify, and ensure the proper use of public resources [42]. It aims to ensure transparency, efficiency, legality, and accountability in the management of state funds and assets. This control comprises the audit of income, expenditures, investments, contracting, and any other financial activity related to the public sector.

### 3. Materials and Methods

#### 3.1. Context for Strategic Platform

The transition towards the digital environment by various governments and societies worldwide is currently driving a transformation among several organizations, including governmental entities. This evolution becomes a crucial strategic element since these organizations are moving towards digital transformation in their processes and strategic objectives, within a society that is transforming cities into smart cities [43]. However, effective adoption of digital technologies poses significant challenges, especially in the context of governmental and fiscal control entities in developing countries [44], such as Colombia. In this context, we are providing the foundation for concepts required for the design of the platform.

##### 3.1.1. Emerging Strategy

Contrary to the traditional vision of strategy as an analytical and rational process of long-term planning, the concept of Emerging Strategy [45] has surfaced, which focuses on adaptation and continuous experimentation. According to the Emerging Perspective, the strategy unfolds organically in response to a changing and uncertain environment. The successful adoption of the strategy requires monitoring, communication, decision making authority, and learning. The Emerging Strategy has been useful in dynamic environments, which are characterized by constant changes, such as the technological sector. It has enabled adaptations within organizations according to trends in different markets. It has been demonstrated that is essential to have clear objectives and appropriate organizational capabilities to execute changes effectively [45].

##### 3.1.2. Strategic Functional Modules

The implementation of the Emerging Strategy can be performed by creating specialized functional modules [46]. These modules can operate as semi-independent units, and each of them is aimed at a specific strategic goal such as learning methodology, process optimization, or the development of key capabilities within the organization. Being coupled in a relatively general manner, the modules enable experimentation and agile adaptation

amongst themselves. The implementation of modules embodies the concept of having “real options” [47] in strategy, where entities or organizations can invest in multiple flexible capabilities tailored to their contexts, which can be enhanced or abandoned as the needs of their users evolve. This modular structure of strategic implementation fosters innovation by allowing for the combination of capabilities in various ways.

### 3.1.3. Digital Transformation in the Public Sector

The digital transformation (DT) of the public sector requires the adoption of digital technologies (mostly from Industry 4.0) to improve services and interactions with citizens [48]. DT has encountered several challenges in the transition to Society 5.0, including system integration (interoperability), public budget constraints, lack of technical skills, and potential cultural resistance to changes, among others. Additionally, digital transformation must be comprehensive, including both technological adoption and organizational transformations. To achieve this, it is essential to adopt agile development models, foster a culture open to innovation, improve collaboration among organizations, and encourage the active participation of external stakeholders, whether they are from the national territory or international. In the public sector, leadership is critical to achieving this transformation, thus establishing a clear and achievable vision and managing the inherent tensions in the digital transformation adoption process [49].

### 3.1.4. Strategic ICT Management

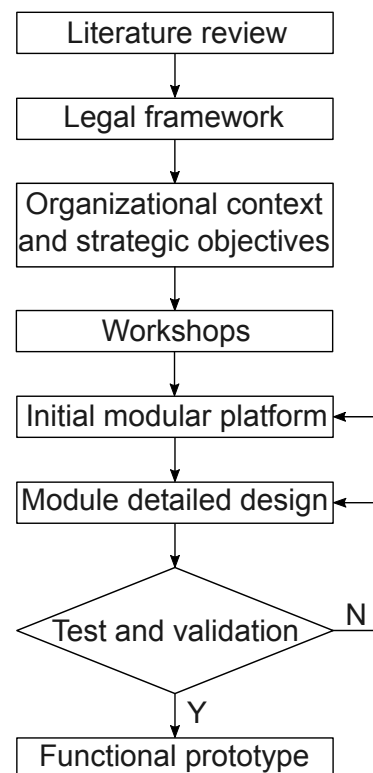
The strategic management of Information and Communication Technologies (ICT) can help achieve the organizational goals proposed in the DT process of any organization. In this sense, it is crucial to align the business strategy and Information Technology (IT), with the joint participation of top management and technology leaders in the country's context [40]. Analyzing the competitive environment and technological trends is crucial in identifying how ICT can provide a differential value in strategic management. In addition to having analytical planning, it is essential to adopt an agile approach that incorporates learning and experimentation into the management process [40]. Such planning and the dynamic capabilities resulting from the process allow for a swift adaptation of ICT and digital strategy in the public sector of the region.

### 3.1.5. Fiscal Control and New Technologies

Analyzing the competitive environment and technological trends is crucial in identifying how ICT can provide a differential value in strategic management. This is linked to the need of having analytical planning, which is essential to adopting an agile approach that incorporates learning and experimentation into the management process [40]. Such planning and the dynamic capabilities resulting from the process allow for a swift adaptation of ICT and digital strategy in the public sector of the region. To address these challenges, a strategic approach is needed to balance the opportunities of emerging technologies with the mitigation of their potential risks. This involves implementing data governance processes, promoting stakeholders' engagement, ensuring accountability, and maintaining proactive communication to build public trust in the DT of regulatory bodies [34]. Hence, a comprehensive strategic approach that blends analytical planning with adaptability is required to achieve an effective DT of regulatory entities. Specialized functional modules facilitate this blend. Furthermore, responsible governance of emerging technologies, such as artificial intelligence, is crucial for realizing their potential benefits in fiscal control, carefully balancing opportunities and risks [34]. The review of the literature on fiscal control and new technologies has revealed a research gap, indicating the need for further research on the ethical and inclusive use of these technologies in the public sector, especially in regions like Latin America.

### 3.2. Design Methodology

The design of the modular strategic platform for the DIARI, which is a specialized unit within the CGR responsible for collecting, analyzing, and responding to information related to its oversight and control functions, requires the use of rigorous techniques (Figure 2). In this work, qualitative and quantitative methods were used in a mixed approach, allowing for a detailed understanding of the organizational context of the DIARI and CGR in Colombia, including international references and integrating relevant technical and statistical data within the context of the platform.



**Figure 2.** Design methodology for strategic platform.

An extensive literature review of various technical articles and documents was initially conducted using databases such as Ebsco and SCOPUS. The search terms used within the search equations were reported in Section 2. The studies found through this review helped establish a theoretical and conceptual framework, essential for the appropriate advancement and development of the platform.

Subsequently, a review of the legal framework relevant to fiscal control in Colombia was conducted. This included a comparison with various international benchmarks to identify key elements to be included in the platform design. In addition, a practical project took place in Bogotá during September 2023, through a series of workshops with the DIARI and technology sector companies. These workshops allowed for the discussion of relevant legal topics related to the DT of the CGR in the national context.

#### 3.2.1. Workshops

The methodology of the workshops was based on the co-creation, open innovation, and design of thinking techniques and tools. This participatory and iterative approach allowed for the analysis and understanding of the current processes of the three DIARI units (Information Unit, Analysis Unit, and Immediate Reaction Unit), identifying areas for improvement and formulating proposals to optimize them.

The workshop began with a presentation of the context and challenges of the DIARI, laying the foundation for identifying critical areas of intervention. It encouraged reflection

on organizational culture and explored the role of current and emerging technologies as possible solutions to existing challenges. A thorough analysis of current technological tools was conducted, problem areas such as high staff turnover and deficiencies in integration and communication were identified, and a detailed vision of the workflow was presented.

The importance of the DIARI observatory (under development at the same time) and its integration into the strategic intelligence model was emphasized. Emerging technologies such as artificial intelligence, machine learning, and robotic process automation (RPA) were explored, and group discussions, case analyses, and a review of international examples of innovation were conducted.

The participants proposed creative solutions to the identified problems, which were then prototyped and refined into solid proposals to improve the DIARI's processes. Some of the proposals that emerged from the workshops include strengthening knowledge management, implementing an alert tracking system, optimizing the use of technological tools, establishing an observatory, and improving data quality management.

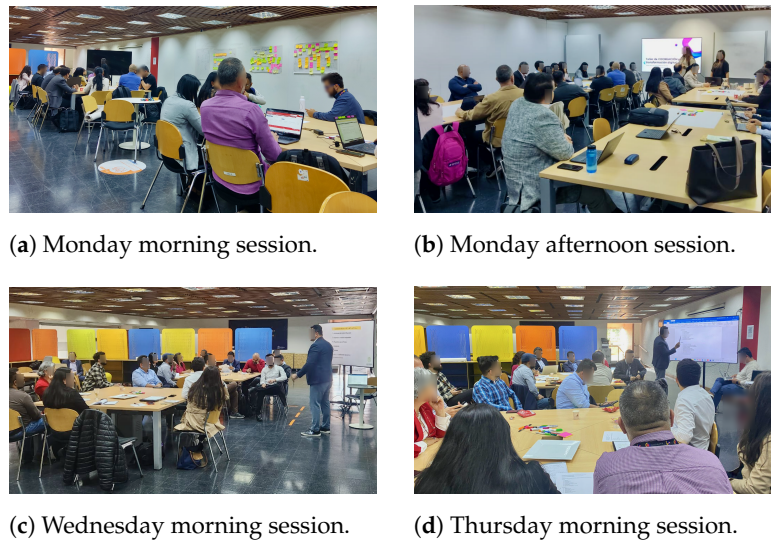
The workshop culminated with the presentation of the proposals to DIARI managers and the development of a detailed action plan for their implementation. Monitoring and evaluation mechanisms were established to ensure the effective implementation of the proposals and to measure the impact of digital transformation on the DIARI.

The co-creation workshops brought together a total of 66 participants, forming an interdisciplinary team that provided a diversity of perspectives and knowledge for the development of solid and successful proposals. This team included 35 DIARI officials from its three operational units, who contributed their internal knowledge and practical experience. In addition, 25 industry representatives participated, including experts in digital transformation, data management, information quality, strategic intelligence, surveillance, prospective methodologies, law, and innovation. These professionals contributed their experience and specialized knowledge to enrich the discussion and generation of ideas. There were also 6 representatives from academia, including researchers and professors from different universities, who contributed their theoretical and methodological knowledge to strengthen the co-creation process.

The co-creation workshops resulted in a list of 19 improvement proposals for DIARI, covering various areas from enterprise architecture and knowledge management to the implementation of emerging technologies and data quality improvement. The priority proposals were enterprise architecture, which seeks to establish a coherent and unified architecture in DIARI aligning technology and business processes with the company's strategy; data governance and management, which involves defining and executing policies, procedures, and responsibilities for the effective management of data in the organization; interoperability, which seeks to integrate different systems and applications to allow fluid communication and efficient data exchange; knowledge management, which aims to consolidate, organize, and facilitate access and transfer of key knowledge within DIARI; and strengthening data quality, which seeks to ensure the accuracy, consistency, and relevance of data through the implementation of quality rules and practices.

These priority proposals were selected for their relevance, feasibility, and potential impact on the digital transformation of DIARI. In addition, a detailed action plan was developed for their implementation, including activities, deadlines, and responsibilities, as well as monitoring and evaluation mechanisms to measure the progress and results of the digital transformation.

Figure 3 contains representative photographs of some of the co-creation workshop sessions which can be appreciated.



**Figure 3.** Photographs of the co-creation workshop sessions.

### 3.2.2. DIARI-Related Documents

To obtain a complete understanding of the organizational context and strategic objectives of the DIARI, several internal unit documents were thoroughly reviewed. These documents were fundamental in understanding the legal and operational framework, policies and procedures, and strategic objectives that guide the DIARI's operation at the national level within the CGR. Among the reviewed documents are Decree 2037 of 2019 [50], referred to as the DIARI creation, Decree 403 of 2020 [31], and the CGR Strategic Plan 2022–2026 [51], which provided a solid foundation for understanding the legal and strategic guidelines that support the DIARI. Additionally, crucial documents for the operation of the proposed platform were reviewed; for instance, “Operational Information Security Policies in the Operation of Information Management and Information Analysis Processes in DIARI” [52] and “Resolution 0072 of 2020” [53], which contains the procedure for obtaining information sources, the procedure for managing requests for analysis or cross-referencing information, and the procedure for developing analytical models in the DIARI.

To complement this information, work was conducted with the knowledge of technology experts and academics. These experts thoroughly discussed the legal and technical aspects relevant to the platform's design. Specific documents such as “Procedure for Formulating the Strategic Plan and Monitoring its Execution [54]”, “Procedure for Managing Requests for Analysis or Cross-Referencing Information in DIARI” [55], and “Procedure for Developing Analytical Models in DIARI” [56], were fundamental in outlining the necessary procedures and methodologies for the strategic platform proposal and the development of analytical models within the platform. Additionally, “Operations Management Procedure—Instruction Manual for Information Backups on Computers Used in the Information Management and Information Analysis Processes of DIARI” [57] was key in establishing the guidelines and responsibilities in information backup management. With the collected and analyzed information, a draft of the initial modular platform could be outlined, defining its objectives, functionalities, and necessary technologies, ensuring that this proposal aligned with the DIARI's strategic requirements and critical processes.

### 3.3. Strategic Platform Proposal

With the information gathered, a draft of the initial modular platform was outlined. This initial platform focused on defining the objectives, functionalities, and required technologies for each module connected to the strategy. In this phase, alignment with the strategic requirements, as well as the mission-critical and support processes of the DIARI, were considered. It was ensured that this proposal was in harmony with the general



strategy of the CGR, guaranteeing that the platform's elements accurately reflected the institutional needs and objectives.

After completing the conceptual proposal, a rigorous technical design process was carried out for each module, and specific technologies suitable for each module were selected. This process was conducted in close collaboration with the DIARI's technology infrastructure team, involving analysts and developers with extensive experience. In addition, decision matrices were used to evaluate technological options and concept tests and validation processes were performed to evaluate their feasibility.

With the technical design validated, the construction of a functional prototype for the six strategic modules proceeded. This prototype was tested by a diverse group of future DIARI users to gather feedback on usability and identify potential improvements. Additionally, comprehensive technical tests were conducted to assess the prototype's performance, stability, and scalability.

Finally, all documentation related to the conceptual and technical design of the modular strategic platform was consolidated into a technical report. This document underwent a thorough review by a committee of experts, both internal to the DIARI and external, who verified its technical accuracy and alignment with organizational needs.

#### 4. Results

The prototype of the strategic platform developed for the Directorate of Information, Analysis, and Immediate Reaction (DIARI) of the Comptroller General of the Republic (CGR) of Colombia incorporates an approach of six interconnected functional modules. Each one is designed to achieve specific strategic objectives through the integration of innovative information technologies. Figure 4 shows the six designed functional modules, their objectives, their key functionalities, and the technologies that can be adapted to them.

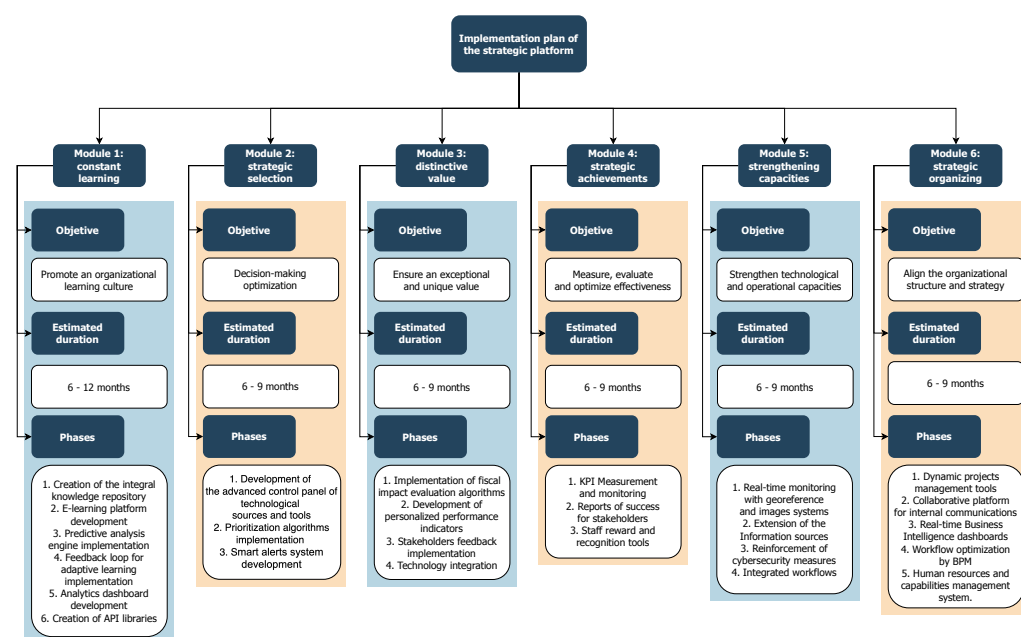


Figure 4. Strategic platform implementation plan.

##### 4.1. Module 1: Continuous Learning

**Aim:** to promote a culture of organizational learning that allows the DIARI to quickly adapt to changing conditions in fiscal and regulatory matters.

**Features:** the Comprehensive Knowledge Repository functions as a NoSQL database with advanced search capabilities provided by diverse search engines. This setup enables the structured and accessible storage of documentation, fiscal laws, case studies, and industry trends.

**E-learning platform:** the Learning Management System (LMS) is integrated with the Knowledge Repository to provide adaptive training to staff on fiscal fundamentals, use of data analysis tools, and programming.

**Predictive analysis engine:** machine learning algorithms implemented on diverse platforms are used to analyze patterns in fiscal data and predict potential irregularities and future trends.

**Feedback loop for adaptive learning:** real-time feedback systems and chatbots are implemented to collect staff evaluations on the effectiveness of implemented strategies and enhance learning processes.

**Analytical dashboard:** business intelligence tools are used to display organizational learning metrics, including staff performance and strategy effectiveness.

**API library:** a set of APIs is available to easily integrate with external systems and public databases, facilitating collaborative learning.

#### 4.2. Module 2: Strategic Selection

**Aim:** to optimize decision making in surveillance and fiscal control through an informed and dynamic selection of data sources and technological tools.

**Features:** the source and tool selection control panel is designed as a high-capacity user interface, currently implemented and developed using different tools, web development frameworks, and data query and manipulation languages, to efficiently select information sources and technological tools.

**Prioritization algorithms:** machine learning models are applied to historical metrics to identify areas prone to irregularities and prioritize actions.

**Smart alert system:** The back-end is developed in the cross-platform runtime environment, with the front-end using the bidirectional communication channel to send real-time notifications about significant changes in the fiscal environment. Open-source message brokering software is used for event management.

#### 4.3. Module 3: Distinctive Value

**Aim:** to ensure that the DIARI generates and delivers exceptional and unique value in its surveillance and fiscal control functions.

**Features:** for the fiscal impact assessment, machine learning algorithms and cost-benefit analysis are developed to estimate the impact of interventions and predict future benefits.

**Performance indicators:** customized Key Performance Indicators (KPIs) in real-time metric control dashboards are used to measure value generation and adjust strategies effectively.

**Stakeholder feedback:** stakeholders' perception classification systems based on natural language processing (NLP) are implemented to assess perception among citizens and stakeholders.

**Technology integration:** data consolidation in data lakes, the use of APIs, and security technologies are carried out to enable advanced analysis and protect information.

#### 4.4. Module 4: Strategic Achievements

**Objective:** to measure, evaluate, and optimize the effectiveness of the DIARI's operations in its mission of surveillance and fiscal control.

**Functionalities:** for KPI measurement, relevant KPIs are configured, and online analytical processing (OLAP) is implemented to consolidate data and facilitate multidimensional analysis.

**Report generation:** data visualization software like Tableau and Power BI is used for the interactive creation of reports and dashboards that assess progress towards strategic objectives.

**Recognition tools:** an incentive and gamification system linked to performance KPIs is implemented to motivate and reward staff.

**Enabling technologies:** Big Data analytics, cloud computing, and APIs such as RESTful and blockchain are used to ensure scalability, data integrity, and traceability.

#### 4.5. Module 5: Capacity Building

**Objective:** to strengthen technological, analytical, and operational capabilities for effective real-time monitoring and information integrity.

**Functionalities:** for georeferenced monitoring, geographic information systems (GISs), IoT sensors, and image processing are integrated for real-time tracking of fiscal projects.

**Expanding information sources:** API connectors, web scraping techniques, and machine learning are used to classify and evaluate new external data sources.

**Reinforcing cybersecurity:** multi-factor authentication, data encryption, and SIEM systems are implemented for threat detection and response.

**Integrated workflows:** coordination between the Information, Analysis, and Immediate Reaction Units for the acquisition, analysis, and efficient use of data.

#### 4.6. Module 6: Strategic Organization

**Objective:** to align strategy and organizational structure for efficient and effective execution of surveillance and fiscal control responsibilities.

**Functionalities:** agile project management allows for flexibility and adaptability to environmental needs. Traditional project management offers more detailed planning and a solid methodology. Hybrid project management techniques are used for complex issues, merging elements from both agile and traditional methodologies to enhance their strengths in organizational development.

**Internal communication:** an encrypted corporate collaborative platform is used for secure communication, including instant messaging and video conferencing.

**Management dashboards:** business intelligence tools are used for the integration of data and real-time metrics, facilitating decision making.

**Process automation:** Business Process Management (BPM) software and business rules are used to optimize and enhance the efficiency of internal workflows.

**Talent management:** a system for tracking staff skills and competencies, allowing for better alignment with project requirements.

Together, these six functional modules are the core components of the strategic platform developed for the DIARI. Through their implementation, the DIARI will be able to leverage advanced technologies in data analytics, artificial intelligence, information security, and strategic collaboration. This will enable this CGR's unit to become a benchmark for innovation in smart fiscal control and public resource management in Colombia and Latin America.

The effective integration of these functional modules will provide DIARI with a more robust and adaptable platform, significantly improving its ability to make informed strategic decisions. By working in coordination, these components will ensure agile and secure access to relevant data, facilitate the generation of predictive insights, and optimize internal processes. The successful implementation of this strategic platform will not only increase operational efficiency but also improve the oversight of public resources and strengthen transparency in fiscal control processes. This will establish the DIARI as a key player in promoting exemplary governmental practices, raising its profile both nationally and regionally in the responsible management of public resources.

Finally, the modular strategic platform designed through a co-creation process with the DIARI provides a viable roadmap for the entity to face the challenges of digital transformation in the coming years of development and growth of smart cities. Although there are significant challenges to overcome, particularly in terms of training and change management, the proposed approach enables an agile, adaptable, and financially sustainable implementation. This platform will serve as the foundation for the DIARI to establish itself as a model entity in innovation for fiscal control in Latin America. To detail its strategic architecture, Figure 5 shows a conceptual map that has been created. This map contains the relationships between the pillars of the Emerging Strategy, mission-critical processes, strategic platform modules, and support processes.

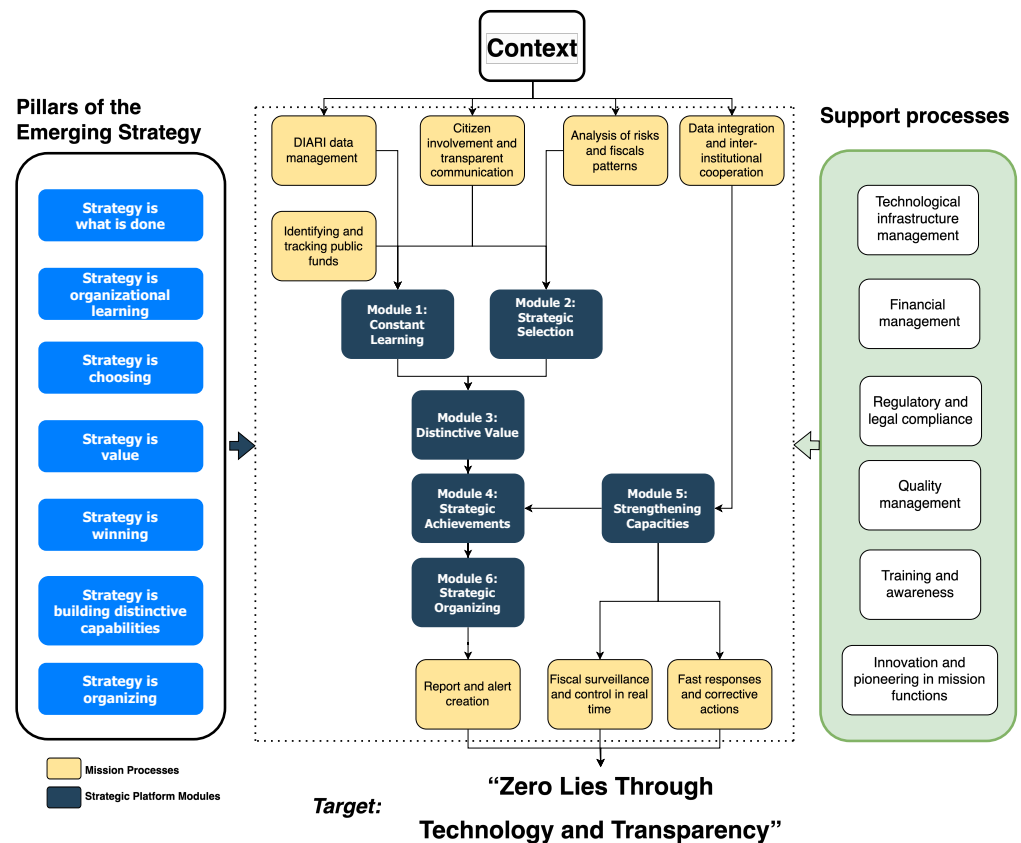


Figure 5. DIARI strategic architecture and modules' workflow.

Figure 5 also shows the workflow within the platform modules. The integration of these mission-critical and strategic modules in DIARI's strategic platform presents multiple key benefits, significantly improving public expenditure oversight and organizational efficiency. This integration has enabled real-time monitoring and has increased early detection of irregularities, providing greater transparency in the management of public data and resources. Figure 6 shows the comparison, for the same period of time in 2023 and 2024, of the number of alerts generated by the DIARI [58]. It can be observed that the number of alerts increased in all months, for a total increase of 29% in the three months of analysis. This clearly shows that the platform is working to detect irregularities in fiscal control processes of the CGR, which have migrated to a preventive and concomitant model. The mission-critical modules, which include the management of technological infrastructure, innovation in mission-critical functions, training, quality management, regulatory compliance, and financial management, ensure that daily operations are efficient and adaptive.

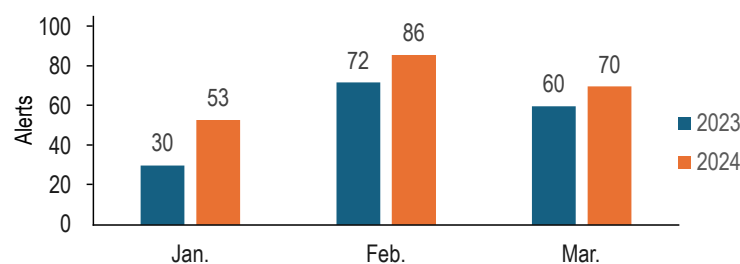


Figure 6. Alerts generated by the DIARI. Comparison for the same period 2023–2024.

By being aligned with the strategic modules, such as continuous learning, strategic decision making, distinctive value creation, strategic achievements, capacity build-

ing, and strategic organization, operational coherence is fostered, enhancing the organization's ability to quickly adapt to environmental changes, continuously improve, and achieve its strategic objectives sustainably. Additionally, the integration facilitates interdisciplinary collaboration, optimizes internal processes through automation, and strengthens information security.

## 5. Discussion

The findings of this research process indicate that the proposal of a modular strategic platform is a promising solution to strengthen the DIARI to address the challenges of its digital transformation and technological modernization process at the national level. Through a participatory approach, which included a series of workshops with the entity's staff and the application of foresight methodologies with experts in technological innovation, it was possible to design a functional module architecture aligned with both the current needs and the future vision of the DIARI.

One of the main strengths of the developed strategic platform lies in its adaptability. Being structured in independent but interconnected modules, it allows for a gradual implementation, enabling the progressive incorporation of new capabilities without compromising existing functionalities. This significantly reduces the risks associated with large-scale digital transformation projects in public sector entities.

Another positive aspect of the developed platform, due to its modularity, is that it facilitates change management within the organization. Modules can be implemented sequentially, allowing teams to gradually adapt to new processes and technologies. Furthermore, the approach based on functional modules encourages greater interdisciplinary collaboration among areas such as technology, operations, and strategy.

Regarding the technologies proposed for each module, the focus has been on scalable, open-source solutions based on standards. This strategy is advantageous because it minimizes licensing costs, reduces dependence on specific vendors, and facilitates the integration of key elements for effective implementation. Furthermore, the adoption of flexible architectures, such as microservices and containers, will allow the DIARI to quickly adapt its systems to new demands and technological trends.

Compared to previous studies on digital transformation in public expenditure control entities, this proposal for a strategic platform for the DIARI presents several innovative elements and stands out as a pioneering initiative in the sector and in the Colombian context. Incorporating cutting-edge technologies such as artificial intelligence, machine learning, and blockchain represents the innovative core of this proposal and is essential for its successful implementation.

Regarding the field of smart governance, by using cutting-edge technologies, this platform not only addresses the current needs of public fiscal control but also sets a benchmark for future implementations in other countries pursuing digital transformation. The participatory approach and modular design ensure that the platform is adaptable and scalable, making it a case study model for other developing nations aiming to enhance their public administration capabilities. This strategic platform uses technological innovation and promotes greater citizen participation and transparency, aligning with the broader goals of smart city initiatives and Society 5.0. It demonstrates how advanced digital tools can be integrated into the supervision of the execution of public resources to promote economic growth, enhance trust in public institutions, and actively engage citizens in governance processes, thus contributing to a more equitable and efficient society.

Nonetheless, the design of the strategic platform also has some limitations and drawbacks that must be addressed during implementation. A key aspect is the need to strengthen the DIARI's internal capabilities, both in terms of human resources and infrastructure. Overcoming these limitations is crucial and involves hiring highly qualified personnel, training existing staff within the organization, and budgeting for and investing in the improvement of networks, computers, and security systems to support the platform. Additionally, proper



data governance and organizational change management will be ongoing and constant challenges throughout the operation time of the strategic platform.

The design of this strategic platform for the DIARI of the CGR is of significant importance both for smart cities and Society 5.0. In the context of smart cities' definitions, the efficient management of public expenditure is expected for the sustainable development of citizen-centric services. Since the strategic platform uses modern technologies and data analytics, the CGR can enhance transparency, accountability, and decision making processes related to public expenditure. In the broader context of Society 5.0, where technologies are in the service of society to enhance human capabilities, such a six-module platform empowers citizens by providing access to information, enhancing trust in public institutions, and facilitating active participation in governance processes.

## 6. Conclusions

This work addressed the design of a strategic modular platform for the smart supervision of public expenditure in Colombia. Considering that an entity can provide society with goods and services to meet emerging technological and social needs of the environment, especially in a context where any individual can easily access high-quality services and information [12] regardless of their geographic location, the integration of smart technologies in the supervision of public spending aligns with the vision of the CGR. This enables more efficient and transparent management of state resources in Colombia; an example of this has been given since the start of the operation of the strategic platform in 2024, provided that in an initial period of three months, the DIARI increased the number of alerts generated by 29%.

The strategically designed platform can be considered a turning point in DIARI's operations, positioning it at the forefront of regional use of advanced technologies for fiscal control and smart supervision. The six interconnected functional modules create a comprehensive and adaptable structure that efficiently integrates technological solutions contributes to the transition from Industry 4.0 to Industry and Society 5.0.

This technological approach not only aims to ensure the availability of goods and services but also to guarantee an equitable and timely distribution of these resources to meet diverse social needs, thus marking genuine progress toward Society 5.0 in developing countries like Colombia. Thus, the convergence between the vision of an inclusive society and the implementation of smart tools in public spending control lays the foundation for advancing towards a more precise and effective resource management. This aligns with the vision of a robust and equitable society through the implementation plan and design of the strategic platform in the case of the DIARI of the CGR.

Once implemented successfully, this plan will transform the DIARI's ability to protect public resources and combat corruption. The functionalities of real-time monitoring, early detection of irregularities, predictive risk analysis, and process optimization represent quantitative and qualitative leaps in fiscal control. Beyond technical capabilities, this project will position the DIARI as a leader in the transparent, ethical, and effective use of cutting-edge technologies for collective well-being. The strategic platform will solidify the institution's commitment to responsible innovation and become an international model of fiscal control for Society 5.0 and smart cities.

**Author Contributions:** Conceptualization, J.A.R.-C., D.A.F., M.S.G., C.A.E., J.S.-P. and R.E.V.; methodology, J.A.R.-C., D.A.F. and M.S.G.; validation, J.A.R.-C., J.C.Z., R.M.V., O.M., Á.M.H., J.S.-P. and R.E.V.; formal analysis, J.A.R.-C., D.A.F., M.S.G., C.A.E., J.S.-P. and R.E.V.; investigation, J.A.R.-C., J.C.Z., R.M.V., D.A.F., M.S.G., L.L., G.G., O.M., Á.M.H., C.A.E., J.S.-P. and R.E.V.; writing—original draft preparation, J.A.R.-C., D.A.F., M.S.G., L.L. and G.G., writing—review and editing, J.A.R.-C., J.S.-P. and R.E.V.; supervision, J.A.R.-C., J.C.Z., R.M.V., C.A.E., J.S.-P. and R.E.V. All authors have read and agreed to the published version of the manuscript.

**Funding:** This work was developed with the funding of Contraloría General de la República (CGR) and Universidad Nacional de Colombia (UNAL) in the frame of Contract CGR-373-2023, with the support of Universidad Pontificia Bolivariana (UPB).

**Data Availability Statement:** Data are available on request from the authors.

**Conflicts of Interest:** The authors declare no conflicts of interest.

### Abbreviations

The following abbreviations are used in this manuscript:

AI	artificial intelligence
CGR	Contraloría General de la República (Office of the Comptroller General of the Republic)
DIARI	Directorate of Information, Analysis, and Immediate Reaction of the CGR
DT	digital transformation
ICTs	Information and Communication Technologies
IoT	Internet of Things (IoT)
IT	Information Technology
KPI	Key Performance Indicator

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