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Strategic Innovation: Integrating System Dynamics into Management Control

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Abstract

This article explores the concept of strategic innovation, with a focus on its integration with system dynamics in the field of management control. By examining the synergies between these two domains, the article proposes innovative perspectives to enhance decision-making processes and overall business management. The authors highlight the benefits of adopting a systemic approach in management control, emphasizing how it can foster a deeper understanding of complex interactions within organizations. Practical case studies illustrate how this integration can lead to significant innovations, providing managers with valuable tools to navigate in an ever-evolving business environment. Ultimately, the article underscores the strategic importance of merging systems thinking with management control to promote more effective, resilient, and future-oriented business management.

Keywords: *Strategic Innovation, System Dynamics, Management Control, Innovation Strategy, Organizational Dynamics, Dynamic Capabilities.*

Introduction

Strategic innovation, at the heart of contemporary organizational concerns, emerges as a major imperative for their survival and growth (Porter, 1990; Teece, 2018). In this dynamic, the integration of system dynamics into management control emerges as a strategic lever, offering an innovative framework to understand the complexity of constantly evolving organizational environments (Forrester, 1961; Senge, 1990). The rapid evolution of markets, technological advancements, and societal changes have profoundly transformed traditional paradigms of strategic management. Classical approaches to management control often appear insufficient to guide organizations through these tumultuous times. In this context, strategic innovation emerges as an essential catalyst, emphasizing the ability to anticipate, adapt, and create value (Tushman & O'Reilly, 1997; Christensen, 1997). This literature review aims to delineate the theoretical and empirical boundaries of the intersection between strategic innovation and the integration of system dynamics into management control. It seeks to synthesize existing knowledge, identify emerging trends, and highlight current gaps in understanding this convergence. In doing so, it aspires to contribute to the construction of a solid conceptual foundation for understanding the complex dynamics that contemporary organizations face. Given the market volatility and the need for increased agility, how can organizations integrate system dynamics into their management control mechanisms to foster and support strategic innovation? This fundamental question guides our exploration throughout this review. The significance of this research lies in its ability to shed new light on how organizations can navigate increasingly complex environments. Understanding how the integration of system dynamics into management control can

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enhance strategic innovation becomes crucial in an era where rapid adaptability is often synonymous with competitiveness (Eisenhardt & Martin, 2000; Pisano, 2015).

To achieve these objectives, our literature review will rely on a rigorous methodology, including a systematic analysis of articles from academic databases such as Scopus. This approach will allow us to delve deeply into the most recent and relevant works on the subject while ensuring a solid foundation for our conclusions. This literature review will be structured into two distinct parts. The first part will focus on the literature review, introducing the concept of strategic innovation, the second will explore system dynamics in the management context, while the third will delve into the role of management control in organizations, followed by an analysis of previous attempts to integrate system dynamics into management control, and then a section examining specific interactions between these two domains. The second part will focus on the research methodology, including qualitative and quantitative studies, as well as a discussion of the results.

Literature Review

Bibliometric Network Visualization of literature of strategic innovation and dynamic system management

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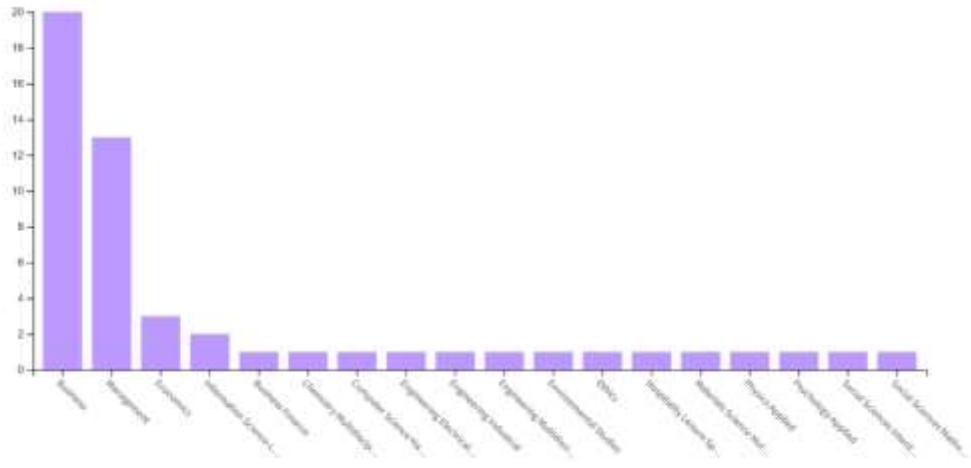
Bibliometric analysis serves as a powerful tool for visualizing the landscape of scholarly research, offering a suite of maps that delineate the intricate web of intellectual dialogue and collaboration. Co-citation maps are particularly illuminating; they display the frequency with which publications or authors are jointly cited, thereby revealing the intertextual conversations that drive scholarly discourse. In these maps, clusters emerge, signifying distinct sub-themes or research communities, each demarcated by the size of their nodes—a metric indicative of the volume of co-citations. The proximity of these nodes to one another further denotes the thematic affinities between research areas. Collaboration maps expand the scope of analysis, laying bare the networks of cooperation between authors, institutions, or nations. Such maps are instrumental in tracing the collective efforts that underpin advancements in strategic innovation, with each link between nodes marking the presence of collaborative endeavors. Lastly, term maps distill the terminological core of a research corpus, spotlighting the most prevalent terms tied to the search query. The recurrence of specific terms serves as a testament to the prevailing concepts within the field, while the clustering of these terms may disclose underlying sub-themes or emergent trends in the discourse. Together, these bibliometric maps provide a multifaceted overview of the dynamics shaping scholarly research, enabling a systematic apprehension of the field's structural and thematic intricacies.

Graph 1. The Number of Publications or Citations Per Discipline Over the Period 2000 To 2024.



Elaborated by authors

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The interpretative utility of bibliometric analysis is encapsulated in the elucidation of graph axes, with the vertical (Y) axis quantifying the scholarly output as it represents the number of publications or citations within each categorial delineation. Commencing at zero, the scale ascends, with the most prolific category surpassing the count of 20. Contrastingly, the horizontal (X) axis functions as a disciplinary spectrum, extending from "Business" to "Social Sciences Mathematical Methods," categorizing the analyzed corpus. The histogram interpretation unfolds a narrative of disciplinary prominence and interconnection. For instance, "Business" stands as the preeminent category, its bar exceeding 20, suggesting a dominion of business studies within the research purview. "Management" trails with a count proximal to 13, underscoring its significant, albeit lesser, scholarly contribution. Such graphical representation illuminates not only the hierarchies of research volume but also the interdisciplinarity within strategic innovation, with disciplines such as "Economics" and "Information Science Library Science" marking notable, if less voluminous, contributions. Conversely, shorter bars representing areas like "Ethics" and "Physics Applied" intimate these fields' peripheral association with the central theme. These variations in bar heights offer insights into the relative weight of each discipline, articulating the diverse academic dialogues that collectively constitute the thematic fabric of strategic innovation. Moreover, the presence of disciplines with minimal publications may signify nascent or niche areas poised for future academic exploration and expansion.

Graph 2. Visualisation of the Distribution of Research Fields or Disciplines

Elaborated by authors

The contextual analysis of the bibliometric mappings illuminates 'Business' as the domain of preponderance, suggesting its pivotal role as the crucible of strategic innovation discourse. Such a finding posits the innovation strategy squarely within the ambit of business studies, foregrounding the preoccupation with corporate practices and business model innovation. The graphic evidence of interdisciplinary collaboration, as manifest in the substantive presence of disciplines such as "Management," "Economics," "Information Science Library Science," and "Social Sciences Interdisciplinary," underscores a rich tapestry of scholarly exchange that transcends traditional academic silos. The nuanced contributions of "Ethics" and "Physics Applied," though less pronounced, punctuate the research landscape as potentially vital niches or as harbingers of emergent research trajectories. The implications of this analysis for management are nontrivial; the primacy of 'Business' and 'Management' in the discourse suggests a significant impact on both theory and praxis within organizational settings. The strategic innovation paradigms emanating from these fields are likely shaping new contours of managerial thought and organizational dynamics. Moreover, there is an invitation implicit in the data to integrate knowledge from less represented yet pivotal domains, like 'Ethics' or 'Psychology Applied.' Such integration promises to augment the understanding of strategic innovation, offering a more holistic, ethically informed, and psychologically nuanced view that could potentially refine strategic orientation and decision-making processes within the organizational milieu. This bibliometric portrait, thus, does more than delineate the

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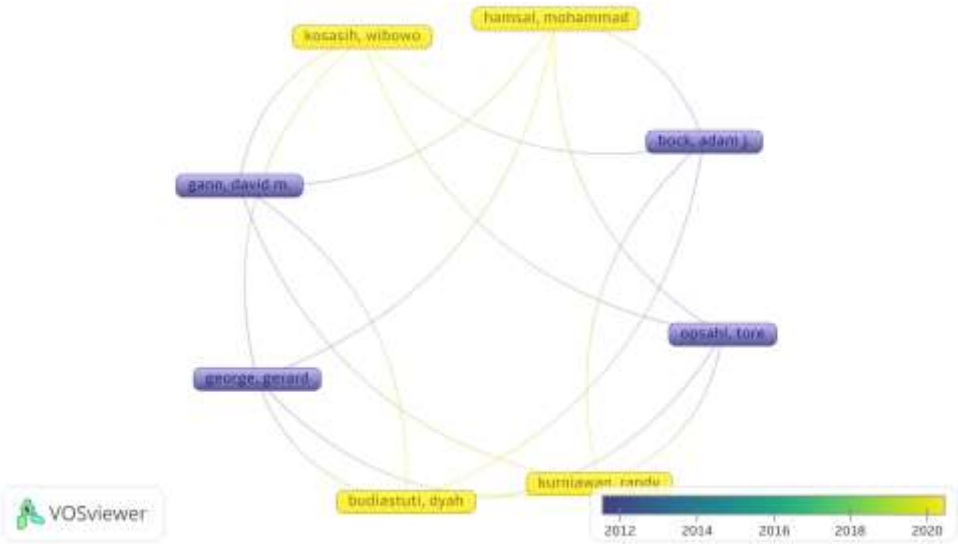
current state of research; it offers a prognostic lens into the evolving dynamics of strategic innovation and its multi-dimensional impact on management scholarship and practice.

Graph 3. Visualising A Network of Co-Authors



Elaborated by authors

In the domain of bibliometric network analysis, nodes serve as pivotal indicators, each symbolizing an author within the complex web of scholarly research. The dimensionality of a node is reflective of an author's scholarly output or influence, indicated by the volume of their publications or the frequency of citations accrued, contingent upon the analytic parameters set within VOSviewer. The chromatic representation of nodes may convey additional metadata, such as the temporal span of an author's contributions or their affiliation with specific collaborative clusters. Inter-author collaboration is elegantly depicted through the connective lines that forge the network's topology; the breadth of these lines is proportional to the intensity of co-authorship, delineating the depth of collaborative ties.

The dissection of temporal dynamics within this bibliometric framework yields insights into the collaborative ethos of the field. Authors exemplified by nodes with central placement, such as "gann, david m." and "george, gerard," may hold influential positions within the research network, potentially acting as nodal points for extensive collaboration or serving in mentoring capacities. Those affiliated with nodes shaded towards the cooler end of the spectrum, like "opsahl, tore" or "kurniawan, randy," could be indicative of burgeoning influence or recent induction into the field's academic dialogue. The architecture of the collaboration network—etched out by the presence or absence of lines—reveals the patterns of partnership and scholarly interdependence. The absence of a line signifies a lack of joint publications between authors, whereas a pronounced line highlights a history of frequent collaboration. Such visual analytics provide a narrative not only of the current state of scholarly interactions but also of the evolution and progression of research alliances over time.

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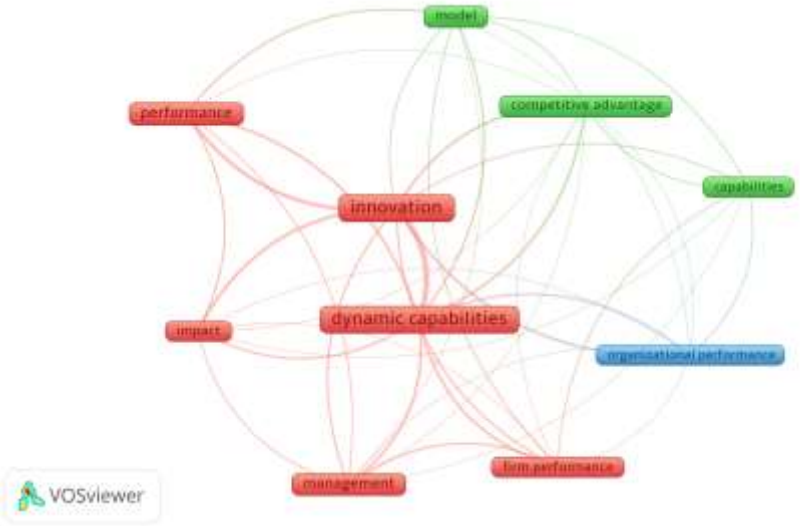
Graph 4. A Keyword Co-Occurrence Map



Elaborated by authors

The relational dynamics within the research corpus are poignantly captured through clusters that emerge in the bibliometric analysis. The Red Cluster, enmeshing terms such as "performance," "innovation," "impact," "dynamic capabilities," and "management," intimates a robust interlinkage. This suggests a prevalent discourse in the literature wherein innovation is intrinsically linked to performance, with such discussions often couched within the frameworks of dynamic capabilities and management. The Green Cluster binds the terms "model," "competitive advantage," and "capabilities," reflecting a recurring association within the academic narrative that postulates theoretical models of capabilities as essential precursors to competitive advantage. Conversely, the Blue Cluster, albeit smaller, unites "firm performance" and "organizational performance," hinting at a specialized research focus on the assessment and determinants of performance at the organizational echelon.

In analyzing and reflecting upon these findings, the pivotal role of "dynamic capabilities" is underscored by its central position within the network, suggesting its recognition as a fundamental construct in the domain of strategic innovation research. The nexus between "innovation" and "performance" emerges as a thematic fulcrum, with the former posited as a critical driver of the latter, underscoring the importance of innovative processes in augmenting performance metrics. Moreover, "competitive advantage" is often portrayed as a consequence of leveraging "capabilities" and "models," illustrating a research inclination towards understanding how the strategic application of capabilities and conceptual models can be translated into a competitive edge in the market. This analysis not only explicates the thematic concentrations within the field but also mirrors the intellectual contours shaping the discourse on strategic innovation, capabilities, and organizational performance.

Concept of Strategic Innovation

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Definition and Dimensions of Strategic Innovation

Strategic innovation lies at the intersection of corporate strategies and the innovation process. According to Christensen and Bower (1996), it can be defined as the successful implementation of innovative, value-creating solutions that enable an organization to gain a sustainable competitive advantage. This concept extends beyond mere product development to encompass profound changes in business models, operational processes, and even organizational culture (Tidd & Bessant, 2014).

The dimensions of strategic innovation manifest across several axes. Firstly, it can be technology-oriented, impacting products, services, or internal processes (Danneels, 2002). It can also be market-oriented, involving changes in customer relations, distribution channels, or target segments (Johnson & Scholes, 2002). Finally, strategic innovation can occur at the organizational level, influencing structure, culture, and management systems (Tushman & Anderson, 1986).

Evolution of Theories and Models Related to Strategic Innovation

The evolution of theories and models related to strategic innovation reflects companies' constant adaptation to their environmental dynamics. Initially focused on technological innovation, theories have evolved to incorporate a broader perspective. Schumpeter (1942), with his theory of creative destruction, marked the beginning of recognizing innovation as an essential driver of economic progress.

In recent years, theorists like Chesbrough (2003) introduced the concept of open innovation, emphasizing the importance of external collaborations in the innovation process. The approach of frugal innovation, popularized by Radjou and Prabhu (2015), has also emerged, highlighting value creation with limited resources.

More recently, the model of ambidextrous innovation, developed by O'Reilly and Tushman (2011), proposes a balanced approach between exploiting existing competencies and exploring new opportunities. These developments reflect the necessity for companies to maintain a delicate balance between seeking operational efficiency and the constant pursuit of new ideas and approaches.

Dynamic Systems and Management

Foundations of Dynamic Systems

Dynamic systems, conceptualized by Jay W. Forrester in the 1950s and formalized in his seminal work "Industrial Dynamics" in 1961, offer a powerful theoretical framework for understanding and modeling complex causal relationships within a system (Forrester, 1961). This approach is based on the principle that structures and interactions within a system significantly influence its dynamic behavior over time.

The fundamental concepts of dynamic systems include feedback loops, stocks, and flows. Feedback loops represent regulation or amplification mechanisms within the system, while stocks and flows describe the accumulation and flow of quantities within the system (Sterman, 2000).

Application of Dynamic Systems in Management Context

The application of dynamic systems in the management context provides a powerful means to model and understand the complex dynamics organizations face. Senge (1990), in his work "The Fifth Discipline," popularized the use of dynamic systems as a tool to address systemic issues and promote organizational learning.

In management, dynamic systems can be applied to model phenomena such as business growth, product life cycles, or supply chain dynamics. For example, Sterman (2000) used dynamic systems models to explore the impacts of strategic decisions on organizations' long-term financial performance.

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The use of dynamic systems in management allows for consideration of the complex interdependencies between different parts of an organization and simulating the long-term consequences of decisions made. It offers a holistic perspective that goes beyond traditional linear models, enabling managers to anticipate the repercussions of their actions on organizational performance.

Management Control in the Context of Strategic Innovation

Importance of Management Control

Management control plays an essential role in organizations, providing a structured framework for planning, coordination, and monitoring activities to achieve strategic objectives (Simons, 1990). According to Kaplan and Norton (1992), management control goes beyond mere financial monitoring, encompassing operational performance measurement, risk management, and alignment of activities with organizational strategy.

In a context of strategic innovation, management control becomes even more crucial as it enables channeling resources toward innovative initiatives while maintaining a consistent trajectory with long-term strategic objectives (Simons, 1995). It becomes a key tool for balancing the exploitation of existing activities and the exploration of new opportunities (O'Reilly & Tushman, 2004).

Specific Challenges Related to Management Control in a Context of Strategic Innovation

• *Measuring Innovative Performance*: Measuring performance in a context of strategic innovation presents particular challenges. Traditional outcome-focused measures may not fully capture the value created by long-term initiatives (Bisbe & Otley, 2004). It becomes crucial to integrate non-financial indicators, such as innovation capacity, organizational flexibility, and customer satisfaction.

• *Risk and Uncertainty Management*: Strategic innovation is often associated with high levels of uncertainty and risk. Control systems must be able to proactively identify, assess, and manage these risks (Simons, 1995). Control models must be flexible enough to adapt to rapid changes and unforeseen events.

• *Strategic Alignment*: Strategic innovation requires close alignment between the company's overall strategy and specific innovation initiatives. Control systems must ensure that resources are allocated in line with the strategy while allowing the necessary flexibility to adjust the strategic trajectory in response to unforeseen opportunities or threats (Simons, 2000).

• *Fostering an Innovation-Friendly Environment*: Management control must promote an organizational culture conducive to innovation. This involves recognizing innovative efforts, tolerance for failure, and promoting a learning-oriented mindset (Govindarajan & Trimble, 2005). Control systems must support calculated risk-taking necessary for innovation.

This structured review aims to provide a comprehensive understanding of the intersection between strategic innovation and the integration of dynamic systems in management control. Through rigorous methodology and exploration of recent literature, it seeks to contribute to a solid conceptual framework for navigating the complex dynamics contemporary organizations face.

Integration of Dynamic Systems in Management Control

Current State of Research on this Integration

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The integration of dynamic systems into management control represents a burgeoning field of research, characterized by an increasing exploration of potential synergies between these two disciplines. Recent works highlight the importance of combining understanding of an organization's internal dynamics with traditional control tools to promote strategic and adaptive management.

Some studies (Geissler & Geißler, 2020) have focused on using simulation models based on dynamic systems to assess financial and operational performance in contexts of strategic innovation. These research efforts underscore the advantage of a holistic approach, allowing for modeling the complex interactions among different components of an organization.

Existing Conceptual Frameworks and Reference Models

• *Senge's Strategic Framework*: Peter Senge, in his work "The Fifth Discipline" (1990), introduced the concept of "Systemic Thinking" in management. His framework emphasizes the necessity of adopting a systemic perspective to understand interconnections and feedback loops among different parts of the organization. It suggests that this systemic thinking is crucial for strategic innovation and decision-making.

• *Simons' Contingency Model*: Robert Simons, in "Levers of Control" (1995), proposes a control model based on four levers, some of which can be adapted to incorporate dynamic systems. The diagnostic lever, for instance, could be used to assess performance through dynamic simulation models, thus providing a deeper understanding of the long-term implications of strategic decisions.

• *Ambidextrous Innovation Approach*: O'Reilly and Tushman (2004) developed the concept of ambidextrous innovation, highlighting the need for organizations to balance exploiting their existing competencies with exploring new opportunities. Integrating dynamic systems into management control can support this approach by allowing continuous evaluation of the long-term impacts of managing resources and innovative activities.

• *Dynamic Simulation Models*: Researchers like Sterman (2000) have explored the use of dynamic simulation models in the context of management control. These models enable simulating the impact of decisions on long-term organizational performance, providing a powerful tool for informing strategic choices and management control.

Synthesis and Gaps in the Literature

Synthesis of Key Findings from Examined Scopus Articles

The literature review based on examined Scopus and Web of Science articles reveals several crucial findings regarding the integration of dynamic systems into management control in the context of strategic innovation.

• *In-Depth Understanding of Complex Interactions*: Recent research, such as that by Geissler and Geißler (2020), emphasizes the importance of an in-depth understanding of complex interactions within organizations. Integrating dynamic systems offers a holistic perspective, enabling modeling and understanding of often overlooked feedback loops and interdependencies in traditional management control approaches.

• *Strengthening Organizational Agility*: Examined articles highlight the potential of integrating dynamic systems to enhance organizational agility (O'Reilly & Tushman, 2004). This approach allows organizations to quickly adjust their business models and processes in response to changes in the environment, thereby promoting better adaptation to the challenges of strategic innovation.

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• *Improving Strategic Decision-Making*: Dynamic simulation models, mentioned by Sterman (2000), emerge as promising tools for enhancing strategic decision-making. They enable managers to test different strategies and scenarios, thus shedding light on the long-term consequences of operational and strategic choices.

Identification of Gaps in the Literature and Research Opportunities

Despite advancements, significant gaps remain in the literature, offering stimulating opportunities for future research.

• *Lack of Integrative Models*: While conceptual frameworks have been proposed, there is a need for concrete integrative models that guide the practical implementation of integrating dynamic systems into management control. Future research could focus on developing applicable models, taking into account the specifics of various sectors and organizational sizes.

• *Impact on Organizational Culture*: Few studies have explored the impact of integrating dynamic systems on organizational culture. Understanding how this integration influences behaviors, attitudes, and resistance to change within organizations represents a significant gap to explore (Senge, 1990).

• *Measuring Innovative Performance*: Evaluating performance in a context of strategic innovation remains a challenge. In-depth research is needed to develop relevant performance indicators that capture the effectiveness of long-term innovative initiatives (Bisbe & Otley, 2004).

• *Adaptability of Control Models:* The adaptability of management control models in constantly evolving environments remains an unresolved issue. Future studies could explore how to design control systems that are both stable and flexible, promoting innovation while maintaining a balance with established strategic objectives (Simons, 1995).

Empirical Part

Research Methodology

Choice of Methodological Framework

For this research on the integration of dynamic systems into management control in the context of strategic innovation, a mixed methodological approach will be adopted. This approach will combine qualitative and quantitative elements to leverage the inherent strengths of each method, thus offering a holistic understanding of the studied phenomenon (Creswell & Creswell, 2017).

Justification for Using a Qualitative and Quantitative Approach

Qualitative Approach:

• *Contextual Understanding*: A qualitative approach, based on semi-structured interviews and content analysis, will be used to gain an in-depth understanding of experiences, perceptions, and practices related to the integration of dynamic systems into management control. This approach will capture the nuances of organizational context and human interactions (Creswell & Creswell, 2017).

• *Exploration of Perceptions*: In-depth interviews with practitioners, managers, and decision-makers will explore their perceptions, challenges, and successes related to this integration. Qualitative data will provide rich insights into organizational dynamics often challenging to quantify.

Quantitative Approach

• *Performance Analysis*: A quantitative approach, through surveys or questionnaires, will be used to collect data on organizational performance related to the integration of dynamic systems into management

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control. This will include financial indicators, operational efficiency measures, and results related to strategic innovation.

• *Modeling Interactions*: Dynamic systems simulation models will be used to quantify the complex interrelations among key variables identified in the literature. These models will help assess the potential impacts of management control interventions on organizational performance.

Implementation of Mixed Approach

Qualitative Phase

• *Participant Selection*: Strategic selection of participants, including senior executives, managers, and employees involved in the integration process, will be conducted.

• *Semi-Structured Interviews*: Semi-structured interviews will be conducted to explore deeply the experiences, perceptions, and practices related to the integration of dynamic systems into management control.

Quantitative Phase

• *Questionnaire Design*: A structured questionnaire will be developed based on variables identified in the literature review. Questions will be tailored to measure organizational performance, key stakeholders' satisfaction, and other quantifiable indicators.

• *Questionnaire Distribution*: The questionnaire will be distributed to a representative sample of the organization, covering various hierarchical levels and departments.

Analysis and Integration:

• *Qualitative Data Analysis:* Qualitative data will be analyzed using methods such as content analysis, allowing for the identification of recurring themes and trends.

• *Quantitative Data Analysis*: Quantitative data will be analyzed using appropriate statistical techniques to assess relationships between variables and measure the impact of integrating dynamic systems on organizational performance.

The use of a mixed approach will allow for data triangulation, enhancing the study's validity and reliability (Creswell & Creswell, 2017). It will also provide complementary perspectives, surpassing inherent limitations of individual methods. This mixed methodology will ensure thorough exploration and comprehensive understanding of integrating dynamic systems into management control in the context of strategic innovation.

The research problem is therefore as follows: "How can organizations integrate dynamic systems into their management control mechanisms to promote and support strategic innovation?" It corresponds to a fundamentally descriptive approach. We focused on formalized companies with over 50 employees. These companies fall into three categories: local subsidiaries of multinational firms (20% of officially declared companies with over 50 employees in Morocco), public or semi-public companies (15%), and private companies (65%).

In a preliminary stage of study framing, exchanges with reference professionals, management controllers, allowed us to highlight the main questions and issues of the study as well as to identify the essential features of integrating dynamic systems into management control in Morocco. Then, an exploratory phase took place, over the period 2021-2022, with interviews in about ten companies in five significant economic sectors of Morocco. This allowed us to develop hypotheses about the state of development and characteristics of integrating dynamic systems into management control in companies in Morocco to promote and support strategic innovation. Then a questionnaire was constructed and tested. A

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confirmatory phase took place, over the period 2022-2023, with the administration and statistical analysis of the questionnaire to which 130 companies representative of the country's economic fabric responded.

Exploratory Qualitative Study

The exploratory study through face-to-face interviews was conducted with ten companies selected in pairs across five key sectors: real estate, agri-food, telecommunications, industry, and banking (see Table 1 below). Semi-structured interviews were conducted with the management controllers using an interview guide. The maximum amount of documentation was collected on-site. Convenience sampling was used as the working base. Data collection stopped when it seemed that conducting more interviews would not change the emerging vision from this initial phase (saturation principle).

Table 1. The 10 Companies Selected For Interviews

Company	Sector	Size and nationality	Interlocutor's role
Company 1	Real Estate	Private Company (180 employees) Social housing	Controller of Management
Company 2		Semi-public Moroccan Company (146 employees) Urban development	Controller of Management
Company 3	Industry	Family-owned Moroccan Company (4500 employees) Steel production	Controller of Management
Company 4		French Group Subsidiary (340 employees) Automobile parts production	Controller of Management
Company 5	Mobile Telephony	One of the largest companies in Morocco (over 11,000 employees)	Controller of Management
Company 6		French Group Subsidiary (1300 employees)	Controller of Management
Company 7	Agro-food	Subsidiary (425 employees) of a major Swiss company	Controller of Management
Company 8		Moroccan Company (500 employees)	Controller of Management
Company 9	Banking	Moroccan Bank (over 28,000 employees)	Controller of Management
Company 10		Moroccan Bank (2000 employees)	Controller of Management

In semi-public companies in the real estate sector, the weight of clientelist games is significant and requires strategies to resist them: "Policies often impose optimization of real estate project management processes on us. This is the danger. We sometimes resort to consultants to define the real needs more objectively." (management controller, Company 1) or "After realizing the negative impact of the constraints imposed by policies, we modeled the necessary resources (human, financial, material) for each stage, allowing for dynamic management control that anticipates changes in planning and costs." (Management controller of Company 2). The functioning of companies is quite bureaucratic, as seen in Company 2: "For each type of expense, we check beforehand if the budget line exists. Afterwards, we obtain signatures and monitor. We conduct surprise checks at the cash level and verify staff levels at work." similar to Company 1: "For the smooth functioning of the company, we have established a procedures manual, which represents, for

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management control, a basic management tool that we use to model system dynamics to anticipate market fluctuations and adjust real estate portfolios accordingly to maximize returns." In Company 1, where private capital is present, the integration of system dynamics into management control is more developed in terms of personnel and tools implemented than in Company 2, with regular reporting and active monitoring of budget variances. In both cases, cost calculations remain very limited because the companies are ordering parties that subcontract construction work to external building companies based on tenders and quotes.

In the industry sector, Company 3, owned by a Moroccan family, shares the market with another competitor. Company 3 does not have the integration of system dynamics into management control. The management team is chosen from within the family circle. Direct supervision is carried out by these managers who have a good management education. On the other hand, Company 4 is a subsidiary of a French group among the leaders in automobile parts production. With a structured management control and permanent integration of system dynamics into management control, "We have set up an autonomous management control service, and a system of integration of system dynamics into management control. Everything is done by the management control service." (management controller of Company 4).

Company 5 is among the market leaders in telecommunications in Morocco. The integration of system dynamics into management control and performance management is very comprehensive, and an ABC management accounting system is installed. In the mobile telecommunications sector, Company 6 is a joint-stock company owned by the French group. It has advanced technology, and its market share is steadily increasing. Its staff is mostly composed of internationally trained executives. The integration of system dynamics into management control is highly developed.

In the agri-food sector, the two companies studied have the same main activity. For Company 7, internal organization is highly structured, and management control is well developed with a range of tools. Management control is autonomous from the financial direction, and the integration of system dynamics into management control is present: "The autonomy of management control and the integration of system dynamics into management control promote its full exercise." (Management controller, Company 7). On the other hand, Company 8 uses some of the latest industry technologies. There is management control, budgets, and a balanced scorecard, but it is not very developed, and it is not very active in terms of integrating system dynamics into management control. There is a cash budget regularly monitored, and full cost calculations are made (with a very recent implementation of the ABC method replacing the traditional method by analysis centers) but no standard costs or variance analysis.

In the banking sector, we were able to study the management control of two major banks belonging to two Moroccan banking groups. According to the management controller of Company 9 met: "The bank is the place of use of high information and communication technology, hence the need to have qualified personnel and strongly instrumented management control both in terms of operation and organization." As for the practices: "There is a banking accounting software that allows for analytical, financial, and budgetary accounting. Analytical accounting allows for the calculation of minimum costs to set bank conditions. We are unaware of advanced methods like ABC. Benchmarking is often done, but there is more mimicry than actual compared cost calculations." For Company 10, the integration of system dynamics into management control is less used. Management control practices seem quite limited, poorly structured, and very poorly instrumented.

What can be deduced?

From the interviews conducted (the elements cited above reflect only part of the information collected), it appears that decision support tools and behavior guidance devices are strongly developed in Company 5 (large telecommunications company), Company 6 (large telecommunications company), Company 7 (large agri-food company), and Company 9 (large commercial bank). We are dealing here, in very technological environments, with a structured, managerial management control (quite similar to what is observed in developed countries where the parent company of the groups is located) and having certain aspects of the integration of system dynamics into management control.

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The interviews conducted in Company 1 (medium-sized, private, real estate) show weak development of the integration of system dynamics into management control, strong pressures exerted by the political environment, and the importance of administrative and legal procedures that characterize a very bureaucratic financial and procedural control (Mintzberg, 1994). This is also the case for Company 2 (medium-sized, semi-public, real estate development) with slightly less rigidity and slightly more management control tools. We are here in systems regulated by procedures. This is also the case, quite surprisingly and with fewer political pressures, for Company 10 (large commercial bank).

Formalized management control is not very present in Company 8 (medium-sized agri-food company), Company 3 (large industry company), and Company 4 (medium-sized industry company). Here, we are dealing with organizational control based on direct supervision by leaders and their close associates, with a system of shared values if we take Simons' typology (1995) and with reduced instrumentation.

Confirmatory Quantitative Survey

These results gathered from a limited number of companies must now be synthesized into a set of hypotheses that are generalizable and statistically testable on a larger scale on a representative sample. These hypotheses, derived from the analysis of interview verbatims, relate to the three control styles diagnosed in the dozen companies studied. Some hypotheses may seem obvious, but they allow us to verify (or not) whether the classic or popular contingency factors in developed countries are also a reality in the context of developing countries like Morocco. The first hypotheses aim to test the difference in instrumentation between subsidiaries of multinational firms and other companies. These hypotheses are: H1: The integration of dynamic systems in management control is more developed in subsidiaries of multinational firms than in local businesses. H2: The application of dynamic systems within the field of management control is more developed in large companies than in SMEs. H3: The implementation of dynamic systems to improve management control is more developed if management controllers have continuous training. Other hypotheses aim to characterize the modes of management control in family SMEs and in public or semi-public enterprises: H4: In the absence of structured management control, there are prudential practices that small and medium-sized enterprises implement, which fall within the framework of organizational control. H5: Management control in public enterprises is limited to budget preparation and monitoring. Other hypotheses aim to test the influence of certain factors on the integration of dynamic systems in management control: H6: Cost reduction initiatives are the prerogative of private sector companies subject to strong competition. H7: Indigenous companies generally use external consultants for the implementation and integration of dynamic systems and management control techniques. The statistical study was conducted through questionnaires. Using the online services platform of the Moroccan Office of Industrial and Commercial Property (OMPIC): www.directinfo.ma, we requested a database of declared companies with over 50 employees. The number of companies in this filtered file amounts to 1500. The questionnaires were sent to 776 companies, and 325 significant returns were analyzed (see details in Table 2 below). The questionnaires, with their context, causal, and explained variables, were administered by fifteen surveyors (master's students in management and trained doctoral students). A letter was sent beforehand to the company's director to inform them of the surveyors' visit and the purpose of the research. Then, the student and doctoral surveyors went to the company to ask questions and fill out the questionnaire. The questions were in the form of closed-ended questions with "yes" or "no" answers, multiple-choice questions, and Likert scales. The survey targets were management controllers or financial directors in companies where the function exists, and executives in companies where the function is absent. Many practical difficulties (limited availability of respondents, reluctance to respond, problems of lack of real knowledge by respondents about the nature of certain tools, etc.) had to be overcome during this survey.

Table 2. Sample Of 325 Companies That Responded to the Questionnaire

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Activity Sectors	Subsidiaries of multinational firms	Public or semi-public enterprises	Medium-sized private family-owned or non-family-owned enterprises	Sendings	Returns
Industry	50	43	58	151	75
Services	133	87	180	400	158
Commerce	100	-	125	225	92
Sent	283	130	363	776	
Returns	65	50	210		325
Total return rate: 42%	23%	38%	58%		

The statistical study consisted of verifying whether the contingency factors identified during the exploratory survey were confirmed in the population of the sample. The statistical results displayed by validated cross-tabulations allowed for typological analyses with population segmentation. Due to the known limitations and biases of surveys through questionnaires, especially on fairly technical questions such as the nature and use of management tools in economically underdeveloped countries, a moderate use of statistical methods was conducted, and we stuck to robust techniques and fairly simple deductions. We were also very modest and cautious in considering the statements on the existence of certain tools because it seemed to us, after cross-checking, that sometimes the responses greatly overestimated the reality on the ground (for example, in the declared use of the ABC method). In this type of survey through questionnaires, the respondent can indeed develop a systematic bias to enhance themselves and to appear modern by claiming to have the tool when it is not true. The respondent may inadvertently misinterpret the nature of the tool by assigning it an inappropriate "label". They may believe that the tool exists because they know it, but it is not available in the company. The tool may be available but not used. It can also be used without satisfaction. All the hypotheses formulated were statistically validated by Chi-square tests.

Discussion

There are obviously differences in management control practices depending on the profession or characteristics of the activity, and this is valid in developed countries as well. Therefore, we have focused our reflection on the characteristic elements of management control system dynamics integration practices in a country like Morocco, in relation to the nature of its economic fabric. The survey results indicate that in the implementation of management control, the major differentiating element in integrating management control system dynamics in Morocco remains the distinction between subsidiaries of multinational firms, public and semi-public enterprises, and Moroccan private family-owned or non-family-owned enterprises.

Subsidiaries of multinational firms (approximately 15% of the usable sample) exhibit the following characteristics: development of management control comparable to that observed in the parent companies of developed countries; a high level of employee training; a strong structuring of the management control function (existence of the position in 3/4 of the companies); use of internal executives for the implementation of management control tools (in 2/3 of cases); rather rapid diffusion of management control techniques; extensive experience of executives in the use of management control techniques; highly developed integration of system dynamics in management control at the operational level (in a little over 75% of cases); extensive use of management control software (80% of cases); highly developed cost calculations (in 80% of companies).

Public and semi-public enterprises (approximately 20% of the usable sample) exhibit the following characteristics: undeveloped management control and bureaucratic operation with limited consideration of economic constraints and efficiency and effectiveness dimensions; a rather high level of employee training

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but not necessarily in the field of management or technique; a fairly strong structuring of the management control function (existence of the position in 2/3 of cases); slow diffusion of system dynamics integration techniques in management control; moderate use of external consultants for the implementation of management control tools (40% of cases observed); developed management instrumentation at the operational level (2/3 of cases); few management control software programs (only in 25% of cases); very underdeveloped cost calculations (in only 1/4 of cases); regulation by the State of enterprise operations through the establishment of administrative and financial procedure manuals (approximately 50% of cases); management control mostly based on rule compliance in purely public enterprises.

Moroccan private family-owned or non-family-owned enterprises (approximately 65% of the usable sample) have the following characteristics: a rather low level of training for purely family-owned enterprises but the presence of employees with a level of "Bac + 2" or higher in positions of responsibility in many non-family SMEs; a weak structuring of the management control function (position in only 20% of these enterprises); frequent strong reliance on external consultants for the implementation of management control tools (in 3/4 of cases); slow diffusion of system dynamics integration techniques in management control; predominant direct supervision at the operational level; few or no management control software programs (used in less than 15% of enterprises); weak management instrumentation at the operational level (less than 10% of cases); fairly developed cost calculations (in about half of the enterprises).

Exploratory Qualitative Study

The exploratory qualitative study presented here aims to understand management control practices in various sectors in Morocco. Semi-structured interviews were conducted with ten companies representing different key sectors, including real estate, agri-food, telecommunications, industry, and banking. The results detail the specificities of each company in terms of management control, highlighting significant differences related to size, public or private nature, and political pressures.

In the real estate sector, management controllers face significant clientelistic games, while in the industry, family management of the company influences control practices. Telecommunications and agri-food companies show high levels of system dynamics integration in their management control, in contrast to some companies in the banking sector.

This raises several points of discussion:

• *Influence of Contextual Factors*: The results show that management control practices are strongly influenced by contextual factors such as company size, industry sector, and status (private, semi-public, public). Real estate seems more influenced by political pressures, while technology companies have more structured management control, as explained by researchers (Meyssonniert & Rasolofo-Distler 2008).

• *Role of Company Size*: Company size seems to play a significant role in the development of management control practices. Large companies, especially those belonging to multinational firms, show greater integration of system dynamics in their management control (Cappelletti & Khouatra 2009).

• *Impact of Management Controller Training*: The study suggests that management controller training could influence the level of system dynamics implementation. This finding underscores the importance of ongoing education for management professionals (EL KEZAZY & HILMI 2023).

Confirmatory Quantitative Survey

The confirmatory quantitative survey aims to statistically validate the trends identified in the qualitative study. The hypotheses formulated concern the difference in instrumentation between subsidiaries of multinational firms and local companies, the impact of company size, the influence of management controller training, and the characterization of management control modes in family SMEs and public enterprises.

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This raises several points of discussion:

• *Validation of Trends*: Statistical results confirm the trends identified in the qualitative study. This reinforces the credibility of the initial observations and suggests some generalizability of management control practices within the sample.

• *Limitations of Quantitative Surveys*: The article highlights inherent limitations in quantitative surveys, including potential biases related to participant responses. Caution in interpreting the results is emphasized, highlighting the complexity of management tool-related issues.

• *Application of Results*: Quantitative results enable the formulation of broader recommendations for practitioners and researchers interested in management control practices in Morocco. This underscores the applicability of the results beyond the specific companies studied.

Conclusion

This in-depth study on the integration of system dynamics into management control in Morocco highlights several crucial conclusions. Interest in this integration seems to vary considerably depending on several factors, including company size, industry sector, and political context.

The influence of contextual factors is undeniable, with companies of different sizes and sectors adopting distinct approaches. Large companies, especially those linked to multinational firms, show a greater propensity to integrate system dynamics into their management control (EL KEZAZY & HILMI 2022). These results underscore the importance of considering these factors when developing dynamic management control strategies.

The study also highlights significant sectoral differences, with certain industries, such as telecommunications and agri-food, adopting this approach more. This suggests that the applicability of system dynamics integration may be specific to operational context and sectoral requirements.

Furthermore, the impact of management controller training on system dynamics implementation underscores the importance of continuous education for management professionals.

Perspectives for the article could include an analysis of the long-term effects of integrating system dynamics into management control, which could be beneficial. This could involve evaluating the impact on companies' financial and operational performance, as well as their ability to adapt and innovate in an ever-changing environment. Additionally, a comparison of management control practices integrating system dynamics across different countries and regions could offer valuable insights into the cultural, institutional, and economic factors influencing these practices. This could help identify learning and improvement opportunities for companies operating in similar contexts.

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