

The Impact of Innovation Management Systems on Firms' Innovation Performance: The Mediating Role of Openness to Innovation

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Abstract: This study examines the impact of Innovation Management Systems (IMS) maturity on companies' Innovation Performance, specifically emphasizing the ISO 56002 standard as a guiding framework. The present investigation explores the mediating role of Open Innovation (OI) in this relationship, investigating how openness to external collaboration affects the effectiveness of structured innovation processes. A Systematic Literature Review (SLR) identifies significant gaps, notably the scarcity of empirical evidence regarding the integration of IMS with OI techniques and their collective impact on performance outcomes. Empirical data were gathered via a survey of 139 medium-to-large Italian enterprises spanning several sectors. The study assesses organizations' IMS maturity, their openness to innovation, and the interaction between these factors in influencing Innovation Performance. Structural Equation Modeling (SEM) demonstrates that an established Innovation Management System (IMS) enhances Innovation Performance both directly and indirectly by promoting openness to external knowledge transfer and collaboration. The results enhance the current IMS literature by illustrating that a systematic approach to innovation management, in conjunction with Open Innovation methods, can yield exceptional innovation results. These findings provide practical guidance for managers and decision-makers aiming to improve their organizations' innovation capacities and attain durable competitive advantages in progressively interconnected markets.

1 INTRODUCTION

In today's dynamic business landscape, innovation serves as a cornerstone of competitive advantage, enabling firms to adapt to rapid technological advancements and shifting market demands. The accelerating pace of change necessitates structured approaches to innovation management, fostering the ability to integrate new knowledge, enhance operational efficiency, and sustain long-term growth.

Organizations are progressively implementing organized frameworks, such as Innovation Management Systems (IMS), to synchronize innovation activities with strategic objectives and improve efficiency. ISO 56002 has emerged as a significant guideline for the implementation and optimization of IMS across various sectors. Nonetheless, whereas IMS frameworks are acknowledged for their capacity to organize innovation, empirical studies regarding their direct

influence on Innovation Performance (IP) and the function of Openness to Innovation (OI) as a mediating factor are still insufficiently established. The current literature emphasizes that IMS improve innovative capabilities by formalizing innovation processes, optimizing resource allocation, and minimizing inefficiencies. By offering a structured framework for innovation management, IMS assists organizations in aligning their innovation strategies with overarching organizational objectives, hence promoting both incremental and radical innovation (Giménez et al., 2023; Silva, 2021). Research on Open Innovation underscores the significance of external information flows and collaborations in enhancing innovation skills (Chesbrough, 2003; Laursen & Salter, 2006; Ghezzi et al., 2022). Notwithstanding these improvements, the interaction between IMS and OI and their collective impact on IP remains poorly investigated. Furthermore, the absence of standardized instruments to assess IMS maturity constrains both scholarly research and

practical implementation. The deficiencies in the literature pose considerable obstacles. Theoretically, they impede the advancement of integrated models that incorporate both internal structures and exterior interactions. In practice, they provide managers with insufficient guidance on optimizing IMS and OI to attain sustained innovation results. Addressing these deficiencies is essential for enhancing knowledge and providing practical guidance for companies operating in increasingly competitive contexts. This study seeks to address these deficiencies by investigating the correlation between IMS maturity, OI, and IP. It specifically addresses two research inquiries: What is the correlation between IMS maturity and IP? What function does OI serve in this relationship?

The study employs data from 139 Italian companies along with Partial Least Squares Structural Equation Modeling (PLS-SEM) to examine these correlations. IMS maturity is evaluated using a scale derived from ISO 56002, whilst OI and IP are tested by recognized multi-item assessments. This research enhances the literature by providing empirical proof of the positive correlation between IMS maturity and IP, while recognizing OI as a significant mediator. The validated IMS maturity scale serves as a significant instrument for future study and practice, facilitating more uniform evaluations across various contexts. The study illustrates the synergistic functions of IMS and OI, offering practical guidance for managers and enhancing theoretical comprehension, while underscoring the need of cohesive innovation strategies for attaining exceptional performance.

2 THEORETICAL BACKGROUND

Innovation is crucial for sustaining competitiveness in the contemporary business landscape, fostering flexibility and growth in ever-changing markets (Schumpeter, 1983; Hansen, 2014; Ghezzi et al., 2016). Innovation, broadly defined as the introduction of new products, processes, or practices, spans various dimensions, including radical and incremental methods, as well as modular and architectural transformations (Goffin & Mitchell, 2005; Henderson & Clark, 1990). Value creation and differentiation in competitive environments are uniquely influenced by each of these dimensions (Damanpour et al., 2009; OECD, 2005; Ghezzi et al., 2014). The mechanisms of invention encompass

both internal and external factors. Internally, organizations depend on the absorptive capacity to recognize and apply external knowledge, organizational structures that foster collaboration, and research and development (R&D) capabilities (Cohen & Levinthal, 1990; Burns & Stalker, 1961). Externally, innovation success is increasingly acknowledged to be contingent upon collaboration with a variety of stakeholders, such as customers, suppliers, universities, and entrepreneurs. Open Innovation, as defined by Chesbrough (2003), emphasizes the significance of integrating external knowledge streams into internal processes. Von Hippel's (1988) user innovation framework similarly underscores the essential significance of involving lead users in the co-creation of new solutions, accentuating their impact on market relevance.

2.1 Innovation Management System

Innovation Management Systems (IMS) provide structured methods for the promotion, coordination, and expansion of innovation initiatives. As defined in ISO 56002:2019, IMS represents a comprehensive and integrated framework including strategic, tactical, and operational duties to systematically plan, coordinate, and control innovation activities (International Organization for Standardization, 2019). The maturity of an IMS indicates its degree of implementation, optimization, and alignment with strategic objectives, significantly contributing to the enhancement of organizations' innovation capabilities and outcomes (Santos & Almeida, 2022). Elevated IMS maturity, defined by systematic management and ongoing optimization, is associated with enhanced innovation results, particularly in balancing exploratory and exploitative innovation endeavours (March, 1991; Martínez-Costa et al., 2019).

Research on standardized frameworks, such as UNE 166002 and ISO 56002, indicates that companies with high IMS maturity attain enhanced innovation efficiency, customer satisfaction, and competitiveness (Giménez et al., 2023; Mir et al., 2016).

2.2 Innovation Performance

Innovation Performance evaluates the effectiveness of a company's innovation initiatives in terms of outputs, processes, and strategic results (Crossan & Apaydin, 2010). It encompasses quantifiable

indicators, like patents and product launches (Hagedoorn & Cloodt, 2003), alongside more extensive effects such as improved strategic positioning and competitiveness (Tidd & Bessant, 2018). Quantitative metrics, such as R&D expenditure and market share from new goods, frequently function as benchmarks, whereas qualitative assessments evaluate the congruence of innovation endeavours with strategic objectives (Gopalakrishnan & Damanpour, 1997; Camisón & Villar-López, 2014).

The correlation between IMS maturity and Innovation Performance is extensively recorded, with advanced systems promoting both incremental improvements and radical innovations (Martínez-Costa et al., 2019). By leveraging structured frameworks, organizations align their innovation efforts with organizational strategy, attaining quantifiable results such as enhanced operational efficiency and market responsiveness (Mir et al., 2016).

2.3 Openness to Innovation

Open innovation enhances companies' capacity to generate and implement novel concepts by promoting information transfer beyond organizational limits (Chesbrough, 2003; Chesbrough & Bogers, 2014). It encompasses inbound innovation, wherein companies assimilate external information via collaborations, partnerships, and licensing, and outbound innovation, which entails externalizing internal innovations to optimize their value (van de Vrande et al., 2009). Research has investigated its influence on business performance through theoretical frameworks such as the knowledge-based view and resource-based view, emphasizing its effect on innovation results (Ahn et al., 2015; Greco et al., 2016). Diverse methodologies have been suggested to evaluate openness, encompassing firm-level metrics that consider external search breadth and depth (Laursen & Salter, 2006) and project-level frameworks like the IFO-Scale and ATOM method, which assess openness via collaboration intensity, transparency, and knowledge exchange (Alam et al., 2022; Bellantuono et al., 2021).

3 METHODOLOGY

Innovation Management Systems (IMS) have emerged as significant frameworks for aligning organizational activities with strategic innovation objectives. Despite their extensive use and the

systematic frameworks established by standards such as ISO 56002, comprehending their concrete influence on companies' Innovation Performance necessitates additional investigation (Silva, 2021; Idris & Durmusoglu, 2021). A crucial part of this relationship involves evaluating how the maturity of these systems results in quantifiable outcomes, especially when firms embrace external knowledge and collaboration (Chesbrough, 2003).

This research operationalizes three main dimensions drawn from the theoretical framework: IMS Maturity, Innovation Performance, and Openness to Innovation. These notions establish the basis for exploring the subsequent research questions:

- **RQ1:** What is the relationship between IMS Maturity and Innovation Performance?
- **RQ2:** What role does a firm's openness to innovation play in this relationship?

3.1 Hypothesis Development

For a better overview, the hypothesized connections between the study constructs, have been summarized and displayed in Figure 1

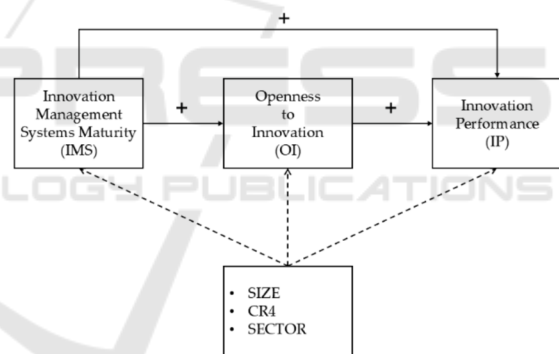


Figure 1. Conceptual Framework.

Evidence from the literature indicates that the implementation of a mature IMS improves innovation performance across a variety of categories, including product, process, organizational, and marketing innovations. Standards like UNE 166002 and ISO 56002 assist organizations in fostering a culture that optimizes both novel and established ideas (Martínez-Costa et al., 2019).

In turn, it is reasonable to hypothesize that:

H1: A mature Innovation Management System positively affects a company's Innovation Performance.

As organizations advance their Innovation Management Systems, it is likely that they will incorporate increasingly advanced techniques for

sourcing innovation from both internal and external sources (Garechana et al., 2017). Consequently, it may be posited that as firms' IMS maturity escalates, they are likely to seek increased external collaborations, promoting better transparency and enhancing the formation of a more resilient innovation ecosystem. Thus, it is hypothesized that:

H2: A mature Innovation Management System will be positively related to company's Openness to Innovation.

Open Innovation (OI) enables companies to utilize external knowledge resources, hence enhancing their innovation capacity. Researches show that firms implementing Open Innovation exhibit enhanced R&D productivity, superior market performance, and increased innovation output (Laursen and Salter, 2006; West & Bogers, 2017). Consequently, based on the literature, it is hypothesized that:

H3: Firm's Openness to Innovation positively influences company's Innovation Performance.

The final inquiry focuses on assessing whether companies that actively participate in Open Innovation activities may moderate the beneficial effects of mature IMS on innovation results. This investigation explores if Openness to Innovation serves as a mediator (Igartua et al., 2010), elucidating the influence of innovation management systems on innovation performance. Consequently, it is postulated that:

H4: Firm's Openness to Innovation mediates the relationship between Innovation Management Systems Maturity and Innovation Performance.

3.2 Research Design

The research relies on a quantitative methodology, employing Partial Least Squares Structural Equation Modeling (PLS-SEM) to evaluate the offered hypotheses. PLS-SEM is especially appropriate for models with numerous components and small to medium sample sizes, as it does not necessitate stringent normality assumptions (Hair et al., 2020). This method facilitates concurrent assessment of measurement and structural models, permitting thorough investigation of direct, indirect, and mediating impacts.

Data was gathered from July 8 to September 16, 2024, focusing on medium and large firms in Italy. A survey was administered to 850 professionals, comprising CIOs, CInOs, Innovation Managers, and

IT Directors, yielding 144 replies, of which 139 were deemed valid following data cleansing.

To guarantee representativeness, the sample encompasses several sectors and organization sizes:

- Company Size: Medium (26%), Large (29%), Very Large (45%).
- Sectors: Manufacturing (34%), Services (32%), Energy (11%), Retail (18%), and Construction (5%).
- Innovative Sectors: Pharmaceuticals (7%), ICT (9%), Electronics (6%), and Automotive & Transportation (12%).

The experimental design for this study was developed in collaboration with Startup Thinking Observatory of School of Management of Politecnico di Milano.

In addition to the survey data, secondary data was sourced from the AIDA database, providing firm-specific information such as revenues and 2007 ATECO codes for sectoral classification. Market concentration (CR4) metrics were calculated to assess competitive dynamics within industries.

3.3 Conceptual Framework

This study employs a conceptual framework to analyze the interaction among three key constructs: Innovation Management System (IMS) Maturity, Openness to Innovation (OI), and Innovation Performance (IP). The framework establishes a basis for examining the interconnections among structured internal procedures, external collaborations, and innovative outputs. The model asserts that a firm's IMS Maturity directly affects its Openness to Innovation and Innovation Performance, with Openness to Innovation acting as a mediating variable that enhances the influence of IMS on IP. This framework facilitates a comprehensive understanding of how internal mechanisms and external interactions collectively influence innovation success.

To augment the explanatory capacity, the model integrates control variables including Firm Size (SIZE), Market Concentration (CR4), and Sector-Specific Dynamics. These variables account for disparities in resources, competitive landscapes, and industry-specific innovation practices.

3.4 Operationalization of Constructs

The study operationalizes the three constructs—IMS Maturity, Openness to Innovation, and Innovation Performance—using established psychometric scales and measurement frameworks to guarantee reliability and validity.

3.4.1 IMS Maturity

Drawing on the framework proposed by Santos & Almeida (2022), IMS Maturity is conceptualized as a multi-level construct reflecting the degree to which firms have implemented, optimized, and aligned their innovation systems with strategic objectives.

A five-point maturity scale grounded in ISO 56002 standards is employed to evaluate essential dimensions, such as leadership, planning, support, operations, and performance assessment.

3.4.2 Innovation Performance

Innovation Performance is conceptualized as a multidimensional construct that includes innovation outputs (e.g., patents, product launches), processes (e.g., R&D activities), and strategic results (e.g., market share increase, profitability) (Crossan & Apaydin, 2010; Martínez-Costa et al., 2019). Quantitative metrics, including the percentage of revenue generated from new goods and the count of innovations launched, are utilized in conjunction with qualitative assessments of strategic alignment.

3.4.3 Openness to Innovation

The operationalization of the third construct concerning a firm's Openness to Innovation, was developed in accordance with Startup Thinking Observatory of School of Management of Politecnico di Milano definitions. The measurement framework is based on Laursen and Salter's (2006) framework, which quantifies external search breadth (number of external sources leveraged) and depth (extent of reliance on specific external partners). This construct captures both inbound (knowledge absorption) and outbound (knowledge sharing) innovation practices (Chesbrough, 2003).

3.5 Experimental Procedure

The research used Partial Least Squares Structural Equation Modeling (PLS-SEM) to investigate the relationships among IMS Maturity, Openness to Innovation, and Innovation Performance. This methodology, executed with SmartPLS software, is appropriate for the exploratory characteristics of the research and the comparatively limited sample size.

The analysis consists of two primary stages: assessing the measuring model to verify the reliability and validity of constructs, and examining the structural model to evaluate the importance and strength of links. Essential measures, including factor loadings, composite reliability, and the R^2 coefficient,

are employed to assess the model's robustness. Bootstrapping techniques are utilized to assess the relevance of both direct and indirect impacts, encompassing mediation pathways. This methodological rigor facilitates a deeper comprehension of how organizational systems and openness affect innovation outcomes.

4 EMPIRICAL RESULTS

4.1 Measurement Model Evaluation

The statistical evaluation of the measurement model demonstrated robust internal consistency and convergent validity for the constructs involved. The Innovation Management System (IMS) exhibited factor loadings ranging from 0.711 to 0.897, alongside a high Cronbach's alpha of 0.923 and a composite reliability (CR) of 0.938. The average variance extracted (AVE) for IMS was 0.686. Openness to Innovation (OI) exhibited factor loadings between 0.526 and 0.853, with a Cronbach's alpha of 0.794, a composite reliability (CR) of 0.859, and an average variance extracted (AVE) of 0.554. Notwithstanding the reduced loading of 0.526 for a single OI item, it was preserved due to its theoretical significance. The variables of Innovation Performance (IP) exhibited

Table 1: Psychometric properties of the measures.

Construct	Factor	Loading (t-value)	Cronbach's α
Innovation Management System Maturity	IMS1	0.871 (36.939)	0.923
	IMS2	0.875 (37.708)	
	IMS3	0.778 (22.178)	
	IMS4	0.897 (52.946)	
	IMS5	0.868 (43.391)	
	IMS6	0.711 (16.152)	
	IMS7	0.782 (16.449)	
Openness to Innovation	OI1	0.853 (36.107)	0.794
	OI2	0.526 (7.796)	
	OI3	0.751 (19.052)	
	OI4	0.780 (21.757)	
	OI5	0.771 (20.370)	
Innovation Performance	IP1	0.616 (7.296)	0.830
	IP2	0.793 (19.140)	
	IP3	0.788 (17.942)	
	IP4	0.848 (30.738)	
	IP5	0.790 (20.857)	
Construct	Cronbach's α	CR	AVE
Innovation Management System Maturity	0.923	0.938	0.686
Openness to Innovation	0.794	0.859	0.554
Innovation Performance	0.830	0.879	0.595

Table 2: Hypothesis Testing and Control Variables.

Model Relationship	Path Value	St-Dev	p-value	Empirical Evidence
Hypothesis H1				
IMS → IP	0.411	0.100	0.000	Yes
Hypothesis H2				
IMS → OI	0.583	0.061	0.000	Yes
Hypothesis H3				
OI → IP	0.205	0.097	0.035	Yes
Hypothesis H4				
Direct Effect IMS → IP	0.411	0.100	0.000	Yes
Indirect Effect IMS → OI → IP	0.119	0.058	0.041	Yes
Total Effect IMS → IP	0.531	0.072	0.000	Yes
Control Variables				
SIZE → IMS	0.240	0.080	0.003	
ICT → IMS	0.904	0.349	0.010	
ELT → IMS	0.612	0.243	0.012	
SIZE → OI	0.149	0.071	0.036	
CR4 → OI	0.189	0.061	0.002	
PHA → OI	0.849	0.274	0.002	

loadings ranging from 0.616 to 0.848, with a Cronbach's alpha of 0.830, a composite reliability (CR) of 0.879, and an average variance extracted (AVE) of 0.595. The model's robustness corresponds with the literature indicating that loadings between 0.50 and 0.70 are acceptable when overall construct reliability and validity are substantial (Hair et al., 2017).

4.2 Structural Model Evaluation

The results presented in Table 2 demonstrate that a mature Innovation Management System (IMS) substantially improves Innovation Performance (IP), as evidenced by a path coefficient of 0.411 and a p-value of 0.000. This underscores the critical role of the IMS. Firm size has a positive impact on IMS, but it does not directly affect IP. Sectors such as ICT and Electronics exhibit a significant influence on IMS maturity. Furthermore, IMS maturity significantly enhances Openness to Innovation (OI), evidenced by a path coefficient of 0.583 and a p-value of 0.000, indicating that organizations with advanced IMS are generally more receptive to innovation. This transparency enhances IP, as evidenced by a positive correlation (path coefficient of 0.205, $p = 0.035$). Moreover, OI serves as a partial mediator in the IMS-IP interaction, demonstrated by a notable indirect

effect (path coefficient of 0.119, $p = 0.041$), while the overall IMS-IP effect remains robust at 0.531 ($p < 0.001$). The CR4 concentration ratio of the sector positively influences OI (path coefficient = 0.189, $p = 0.002$), while the pharmaceuticals sector (PHA) demonstrates a strong positive effect on OI (path coefficient = 0.849, $p = 0.002$).

5 DISCUSSIONS

The findings validate that developed IMS frameworks, particularly those aligned with ISO 56002, markedly improve innovation outputs by formalizing systematic procedures and promoting coherence with strategic goals (Silva, 2021; Rezak et al., 2023). The formalization of innovation processes allows firms to deploy resources more efficiently, minimize inefficiencies, and maintain a competitive edge through ongoing innovation initiatives. This study illustrates that a properly executed Innovation Management System (IMS) can harmonize structure and adaptability, promoting innovation while ensuring operational consistency, contrary to the belief that standardization suppresses creativity (Blind et al., 2013; Giménez et al., 2023). Furthermore, the mediating function of OI highlights its significance in enhancing the advantages of IMS maturity. Companies that actively pursue external collaborations—such as alliances with startups, research institutions, or other enterprises—can enhance their internal capabilities with external insights, technology, and skills (Chesbrough, 2003; West & Bogers, 2017). The integration of internal and external knowledge flows is especially advantageous in dynamic sectors such as ICT and Pharmaceuticals, where innovation frequently relies on the capacity to access and leverage varied external resources (Laursen & Salter, 2006). Integrating OI methods into a systematic IMS enables organizations to improve their agility, resilience, and ability to sustain innovation. The research emphasizes sectoral and firm-specific dynamics, indicating that industries characterized by high technological intensity derive the greatest advantages from established IMS and OI processes. It contests the notion that business size is directly linked to enhanced innovation performance, indicating that the strategic management of innovation processes is more pivotal than mere resource availability (Tidd & Bessant, 2018).

6 CONCLUSIONS AND LIMITATIONS

The interplay between Innovation Management System (IMS) maturity, Openness to Innovation (OI), and Innovation Performance (IP) provides new insights into the domain of innovation management. This research emphasizes the essential function of structured innovation frameworks in improving organizations' innovation results by implementing IMS maturity according to ISO 56002 (International Organization for Standardization, 2019). The results validate that a developed IMS allows firms to manage resources effectively, synchronize innovation initiatives with strategic objectives, and establish mechanisms that maintain competitive advantage through regular innovation outcomes (Silva, 2021; Giménez et al., 2023). The mediating role of Openness to Innovation underscores its significance as a complementary element in enhancing the advantages of IMS maturity. Organizations with robust IMS frameworks exhibit enhanced ability to assimilate external knowledge and partnerships, resulting in superior innovation performance (Chesbrough, 2003; Laursen & Salter, 2006). This synergy highlights the importance of integrating strong internal systems with dynamic external interactions to enhance adaptation and resilience in innovation efforts (West & Bogers, 2017). Sectoral differences revealed as a crucial factor affecting the correlation between IMS maturity and innovation results. Industries with high technological intensity, such as ICT and Pharmaceuticals, gain substantial advantages from organized IMS and OI procedures due to their dependence on external information flows and collaborations (Idris & Durmusoglu, 2021). Conversely, industries characterized by dominant internal innovation capabilities, such as Automotive, demonstrate less significant effects, indicative of sector-specific dynamics.

Despite its merits, this work has specific limitations requiring consideration. The dependence on self-reported data creates the potential for subjective biases, as replies may not accurately reflect the objective reality of organizations' innovation activity. Subsequent investigations may rectify this by incorporating objective criteria, such as patent tallies or new product introductions, to enhance self-reported assessments (Mir et al., 2016). The geographical emphasis on Italian enterprises restricts the generalizability of the results. Incorporating organizations from varied cultural and economic backgrounds might enhance the comprehension of IMS and OI procedures (Laursen & Salter, 2006). The

application of arithmetic means for calculating IMS dimensions and the uniform weighting of these dimensions pose methodological constraints. Subsequent research may enhance the analysis by employing weighted scoring models or sophisticated methods such as factor analysis to address the differing importance of IMS components in affecting innovation results (Blind et al., 2013). Moreover, although Openness to Innovation was recognized as a mediator, its partial influence indicates that additional mediators—such as digital transformation or organizational learning—could elucidate the relationship between IMS and IP more comprehensively.

This research highlights the revolutionary potential of combining structured IMS frameworks with strategic openness to external innovation. By leveraging these complimentary dimensions, companies can improve their innovation capability, sustain competitiveness, and adapt to evolving market dynamics. Subsequent research ought to further enhance IMS evaluation instruments, investigate additional mediating factors, and broaden the analysis to an international framework to enrich the understanding of innovation management practices.

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