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# Unlocking human power: how artificial intelligence can transform performance measurement and management systems enhancing organizational decision-making

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## Abstract

The research meso-structure follows a clear logic in highlighting the existing body of literature, the main themes, and the gaps within the discipline. Starting from the three pivotal dimensions as performance measurement and management systems (PMMS), artificial intelligence (AI) and decision-making (DM), the investigative strategy goes beyond a traditional systematic and gap analysis approach, establishing a longitudinal examination over an 18-month timeframe from the initial inquiry, enhanced by textual and co-occurrence analyses, performed using both machine-driven and critical human-centric sensitivity. The authors shape the lines of a roadmap that, on one hand, simplifies the navigation of academic contributions and on the other, moves the initial steps toward a formulation of an alternative trajectory capable of injecting new vitality into organizational practice. This objective has been conceptually achieved through the development of a trinomial approach: an integrative model of PMMS, human capital and AI. Starting from PMMS evolutionary paths, the authors depict the potential for enabling organizational performance processes within complex environments. The roadmap helps to understand the reshaping of the human role within the inter-intra-organizational perspective across both private and public sectors in the contemporary context and in the near future of decision-making. This structured view goes beyond the traditional information system logic, involving a hybridized and coordinated action between emerging "disruptive" technologies and human resources. In this way, the human role would find its enhanced expression within a redesigned organizational structure, also and above all, drawing on data interpretation and the entrepreneurial judgment that distinguishes decision-making between risks and opportunities.

**Keywords** Performance management and performance measurement systems · Artificial intelligence · Decision-making · Organizational change · Industry 5.0 · Industry 6.0

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## Introduction

Topics relating to AI have been debated since its global emergence. Its relevance has determined an important discussion on the integration within organizational information systems (Collins et al., 2021), involving management accounting and auditing processes (Spanò, 2022). Both in the private and public sectors, AI has gained considerable momentum from a business and management perspective (Abousaber & Abdalla, 2023; Wang et al., 2021), although it remains underexplored among performance measurement scholars in relation to decision-making (DM). Performance measurement, traditionally conceived, outlines a web of activities such as the collection, analysis and visualization of information on an organization's health, status quo and broadly defined performance (Smith & Bititci, 2017). Performance management, in its evolutionary sense (compared to previous meanings), defines a series of activities such as dissemination, communication and improvement of achieved performance, appropriately aimed at managing organizational performance measurement (Franco-Santos et al., 2012). A performance measurement and management system (PMMS) is therefore an integrated and dynamically balanced system designed to foster an optimal performance management process (Neely et al., 2001). The DM process is defined as *"the act or process of deciding something*, *at an academic level as a process reducing n alternatives to one"* (Dreher & Tremblay, 2009). Some authors define artificial intelligence (AI) as a critical factor for change in the DM process and indispensable support for this dimension, as well as for the promotion of flexibility and human-machine integration (Jarrahi, 2018; Loureiro et al., 2021; Shrestha et al., 2019). This study proposes a paradigm shift from the mere binomial human–machine interaction (information system by information technology - IT - and measurement) to a more complete relationship aimed at promoting the construction of real knowledge through the application of AI to the already well-established PMMS. It reframes the information generated by IT and various enterprise resource planning software within a framework of DM and strategic human participation. With the advent of global competition and the growing complexity of markets, this perspective fits within a theoretical framework grounded in complexity theory (Byrne & Callaghan, 2022). However, what makes this statement particularly true is the fact that we are witnessing a shift in the scope of performance measurement towards integrated performance measurement and subsequently towards integrated performance management (Bititci, 2015). This change can be attributed to the recognition that to thrive in the global marketplace, organizations must have a holistic understanding of their performance, which encompasses more than just financial metrics (Kaplan & Norton, 2004). This awareness has led scholars and practitioners to advocate for a shift in focus from control-oriented performance measurement approaches to those that prioritize learning and continuous improvement (Franco-Santos et al., 2012). Therefore, the literature highlights the importance of moving away from traditional control-based performance measurement towards a more dynamic and learning-oriented approach (Davenport & Harris, 2007). This should be interpreted within an integrative perspective that sees an effective PMMS when its design is both connected and interacting (Smith & Bititci, 2017). The challenge in ensuring real effectiveness of the system is to systematize both dynamics as an integrated whole towards the

corporate strategic and operational definition, a self-sustaining system grounded in a learning perspective (Bititci et al., 2012; Davenport & Gardiner, 2007; Franco-Santos et al., 2012). In this direction, to cope with the specificities of our time and its dense complexity, the support tool, as well as mediator and glue, can be AI, in order to achieve increasingly adequate, timely and cost-effective decisions. This study is based on the existing literature, which shows that little evidence exists regarding the integration of PMMS, AI and DM; therefore, this justifies its relevance and originality. The methodology used by the authors involves the structuring of a roadmap as the final output. Therefore, it was necessary to begin with a systematic literature review (SLR) on different databases to also define a two-stage gap analysis. This perspective, starting from August-November 2023, was further strengthened in the longitudinal comparison subsequently conducted using textual data analysis software, first considering the data of 2023, subsequently analysing those reported in January 2025. Within the Industry 5.0 and 6.0 paradigms, this study also seeks to indicate how AI can contribute to defining evolutionary horizons for the establishment of a favourable trinomial interchange between PMMSs, human resources (HR) and AI itself, in order to generate actionable, timely and flexible knowledge and to provide guidance for the DM process. In this direction and moving, as the contextual complexity and maturity of PMMSs grow, increasingly towards inter-organizational dynamics (Sardi et al., 2019, 2020, 2021; Smith & Bititci, 2017), the study aims to respond to two research questions:

RQ1: *Can AI transform PMMS by enhancing organizational DM?*
RQ2: *How can AI be integrated into PMMSs?*

This study aims to provide useful guidelines for the near future, essentially to define the contours of a rapidly evolving dynamic. In this regard, a roadmap seems to be the appropriate proposal to hermeneutically evaluate the potential of AI in its dimension of interconnection with targeted PMMSs to achieve the optimization of strategic organizational objectives through the DM process by rediscovering the human-centric expression of the entrepreneurial view in reading the present, assuming risk and rapidly adapting to future challenges (Fayolle et al., 2014; Gunther McGrath & MacMillan, 2001).

The model proposed in this manuscript introduces several significant innovations compared to the existing literature on PMMS, AI and DM processes. Therefore, the model's main innovations lie precisely in overcoming the traditional view and moving toward an integrated trinomial approach, which merges three key dimensions: (a) IT-based PMMS; (b) human capital, with a particular emphasis on entrepreneurial skills and critical judgment; (c) AI, seen not only as a technological tool, but as a catalyst and mediator for process optimization. While previous literature has often focused on the binary human-machine interaction (or information systems and measurement), the proposed model strategically integrates AI within established PMMS to promote the construction of "real knowledge", instantly producible, usable, and actionable knowledge rather than merely distributable data. This mechanism can be conceptually formalized in practice with a view to integrating human capital within the Industry 5.0 and 6.0 framework (Sardi & Modarelli, 2026), since unlike

purely automated approaches, the model values the human role (judgment, creativity and intuition - typical of entrepreneurs), which operate in symbiosis with the analytical capabilities of AI. However, regarding the "democratization" process, as expressed in this article, in parallel with the participatory approach, the model proposes a transition from "immature" systems (based on pure control) to advanced ones, "democratic" and participatory systems, capable of operating at both the intra-organizational and inter-organizational levels, adapting to the challenges of today's complex environments, founded on timely availability and sharability.The structure of the paper is based on the following paragraphs: after the introductory paragraph, the second paragraph contextualises the research in relation to performance measurement, performance management and the combination of both in an interaction scenario for AI integration. Paragraph 3 defines the methodology adopted, the research protocol followed and the design; the following paragraph highlights the results of the analysis; this is followed by a critical discussion and, finally, a paragraph dedicated to conclusions.

## Research background

### Performance measurement: the origin of a myth

In 1991, Professor Robert Eccles of Harvard University drew up the "Performance Measurement Manifesto" (Eccles, 1991), in which it was declared that, for years, numerous managers and directors in many companies have focused their activities on performance measurement, recognizing the need to make organizations competitive through the demand for strategically oriented measurement systems. According to Hatry and Bryant (1998), "performance measurement" is a term used throughout the world to identify the regular measurement of performance, including the measurement of efficiency and of disaggregated data in order to provide explanatory information (also containing comparisons) (Hatry & Bryant, 1998). It (i) provides data collection, analysis and reporting, (ii) allows self-monitoring of activities, (iii) encourages the use of key performance indicators and (iv) encourages self-measurement of performance (Sardi et al., 2020). As stated by Neely et al. (2001), given its nature, performance measurement draws from numerous scientific disciplines (psychology, sociology, accounting, marketing, etc.) (Neely & Adams, 2001). Although this multidisciplinary nature is enriching, a holistic approach is often lacking (Bititci et al., 2012; Bourne et al., 2018; Sardi et al., 2021). Traditionally, accounting performance measurement has been structurally anchored to quantitative approaches in measuring organizational performance, generating a purely financial tool (Otley, 2002) that is limited (Kaplan & Norton, 2004; Tangen, 2004). Further non-pecuniary perspectives connected to the philosophy of measurement (Tal, 2013) have been provided over the years, for example that of marketing, which is important for the dynamics of stakeholder involvement (Clark, 2002). This reference framework has given rise to sustainability reports (Kolk, 2004), non-financial reporting in general (Turzo et al., 2022) and integrated reports (Paolone et al., 2020). The measurement crisis evolved in this direction and, in the second half of the 1990 s and the early 2000 s, perfor-

mance measurement literature proposed an active construction of methods and tools such as the balanced scorecard, activity-based costing and the performance prism (Neely & Adams, 2001), projecting an evolution towards new generation tools such as performance scorecards, performance wheels and small business performance pyramids (Watts & McNair-Connolly, 2012). This shift has progressively transformed the traditional philosophy of performance measurement.

### Performance management: from dream to reality

Following the previous paragraph and with a logic of continuity on the evolutionary timeline, Meyer (2002) defines the key principles of what ideal measurement should entail (Meyer, 2002). He argues that in a context of perfect measurement, not too many indicators are considered, with a balance between financial and non-financial; further, the latter need to be connected to the former, explaining them. The measures used must be adopted across the organization and proceed both from the bottom up and vice versa – but also horizontally. In any case, they must tend to be stable and must be the basis for compensation for people's work. Tangen (2004) also identifies the main key factors necessary for adequate measurement, namely: supporting strategic objectives, having a balance, guarding against sub-optimization, being limited in the number of measures and being easily accessible and understandable (Tangen, 2004). Performance management (i) provides for continuous feedback, suggestions and support, (ii) facilitates relationships, information-sharing and discussion, (iii) encourages self-management of knowledge, skills and abilities, and (iv) leads towards open projects on specific topics. This reference framework constitutes the basis for the stratification of logics connected to knowledge management (Bititci et al., 2012; Franco-Santos et al., 2012; Sardi et al., 2020), which necessarily must be considered in the implementation of a system architecture based on PMMSs. Specific areas of investigation have increasingly focused on the analysis of visual performance management systems (Bititci et al., 2016), identifying their organizational impact. Even in the public sector, the dimension of measurement and performance management has taken hold, especially with the advance of the New Public Management movement at the dawn of the 1990s (Garengo & Sardi, 2021; Hood, 1991), leading over time to substantial criticism (Radnor & McGuire, 2004) in its evolutionary phase, towards the end of the first decade of the 2000s. The broader question emerging from the literature, and more closely aligned with the aims of the present research, is how to establish a link between strategic management and performance measurement (Bassioni et al., 2004) and, above all, how to address the major challenges in the field. This implies a significant transition from philosophy to practice (Tangen, 2004) or from dream to reality. Among the great challenges, Bititci et al. (2012) include the construction of a social system capable of orienting measurement towards a network dynamic and self-determination as learning systems, in light of the support provided by information technology (Bititci et al., 2012). The contribution made up of the growing value of knowledge, which can also be generated thanks to open innovation, is necessary. On this basis and in this ideological current, the proposal to translate performance measurement systems from a rational control to a cultural one is structured, with a perspective of open and inclusive management

(Bititci et al., 2016). Although performance management took off as an evolutionary dimension of traditional measurement, it itself would appear to have been "broken". The reason for this break could be attributed to the fact that a stratified literature provides prescriptions on how to carry out correct performance management on the basis of the philosophy of measurement, while losing sight of the daily dimension and contemporary needs. This has reduced a broad-spectrum dimension, qualitatively and hermeneutically oriented towards knowledge of private and public organizations' performance, to formal practices and prescriptive recipes which do not always adapt to all contexts but which above all leave limited space for the dynamics of DM, which should be the primary output of PMMS-based processes.

## The combination of performance measurement and management: an interplay scenario for AI integration

As with performance measurement, although there is one for management in general designed by Ghoshal et al. (1999), performance management also needs a longitudinal perspective and its own manifesto (Ghoshal et al., 1999). The integration of performance measurement and management can be a solution but not a definitive one for the near future – even if functional for the definition of an interplay scenario. The crucial questions raised on the occasion of the publication of the "Performance Measurement Manifesto" by Eccles (1991) are thus back in vogue and are proposed again as follows to outline the contours of a growingly evolving phenomenon: What are the most important measures to use? How do these measures relate? And in what terms can they predict success? These are questions that lay the foundations for the construction of an interplay scenario if the contribution of 4.0 technologies and, above all, AI is added to the integration of the PMMS. This can be revisited and rethought in the light of an open-mindedness on process architectures, which need to be increasingly effective and efficient both now and in the future. This is a call to overcome the mere combinatorial binomial that links information and measurement systems, guaranteeing a trinomial revolution capable of favouring the emergence of an alternative turning point – of a third solution capable of grafting reciprocal and interdependent relationships between PMMSs, HR and AI from a strategic DM perspective. The conceptual vision framework proposed, based on the existing theoretical one, is shown graphically in Fig. 1, through Fig. 3. As previously stated by Bititci et al. (2012) in reference to challenges for the future, the shift from rational control to cultural dynamics can only occur through human and AI integration in a complex environmental system. This revolution, within a 4.0 framework which is participatory and democratically oriented[1], can represent a shock for the organizational environment but also its inherent salvation in performance - simply by modifying the basis on which it rests (i.e., measure-

[1] Democratic: implies that the new operating base, thanks to the integration of human and sub-human (AI), is no longer an elitist and rigid domain, but a more open and distributed structure.

Participatory: Suggests that change and continuous improvement are achieved through active interaction (interplay) between the various factors and actors (humans, AI and IT systems) within the complex environment.

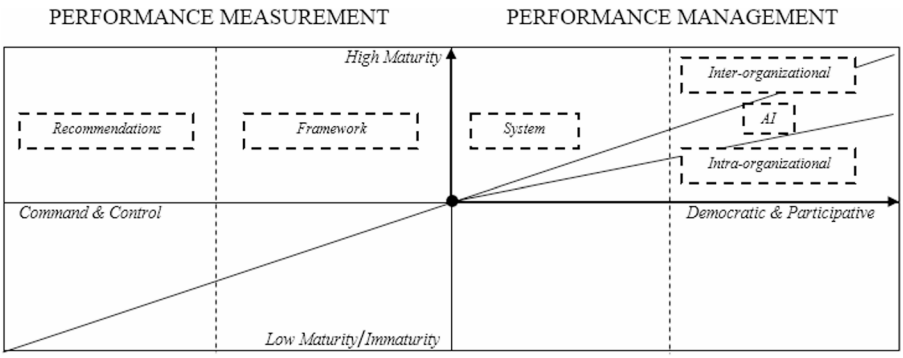


**Fig. 1** Performance management/measurement evolutionary paths. Source: Authors' elaboration (from: Bititci, 2015; Sardi et al., 2019, 2021)

ment). By integrating measurement with conscious, timely and flexible management, supported by enterprise resource planning systems, the Internet of Things, and AI-enabled big data analytics, organizations can develop an informed and adaptive operational paradigm. This operational paradigm is increasingly aligned with contemporary organizational needs. The literature confirms the importance of the role of interplay among the factors under study (Smith & Bititci, 2017) starting from the need to be constantly in contact with the external system (Secinaro et al., 2022). The challenge lies in systematizing what has been declared at an academic level and evaluated in practice (Schleicher et al., 2018).

Currently, digital transformation appears to be a process that impacts every element of corporate and social activity, with the attempt, through technological solutions, to improve the information, networking and communication combination. In these terms and the research objectives stated, the determination of a review of what AI can guarantee to the organizational system in integration with a PMMS is to be found in (a) the minimization of errors, (b) the reduction of response times, (c) cost reduction, (d) the optimization of tasks and activities and (e) the reduction of routine activities; (f) in terms of operational work, there would be a close connection with DM and organizational performance (Li et al., 2023). The final element (f) emerges as the decisive factor upon which the logical framework underpinning the development of the present research was constructed. Moreover, assessment mechanisms have faced scrutiny due to their limited capacity to offer a comprehensive perspective (Hamel, 2009). Conversely, the authors contend that this issue could be addressed through the application of an interconnected integration logic:

PMMS (Inf. syst. IT-based)→←HR→←AI (Duan et al., 2019).

This vision of trinomial integration explicitly reflects what is reported in the holistic vision proposed by Kaplan & Norton (2004) in a functional alignment with the practice of PMMS augmented in its human dimension by AI. The trinomial integrative dynamics anchors the holistic perspective conceptually and makes it a practical expression in the steps proposed by the map in the conclusions.

## The complexity-referring paradigm: an evolutionary trend of PMMSs from immaturity to democratization and participative approach

Meyer (2002) provides details of performance measurement as a new discipline in the area of management. He states that performance is not an easy subject to implement, so it is necessary to rethink how it is measured (Meyer, 2002). This stage of awareness was reached around 1990. Today, however, in light of new emerging and disruptive technologies (Bresciani, 2016), a context characterized by increasing complexity, volatility, ambiguity and urgency and dictated by the need for efficiency and timeliness, new corporate and organizational needs must be satisfied. In order to be compatibly integrated into organizational and strategic decisions, the latter require an overall vision that includes network dynamics and translates onto this level all the dynamics that were traditionally managed uniquely by the single organization (intra-organizational view) towards an inter-organizational view. Graphically, this perspective can be identified in Figs. 1 and 2 and suggests favouring a change of a necessary nature such that, as contextual factors increase, we can no longer speak of an external context but of external variables induced by shocks, volatility, urgency, complexity and ambiguity (Johansen & Euchner, 2013). In this direction, measurement and analysis are no longer linked to just one response but to multiple timely and flexible responses. Furthermore, reference will no longer have to be made to a single generic strategy but instead to multiple strategies to be redetermined as the responses on the measurements are redetermined.

It is true that complexity negatively influences the process of continuous performance improvement. It can arise from internal factors, but above all it arises from exogenous shocks. Traditionally conceived PMMSs tend to be static and offer limited flexibility and timely support to decision-makers. Consequently, their application

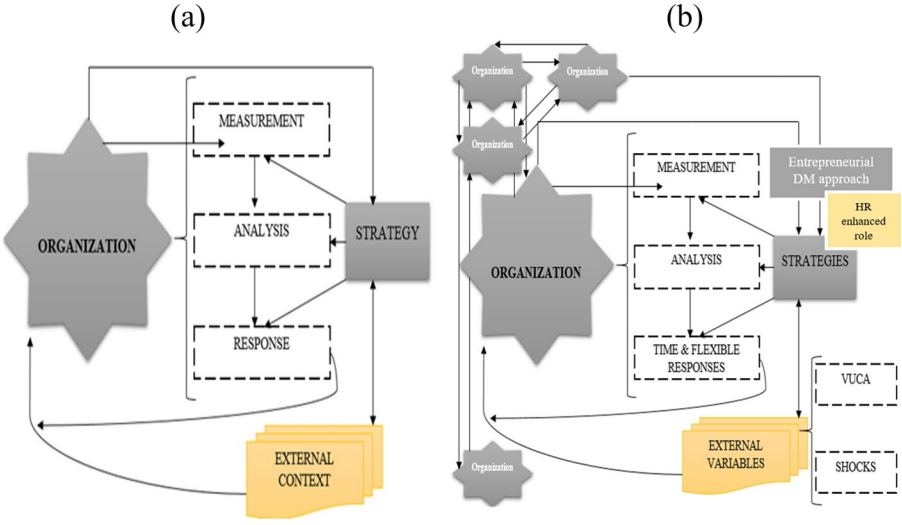


**Fig. 2** Performance measurement enabling the performance management process from tradition to the future. Source: Authors' elaboration (from: Smith & Goddard, 2002)

becomes extremely challenging in contexts of increasing complexity (Cosa & Torelli, 2024; Okwir et al., 2018; Sahlin & Angelis, 2019).

Zimmerman et al. (1998) provide a definition of complexity science, which can be described as a multidisciplinary field that focuses on the study of systems in which contingencies interact in an unpredictable way based on linear relationships. In such systems, the emergence of various phenomena becomes possible and these same phenomena have the ability to generate non-linear dynamics and instigate change (Zimmerman et al., 1998).

In light of this consideration, it becomes evident that a radical change is necessary, originating from emerging complexity. In detail, we are referring to a rethinking of the logic on which PMMSs are based, under the influence of emerging system architectures enabling the implementation of flexible, timely and participatory control networks to support strategic DM dynamics.

Following this logic, the evolutionary process on which we base the theoretical-conceptual roots of the discussion would refer to the fact that in the process of moving from the mere "measurement" of performance to the more holistic "management" of the same, the transition moves from a pure and simple control (a peculiar trait of an immature system, crucial in the literature of recommendations and much ahead of frameworks) to a more advanced, democratic and participatory system which finds its reason for being in the dual direction of inter-intra-organizational instruments. The more maturity increases, the more participation and democratization aimed at the logic underlying the use of the PMMS tool increases. Moreover, as complexity grows, the significance of the inter-organizational viewpoint becomes more vital.

The facilitation of interaction between objects of measurement, as well as the assessment of the measured object and the strategic direction towards which measurement is needed to determine actions, will stem from the emergence of advanced technologies. First, IT to intercept results relating to basic information systems, today and increasingly in the future AI to bring closer and consciously integrate PMMS processes with human-machine dynamics (see Fig. 3).

Therefore, if on the one hand it is properly expressed that digital transformation is redefining the panoramas and boundaries of corporate action, pushing organizations to rethink not only operations but also governance and control mechanisms (Brynjolfsson & McAfee, 2014), on the other hand it enables faster, more transparent and data-driven human DM processes (Vial, 2019). This evolution is recognized as a strategic change that goes beyond the mere adoption of digital tools (Hansen & Schaltegger, 2016); it requires a profound review of governance structures to fully exploit the potential offered, detecting in the dynamics of complexity the necessary human predisposition to entrepreneurship (Shane & Nicolaou, 2015), aimed at developing mechanisms of balanced interrelation between risks and opportunities (Palmer, 1971; Lumpkin et al., 2010). Precisely from this perspective, the current scenario proposes an investigative and functional projection field for human resources with unprecedented DM powers. Despite the importance of the topic, Möller (2022) notes that research on how digital transformation internally reshapes governance and control functions is still limited and even more limited if aligned with organizational dynamics. In this context, it is essential to integrate a human-centric dimension (Rogha, 2023), recognizing that the heart of the transformation lies in human-machine inte-

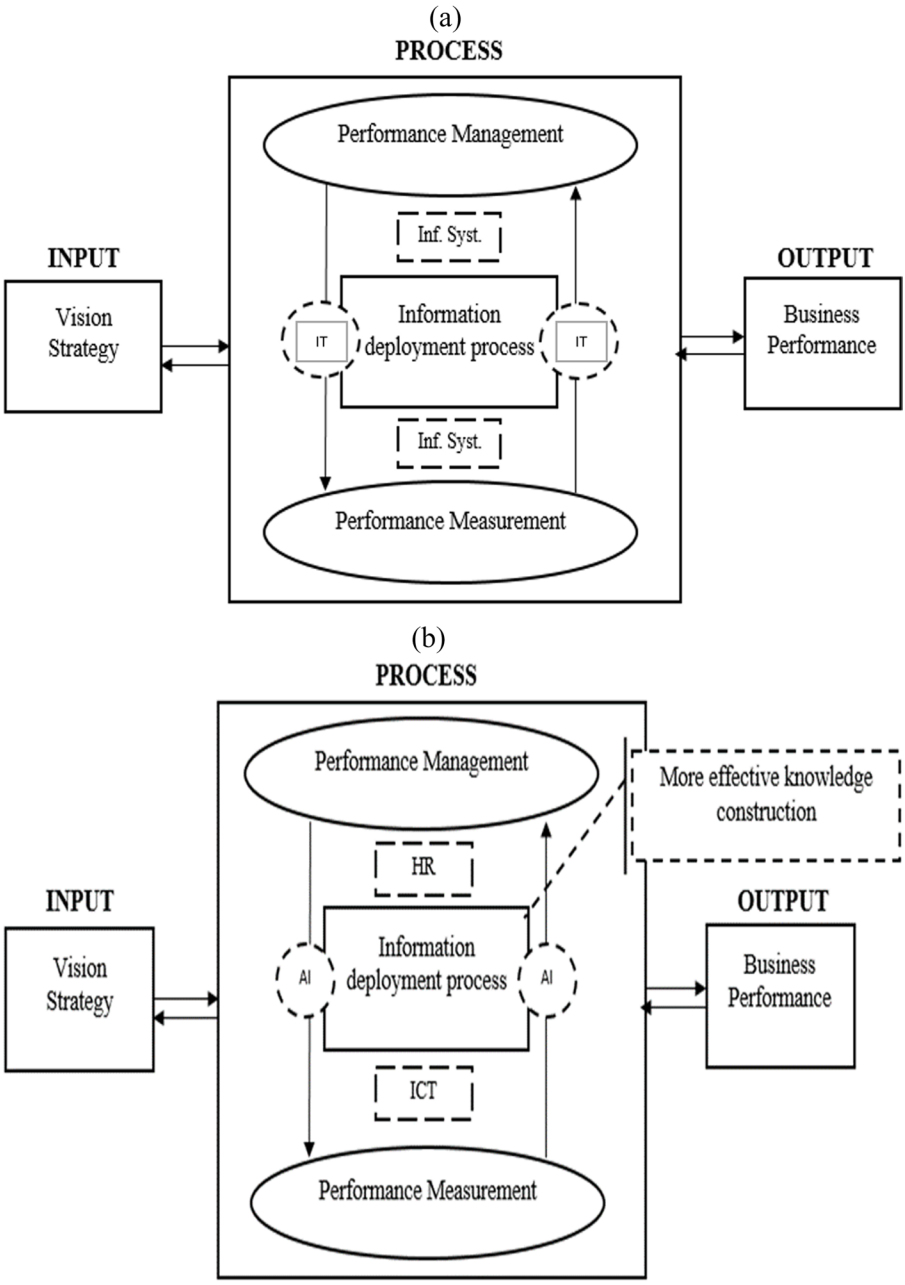


**Fig. 3** The performance measurement/management process from tradition to future. Source: Authors' elaboration (from: Kagioglou et al., 2001)

gration (O'Callaghan, 2023), in particular through AI, which is not to be understood as a mere tool, but a catalyst that allows a symbiosis between the analytical and data processing capabilities of machines and the human skills of judgment, creativity and intuition (Modarelli et al., 2024), typical of the entrepreneur (Audretsch et al., 2006; Schumpeter & Backhaus, 2003) for its pioneering initiatives creation and business development. This human-AI interconnection has a direct impact on the redesign of organizational structures (Mather, 2025), opening new horizons to currently unknown business models and providing a valid replacement of traditional hierarchies with more agile and collaborative networks where teams can be composed of individuals and algorithms working synergistically (Simón et al., 2024). DM thus becomes the result of a continuous dialogue between the data analysis generated by AI and the strategic and contextual interpretation provided by humans. The entrepreneur, in his deepest essence, is an individual driven by an innate human ability to perceive and shape the future (Scheu & Kuckertz, 2023). He is not only the one who manages risk or organizes production, but also the one who, with intuitive creativity, discovers latent opportunities and transforms them into reality (Kruger, 2005). Entrepreneurs can thus detect even faint signals, an ability that extends beyond analytical reasoning and is grounded in deep intuitive insight (Scheu & Kuckertz, 2023). It seems necessary to build the organizational prospective vision of the future on these truly human characteristics, balancing the integration of PMMSs with the enhancing capabilities AI would provide. In this way, what was described by Audretsch et al. (2005) twenty years ago, becomes really true in flourishing entrepreneurial studies within management field (Audretsch et al., 2005).

## Methodology

### Research protocol and design

In order to arrive at the above-mentioned solution in conceptual terms, a comprehensive gap analysis was conducted to validate and support the main research questions, using important scientific literature databases such as SCOPUS and EBSCOHost. The two databases were used together to take advantage of the citation coverage and impact analysis of Scopus on the one hand and the disciplinary specificity of EBSCOhost on the other (Secinaro et al., 2021).

Drawing from human-awareness-based (HKS) and dynamic-machine-based coding approaches (VOSviewer, Ngram Viewer and Voyant), the extent of the research gap and prevailing trends in the literature were determined, as widely confirmed by Alonso et al., (2025). The paucity of studies focusing on the adoption of PMMSs in contemporary organizational contexts, which are shaped by technological advances and disruptive innovations, has already been recognized by numerous studies (Jardioui et al., 2019; Sardi et al., 2020, 2021) and is validated by the present study. This supports the originality and validity of the study (Jardioui et al., 2019; Sardi et al., 2020, 2021). With reference to the detail of reproducibility and methodological rigor in the SLR, the steps provided by Massaro et al. (2016) were followed also in relation to the software used subsequently for the analysis (Massaro et al., 2016). The follow-

ing steps were followed: (i) the details of the complete search strings (with Boolean operators), the access date (e.g. 5 Aug. 2023, 3 Nov. 2023) and the databases used are provided in response to specific search queries (SCOPUS, EBSCOHost); (ii) the application of the PRISMA logic is functional to the systematization of an organically constructed SLR in its correct methodological formulation; (iii) explicit definition of the inclusion/exclusion criteria and the human sensitivity approach (HKS); (iv) detailed report on the purposes, main contents and results of the primary coding (Appendix A.1); (v) precise indication of the software used (VOSviewer, Voyant Tools, Ngram Viewer), the data analysed (abstract, title, keywords) and the type of analysis (Co-occurrence, Statistical Correlation); (vi) presentation of the Gap Analysis findings (see Table 1.) and the results of the Comparative Longitudinal Analysis at a later time point (18 months). The analytical architecture of the research is developed through the sequential integration of various software tools and approaches, such that

**Table 1.** Gap analysis evidence on SCOPUS, and EBSCO Host databases

Scopus

| ***FILTER*** | **Business, Management & Accounting - Article - Academic Journal** | | | | | | |
|---|---|---|---|---|---|---|---|
| **Keyword** | **Boolean** | **Keyword** | **Boolean** | **Keyword** | **Boolean** | **Keyword** | **RESULT** |
| *Performance Measurement* | AND | *Performance Management* | AND | *Business Performance* | AND/OR | *AI Artificial Intelligence* | **76** 5 Aug. 2023 |
| *Performance Measurement* | AND | *Performance Management* | AND | *Business Performance* | AND/OR | *AI Artificial Intelligence* | **79** 3 Nov. 2023 |
| *Performance Measurement* | AND | *Performance Management* | AND | *Decision-Making* | AND/OR | *AI Artificial Intelligence* | **1*** 3 Nov. 2023 |
| *Performance Measurement* | OR | *Performance Management* | AND | *Decision-Making* | AND/OR | *AI Artificial Intelligence* | **23*** 3 Nov. 2023 |

EBSCOhost

| **Keyword** | **Boolean** | **Keyword** | **Boolean** | **Keyword** | **Boolean** | **Keyword** | **RESULT** |
|---|---|---|---|---|---|---|---|
| *Performance Measurement* | AND | *Performance Management* | AND | *Decision-Making* | AND/OR | *AI Artificial Intelligence* | **377** 3 Nov. 2023 |
| ***Area*** | | IT Management | | | | | **34*** 3 Nov. 2023 |
| ***Area*** | | *Business Administration (general)* | | | | | **3*** 3 Nov. 2023 |
| *Performance Measurement* | OR | *Performance Management* | AND | *Decision-Making* | AND/OR | *AI Artificial Intelligence* | **642** 3 Nov. 2023 |
| ***Area*** | | IT Management | | | | | **35*** 3 Nov. 2023 |
| ***Area*** | | *Business Administration (general)* | | | | | **26*** 3 Nov. 2023 |

*GAP

Source: Authors' elaboration on SCOPUS, and EbscoHost databases (accessed: 5th Aug. & 3rd Nov. 2023).

Fig. 6. VOSviewer co-occurrence, connections, and frequency analysis for "performance measurement", "performance management", "business performance", "artificial intelligence" – 25 items

the initial bibliographic scouting phase was conducted using the Scopus and EBSCO databases, supported by NGRAM Viewer and VOSviewer for preliminary thematic mapping. Subsequently, the data analysis phase was refined by adopting a hybrid approach that combines human sensitivity (HKS) with the precision of machine-based coding (MBCA), specifically using Voyant software for secondary coding and VOSviewer for co-occurrence analysis, thus ensuring a rigorous transition from analysis to the final synthesis of the integrated model. The software used has the following characteristics: (a) Ngram Viewer is a free online search engine, developed by Google in collaboration with Harvard University, capable of tracking the frequency of words or phrases in digitized books; (b) VOSviewer is a software developed by van Eck and Waltman which allows you to create interactive maps based on citations, co-citations, bibliographic coupling or co-occurrence of keywords; (c) Voyant is a software designed by Sinclair and Rockwell for reading and analysing textual corpora. The comprehensive design perspective is provided in Fig. 4.

Furthermore, in line with Neely's (2002) observation on the diversity of scholars in the field (Neely & Austin, 2002), an SLR was functionally necessary. This type of research is critical to uncover the study's key constructs and concepts, thus facilitating future advancements in PMMS studies.

The design thus expressed would allow for more complete analytical dynamisms, enriching the investigative perspectives and research horizons in this field, including DM and AI as subdimensions of a broader and more discussed macro-theme. The

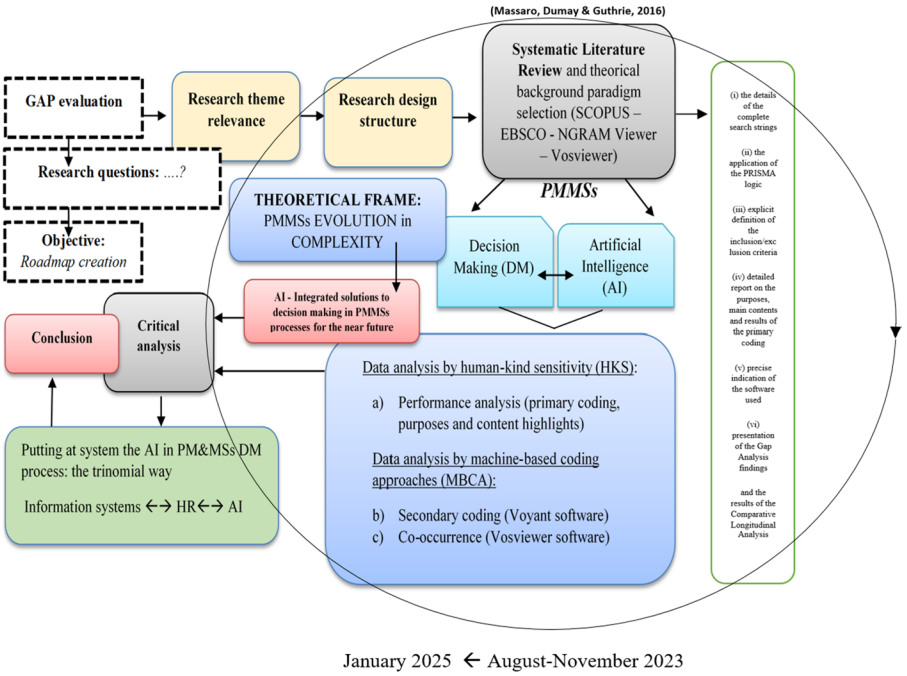


**Fig. 4** Research protocol and design of the double longitudinal comparative analysis cycle. Source: Authors' elaboration

reflective nature of the analysis would then simplify the task of researchers by helping them identify gaps in previous studies and potential innovations for future ones.

Consequently, it is functional to justify the implementation of an SLR, as the latter would play an increasingly crucial role in supporting further research efforts, particularly in relation to emerging constructs such as those related to treatment (Hijriyah et al., 2023).

In order to conduct a comprehensive review of the research landscape related to PMMSs, DM and AI, an in-depth review of the relevant literature was undertaken. It is reiterated that the use of an SLR methodology allows the mapping of the current research landscape and the identification of future research directions.

Through the implementation of systematically well-organized, transparent and reproducible methodologies, it is possible to guarantee an in-depth exploration of relevant literature capable of accelerating further inferences by other study groups in the specific reference field and/or even in transversal fields. As mentioned, the attributes described underline that a systematic review is the optimal technique for identifying discrepancies, gaps and progressions in research on emerging constructs in well-structured dynamics such as PMMSs.

Thus, a combination of trend analysis, topic analysis, gap analysis and a mainstream-focused systematic review of existing literature was used to answer the research questions. This study integrates numerous studies (Folan & Browne, 2005; Kagioglou et al., 2001; Sardi et al., 2020; Smith & Goddard, 2002), (i) the PMMS evolutionary model presented by Sardi et al., (2020) and Folan & Browne (2005); (ii) the PMMS process clarified by Smith & Goddard (2002); and (iii) the PMMS dynamics of Kagioglou et al. (2001) through a strategic orientation to DM. By combining these individual models into a holistic framework, researchers can optimize their benefits and mitigate their limitations, facilitating a synergistic approach to maximizing cognitive potential.

This study scrutinizes 76 research articles in its first analysis, considering the research query (accessed 5 Aug. 2023 on SCOPUS) reported in Table 1.. In this investigation, the authors adhered to the preferred reporting items for systematic reviews and meta-analyses (PRISMA) logic for the formulation of a methodologically correct SLR.

To begin the process, the authors formulate search requests and identify the most appropriate bibliographic databases, using relevant search terms for exploration. Criteria for the review which outline the standards for including or excluding articles are then established. The selection in the study was made on a human-kind sensitivity (HKS) framing based approach (Entman, 1993). Then, a performance analysis (primary coding, purposes and content highlights) was carried out as reported in Appendix A.1.

Subsequently, a methodological review protocol was formulated to evaluate the articles identified through a machine-based coding approach (MBCA). Secondary coding, through the software Voyant Tools, made hermeneutic inferences possible for the results that emerged from the statistical correlation highlighted on specific terms.

In addition, a co-occurrence analysis (on VOSviewer software) made visible interrelationships between terms deriving from the analysis of the 79 articles (abstract, title and keywords) extracted from the SCOPUS database (accessed 3 Nov. 2023),

which found an increase of literature on the matter of 3.9%, of which only one can actually be attributed to the dimension of PMMS, DM and AI. The systematic review follows a meticulous sequence of steps, as illustrated in Table 1.. Throughout the process, emphasis was placed on the nature of the sources, the keywords used in the search, the selection of the search engine and the specific period.

As can be seen in Fig. 5 (Ngram Viewer extract), while contributions on performance measurement and management tend to maintain a constant trend since the beginning, AI initially peaked with the emergence of the first computers and, today, above all with the implementation of tools such as ChatGPT. Similarly, but in an extremely more pronounced manner, the trend of the topic inherent to DM remains at far higher levels with strong growth between the 1980 s and the first decade of the 2000s. This identifies a strong interest in the topic up to today. DM, in this way, can be intersected by the growing contribution of AI, in a niche area (that of PMMSs), yet still highly relevant in the business and management fields.

## Gap analysis evidence

Evidence relating to the gap analysis is reported in Table 1..

An asterisk (*) has been inserted to define the framework of relevance inherent to the literary gap on which the proposed research takes its steps.

In all, 76 results emerged from the initial query (5 Aug. 2023), subsequently validated in 79 a few months later (3rd Nov. 2023). This constitutes symptomatic evidence, as the limited increase, but existing in the scientific panorama relating to the area of investigation, would connote its traits of interest and relevance. The results begin to decrease, highlighting a rather large gap, if we shift the attention from the "business performance" search criterion to the specific "decision-making" one. Respectively, depending on the Boolean factor (AND/OR inserted on the "performance management" -"performance measurement" criteria) on SCOPUS, 1 result and 23 results are found, respectively. Given the specificity of the database used, on EBSCOHost the results increase slightly (3 and 26 for the business administration - general area), but they still tend to be limited and therefore constitute a useful space for manoeuvre for scholars in the sector. While the gap analysis proved to be func-

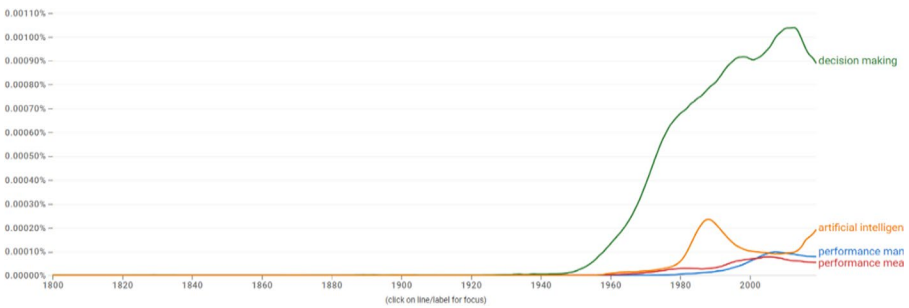


**Fig. 5** Ngram Viewer trends "decision-making", "artificial intelligence", "performance management" and "performance measurement". Source: Authors' elaboration on Ngram Viewer Google Analytics tool (accessed: 3rd Nov. 2023)

tional and instrumental in defining the field of investigation and the operational need to investigate it, due to the nature of the evidence expressed, the authors deemed it appropriate to move the co-occurrence analysis (VOSviewer software) to the section on results, as well as what emerged from the SLR (Appendix A.1.). In addition to what was previously explained, a comparative longitudinal analysis perspective was carried out 18 months after the first investigation, precisely to better define the contours of a phenomenological scenario in the process of evolution. The uncertainties existing at the emergence of the phenomenon are subsequently framed through the recurrence of themes, key areas of investigation that reflect a panorama increasingly defined in its contours. Here, the structuring of a comparative longitudinal analysis, in addition to the mere SLR, manages to capture aspects that could otherwise only be ascribed to the period of processing of the collected data. A vision of a longer period, instead, carefully reflects on the critical parameters of the evolving phenomenon, effectively determining the pillars for a roadmap capable of guiding, or in any case better framing the change. Roadmapping defines the application of a temporal-spatial structured strategic lens (Kerr & Phaal, 2020). In this sense, the study, first through the configuration of the SLR in its preliminary features, then through the determination of the post-encoding interpretative dimension of the evidence, is able to provide, in addition to the theoretical-practical implications and the theoretical conceptualization of the vision behind the intuition of trinomial integration, an identification and a guidance on the operational steps through which to promote the effective implementation of a human-centric and AI augmented alignment within PMMS contexts (Kaplan & Norton, 2004).

## Results

The architecture of the research protocol and the design is capable of taking into account current needs, identifying future developments for the thematic area of investigation and characterized by the presence of evolutionary influences in the dynamics of PMMSs, DM and AI.

The prospective framework highlighted by the authors provides clear evidence in this regard.

For example, seven negative effects of PMMSs are significantly appreciated by the community of scholars, such as (i) time-consuming, (ii) dependent on financial resources, (iii) bureaucratic; (iv) overcomplicated measures; (v) misleading prioritization, (vi) mechanistic and (vii) monotonous (Martinez et al., 2008). In agreement with Acemoglu and Restrepo (2019) and Hage (1999), it is possible to state that highly redundant and repetitive jobs can be absorbed by automation (Acemoglu & Restrepo, 2019; Hage, 1999).

In this situation, AI could absorb these tasks in a simplified intra-organizational perspective and in the context of inter-organizational complexity.

This would make the future of PMMSs sustainable and suitable for the organizations of the near future, configuring strategic and DM alignments to the perspective of multifaceted efficiency and timeliness of response towards a complex environment characterized by shocks, growing networking, urgency, ambiguity and complexity in

general (precisely the identifying perspective of a PMMS which tends towards the definition of integrated systems to support DM and a range of performance measures based on tangible and non-tangible assets) (Garengo et al., 2021).

This led the authors to calibrate the theoretical-conceptual intervention deriving from the analysis of the literature towards the configuration of a trinomial model capable of inserting information systems (IT-based), HR and AI for strategic decisions.

What has been stated is functionally constructed based on the evidence that emerged during the co-occurrence analysis, the extracts of which are shown graphically (Fig. 6).

From this first co-occurrence analysis, generated using VOSviewer software on the basis of the criteria *"performance measurement"*, *"performance management"*, *"business performance"*, *"artificial intelligence"* and limited to 25 items, it was easy to deduce the following points. It is noted that the crucial point, in addition to being the one with the greatest citation frequency, is the one that defines the strongest links with *"performance measurement"* and "business performance" and guarantees a triangulation of links with "decision support systems" and *"decision-making"*. Within this representative framework it is possible to define the application purpose of AI in the performance measurement process, that is, decision support. This perspective would ideally be in line with what the authors described above. A second co-occurrence analysis was carried out, taking into account only the "*performance measurement*" and *"performance management"* criteria. A time frame from 2011 to 2023 was specifically considered in the logic of defining a longitudinal perspective in the medium term. Figure 7(a) was limited to the selection of 50 items and Fig. 7(b) was limited to the level of enhanced linkages. Drawing from the two main criteria, which

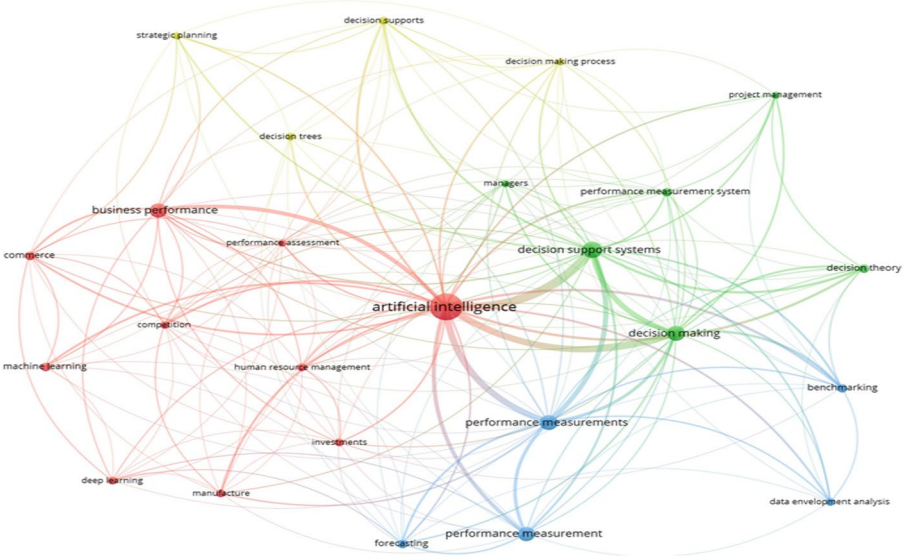


**Fig. 6** VOSviewer co-occurrence, connections, and frequency analysis for "performance measurement", "performance management", "business performance", "artificial intelligence" – 25 items. Source: Authors' elaboration from VOSviewer software (Scopus data accessed: 3rd Nov. 2023)

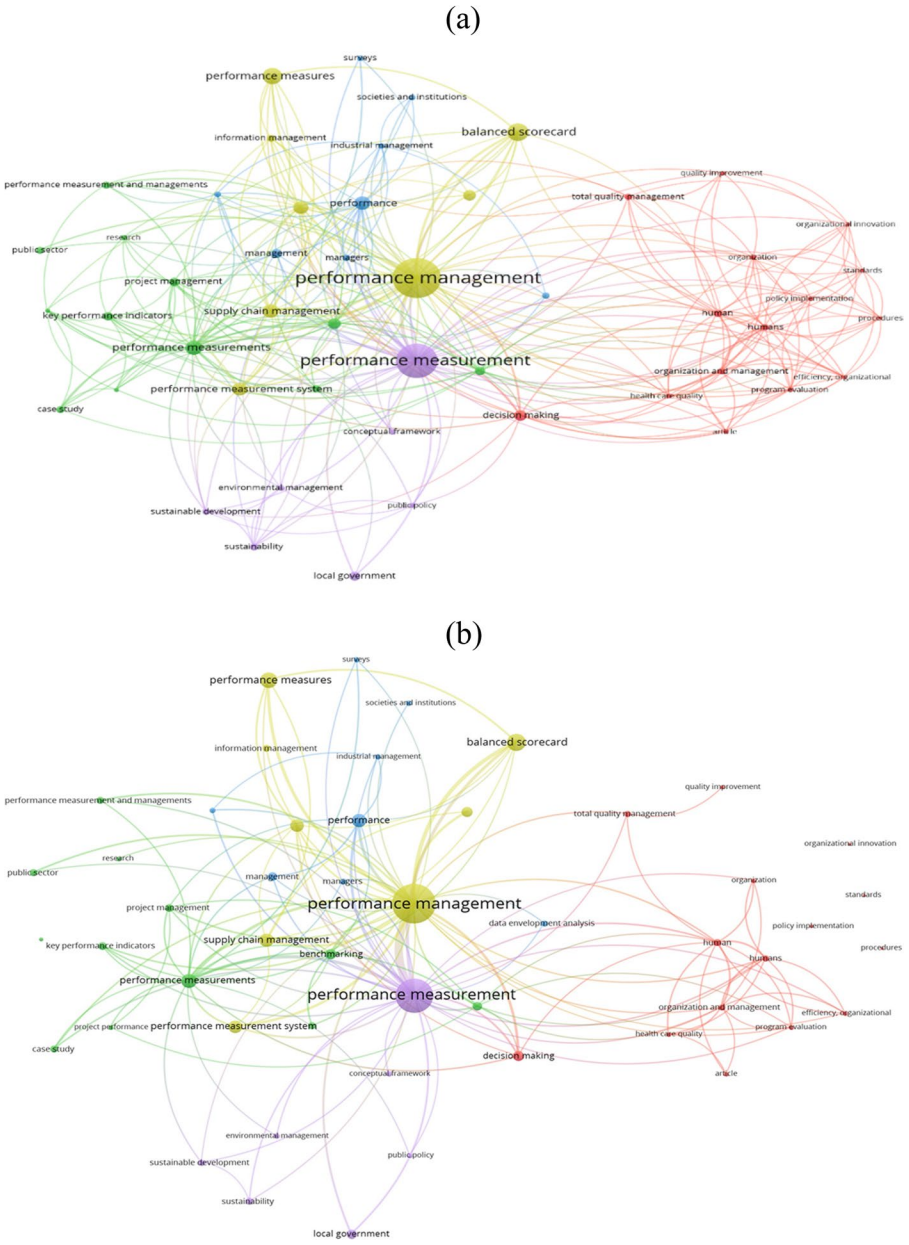


**Fig. 7** VOSviewer co-occurrence, connections and frequency analysis for "performance measurement", "performance management" (2011 to 2023) (**a**) 50 items, (**b**) enhanced linkages. Source: Authors' elaboration from VOSviewer software (Scopus data accessed: 3rd Nov. 2023)

define the main points of the analysis – especially in Fig. 7(b) – it is possible to consider strong links as those connected to DM, the balanced scorecard, performance measures/measurement and performance measurement systems. The logic of the authors and of the study in its overall configuration, in light of what emerged, finds its reason for being in the dynamic expression of constructs identifying relationships that are inserted within PMMSs, if these are conceived holistically within internal and external organizational dimensions. Therefore, emerging complexity, like technologies, structures and restructures strong links with the human fabric teleologically oriented towards the formulation of strategies and decisions on a rational basis. This rational basis, through AI, can overcome the limits of the constituent fixity of traditional PMMS approaches, implementing and assisting the human sensory situation and information tools that have guided organizations for years.

The foregoing has been validated by analysis of the literature which, for formatting reasons, is placed in Appendix A.1.

The processing of the textual data was primarily extrapolated through HKS-based discernment. Therefore, a primary selection and a primary coding (performance analysis) are attributable to the precision of the identification of the authors individually. A secondary coding with related correlation analysis was implemented via software and therefore using an MBCA.

The software used for the analysis was the Voyant tool (Nyhan et al., 2023) (accessed: 3 Nov. 2023) (see the Appendix A.2).

The first column was used for the attribution and extraction of the main keywords on an HKS basis.

The second column represents an HKS-based summary formalization of the main purposes.

The last column represents an HKS-based synthetic formalization of the main contents.

The second and last columns were subjected to textual analysis using MBCA, the results of which are expressed graphically in Table 2.

From the figure provided and the transcriptions in Appendix A.1., paying attention to section (a), it is critically clear that the terms *"measurement"* and *"performance"* are strongly correlated, as are *"analytics"* and *"improved"*. This suggests that to improve measurement and the analysis connected to it, it will have to provide an integrated structure with the DM aspect, *"including"* an *"integrated"* management, such that *"measurement"* is a reference *"framework"* for *"performance"* in *"organizations"* aimed at *"automation"*.

What has been expressed takes on greater value within the thesis put forward by the authors.

This analysis is accompanied by a second one which essentially follows its guidelines (b), providing useful information on two of the factors that the authors highlight in the proposed trinomial dynamics.

Therefore, for an *"innovative"* and *"evaluative"* management *"containing"* the DM aspect, *"automation"*, together with the human perspective of *"HR"*, affects the sphere of *"performance"*. In this direction, AI is the closest to automation in data analysis and the most dynamic one for strategically oriented DM based on emerging

**Table 2** Voyant text correlation analysis from Appendix A.1. data (a) Extracted Correlation (MBCA) on HKS coded purposes

| (a) Extracted Correlation (MBCA) on HKS coded purposes | | | | |
|---|---|---|---|---|
| Term 1 | ← | → | Term 2 | Correlation |
| measurement | | | performance | 0.87372106 |
| analytics | | | measurement | 0.83205026 |
| improved | | | measurement | 0.83205026 |
| maintenance | | | measurement | 0.82298136 |
| allow | | | decision | 0.80759716 |
| chains | | | decision | 0.80759716 |
| including | | | management | 0.80403024 |
| integrated | | | measurement | 0.7867958 |
| organisations | | | performance | 0.78083587 |
| framework | | | measurement | 0,7569987 |
| automation | | | management | 0.74972284 |
| (b) Extracted Correlation (MBCA) on HKS-coded content | | | | |
| Term 1 | ← | → | Term 2 | Correlation |
| Anp | | | Decision | 0.9428775 |
| Benchmark | | | Decision | 0.9428775 |
| Bpnn | | | Decision | 0.9428775 |
| Automation | | | Business | 0.89773107 |
| Hr | | | Performance | 0.87515116 |
| Affects | | | Management | 0.8181818 |
| Feedback | | | Management | 0.8181818 |
| Innovative | | | Management | 0.8181818 |
| Containing | | | Decision | 0.8179178 |
| evaluation | | | Management | 0.79527503 |

Source: Authors' elaboration from Voyant (accessed: 3rd Nov. 2023)

complexity in close connection with the perspective of the human being as a judicial resource.

With reference to the comparative longitudinal perspective, the analysis procedure followed the same dynamic investigation cycle, retracing the evaluation stages of the texts on the Vosviewer and Voyant software. This served functionally to decree the existence of 44 more publications (Appendix A.2. 5 Jan 2025) compared to the first SLR (Appendix A.1. 3 Nov. 2023).

In light of what actually emerged in the first analysis, with reference to the evidence that emerged and reported in Appendix A.1, those of Appendix A.2 reflect a scenario of effective integration, considering the human-machine contribution as necessary to define the prospective vision of the PMM for the future of organizations.

As previously mentioned, by establishing alignments that encourage effectiveness and prompt reactions to a complex environment, as well as reflecting integrated systems that assist decision-making, this will guarantee the durability and usefulness of PMMSs for organizations in the future. In addition to the previous textual analysis made on the Scopus data referred to 3rd Nov. 2023 (Fig. 6), the following comparative-longitudinal perspective (Fig. 8) would represent a pool of important information on the evolution of scientific publications in the area of investigation. In fact, at a thematic level, although the identified clusters remain relevant, a greater pre-eminence is pronounced in relation to AI.

The prepared analysis on the Vosviewer software determines a centrality of the AI theme within the co-occurrence cloud. Therefore, the main links are defined, precisely by *"machine learning"*, *"business performance"*, *"innovation"*, *"information systems"*, *"digital transformation"*, "*decision theory"*, *"internet of things"*, with a

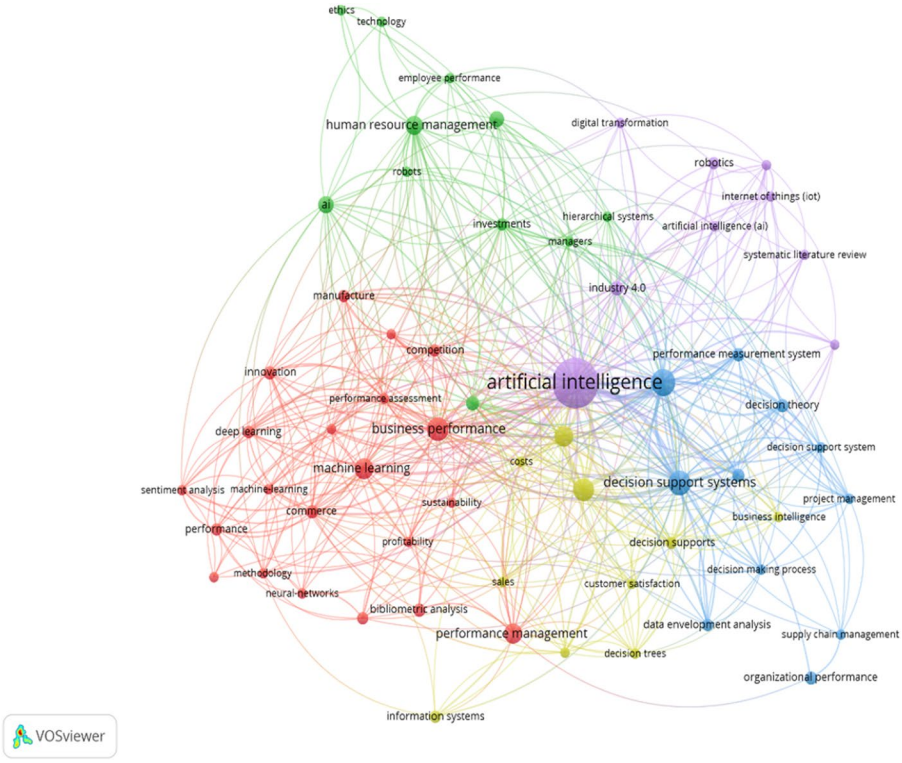


**Fig. 8** Vosviewer co-occurrence, connections, and frequency analysis for "performance measurement", "performance management", "business performance", "artificial intelligence" – 62 items. Source: Authors' elaboration from VOSviewer software (Scopus data accessed: 5th Jan. 2025)

renewed emphasis in the longitudinal comparative analysis on themes related to the human sphere, including *"ethics"* in *"human resource management"* and more generally to *"organizational performance"*.

In these terms, an evolving scenario is emerging that increasingly builds awareness of AI systems in close connection with the human dimension of work and organizations.

Therefore, moving from the preparation of the *"business performance"* theme to one of *"organizational performance"*, presupposes a holistic and group vision, implying the need for *"innovation"* as *"investment"*, but not disregarding the human factor.

On this basis, the trajectory outlined by the authors would find a specific reason to exist in the trinomial integration defined in the previous paragraphs.

The comparative and longitudinal analysis of the deviations would have defined, at least in this preliminary phase, the peculiar traits of the roadmap for the future of organizations.

This output will be further confirmed by the co-occurrence, thematic, textual and correlation analyses, which will be proposed in the following paragraphs, in order to

triangulate the outcomes and evidence for a clearer, more reproducible and robust meso-structure of results.

Taking into consideration the more specific analysis oriented to the construction of links between *"performance measurement"* and *"performance management"* as key criteria of the research, also in this case, on a wider time span (2011–2025) and at two levels of analysis (50 items – a; 25 items – b Fig. 9), the co-occurrence results and their connections tend to represent in the cloud of nodes, on the one hand the dimension of *"management control"* and *"information management"*, which in the previous evidence (referring to the period 2011–2023) were not present except in the form of *"local government"* and which today find a broader response towards the human sphere in decision making.

This is visible precisely in the deviation and repositioning that the words *"key performance indicators"* (KPI) and *"human(s)"* have undergone.

While in the first case, the KPIs were expressly referred to performance measurement and management connections, they are currently positioned in the reference cluster of the human dimension, decreeing a sort of evolutionary awareness towards the tool, which no longer pertains solely to the sphere of *"information systems"*, but matures towards a more holistic organizational dimension *("organization"*; *"organization and management"*) in an increasingly *"sustainability"* perspective of *"performance"* and *"total quality management"* for *"continuous improvement"*.

The authors, after having carried out this analysis on Vosviewer software, close the cycle of the protocol used by carrying out a text analysis (purposes and content – Appendix A.2.) with Pearson correlation index, in reference to the implemented literary panorama 18 months after the first analysis. What emerged, in terms of positive statistical correlation between highlighted terms and in the main characters, is reported in Table 3.

As regards the narrative elaboration of the evidence expressed, it is possible to decree a shift that is not so wide as regards performance measurement and management, but still significant, of a passage from the mere logic of business performance to a more holistic organizational representation of the same. If at first, in the correlation analysis an intricate link was highlighted between *"measurement"* and *"performance"*, as are *"analytics"* and *"enhancement"*. Consequently, to achieve advancements in measurement and its associated analysis, an integrated framework incorporating the DM aspect of *"automation"* is considered. The human aspect, although existing and essential, is nevertheless marginalized. In the second analysis, however, an element of detail referred to the human sphere is certainly more prominent. In fact, through the *"adoption"* of *"AI"* the aim is to have a direction and a decisional design ("*draws*") more oriented towards the *"effectiveness"* of the *"circular" "performance"*. The decisional derivation, also in reference to industry 4.0 ("*i4.0*"), which feeds performance management and measurement, finds its place in the *"innovation"*, in the *"adoption"* of *"AI"* in the light of *"big data"*. This construct, in the light of the evolution of technology, in its most recent vision, seems to duly take into account the most proper human perspective, that of *"creativity"*. The relationship with the construction of *"knowledge"*, defines a paradigm ever closer to that proposed by the authors for the trinomial integration, referring to an extremely

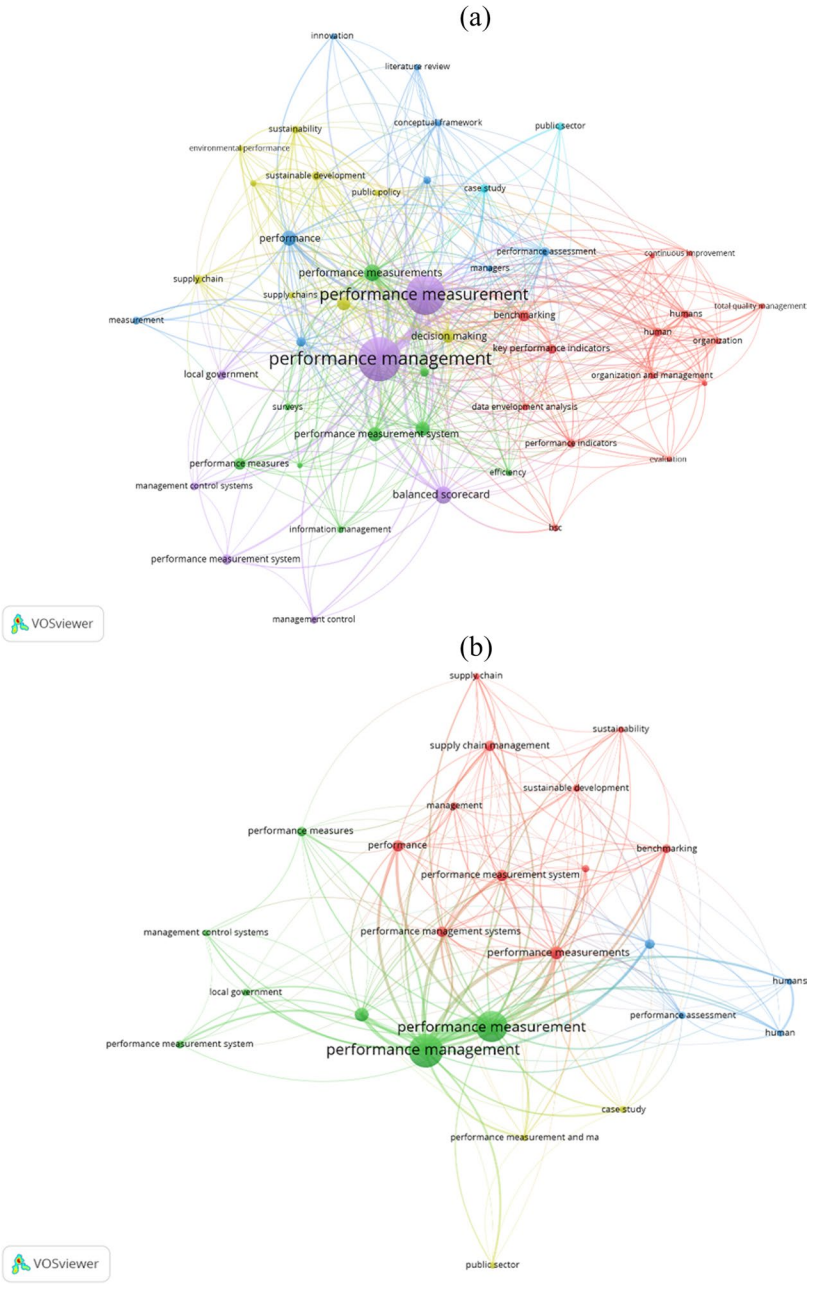


**Fig. 9** Vosviewer co-occurrence, connections and frequency analysis for "performance measurement", "performance management" (2011 to 2025) (**a**) 50 items, (**b**) 25 items enhanced linkages. Source: Authors' elaboration from VOSviewer software (Scopus data accessed: 3rd Nov. 2023)

**Table 3** Voyant text correlation analysis from Appendix A.2. data

| (a) Extracted Correlation (MBCA) on HKS coded purposes | | | | |
|---|---|---|---|---|
| Term 1 | ← | → | Term 2 | Correlation |
| Deal | | | Decision | 0.8964215 |
| Draws | | | Knowledge | 0.7448841 |
| Approaches | | | Performance | 0.7340318 |
| Advanced | | | Performance | 0.69631064 |
| Circular | | | Performance | 0.67965907 |
| Effectiveness | | | Performance | 0.67965907 |
| Allow | | | Decision | 0.6520507 |
| Adoption | | | AI | 0.6499743 |
| Continue | | | Knowledge | 0.6384484 |
| (b) Extracted Correlation (MBCA) on HKS-coded content | | | | |
| Term 1 | ← | → | Term 2 | Correlation |
| Benchmarking | | | Decision | 0.945373 |
| Implementing | | | Organizational | 0.92154557 |
| Approach | | | Decision | 0.8694756 |
| Analytics | | | Innovation | 0.86832577 |
| Big | | | Data | 0.08669574 |
| Data | | | Innovation | 0.85247535 |
| Big | | | Innovation | 0.83652425 |
| Innovation | | | Organization- | 0.80771255 |
| i4.0 | | | al Innovation | 0.806795 |
| Adoption | | | Ai | 0.78985808 |
| Creativity | | | Innovation | 0.7885808 |

Source: Authors' elaboration from Voyant (accessed: 5th Jan. 2025)

human logic of awareness of use of the mass of data generated for *"organizational" "innovation"* purposes and not merely for business.

## Critical discussion

If in the 1980 s the problem became the crisis of measurement due to the inconsistency of the systems used, we are currently faced with another problem connected to the philosophy of measurement – what Neely & Austin (2002) call "obsession with measurement" and which we could call "madness for measurement" (Neely & Austin, 2002). This is what drives organizations to the extreme of exhaustion, as well as the people within the organizations. In this sense, it is necessary to identify a third, alternative way capable of redeeming the system and systematizing PMMSs within the organizational operational context. Therefore, at present, the *"madness"* connected to the obsessive pursuit of measurement aimed at extremizing performance loses sight of the basic concept by which measurement makes sense to exist, that is, providing information frameworks capable of directing the DM process and consequently the choices. If the retention of PMMSs is accomplished through formal efforts, it loses credibility and adds no value. Here, the trinomial dynamic perspective provided by the authors restores a raison d'être and consistency to PMMSs from a DM perspective, updated in light of the potential offered by AI. Already in 2003, 20 years ago, the literature in the field of investigation had identified deficiencies and difficulties in performance measurement systems, reaching a turning point (Bourne et al., 2003). Today we are once again in

the balance, needing new solutions and applications oriented to current needs. With the emergence of the fourth industrial revolution (Skilton & Hovsepian, 2018) and at the dawn of the fifth (Demir et al., 2019), a *cornerstone* would be placed thanks to the potential arising from AI and big data. In a race, even an academic one, in the field of PMMSs – where it seems that there is never enough of them and such that the entire corporate world has used the balance scorecard as the main operational support tool for the evaluation of organizational and strategic performances (Kaplan, 2009) – *What is the future?*

The literature highlights significant perceived negative effects of traditional PMMSs (e.g., cumbersome, monotonous, bureaucratic), suggesting that automation and AI could absorb the most repetitive and redundant tasks. AI is seen as a factor in making future PMMSs more sustainable and strategically aligned with performance measurement, in a complex and rapidly evolving organizational context. This supports the proposed trinomial model.

The first co-occurrence analysis established that the crucial point is the triangulation between "performance measurement", "business performance" and "decision support systems/decision-making". The application objective of AI in the performance measurement process is clearly decision support.

The second analysis (on "performance measurement" and "performance management") confirmed strong links with performance measurement, balanced scorecards and measurement systems. This underscores the need to conceive PMMSs holistically, where complexity and technologies (such as AI) are structured in relation to the human factor for rational decisions, overcoming the rigidity of traditional approaches.

The initial textual analysis highlighted a strong correlation between "measurement" and "performance" and between "analytics" and "improved". It suggested the need for automation and integrated management that includes DM to improve measurement.

The longitudinal comparative analysis (from 2011 to 2025) confirmed and strengthened previous findings, such that the AI theme has gained even greater centrality, with strong links to "machine learning", "innovation" and "digital transformation". Greater attention to the human sphere has emerged, with the relevance of concepts such as "ethics" and "human resource management". A shift from "business performance" to "organizational performance" is noted, implying a more holistic view (Kaplan & Norton, 2004). This perspective is in line with the regulations currently in force on the use of AI including: (a) the European one Reg. Eu 1689/2024, known as the EU Artificial Intelligence Act (AI Act) and (b) with the law L. 23 September 2025, the first to ratify the European regulation in Italy. This legal framework suggests an anthropocentric and augmentative rather than substitutive vision of man, in line with the holistic dimension and the trinomial integrative vision proposed by the authors. Generally, the model developed, not only shifts from traditional binary interactions to a more holistic perspective, emphasizing human involvement in the context of Industry 5.0 and 6.0 (Sardi & Modarelli, 2026), but also promotes the evolution from rudimentary control systems to mature participatory dynamics in DM processes.

## Conclusion

Within an interpretative perspective of overcoming traditional measurement methods, in light of the emergence of new technologies such as AI, the research frame adheres to a specific rationale in underscoring the current literary output, predominant themes and deficiencies within the discipline of PMMS, decreeing a line of augmentative restructuring of the human condition in light of AI rather than a substitutive dynamic, according to an integrative trinomial vision in DM. The investigative methodology transcends conventional systematic and gap analysis, instituting a longitudinal assessment over an 18-month period from the initial inquiry. Through textual and co-occurrence analyses, executed through both algorithmic and critically human-centric lenses, the authors delineate a roadmap that, on one side, facilitates the navigation of scholarly contributions, while on the other, initiates preliminary steps towards the development of an alternative pathway capable of infusing new dynamism into organizational practice.

Currently, we wait weeks and months for performance reports on which to base decisions and the risk is that rapid contextual changes make the strategic organizational-DM perspectives identified inapplicable and obsolete. "Timeliness, flexibility and prompt response" is the necessary mantra for organizations of the future. Only by trinomially integrating the outlined perspectives will PMMS tools still be suitable for organizations in the near future, aiming for an Industry 5.0 and 6.0 horizon (Demir et al., 2019). This study addresses the inquiry by Lee, Hayes and Maher (2024) regarding "AI as a budgeting tool: Panacea or Pandora's Box?" and responds to the call for insights on digital transformation, suggesting that a comprehensive digital transformation, particularly with AI, can facilitate overcoming existing barriers (Cinar et al., 2021) and enhancing the understanding of accounting data, performance assessments and users' needs. This prospective dynamic is inevitably circumstantiated by the feasibility of accepting technology and the mediating capacity between it and the human being. However, what is suggested by the in-depth analysis of the literature, especially thanks to the textual content dimension that the authors have produced, is the necessary human contribution to the dataistic extremization that characterizes the increasingly technology-driven measurement logics. In this direction, the human contribution, of judgment, of resolution, analytical and critical creativity, must necessarily favor the creation of an organizational ecosystem that aims at holistic and circular performance, rather than mere performance per se, reintroducing the real meaning of entrepreneurial perspective within organizational environments (Davidsson, 2016). In this sense, the main contribution, with reference to the proposed model, offers new interpretative and implementation keys in the literature. This occurs primarily thanks to the introduction of the binomial human-machine approach in favor of a more holistic trinomial integration, which involves IT-based PMMS, human capital (in its sense of critical and judgmental uniqueness) and AI as an empowering analytical tool. The conceptual configuration then finds its practical formalization by bringing the model closer to the perspective of Industry 5.0 and 6.0 (Sardi & Modarelli, 2026), supported by an explanatory roadmap.

The structuring of a roadmap, insightful and full of suggestions, still preliminary, derives from the use of a longitudinal and comparative methodological perspective,

precisely aimed at highlighting possible deviations in the awareness of scholars over a medium-long period of time, to identify the pillars of a rapidly growing phenomenon boosted by the ever increasing effects of emerging technologies. The ethical aspects of use, the human centralization of management and the beneficial instrumentalization of data extraction tools, become a fundamental combination for the organizations of the future and for their sustainable permanence. Inherent in this vision of permanence, the conceptually identified figure of the entrepreneur would assume ever greater relevance, strengthening and redrawing the boundaries of the DM dynamics towards a long-term orientation trajectory.

In this organizational ecosystem, the trinomial aspect, which does not see the supremacy of one over the other, but the stringent coordinated cooperation, will presumably determine the prospective framework of a holistic PMM vision (Kaplan & Norton, 2004).

The first research question (RQ1) can be answered: traditionally conceived PMMSs no longer find their place within the challenges posed by the current context. To remain current and therefore answer RQ2, PMMSs can be integrated within the DM dynamics that compete within a context dictated by emerging complexity, only through new solutions capable of promoting interacting dynamics between processes and measurement tools, objects of measurement, judgement on the object measured and strategic orientation towards the definition of actions. As suggested by the analysis carried out, a third way, that of human-machine interaction, within the dynamics of a PMMS, both in the private and public sector, would be possible with the help of AI.

While the theoretical and conceptual results stop at the definition of trinomial integration, the practical and applicative results of the study provide the main steps of the roadmap. Effective application of the model requires: (i) shifting the focus from "madness for measurement" to "measure to decide"; (ii) Rethinking PMMS as integrated systems to support DM; (iii) mapping existing PMMS processes (data collection, basic reporting, repetitive calculations) to identify activities that are perceived as monotonous, bureaucratic and time-consuming; (iv) implementing AI solutions to absorb these repetitive tasks, freeing up staff for value-added analysis and DM; (v) Creating an integrated data and analytics infrastructure that acts as a bridge between raw data (Big Data) and human decision-making. In this way, AI acts as an integrated (trinomial) decision support system, providing fertile ground for the implementation of non-replacement (anthropocentric) augmented human enhancement.

The main implications are, on the one hand, a theoretical conceptualization, instrumental to advancing studies in the area and on the other, the practical definition of a roadmap guiding the transition from "madness for measurement" to "measure to decide". This ideological reversal represents the most obvious practical implication of the contribution, as a practical and replicable example of the model's application. The model representation starts here in the paper, inherently with the methodology used to describe it, which highlights its distinctive features, traits and peculiarities. In this sense, the strengthened human role would find its raison d'être in this example. In any case, the practical implications of the roadmap could be traced back above all to the managerial perspective, foreseeing a refocus intended as a cultural shift from the view of the account to what matters for decisions, where the trinomial model is

therefore considered a sophisticated PMMS supporting the DM, an exoskeleton and not a superstructure as in the past.

Regarding limitations, the lack of empirical data can be seen as such, but it is also the cornerstone of future developments in this direction that can complement the contribution of the initially proposed trinomial model by effectively providing direct case studies and personal observations in practice. Therefore, pilot companies and pilot company areas can functionally contribute to the preparation of experiments and testing environment to evaluate short- and medium-long-term impacts, advantages and disadvantages of the trinomial integration model, as well as determine and redefine the steps indicated for the roadmap in its applied version.

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