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THE IMPACT OF ENHANCING PERFORMANCE MANAGEMENT PROCESSES ON TECHNOLOGICAL INNOVATION OUTPUTS: A FIELD STUDY IN LAGHOUAT CEREALS COMPANY

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Purpose. In this field study, the author investigates the impact of enhancing performance management processes toward creating high-performance management systems and their impact on technological innovation outputs. The main purpose is to study the relationship between performance management processes and technological innovation outputs, assess specific processes' impact, identify key factors for success, adapt processes for better support, analyse implementation challenges, and propose recommendations for improvement.
Results. Findings suggest that improvements in performance management processes positively influence technological innovation outputs, enhancing efficiency, creativity, and competitiveness in the cereal industry. The study contributes to understanding the role of performance management processes in fostering technological innovation and offers practical insights for companies seeking to optimise their technological innovation processes and outcomes. In addition, results ensure that clear goal setting in performance management aligns innovation with organisational objectives; reassuring innovative contributions motivates employees; training fosters skill development; organisational supportive cultures facilitate innovation; fair evaluations encourage participation; collaboration enhances creativity; and diversity enriches perspectives.
Scientific novelty. Performance management processes and systems play a critical role in fostering innovation by setting goals, providing feedback, identifying training needs, and aligning objectives, ultimately driving the development of technological innovations. We have conducted a quantitative study and collected data in a real-world setting through questionnaires, to explore the relationship between performance management processes and the level of technological innovation achieved by the company.
Practical value. The study can help practitioners determine the main focus areas in their performance management processes to reach the desired technological innovation outputs, as we found that performance management processes can positively impact technological innovation in a company, and more precisely, the goal setting process beside training and development. Therefore, concentrating on aligning innovation efforts with organisational objectives through clear goal-setting, and providing training and development opportunities to develop employees' skills and knowledge leads to higher technological innovation rates in the company.
Key words: performance management processes, performance management systems, technological innovation outputs.

Introduction. Performance appraisal has always been an area of interest in the literature, and scholars mostly used the terms appraisal, assessment, and performance review synonymously. They are indicating the process of measuring individuals' and

teams' performances to achieve organizational goals. Performance management is considered a new research area because of the lack of a historical background. However, performance management processes (PMP) were discussed vastly in previous literature (e.g., goal setting, training and development, incentives and rewards, etc.). Thereafter, the pillars to implement a comprehensible performance management system have existed since the last century.

Performance management gained its maturity and became an inclusive process that is divided into five main areas, planning, monitoring, developing, rating, and rewarding. However, the translation of these processes should result in a successful PMS (performance management system). PMSs seek to pursue and measure the employees' performance continuously. This latter is a set of technologies and methods that allows the organization to synergize the efforts of its employees and follow up on their performances concerning achieving the overall goal.

Improving PMSs became a crucial process to face the environmental shifts and building high PMSs that lead the organization toward the best performance. Improved PMSs can rely on multiple anchors that may differ from one organization to another. However, there are some important dimensions that many scholars agree on. Murphy & Olsen (2009) have gathered based on multiple research (e.g. Murphy & Williams, 2005; Pfeffer et al., 1995) the dimensions that help improve PMSs toward high PMSs (e.g., high wages, incentives pay based on performance appraisal, information sharing, self-managed teams, etc.).

To build a successful PMS, the organization should focus mainly on applying performance management processes correctly. This latter encompasses various elements, including performance appraisal, alongside factors such as setting objectives, training and development initiatives, as well as incentives and rewards. Therefore, performance management is a structured process wherein managers collaborate with their employees to establish expectations, assess and review outcomes, and provide incentives based on performance. Its objective is to improve employee performance and positively impact organizational effectiveness. Therefore, by aligning individual and team objectives with those of the company, the PMS models seek to maximize performance outcomes and enhance overall organizational success.

Some organizations who seek to implement technological innovations are failing, this failure is due to the absence of performance measurement or the irrelevant one (White, 1996; Santa et al., 2014). This leads us to the emphasis on the role of enhanced PMP on technological innovation – inputs, processes, and outputs. Therefore, this research addresses the question *"Can enhancements in performance management processes influence the outputs of technological innovation?"*. To better conduct this research, a quantitative approach was put into service, using a questionnaire directed to employees of an Algerian organization that has significantly implemented technological innovation processes.

Relevance of research:

1. Understanding how performance management processes affect technological

innovation outputs helps align innovation efforts with broader organizational goals.

2. Insights from this study aid in optimizing resource allocation, ensuring investments are directed towards innovation initiatives with the highest potential for success.

3. Implementing effective performance management strategies can lead to a competitive edge through enhanced innovation capabilities and market differentiation.

4. By fostering a supportive work environment, organizations can boost employee engagement and motivation in innovation-related roles, driving creativity and collaboration.

5. This study contributes to long-term organizational success by improving innovation processes, fostering a culture of innovation, and achieving sustained growth in dynamic market environments.

Review of literature. *Performance management.* Performance management, appraisal, and assessment were used before the 1980s synonymously. Later, there was a new term emerged to describe the formal process of appraisal and assessment, which is "performance review'' (Lansbury, 1988). DeNisi & Murphy (2017) confirm based on their research that the interest in performance management is a recent phenomenon while the interest in performance appraisal goes back one century before. Thus, in the previous 100 years, many studies focused on performance appraisal, but so limited ones sought in performance management. Hence, it is a much more recent direction with less historical background to describe it (DeNisi & Murphy, 2017). On the other side, the components of performance management have been widely discussed in the previous literature, such as feedback and goal setting (DeNisi & Murphy, 2017).

Previous studies have shown that performance management should be viewed as a continuous process, as goals might alter over time (Malik et al., 2021). Moreover, researchers confirmed that performance management is a term that includes performance appraisal besides many other processes such as determining objectives (Lansbury, 1988), training and development, incentives and rewards, etc. (Lebas, 1995). Thence, a process where managers continuously share with their employees the setting of expectations, the measurement and review of results, and incentives and rewards, to enhance employee performance, and positively affect the organizational performance (Den Hartog et al., 2004).

Therefore, performance management is a holistic approach that uses both qualitative and quantitative approaches and has several measuring instruments available (Al-Delawi & Ramo, 2020) to enhance employee performance and help organizations balance conflicts caused by changes in purpose, values, revenue creation, and procedures (Manville & Greatbanks, 2020). On the other hand, some studies on the application of performance management for performance enhancement have shown inconsistent results and addressed various goals (Zhang et al., 2021). However, the focus on performance management led to the born of new models dealing with how to manage and improve performance (Aguinis & Pierce, 2008; DeNisi & Pritchard, 2006; Levy & Williams, 2004; Murphy & DeNisi, 2008; Pulakos, 2009). Whereas, all these

models have focused mainly on adjusting individual or team performance with corporate goals (DeNisi & Smith, 2014).

Performance management literature sheds light on the process of improving and motivating individual employees' performance (DeNisi & Smith, 2014), through integrating knowledge and innovation along with all performance management processes (Di Vaio et al., 2021). Nevertheless, this whole process of improving individual and team performances aims to achieve the ultimate goal, which is improving firm-level performance (DeNisi & Smith, 2014) And increasing employees' job satisfaction (Kubiak, 2022) through guiding decision-makers toward creating competitive strategies and measuring their outcomes (Gruenbichler et al., 2021). However, improving individual performance does not necessarily improve firm-level performance. On the contrary, some articles focused on improving firm-level performance and the influence of human resources processes at that level, more precisely, "how these processes could create the transformation from individual-level to firm-level performance" (DeNisi & Smith, 2014). Our data reveals that performance management involves.

Performance Management Systems. After 2000, performance management resulted in many undesirable shortcomings across different industries, leading to a new generation of performance management systems claiming to increase the complexity of the measures to be more comprehensive (Vainieri et al., 2020). Schrøder-Hansen & Hansen (2023) define PMSP (performance management systems and processes) as an information exchange system inside the organization, this process aims to create value by achieving organizational goals. Based on many scholars' definitions, performance management is a set of activities that aim to enhance performance on an individual and/or a team level, by emphasizing the ultimate goal which is improving performance and effectiveness on an organizational level (DeNisi & Kluger, 2000; Baron & Armstrong, 1998). This latter is a process of measuring performance outcomes to determine the landmarks of good and high performances to better design the performance management system (Den Hartog et al., 2004).

Performance models differ in terms of levels (e.g. individual, group, organization). Still, they are similar, so performance can be seen as a multi-level construct, and also as a cross-level construct (performance at one level of analysis influences performance at other levels) (Den Hartog et al., 2004). To have a good performance management system, organizations should focus on two main objectives: evaluating employees' performance and identifying their potential for advancement (Robert et al., 2022), besides building effective performance appraisal models by determining what makes a good performance, and know what should be measured and stimulated (Fletcher, 2001). And more importantly, the link between performance indicators of individual, group, and organizational levels (Molleman & Timmerman, 2003).

Towards improving PMS. To build a well-designed performance management system, the organization should encompass both individual and team levels, give more

authority to teams, and have adequate resources to reach the goals of increasing individual, team, and organizational performance (Aguinis et al., 2013). Performance management systems can differ in components from one organization to another. However, scholars have sought to create solid anchors that ensure the success of a performance management system (e.g., Morgan, 2001; Murphy & Williams, 2005; Pfeffer et al., 1995; Pfeffer, 1998; Murphy & Olsen, 2009). The Table 1 represents a set of anchors that improve PM processes toward high PMS.

Table 1

The anchors of improved/high-performance management systems

Anchors	Components	Researchers
High wages	Pay raises, share ownership, stock options, profit sharing, funding for skill improvement, and individual or team incentives	Morgan (2001)
Incentive pay based on performance appraisal	Gain sharing, profit sharing, pay for talent, or other types of individual or team incentives	Pfeffer et al. (1995)
Information sharing	On topics such as financial performance, strategy, and operational metrics. This demonstrates to the organization's employees that they are trustworthy	Morgan (2001)
Participation and empowerment	They promote decentralization of decision-making, as well as extensive worker engagement and empowerment in managing their work processes	Pfeffer et al. (1995)
Self-managed teams	Qualitative and quantitative research demonstrates that workers in self-managed teams experience more autonomy, flexibility, discretion, and job satisfaction, resulting in teams outperforming traditional work groups	Pfeffer (1998)
Training and skill development	Training, cross-training, and cross-utilization are critical components of high-performance work systems	Pfeffer (1998)
Reduced status distinctions and barriers	Including clothes, language, workplace layout, and compensation variations across levels	Pfeffer (1998)
Quality of work / life	The level of emotional, intellectual, or cultural happiness in one's daily life differs from the level of material comfort	Murphy & Williams (2005)
Diversity	Defined as a collective blend of contrasts and similarities that are employed in pursuit of corporate objectives	Murphy & Olsen (2009)

Source: Murphy & Olsen (2009).

Technological innovation. Innovation has several forms, including product, process, and organizational innovation. Product innovation is the most often researched sort of innovation (Saunila, 2020). Hence, product innovation is crucial, but as the sector matures, output growth slows, entry decreases, and producer numbers decrease, making it less important, process innovation increases (Markard, 2020), therefore, both product and process innovations are crucial. However, innovation alone is not sufficient for growth since businesses no longer simply purchase goods and services,

but also employ technology to help and improve these services through current technological innovation (Chege et al., 2020). Technological innovation is the result of individual acts motivated by market incentives, leading to the creation of wealth, rather than random remains (Omri, 2020). On the other hand, Fisher & Pry (1971), define technological innovation as a competitive process that involves replacing outdated technologies with newer ones (Liu et al., 2020).

Innovation is frequently split into technological innovation and organizational innovation, whereas, organizational innovation affects all parts of the organization including all types of innovation, besides factors such as workforce development, work design, employee voice, and shared rewards (Mothe & Uyen Nguyen Thi, 2010). The broad aspects of organizational innovation include strategies, along with structural, and behavioral dimensions (Gu & Gera 2004). Hence, the implementation of new methods in business processes, workplace organization, or external relations is referred to as organizational innovation (OECD, 2005). However, according to many studies, companies engaged in technological innovation typically adopt complementary organizational processes. Therefore, technological innovation is an important catalyst for organizational changes that force businesses to restructure their production, workforce, sales, and distribution systems (Mothe & Uyen Nguyen Thi, 2010).

People can now live longer and more fulfilling lives thanks to technological advancements, whether they take the form of new knowledge or new goods and services (Glied & Lleras-Muney, 2008). Therefore, plenty of research has been done on the factors that help or hinder people from adopting new technologies (Howell & Higgins, 1990). To aid organizations in facing the organizational environments' change and complexity by acquiring technological advantages and developing and implementing technological innovation strategies and methods (Ouyang et al., 2020) such as productivity, competition, and survival tools. However, this latter is strongly linked to the presence of a champion (i.e., a person who formally enters an organization and contributes decisively to the innovation by actively and enthusiastically encouraging its advancement through the important organizational phases) (Howell & Higgins, 1990).

Globalization and the new world economies created new markets due to the emergence of new industries and the escalation of market competition. Thus, firms must depend on innovative technological advances (Howell & Higgins, 1990) to go along with the new markets' demands. Technological innovation has a vast body of research, broadly defined as the methods that focus on issues with technology-based change in organizational and social settings (Allen, 2000). Therefore, technological innovation studies aim to explain technological change in a social context by focusing on management, economics, sociology, and communications (Allen, 2000).

Christensen (1995) discussed that technological innovation is primarily attributed to a firm's R&D assets, thence R&D capacity is the primary asset responsible for generating technological innovation the most important intangible innovation expense (Evangelista et al., 1997; Yam et al., 2004). On the other side, Schumpeter built a definition based on the socio-scientific debate of innovation, confirming that

innovation is generally understood to be an activity that encompasses R&D activities, the creation and effective marketing of new products, the introduction of new production technologies, as well as the reorganization of processes (Hirsch-Kreinsen, 2008). At the same time, Linton et al. (2002) considered technological innovation as an exclusive technique or manufacturing process of an organization that grants quick reactions to environmental changes. Moreover, TI denotes the organization's ability to select, disseminate, and enhance its existing technologies, thence it is a process of experience cumulation (Azubuike, 2014).

According to Damanpour (1992), innovation is the adoption of an idea, behavior, system, policy, program, device, process, product, or service that is novel to the organization (Mothe & Uyen Nguyen Thi, 2010). Therefore, technological innovation is rarely solely based on new research (Kline & Rosenberg, 2010) and the exploitation of current scientific knowledge for particular technical tasks within the innovation process might fall under the other subcategory (Christensen, 1995). Moreover, the term "technological innovation" is frequently used to refer to both product and process innovation. Product innovation is the injection of a new good or a new quality in the market (Simonetti et al., 1995), hence the introduction of products or services that are novel or significantly improved in terms of their features or intended applications including materially better technical requirements, parts and materials, software integration, user-friendliness, or other functional qualities (OECD, 2005). Process innovation is the introduction of a new technique of production that has not yet been experimentally proven in the relevant sectors, as well as a new manner of dealing with commodities economically (Simonetti et al., 1995).

The skills (knowledge, information) needed to innovate technologically do not only come from the technical recipes that are recorded in documents, articles, and patents but also from the technical knowledge that is stored in the heads of specific people. Innovative abilities are based on experienced tacit knowledge just as much as they are on articulable knowledge and recipes, as Nelson and Winter argued and more recently further developed. Additionally, because technological endeavors require teamwork, managerial and organizational skills are at least as crucial to technological capabilities as are purely technical skills (Christensen, 1995).

Hypotheses of the study:

H1: There is a statistically significant relationship at a 5 % significance level between performance management processes and technological innovation outputs.

H1.1: Goal setting affects positively the outputs of technological innovation.

H1.2: Performance appraisal processes have a positive relationship with technological outputs.

H1.3: Training and development improve technological innovation outputs.

H1.4: Incentives and rewards encourage developing better technological innovation outputs.

H2: There are statistically significant differences in the effect of performance management processes and their dimensions on the technological innovation outputs,

in the presence of at least one moderator through personal data variables (age, gender, qualification, experience, job type).

Materials and methods. *Research objectives:*

1. To investigate the relationship between performance management processes and the outputs of technological innovation.
2. To assess the impact of specific performance management processes on the effectiveness of technological innovation processes.
3. To identify the key performance management factors that contribute to successful technological innovation outputs.
4. To explore how performance management processes can be tailored to better support and enhance technological innovation within the organization.
5. To analyse the challenges and barriers that organizations face in implementing effective performance management strategies to support technological innovation.
6. To propose recommendations for improving performance management processes to optimize the outputs of technological innovation.

Research model. In this research we used a study model that aids us measure the impact of performance management processes on the technological innovation outputs, the Figure 1 illustrates the proposed study model.

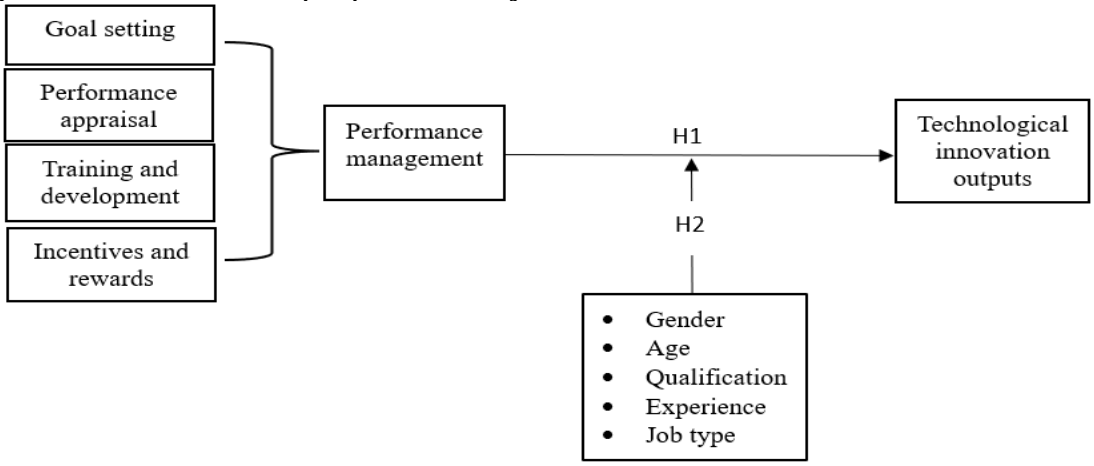

Figure 1. The general research model

Source: prepared by the author depending on previous studies.

Our research is built upon the deductive approach. To answer the research questions, we chose the descriptive approach to better identify the characteristics of the research problem and demonstrate a general understanding of the relationships between variables. We decided to employ primary data that was collected from the employees of the company "Laghouat Cereals" which is situated in Laghouat, Algeria. The used tool for this process was a questionnaire that was divided into four sections (Demographic variables, Improvement of performance management processes, and Technological innovation outputs), and the method of our variables' measurement was the Likert 5-point ordinal scale. Also, we gathered the data at a single point in time; thus, our study is cross-sectional.

The methodology of our research is a field study, as we aim to have a detailed study of the specific individuals that have a direct/indirect relationship with

technological innovation outputs, and the company's role in implementing improved performance management processes. To test our hypotheses, we chose a quantitative method and used primary data sources, and thence, we investigated the correlations between our variables. Research variables, sampling and data collection, and sampling process, are discussed in this section.

Research variables. The independent variable in this research represented in improved performance management processes involves four dimensions: 1 – performance appraisal, 2 – goal setting, 3 – training and development, and 4 – incentives and rewards. The dependent variable which is technological innovation outputs consists of statements related to its outputs which are: 1 – new products, 2 – new production technologies, and 3 – reorganization of production processes. And last, we included: Age, Gender, Qualification, Experience, and Job type, in demographic variables to examine their moderation effects over the independent and dependent variables.

The company under examination – AGRODIV industry. The AGRO-industries group AGRODIV was born from the restructuring of the public trading sector in February 2015, its purpose is in the agro-industries in all its diversity, and its strategy is based on a logic of supply chain integration. It has more than 6,000 employees. It was launched in 2015, this industry is active in production and distribution. The legal form of this industry and its subsidiaries is a joint-stock company and public economic enterprise, that is partially owned by the state and controlled by public authorities.

Group activities:

1. 1st and 2nd cereals processing and derivatives;
2. Production of juices, beverages, and preserves from the processing and packaging of fruits and vegetables;
3. Phoenix culture and date processing;
4. Packaging of coffee, sugar, dried vegetables, and rice;
5. Storage, packaging, and marketing of various food products.

Group sectors:

Cereal sector:

1. 6 subsidiaries for cereal processing;
2. 29 industrial and commercial complexes;
3. Crushing capacity: 20 million quintals per year;
4. Cereal storage capacity: 8.5 million quintals;
5. Locations: national territory.

Distribution sector:

1. Distribution and packaging subsidiary;
2. Marketing and storage platforms;
3. Roasting and packaging units.

Agricultural production valorization sector:

1. Agricultural subsidiary "Agro-Sud"

- Experimental pilot farm.
- Total area: 1134 hectares, including:

- Date palm plantation: 14 hectares (1083 palm trees).
- Various cereals under experimentation: 16 pivots of 30 hectares each (green forage, barley, wheat).

2. Water resources:

- 16 wells with a flow rate > 45 liters per second.

Sampling process. To choose the sample for our research by which the population is represented, we chose a purposive sampling method, which is a non-probability technique where researchers rely on their judgment in the process of selecting members from the population to participate in the questionnaire. Our questionnaire was distributed in the subsidiary of Laghouat "Laghouat Cereals", which is mainly active in 1st and 2nd cereals processing and derivatives, their main products are (Semolina of hard wheat; Wheat flour; Durum wheat flour). The population size is 241 employees, and to determine our sample size which is 149 we used the formula of Thompson (2012). In this regard, we dispensed 150 copies of our questionnaire to different departments in the firm (marketing, HRM, accounting, production, and quality management). We have received 83 copies, and the recovery rate is 55.33 %. The non-analysable copies among the 83 were 11 therefore we excluded them and used the final 72 copies.

Data collection. In this paper, and to achieve the main purpose which is analysing the influence of improved performance management processes on technological innovation outputs, we decided to use the questionnaire method, we built a questionnaire divided into three sections, the first one is about the demographic variables (gender, age, qualification, experience, job nature), the next section is about performance management processes (goal setting, performance appraisal, training and development, incentives and rewards), the third one comprises paragraphs regarding technological innovation outputs. This operation will be conducted in presence at the company of interest "Laghouat Cereals".

Results and discussion.

1.1. Descriptive statistics. In our research, we employed five distinct personal variables to gain deeper insights into their impact on our variables. These characteristics aid us in assessing the outcomes of the differentiation test, as they serve as moderating variables. Their frequencies are shown down below (Table 2).

Table 2

The distribution of sample individuals according to personal variables

Characteristics	Statement	Frequency	Percentage, %
1	2	3	4
Age	30 years or less	14	19.4
	From 31 to 40	39	54.2
	From 41 to 50	14	19.4
	51 years or more	5	6.9
Gender	Male	55	76.4
	Female	17	23.6
Qualification	A secondary degree or less	20	27.8
	Bachelor's degree	26	36.1
	Master's degree	26	36.1

Continuation of Table 2

1	2	3	4
Experience	5 years or less	16	22.2
	From 6 to 10 years	29	40.3
	From 11 to 15	12	16.7
	16 years or more	15	20.8
Job type	Administrative	25	34.7
	Technical	28	38.9
	Mixed (administrative and technical)	19	26.4

Source: prepared by the author relying on the outputs of the "IBM SPSS statistics 26" program.

1.2. Measurement model evaluation. To analyse the measurement model, we will rely on indicators through the "SMART PLS 4" program for analysing the results and studying our model. We will base our analysis on the model's quality indicators (construct reliability and validity, Discriminant validity, R-square, and F-square) which provide clearer insights into the suitability of the model for the study in comparison to the proposed model.

1.2.1. Construct reliability and validity. The reliability and validity tests are indicators that help reveal the extent to which the questions converge with each other. Based on (Sarstedt et al., 2022), the criteria for evaluating reliability and validity are Factor loading, Composite reliability, and Average value extracted (AVE). After the evaluation of the study model, we found the following results (Table 3).

Table 3

Results of construct reliability and validity

Dimensions	Statements	Factor loading	Cronbach's alpha	Composite reliability	Average value extracted
1	2	3	4	5	6
Goal setting	x11	0.774	0.896	0.921	0.700
	x12	0.856			
	x14	0.756			
	x15	0.702			
	x16	0.716			
Performance appraisal	x21	0.721	0.913	0.916	0.616
	x23	0.833			
	x24	*0.479*			
	x25	0.716			
	x26	0.732			
	x27	*0.692*			
	x28	0.783			
Training and development	x31	0.793	0.918	0.912	0.573
	x32	*0.510*			
	x33	0.795			
	x34	*0.483*			
	x35	0.718			
	x36	*0.689*			
	x37	0.725			
	x38	0.864			

Continuation of Table 3

1	2	3	4	5	6
Incentives and rewards	x41	0.777	0.948	0.959	0.823
	x42	0.729			
	x43	0.841			
	x44	0.717			
	x45	0.870			
Technological innovation outputs	y2	*0.516*	0.905	0.923	0.578
	y3	0.875			
	y4	0.774			
	y5	*0.633*			
	y6	0.822			
	y7	0.860			
	y8	0.802			
	y9	0.700			
	y11	0.789			

Source: prepared by the author based on the outputs of the 4PLS Smart program.

Based on these results, we found that the factor loadings of (x24, x27, x32, x34, x36, y2, y5) are less than 0.7. Therefore, we have to delete these factors because they are unsaturated, and keep the rest because the factor loading is above 0.7. Moreover, we notice that all Chronbach's alpha factors are significant and statically accepted (>0.7), as well as the Composite reliability (>0.7), and the AVE (>0.5). This indicates that the study is reliable and valid.

1.2.2. Discriminant validity.

1) Cross loadings. In this phase, we seek to ensure that the correlation value between the statement and the dimension it belongs to must be greater than its correlation value with the other dimensions (Table 4).

Table 4

Cross loading results

Variable	Goal setting	Performance appraisal	Training and development	Incentives and rewards	Technological innovation outputs
1	2	3	4	5	6
x11	*0.774*	0.632	0.530	-0.401	0.697
x12	*0.856*	0.203	0.425	-0.196	0.398
x14	*0.756*	0.295	0.325	-0.196	0.398
x15	*0.702*	0.446	0.478	-0.484	0.687
x16	*0.716*	0.595	0.577	-0.493	0.462
x21	0.618	*0.721*	0.680	0.178	0.373
x23	0.207	*0.833*	0.279	0.191	0.312
x25	0.549	*0.716*	0.656	0.003	0.256
x26	0.273	*0.732*	0.416	0.401	0.697
x28	0.558	*0.783*	0.584	0.081	0.203
x31	0.500	0.361	*0.793*	0.178	0.373
x33	0.042	0.281	*0.795*	0.191	0.312
x35	0.421	0.511	*0.718*	0.003	0.256

Continuation of Table 4

1	2	3	4	5	6
x37	0.283	0.625	*0.725*	0.196	0.398
x38	0.539	0.483	*0.864*	0.081	0.203
x41	0.498	0.086	0.088	*0.777*	0.123
x42	0.460	0.104	0.104	*0.729*	0.310
x43	0.553	0.209	0.207	*0.841*	0.501
x44	0.066	0.195	0.194	*0.717*	0.415
x45	0.220	0.048	0.046	*0.870*	0.323
y3	0.387	0.464	0.461	0.160	*0.875*
y4	0.001	0.422	0.421	0.181	*0.774*
y6	0.238	0.193	0.659	0.193	*0.822*
y7	0.299	0.566	0.453	0.566	*0.860*
y8	0.530	0.460	0.564	0.460	*0.802*
y9	0.444	0.180	0.203	0.180	*0.700*
y11	0.281	0.251	0.247	0.177	*0.789*

Source: prepared by the author based on the outputs of the 4PLS Smart program.

As observed in the Table 4, it is evident that the statements are independent and self-sufficient because the statements within each dimension show a strong correlation with their respective dimensions rather than with others.

2) Variable correlation. Each variable should be strongly correlated to itself to ensure that this latter represents itself in the best way possible, to discover this we used the Fornell-Larcker criterion and found the following results (Table 5).

Table 5

Fornell-Larcker criterion results

Indicator	Goal setting	Performance appraisal	Training & development	Incentives & rewards	Technological innovation outputs
Goal setting	0.836	-	-	-	-
Performance appraisal	0.583	0.785	-	-	-
Training & development	0.483	0.500	0.757	-	-
Incentives & rewards	0.452	0.146	0.144	0.807	-
Technological innovation outputs	0.675	0.554	0.552	0.418	0.760

Source: prepared by the author based on the outputs of the 4PLS Smart program.

3) Heterotrait-monotrait ratio. From the Table 6, it can be observed that all criterion values are below the threshold level, indicating justification for stating that the dimensions exhibit construct validity in the study's measurement model.

Table 6

HTMT criterion results

Indicator	Goal setting	Performance appraisal	Training & development	Incentives & rewards	Technological innovation outputs
1	2	3	4	5	6
Goal setting	-	-	-	-	-
Performance appraisal	0.899	-	-	-	-

Continuation of Table 6

1	2	3	4	5	6
Training & development	0.877	0.803	-	-	-
Incentives & rewards	0.416	0.315	0.307	-	-
Technological innovation outputs	0.673	0.443	0.436	0.412	-

Source: prepared by the author based on the outputs of the 4PLS Smart program.

1.3. Structural model evaluation.

1.3.1. The quality of the model. Before we passed to hypothesis testing, we assessed the indicators of the structural model quality.

1) The coefficient of determination (R-squared). Based on the calculations we notice that the coefficient of determination (R-squared = 0.503) is moderate, indicating that the independent variable (performance management) has sufficient ability to explain the variation in the dependent variable (technological innovation outputs) within the organization sampled for the study.

2) Effect size coefficient (F-square). Based on the calculations we observe that the independent variable (performance management) and its four dimensions (goal setting; performance appraisal; training and development; incentives and rewards) have a very strong impact, with a value of 0.794, exceeding 0.35 according to Cohen (1988). This indicates a very significant impact of performance management on the dependent variable (technological innovation outputs).

1.3.2. Hypotheses testing.

a) 1st Hypothesis testing (Table 7).

Table 7

The first hypothesis testing results

Indicator	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P-values
x -> y	0.647	0.670	0.070	9.210	0.000
x1 -> y	0.608	0.499	0.285	2.133	0.033
x2 -> y	0.462	0.558	0.352	1.313	0.189
x3 -> y	-0.492	-0.481	0.250	1.966	0.049
x4 -> y	-0.007	-0.049	0.148	0.045	0.964

Source: prepared by the author based on the outputs of the 4PLS Smart program.

Through the Table 7 presented above we notice that the performance management processes have an impact on technological innovation outputs at the significance level of ($\alpha = 0.05$) because its value is (0.000). Besides the sub-hypotheses goal setting and training and development affect the outputs of technological innovation at significance levels of (0.033, 0.049) successively.

b) 2nd Hypothesis testing (Table 8).

From the Table 8, we note that the interaction term's effect of two moderators on the internal construct is significant. Therefore, we conclude that the moderators (gender and experience) have a significant moderating effect on the relationship between performance management processes on technological innovation outputs at the significance level of ($\alpha = 0.05$) with P-values of (0.000, 0.001) sequentially.

Table 8

Results of testing the moderating effects

Indicator	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P-values
Gender -> y	0.308	0.301	0.084	3.664	*0.000*
Age -> y	0.069	0.065	0.106	0.647	0.518
Qualification -> y	0.027	0.009	0.144	0.187	0.852
Experience -> y	0.343	0.342	0.106	3.244	*0.001*
Job type -> y	-0.128	-0.121	0.090	1.421	0.155

Source: prepared by the author based on the outputs of the 4PLS Smart program.

2. Discussion. Improving performance management processes is regarded as one of the best methods to develop high PMSs, and this latter represents a strong tool that companies use to face their changing environments alongside the need to innovate and achieve competitive advantages. Technological innovation has become a crucial result that most companies seek to reach, regardless of its difficulty. Therefore, we sought deeply into this phenomenon by emphasizing the role of enhancing performance management processes as a generator and motivator of the technological innovation outputs. By studying the impact of PMP on technological innovation outputs and based on the existing literature exploring innovation and performance across both public and private sectors, we hypothesized that there is a positive influence relationship, besides the existence of at least one moderator variable that impacts the relationship between our variables.

2.1. Validation of hypotheses. Based on the results of our research, we found that enhanced performance management processes have an influence over technological innovation outputs and this confirms the main streams of previous studies (Singh et al., 2017; Walker et al., 2011; Zhang et al., 2019). Thus, we validate the 1st hypothesis "there is a statistically significant relationship at 5 % significance level between performance management processes and technological innovation outputs" and reject the null hypothesis. However, we found that among the four dimensions of performance management (goal setting, performance appraisal, training and development, incentives and rewards) there are only two that affect the technological innovation outputs, which are goal setting and training and development.

Goal setting process in performance management can impact technological innovation outputs in multiple ways, such as:

– *Alignment with organizational strategy:* performance management involves setting goals that align with the organization's overall strategy and objectives. When technological innovation goals are aligned with broader strategic goals, it ensures that innovation efforts contribute directly to the organization's mission and long-term success;

– *Focus on innovation objectives:* setting specific innovation goals within the performance management framework ensures that innovation receives the necessary attention and resources. These goals may include developing new products or services,

improving existing technologies, or implementing innovative processes;

– *Accountability and responsibility:* clear performance goals hold individuals and teams accountable for their contributions to technological innovation. When employees are accountable for achieving innovation goals, they are more likely to actively engage in creative problem-solving, experimentation, and knowledge sharing to drive innovation forward;

– *Encouragement of risk-taking:* performance management systems that incorporate innovation goals encourage risk-taking and experimentation, creating a culture that embraces innovation;

– *Feedback and evaluation:* regular performance reviews provide feedback on progress towards innovation goals. The evaluation of performance against innovation allows organizations to identify strengths and areas for improvement, providing valuable insights for refining innovation strategies and allocating resources more effectively;

– *Recognition and rewards:* linking innovation goals to performance management enables organizations to recognize and reward employees for their contributions to technological innovation. Rewarding innovative behavior and achievements reinforces desired behaviours and motivates employees to continue generating and implementing innovative ideas;

– *Learning and development opportunities:* performance management processes can include opportunities for learning and development related to technological innovation;

– *Continuous improvement:* performance management systems facilitate continuous improvement in technological innovation by setting iterative goals and encouraging reflection on past performance.

Training and development initiatives have a profound impact on technological innovation outputs within organizations. These programs play a crucial role in enhancing employees' skills and knowledge, equipping them with the technical expertise needed to leverage emerging technologies effectively, and learning how to identify opportunities for innovation and apply new tools and techniques in their work. Moreover, development programs often focus on fostering creativity and problem-solving abilities, and these are essential traits for generating innovative ideas and overcoming technological challenges. Additionally, training provides access to the best processes and industry standards in technological innovation, enabling employees to adopt efficient processes and methodologies that enhance innovation outcomes.

Furthermore, by helping employees adapt to new technologies and work processes, training and development initiatives reduce resistance to change, accelerating the adoption of innovative solutions. Ultimately, investing in training and development demonstrates a commitment to employee growth and development, boosting morale, increasing job satisfaction, and reducing turnover, which fosters a culture of innovation. Consequently, organizations that prioritize training and development to support technological innovation gain a competitive advantage by

nurturing a skilled and adaptable workforce capable of driving meaningful technological advancements and maintaining relevance in a rapidly evolving business environment.

In the 2nd hypothesis, we discovered that gender and experience have a moderating role in the association between performance management practices and technological innovation outcomes. Gender can moderate this relationship through its influence on leadership styles, biases, work-life balance, training and development, and organizational culture. Recognizing and addressing these gender-related factors can help organizations optimize their performance management processes to better support and enhance innovation outputs for all employees.

On the other side, experience can moderate the relationship between performance management processes and technological innovation outputs by influencing employees' knowledge, risk-taking behaviours, adaptability, leadership roles, perceptions of organizational culture, and influence over resource allocation decisions. Recognizing and leveraging the unique contributions of experienced employees can enhance the effectiveness of performance management processes in driving innovation within organizations.

2.2. Theoretical implications. The impact of performance management processes on technological innovation outputs has several theoretical implications that shape our understanding of how organizations foster innovation. Based on our findings we suggest the following implications that come from various theories that may better explain the relationships between performance management processes and technological outputs in future research.

Goal-setting theory (Shi et al., 2022) in our paper showed that goal setting processes impact technological innovation outputs in several ways. According to goal-setting theory, clear and challenging goals can motivate individuals and teams to achieve higher levels of performance. In the context of technological innovation, performance management processes that set specific innovation-related goals can provide a clear direction for innovation efforts and enhance the likelihood of achieving desired innovation outputs.

Resource-based view (RBV) theory (Gerhart & Feng, 2021) training and development is an important process in performance management that strongly affects technological innovation outputs, and this latter can be better explained by analysing it through a resource-based view. The RBV theory posits that a firm's competitive advantage is derived from its unique and valuable resources and capabilities. Performance management processes that invest in developing employees' skills, knowledge, and abilities related to technological innovation can contribute to the accumulation of valuable human capital, thereby enhancing the organization's innovation outputs and competitive advantage.

Social exchange theory (Ahmad et al., 2023) incentives and rewards were found to have no impact on technological innovation outputs in this paper. However, explaining this relationship through social exchange theory can give valuable insights.

The social exchange theory suggests that individuals engage in reciprocal relationships based on the expectation of mutual benefits. Performance management processes that recognize and reward innovative behavior can create a positive exchange relationship between employees and the organization, motivating employees to contribute their creative ideas and efforts to technological innovation.

Social learning theory (Khechine et al., 2020) based on our findings identified a strong need for a supportive organizational culture that encourages employees to learn and share new ideas. This lack confirms the importance of generating a supportive culture and emphasizing its presence in all performance management processes to guarantee its success in achieving better technological outputs. Social learning theory emphasizes the role of social interactions, observation, and imitation in learning and behavior change. Therefore, it can help us explain performance management processes that foster a culture of knowledge sharing, collaboration, and learning that can facilitate social learning processes within organizations, leading to the generation of new ideas, insights, and approaches to technological innovation, thereby enhancing innovation outputs.

2.3. Practical implications. Our research led to several implications that may help practitioners develop their performance management processes, including:

– Clear goal setting in performance management aligns innovation efforts with organizational objectives, enhancing innovation outputs;

– Recognition and rewards for innovative contributions motivate employees to actively engage in technological innovation, boosting innovation outputs;

– Providing training and development opportunities fosters skill development and knowledge acquisition, leading to improved innovation outputs;

– Cultivating a supportive organizational culture that values creativity and risk-taking facilitates innovation and enhances innovation outputs;

– Effective performance evaluations that are fair and objective encourage employee participation in innovation initiatives, positively impacting innovation outputs;

– Encouraging collaboration and knowledge sharing among employees enhances their creativity and problem-solving abilities, resulting in higher innovation outputs;

– Regular feedback and evaluation of innovation efforts provide insights for continuous improvement, optimizing innovation outputs over time;

– Ensuring diversity and inclusivity in innovation teams promotes a variety of perspectives and approaches, enriching innovation outputs.

Conclusions. Performance management processes in an organization aim to reach high organizational performance by developing individual and team-level performances through goal setting, performance appraisal, training and development, and incentives and rewards, while performance management systems are the information exchange tools that ensure the success of these processes within the organizational context. According to our findings, we confirm that improving individual and team level performances through PMP (precisely, goal setting and

training and development) does improve organizational performance by affecting positively technological innovation outputs.

Goal setting and training and development are the pillars of PMP when it comes to developing technological innovations. Therefore, PMSs should settle on developing tools that encourage collective goal setting, which allows aligning individual and team goals with broader organizational objectives, ensuring that all employee efforts contribute to the organization's success. Moreover, collective goal setting fosters clarity and transparency regarding organizational priorities and expectations, which helps communicate individual and team expectations effectively. In addition, PMSs can incorporate assessments of teamwork and collaboration alongside individual performance metrics to develop teamwork in the organization. In essence, PMSs and collective goal setting emphasize the need to align individual and team efforts with organizational goals besides fostering collaboration and communication.

Moreover, PMSs should be developed in a manner that helps identify training and development needs, by using performance appraisals and feedback sessions, besides setting development goals aligned with performance goals to ensure that employees have opportunities to develop their skills. Also, PMSs help the organization track its training programs and measure their effectiveness by assessing whether employees have improved their performance in areas targeted by the training. Overall, integrating training and development initiatives with performance management systems creates a continuous cycle of improvement.

During this research, we met several limitations that hindered the advancement of this paper, these constraints are mentioned below:

– Sampling limitations: although we used the purposive sampling method to reach and include specific units in our sample that have specific characteristics such as higher qualifications, and jobs related to performance management and R&D departments, we had to include other administrative staff that are not directly related to performance management processes;

– Measurement limitations: the measurement tool used to collect data in this study was a questionnaire, some of the participants had difficulties in understanding the paragraphs;

– Participant bias: due to the sampling limitations that we met, some participants provided inaccurate information, the reason behind this may be the insufficient knowledge base that they had (difficulties in understanding the questionnaire), or their loyalty towards the company, etc.

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