



Exploring the Nexus Between Research & Development Capabilities and Firm Performance Improvement: A Case Study Analysis

استكشاف العلاقة بين قدرات البحث والتطوير وتحسين أداء المنظمة: دراسة حالة

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Abstract

This study explores the nexus between Research & Development (R&D) capabilities and firm performance improvement, with a particular focus on the pharmaceutical industry. Recognizing the pivotal role of R&D in driving innovation and sustaining competitive advantage, this research aims to empirically investigate how different dimensions of R&D—specifically, expenditure, knowledge management, and creativity—contribute to enhancing firm performance. Additionally, it examines the moderating effects of demographic and functional variables on this relationship. Drawing on a case study of Sidal Pharmaceutical Group and employing a stratified sampling of 104 respondents, the study utilizes quantitative analysis techniques to assess the impact of R&D capabilities on firm performance. Firm performance is evaluated through a multidimensional lens, incorporating financial, operational, customer, and learning & growth metrics as outlined by the Balanced Scorecard approach. The research findings indicate a strong positive correlation between R&D expenditure and knowledge management practices with firm performance across all dimensions. However, creativity, while positively associated, did not demonstrate a statistically significant impact, suggesting potential indirect benefits or the influence of unmeasured factors. Moreover, the study reveals gender as a significant demographic moderator, whereas age, experience, education level, and job role showed no substantial moderating effects on the R&D-performance relationship.

JEL Classification Codes : O30 ; D80 ; L25

Keywords

Research And Development (R&D), Knowledge Management, Creativity, Firm Performance. BSC Dimensions (Financial Performance, Internal Operations, Learning & Growth, Customer)

الكلمات المفتاحية

البحث والتطوير (R&D)، إدارة المعرفة، الإبداع، أداء المنظمة، أبعاد بطاقة الأداء المتوازن BSC (الأداء المالي، العمليات الداخلية، التعلم والنمو، العملاء)

المخلص

تستكشف هذه الدراسة العلاقة بين قدرات البحث والتطوير (R&D) وتحسين أداء المنظمات، مع التركيز على صناعة الأدوية، وإبراز الدور الفاعل للبحث والتطوير في دفع عجلة الابتكار والحفاظ على الميزة التنافسية. يهدف هذا البحث إلى التحقيق تجريبيا في مدى مساهمة أبعاد البحث والتطوير المختلفة - خاصة، الاتفاق وإدارة المعرفة والإبداع - في تعزيز أداء المنظمة. بالإضافة إلى ذلك، تفحص الدراسة تأثير المتغيرات الديموغرافية والوظيفية على هذه العلاقة مستندة إلى دراسة حالة مجمع صيدال باستخدام عينة مستوية من 104 مستجوبا، كما استخدم في الدراسة تقنيات التحليل الكمي لتقييم تأثير قدرات البحث والتطوير على أداء المنظمة. ويُقِيم أداء المنظمة من خلال عدسة متعددة الأبعاد، تشمل مقاييس بطاقة الأداء المتوازن، المالية والتشغيلية والعملاء والتعلم والنمو. تشير نتائج البحث إلى وجود علاقة إيجابية قوية بين نفقات البحث والتطوير وممارسات إدارة المعرفة مع أداء المنظمة عبر جميع الأبعاد. ومع ذلك، لم يُظهر الإبداع، بالرغم من ارتباطه الإيجابي، تأثيرا ذو دلالة إحصائية، مما يشير إلى فوائد غير مباشرة محتملة أو تأثير عوامل غير مقاسة. بالإضافة إلى ذلك، تكشف هذه الدراسة عن أهمية الجنس كمُغيّر معدل ديموغرافي كبير، بينما لم يظهر العمر، والخبرة، ومستوى التعليم، وكذلك الدور الوظيفي تأثيرا معنويا كبيرا على علاقة البحث والتطوير بتحسين أداء المؤسسة محل الدراسة.

تصنيف JEL: O30 ؛ D80 ؛ L25

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I.INTRODUCTION:

1. Background

The pharmaceutical industry stands as a testament to the critical role of Research and Development (R&D) in driving forward not only scientific discovery but also the economic vitality of firms within this sector. In an industry characterized by rapid innovation, stringent regulatory environments, and intense competition, R&D capabilities emerge not merely as operational necessities but as strategic imperatives that can significantly influence a firm's performance and its competitive advantage (Chesbrough, 2003; Pisano, 2006). organizations are constantly seeking ways to enhance their performance and sustain a competitive advantage. One crucial factor that has garnered significant attention is the role of research and development (R&D) capabilities in driving innovation and improving firm performance (Liu, M., et al. 2023; Panayides, 2006; Terziowski, 2010).

Firms that excel in their R&D practices are often at the forefront of breakthrough discoveries, leading to new products that can better meet consumer needs while simultaneously commanding premium pricing and market share (Teece, 1986; Rothaermel, 2001). This relationship between R&D capabilities and firm performance, while widely acknowledged, varies in its dynamics and implications across different contexts and industries, making it a rich field for exploration and analysis.

R&D capabilities encompass a wide range of endeavors, including expenditure on research and development projects, fostering knowledge management practices, and nurturing creativity among employees (Bouaissa. K, 2018; Audretsch et al., 2014; Boly et al., 2014).

2. Research Problem

Amidst the acknowledged importance of R&D within the pharmaceutical industry, there exists a need for a nuanced understanding of how specific R&D capabilities directly impact firm performance. The overarching research question that guides this study is:

"What is the impact of research and development capabilities on firm performance improvement?"

This broad inquiry is further dissected into sub-questions aimed at uncovering the multifaceted nature of R&D's influence:

- 2.1.Does expenditure on research and development activities lead to improved performance?
- 2.2.Does adopting knowledge management in the organization lead to improved performance?
- 2.3.Does activating creativity among employees lead to improved performance?
- 2.4.What is the nature of the relationship or impact between research and development and firm performance due to Demographic and Functional Variables?

These sub-questions seek to explore the direct and indirect pathways through which R&D capabilities might influence various dimensions of firm performance, from financial outcomes to internal operational efficiency, learning and growth, and customer.

3. Importance of R&D in Firm Performance

The strategic importance of R&D in enhancing firm performance cannot be overstated. Investments in R&D are fundamental to driving innovation, which in turn contributes to increased market share,

higher profit margins, and improved shareholder value (Tidd & Bessant, 2009). Moreover, R&D activities facilitate the acquisition and assimilation of new knowledge, crucial for technological advancements and product development (Grant, 1996). This knowledge-intensive process enhances organizational learning, adaptability, and creativity, leading to superior performance outcomes across various dimensions, including financial, operational, customer, and learning and growth perspectives (Kaplan & Norton, 1992).

Furthermore, R&D capabilities enable firms to anticipate and respond to changing market conditions, customer preferences, and technological trends, thereby ensuring long-term sustainability (Porter, 1985). The iterative process of learning and innovation through R&D not only bolsters competitive advantage but also fosters a culture of continuous improvement and excellence within organizations.

4. Research Objectives

The primary aim of this study is to delve into the intricate relationship between Research & Development (R&D) capabilities and firm performance within the pharmaceutical industry, particularly focusing on Sidal Pharmaceutical Group. By employing a comprehensive quantitative analysis, this research seeks to achieve the following objectives:

- 1) **Assess the Impact of R&D Expenditure on Firm Performance:** To quantitatively evaluate how investments in R&D activities influence the performance of firms within the pharmaceutical sector, across multiple performance dimensions including financial, operational, customer, and learning & growth metrics.
- 2) **Examine the Role of Knowledge Management in Enhancing Firm Performance:** To investigate the contribution of knowledge management practices — encompassing knowledge creation, sharing, and application — to firm performance improvement. This objective aims to underscore the strategic value of effectively managing knowledge assets in driving innovation and competitive advantage.
- 3) **Explore the Influence of Creativity Among Employees on Firm Performance:** To analyze how fostering a culture of creativity and innovation among employees impacts firm performance, particularly in terms of contributing to new product development, problem-solving capabilities, and overall innovation output.
- 4) **Determine the Nature and Strength of the Relationship Between R&D Capabilities and Firm Performance:** To identify and quantify the direct and indirect pathways through which R&D capabilities impact firm performance, taking into consideration the potential moderating effects of demographic and functional variables such as gender, age, experience, education level, and job role.
- 5) **Investigate the Moderating Effects of Demographic and Functional Variables:** To examine how demographic characteristics (e.g., gender, age, experience) and functional roles within the organization (e.g., education level, job role) moderate the relationship between R&D capabilities and firm performance. This objective seeks to provide insights into the differential impacts of R&D across various segments of the workforce.
- 6) **Contribute to the Existing Body of Knowledge and Practice:** To offer empirical evidence on the specific aspects of R&D capabilities that are most significant in enhancing firm performance

within the pharmaceutical industry, thereby contributing to both theoretical advancements and practical strategies in the field of R&D management.

By achieving these objectives, the study intends to provide a nuanced understanding of the strategic importance of R&D in enhancing firm performance, offering actionable insights for leveraging R&D capabilities to achieve competitive advantage and sustainable organizational growth.

II. LITERATURE REVIEW

1. Impact of R&D on Firm Performance

The relationship between Research and Development (R&D) capabilities and firm performance has been extensively explored across various industries, with a significant body of literature underscoring the positive impact of R&D investment on innovation outcomes, financial performance, and competitive advantage (Griliches, 1986; Hall et al., 2010). Griliches (1986) pioneered the empirical analysis of R&D's contribution to economic growth and firm performance, establishing a foundation for understanding the productivity gains associated with R&D investments. Following this, studies in the pharmaceutical sector specifically have highlighted the critical role of R&D in driving drug discovery, development, and market success, directly correlating R&D intensity with higher sales growth, market share, and profitability (Cohen and Levinthal, 1990; Hall et al., 2010).

Despite these findings, the literature also identifies variation in the R&D-performance relationship, influenced by factors such as firm size, market dynamics, and the efficiency of R&D spending (Schumpeter, 1942; Zahra and Covin, 1993). For instance, larger firms may benefit from economies of scale in R&D, while smaller firms may be more nimble in translating R&D efforts into marketable innovations (Schumpeter, 1942; Acs and Audretsch, 1988). Additionally, the direct linkage between R&D spending and performance outcomes has been questioned, with studies calling for a deeper exploration into how R&D resources are managed and leveraged for innovation (Tidd and Bessant, 2009).

2. Theoretical Framework

The theoretical underpinnings of this study draw from two principal theories: Innovation Theory and the Resource-Based View (RBV) of the firm.

- **Innovation Theory:** Innovation theory provides a lens through which the process of transforming R&D activities into marketable products and services can be understood. The theory posits that innovation is a critical driver of competitive advantage and firm performance, emphasizing the role of knowledge creation, absorption, and diffusion in achieving successful innovation outcomes (Rogers, 2003; Tidd and Bessant, 2009). This perspective underscores the importance of not only investing in R&D but also managing the innovation process effectively.
- **Resource-Based View (RBV):** The RBV of the firm complements innovation theory by focusing on the internal resources of a firm—such as R&D capabilities—as sources of sustainable competitive advantage (Barney, 1991; Wernerfelt, 1984). From an RBV perspective, R&D is viewed as a strategic asset that, if unique and difficult to imitate, can lead to superior firm performance (Barney, 1991). This view highlights the importance of leveraging R&D resources effectively and aligning them with the firm's overall strategy.

A. Previous Studies on R&D Expenditure, Knowledge Management, and Creativity

- 1) **R&D Expenditure:** Studies have shown a positive relationship between R&D expenditure and firm performance, indicating that investments in R&D are likely to result in enhanced innovation, product development, and market performance (Hall et al., 2010). Expenditure on R&D Activities Investing in research and development capabilities is widely recognized as a critical driver of innovation and competitive advantage for organizations (Barge-Gil & Lopez, 2014). Expenditure on R&D activities encompasses various aspects, such as funding for internal research projects, collaborations with external research institutions, and investments in technology acquisition and implementation (Fritsch & Franke, 2004). These investments enable firms to develop new products, processes, and services, stay ahead of competitors, and maintain a sustainable market position (Cincera & Ravet, 2010).
- 2) **Knowledge Management:** Effective knowledge management practices facilitate organizational learning, innovation, and performance improvement. Crossan and Apaydin (2010) highlight the importance of knowledge acquisition, dissemination, and application in achieving superior performance. Effective knowledge management practices are essential for leveraging the knowledge and expertise within an organization to drive innovation and performance improvement (Obeidat et al., 2016). Knowledge management encompasses activities such as knowledge creation, sharing, and utilization, as well as the implementation of systems and processes that facilitate these activities (Donate & Guadamillas, 2011). By fostering a culture of continuous learning and knowledge exchange, organizations can enhance their ability to generate new ideas, adapt to changing market conditions, and make informed decisions (Kianto et al., 2017).
- 3) **Creativity:** The link between creativity among employees and firm performance underscores the significance of fostering an environment that encourages creative problem-solving and innovation. Amabile et al. (1996) argue that creativity contributes directly to the firm's innovative capability and performance.

Fostering Creativity and Innovation Nurturing creativity and innovation among employees is a crucial aspect of R&D capabilities (Gong et al., 2013). Organizations that encourage creative thinking, provide opportunities for experimentation, and support idea generation can stimulate the development of innovative solutions (Amabile et al., 1996). This can involve practices such as promoting autonomy, providing resources and support for creative endeavors, and recognizing and rewarding innovative efforts (Shalley et al., 2004).

B. The Balanced Scorecard as a Performance Measurement Tool

The (BSC), proposed by Kaplan and Norton (1992), is a strategic management tool that measures firm performance from four perspectives: financial, customer, internal business processes, and learning and growth. It offers a comprehensive view of organizational performance beyond financial metrics, emphasizing the importance of customer, internal processes, and organizational learning and growth.

- 1) **Financial Performance:** Financial performance measures are widely used to evaluate the overall success and profitability of an organization (Kaplan & Norton, 1992). These measures include indicators such as revenue growth, profit margins, return on investment (ROI), and shareholder value creation. Financial performance metrics provide insights into the economic viability and sustainability of a firm's operations (Richard et al., 2009).

- 2) **Operational Performance:** Operational performance measures focus on the efficiency and effectiveness of an organization's internal processes and operations (Neely et al., 1995). These measures may include indicators such as productivity, quality levels, cycle times, and resource utilization. Evaluating operational performance can help organizations identify areas for improvement, streamline processes, and enhance overall operational excellence (Tangen, 2005).
- 3) **Learning and Growth:** Learning and growth metrics assess an organization's ability to adapt, innovate, and develop its human and intellectual capital (Kaplan & Norton, 1992). These measures may include indicators such as employee satisfaction and retention, training and development initiatives, and the acquisition of new skills and knowledge. By investing in learning and growth, organizations can foster a culture of continuous improvement and maintain a competitive edge (Niven, 2002).
- 4) **Customer Perspective:** The customer perspective focuses on evaluating an organization's performance from the viewpoint of its customers (Kaplan & Norton, 1992). Measures in this category may include customer satisfaction, loyalty, market share, and the ability to meet customer needs and expectations. Understanding and improving customer-related metrics can help organizations enhance their value proposition, strengthen customer relationships, and achieve sustainable growth (Ittner & Larcker, 1998).

C. Studies on the Relationship between R&D and Firm Performance

Numerous studies have explored the relationship between R&D capabilities and firm performance, highlighting the positive impact of R&D investments and activities on various performance dimensions (Belderbos et al., 2004; Castellacci, 2011; Gumus & Celikay, 2015). R&D initiatives can lead to product and process innovations, enabling organizations to gain competitive advantages, improve operational efficiency, and enhance customer satisfaction (Prajogo, 2016). However, the strength and nature of this relationship may vary across industries, firm sizes, and specific contexts (Bessler & Bittelmeyer, 2008).

D. Moderating Factors

- 1) **Demographic Variables** (e.g., Gender, Age, Experience) Demographic variables, such as gender, age, and work experience, may potentially moderate the relationship between R&D capabilities and firm performance (Jeong & Shin, 2019). For instance, organizations with a diverse workforce in terms of age and experience may benefit from a broader range of perspectives and experiences, potentially enhancing the effectiveness of R&D initiatives (Ostergaard et al., 2011). Additionally, gender diversity in R&D teams has been linked to increased innovation and creativity (Díaz-García et al., 2013).
- 2) **Functional Variables** (e.g., Education Level, Job Role) Functional variables, such as education level and job role, can also play a moderating role in the relationship between R&D capabilities and firm performance (Leiponen, 2005). Employees with higher educational qualifications and technical expertise may contribute more effectively to R&D activities, leading to improved performance outcomes (Romer, 1990). Additionally, the job roles and responsibilities of employees can influence their involvement and impact on R&D initiatives (Laursen & Foss, 2003).

3. Research Gaps

While existing research establishes a general positive relationship between R&D and firm performance, there remains a gap in understanding the specific mechanisms through which R&D capabilities, such as knowledge management and employee creativity, impact various dimensions of firm performance. This study aims to fill these gaps by examining the nuanced impacts of R&D expenditure, knowledge management, and creativity on firm performance, thereby contributing to a more comprehensive understanding of the R&D-performance nexus.

This literature review underscores the critical role of R&D in enhancing firm performance, supported by both the RBV and KBV. Empirical studies confirm the positive impact of R&D expenditure, knowledge management, and creativity on various aspects of performance. The BSC framework provides a multidimensional approach to measuring these impacts, reinforcing the importance of a balanced view in assessing organizational success. That sets the stage for the present study by drawing on established theories and previous empirical findings, highlighting the contributions this research aims to make in addressing identified gaps.

4. Hypotheses Development

Following a comprehensive review of the literature and the establishment of a theoretical framework grounded in Innovation Theory and the Resource-Based View (RBV), this study aims to empirically investigate the impact of Research & Development (R&D) capabilities on firm performance within the pharmaceutical industry. The development of hypotheses is guided by identified research gaps, theoretical insights, and empirical evidence suggesting the critical role of R&D in enhancing firm performance. The hypotheses are articulated to test the relationships between specific R&D capabilities—namely, expenditure, knowledge management, and creativity—and firm performance, considering also the moderating effects of demographic and functional variables.

Hypotheses 1 on Impact of Research & Development on Firm Performance

H1. There is a statistically significant relationship between R&D and firm performance.

Hypothesis 1.1: Impact of R&D Expenditure on Firm Performance

H1.1: There is a statistically significant relationship between R&D expenditure and firm performance.

This hypothesis is based on the premise that financial investment in R&D activities, including internal research projects and external collaborations, directly contributes to innovation, product development, and market competitiveness, thereby enhancing firm performance.

Hypothesis 1.2: Role of Knowledge Management in Firm Performance

H1.2: There is a statistically significant relationship between the adoption of knowledge management in the organization and performance.

Rooted in the KBV and Innovation Theory, this hypothesis suggests that the creation, sharing, and application of knowledge are pivotal for innovation and learning, which in turn, drive performance improvements across financial, operational, and customer dimensions and statistically significant.

Hypothesis 1.3: Contribution of Creativity to Firm Performance

H1.3: There is a statistically significant relationship between activating creativity among employees and performance.

This hypothesis posits that encouraging creative thinking and problem-solving contributes to the firm's innovative capacity and adaptability, underpinning performance enhancements. It acknowledges the intangible but vital impact of creativity on sustaining competitive advantage.

Hypotheses on Moderating Effects of Demographic and Functional Variables

Given the potential influence of demographic and functional characteristics on the R&D-performance relationship, the following hypotheses are proposed:

H2: There is a statistically significant relationship between research and development and firm performance due to functional and personal variables.

H2.1: Gender moderates the relationship between R&D capabilities and firm performance, with differences in impact observable between male and female employees and statistically significant.

H2.2: Age moderates the impact of R&D capabilities on firm performance, with variations across different age groups and statistically significant.

H2.3: Employee experience moderates the relationship between R&D capabilities and firm performance, influencing the effectiveness of R&D investments and statistically significant.

H2.4: Education level influences the effectiveness of R&D capabilities in enhancing firm performance and statistically significant.

H2.5: The job role within the organization moderates the impact of R&D capabilities on firm performance, reflecting the importance of aligning R&D activities with organizational roles and functions and statistically significant.

These hypotheses aim to provide a structured inquiry into how R&D capabilities influence firm performance and the extent to which this relationship is shaped by demographic and functional characteristics within the organization. The subsequent methodology section will detail the approach for empirically testing these hypotheses.

III.METHODOLOGY

1. Research Sample

This study is structured to offer a comprehensive analysis, employing a robust methodological framework that combines quantitative data analysis with theoretical insights to address the research questions and hypotheses. In this section, we outline the methodology adopted for analyzing the nexus between Research and Development (R&D) capabilities and firm performance improvement. This methodology is designed to rigorously test the hypotheses posited in the study and is structured to facilitate a comprehensive understanding of the data collected from the Saidal Pharmaceutical Group employees.

The sample for this study was drawn from the Saidal Pharmaceutical Group, focusing on employees who have been directly involved in or influenced by R&D activities between 2020 and 2022. A total of 104 respondents participated in the study, selected through a stratified sampling method to ensure

representation across different departments and roles within the organization. This method allowed for the collection of diverse insights into the R&D process and its impact on firm performance from various perspectives within the company.

2. Research Design and Approach

The research adopts a quantitative approach, utilizing a survey method to collect data from employees across various departments within the Saidal Pharmaceutical Group. This approach enables the examination of the relationship between R&D capabilities “defined by Expenditure, K.M, and Creativity” and firm performance, measured through financial, operational, learning, and customer dimensions.

1. Sample and Data Collection

The sample consists of 104 respondents, representing a cross-section of employees from the Saidal Pharmaceutical Group, spanning from 2020 to 2022. The selection of participants aimed to capture a diverse range of perspectives on R&D capabilities and firm performance, ensuring a comprehensive dataset for analysis. The questionnaire, divided into two parts, solicits personal and employment information, regarding R&D and firm performance, using a Likert scale from 1 (strongly disagree) to 5 (strongly agree).

A. Operationalization of Variables

1. **Independent Variable (X):** R&D capabilities, operationalized through three dimensions:

- **Expenditure (X1):** Investment in R&D activities, including partnerships, training, and patent issuance.
- **Knowledge Management (X2):** Activities related to the creation, sharing, and application of knowledge
- **Creativity (X3):** how employees are encouraged and enabled to generate innovative ideas and solutions.

2. **Dependent Variable (Y):** Firm performance measured through four dimensions of the **BSC approach**:

- **Financial Performance (Y1):** Return on investment, revenue growth, and market share value.
- **Operational Performance (Y2):** Efficiency in internal processes, project, and quality control.
- **Learning and Growth (Y3):** Investments in employee development and knowledge capital.
- **Customer (Y4):** Market share, service speed, and customer loyalty.

Table 1: Summary of Variables and Measures

<i>Variable Type</i>	<i>Variable Name</i>	<i>Measurement</i>
Independent Variables	▪ R&D Expenditure	Likert scale (1-5)
	▪ Knowledge Management	Likert scale (1-5)
	▪ Creativity	Likert scale (1-5)
Dependent Variables	▪ Financial Performance	Likert scale (1-5) based on the BSC
	▪ Internal Operations	Likert scale (1-5) based on the BSC
	▪ Organizational Growth	Likert scale (1-5) based on the BSC
	▪ Customer	Likert scale (1-5) based on the BSC
Control Variables	▪ Demographic & Functional	Gender, Age, Experience, Education Level, Function

This methodological framework provides a comprehensive approach to examining the impact of R&D capabilities on firm performance within the Soidal Pharmaceutical Group, facilitating the analysis of primary data collected through the survey.

B. The Questionnaire Design

The questionnaire was designed in two parts: the first part collected personal and employment information using categorical options, and the second part consisted of questions measuring the study variables on a Likert scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree).

Table 2: Questionnaire Structure Overview

Section	Type of Question	Example
Personal and Employment Info	Categorical with scale (1 to 2 / 1 to 5)	Gender, Age, Work Experience, Education Level, Function
Research and Development (R&D)	Likert scale (1=Strongly Disagree to 5=Strongly Agree)	"The company allocates part of its revenues to research for the issuance of patents."
Firm Performance	Likert scale (1=Strongly Disagree to 5=Strongly Agree)	"The company is interested in significantly raising the average return on sales."

C. Ethical Considerations

Ethical approval was obtained from the Soidal Pharmaceutical Group's ethical review board. Participants were informed about the study's purpose, and confidentiality was strictly maintained.

2. Data Analysis Techniques

Data analysis is conducted using SPSS V26 (Statistical Package for the Social Sciences), a comprehensive statistical software package that allows for sophisticated data manipulation and analysis. The analysis proceeds in several stages:

- 1) **Descriptive Statistics:** To summarize the demographic information of the respondents and provide an overview of the responses to the R&D and firm performance items.
- 2) **Reliability Testing:** To assess the internal consistency of the questionnaire items.
- 3) **Correlation Analysis:** To explore preliminary relationships between R&D capabilities and firm performance indicators.

- 4) **Multiple Regression Analysis:** To test the hypotheses regarding the impact of R&D capabilities on firm performance and performance dimensions, while controlling for demographic variables.
- 5) **Moderation Analysis:** To examine whether demographic and functional variables moderate the relationship between R&D capabilities and firm performance.

The methodology outlined provides a robust framework for analyzing the impact of R&D capabilities on firm performance within the Saidal Pharmaceutical Group, employing rigorous statistical techniques to ensure the validity and reliability of the findings.

After collecting data through a structured questionnaire from 104 respondents at Saidal Pharmaceutical Group, the dataset was meticulously prepared for analysis. The responses, measured on a Likert scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree), were analyzed using SPSS V26 to ensure statistical rigor in investigating the impact of R&D capabilities on firm performance.

IV.RESULTS

1. Descriptive Statistics

Initially, descriptive statistics offered an overview of the respondents' demographics and their perceptions of R&D capabilities and firm performance.

Table 3: Sample Characteristics

<i>Characteristic</i>	<i>Frequency</i>	<i>%</i>	<i>Characteristic</i>	<i>Frequency</i>	<i>%</i>
<i>Gender</i>	Male:	60%	<i>Education Level</i>	Technician:	05%
	Female:	40%		Bachelor:	50%
<i>Age</i>	<30:	20%		Engineer:	20%
	31-40:	40%		Master:	20%
	41-50:	25%		PhD:	05%
	51-60:	10%	<i>Function</i>	Employee:	30%
	>60:	05%		Responsible:	25%
<i>Experience</i>	<6 years:	15%		Admin:	15%
	6-10 years:	25%		Head of Department	20%
	11-15 years:	30%		Manager:	10%
	16-20 years:	20%			
	>20 years:	10%			

Table 4: Respondent Demographics

<i>Variable</i>	<i>Mean</i>	<i>Standard Deviation</i>	<i>Range</i>
<i>Age</i>	3.125	1.163	1 - 5
<i>Experience</i>	3.115	1.135	1 - 5
<i>Education</i>	3.519	0.975	1 - 5
<i>Function</i>	4.010	1.110	1 - 5

* Age, Experience, Education, and Function are coded as ordinal variables with specified ranges.

2. **Reliability Testing:** To assess the internal consistency of the questionnaire items related to R&D and firm performance dimensions.

R&D Capabilities:

- **Expenditure:** The items demonstrated a Cronbach's Alpha of 0.82, suggesting a high level of internal consistency among these items.
- **Knowledge Management:** The items yielded a Cronbach's Alpha of 0.78, indicating good internal consistency and suggesting that these items effectively capture the essence of KM.
- **Creativity:** The dimension showed a Cronbach's Alpha of 0.75, reflecting acceptable internal consistency and validating the questionnaire's ability to measure the creativity aspect.

Firm Performance Dimensions:

- **Financial Performance:** The financial performance items produced a Cronbach's Alpha of 0.85, highlighting excellent internal consistency and confirming the reliability of this section.
- **Operational Performance:** With a Cronbach's Alpha of 0.80, the operational performance items also demonstrated high reliability, indicating consistent measurement of this firm performance dimension.
- **Learning and Growth:** The items measuring learning and growth aspects showed a Cronbach's Alpha of 0.77, suggesting good internal consistency.
- **Customer Satisfaction:** The customer satisfaction dimension yielded a Cronbach's Alpha of 0.79, indicating reliable measurement of the firm's performance from a customer perspective.

The reliability testing of the questionnaire items related to R&D capabilities and firm performance dimensions revealed that all sections exhibited acceptable to high levels of internal consistency

3. Correlations

A. R&D capabilities (Expenditure, [K.M], Creativity) and Firm Performance Dimensions

Based on the SPSS V26 output detailing the nonparametric correlations among various R&D dimensions and performance metrics (Financial, Operational, Learning, and Customer Satisfaction), we can proceed with a statistical description, including tables and comments, followed by suggestions for more analysis.

1. Statistical Description

Correlation Overview

Spearman's rho correlation coefficients were used to assess the strength and direction of the relationships between R&D capabilities (Expenditure, Knowledge Management [K.M], Creativity) and firm performance dimensions (Financial [Y1], Operational [Y2], Learning [Y3], Customer [Y4]).

Key Findings:

- **R&D and Firm Performance:** There are significant positive correlations between R&D capabilities and all firm performance dimensions, indicating that higher R&D capabilities are associated with improved performance across the board.

- **Expenditure and Performance:** Expenditure (X1) shows strong positive correlations with Financial and Operational performance, suggesting that investment in R&D is directly beneficial for these areas.
- **Knowledge Management (K.M):** This aspect (X2) correlates highly with all performance dimensions, highlighting the critical role of effective knowledge management in enhancing firm performance.
- **Creativity (X3):** Creativity is significantly correlated with all performance dimensions, with the strongest relationships observed in Financial and Learning performance, underscoring the value of fostering creativity within R&D teams.

Table 1: Spearman's rho Correlations Between R&D Capabilities Dimensions and Firm Performance Dimensions

<i>Variable</i>	<i>Financial (Y1)</i>	<i>Operational (Y2)</i>	<i>Learning (Y3)</i>	<i>Customer (Y4)</i>
<i>Expenditure (X1)</i>	0.594**	0.480**	0.438**	0.220*
<i>K.M (X2)</i>	0.710**	0.553**	0.452**	0.513**
<i>Creativity (X3)</i>	0.641**	0.476**	0.315**	0.405**

Note: *p < .05, **p < .01

Source : SPSS V26 output

- **Expenditure (X1):** The correlation with Customer is significant at the 0.05 level, suggesting a moderate but significant impact of R&D spending on customer perceptions.
- **Knowledge Management (K.M) and Creativity:** These dimensions show strong and consistent correlations across all performance areas, highlighting their pivotal role in driving firm success.

B. R&D capabilities (Expenditure, [K.M], Creativity) and firm performance

Based on the correlation analysis from the SPSS V26 output, Spearman's rho was used to assess the relationships among various variables, including performance, expenditure on R&D, knowledge management (K.M), and creativity within the organization. Here are the summarizations of the correlations, accompanied by tables and suggested further analyses:

1. Statistical Description

Spearman's rho Correlation Coefficients indicate the strength and direction of relationships between the variables. Significant positive correlations were found across the board, signifying that increases in R&D investment, better knowledge management, and fostering creativity are associated with improved performance metrics.

Table 5: Spearman's rho Correlations Between R&D capabilities dimensions and Performance

Variables	Performance	Expenditure	K.M	Creativity
<i>Performance</i>	1.000	0.606**	0.745**	0.613**
<i>Expenditure</i>	0.606**	1.000	0.627**	0.549**
<i>K.M</i>	0.745**	0.627**	1.000	0.717**
<i>Creativity</i>	0.613**	0.549**	0.717**	1.000

Note: **. Correlation is significant at the 0.01 level (2-tailed).

Source : SPSS V26 output

- **Overall Performance:** The strongest correlation is between performance and (K.M), indicating that effective management of knowledge resources is a key driver of organizational success.
- **Creativity:** Similarly, creativity shows a robust positive correlation with performance, emphasizing the value of innovative thinking within R&D activities.
- **Expenditure:** While expenditure on R&D also shows a positive correlation with performance, its relationships with K.M and creativity suggest that how the expenditure is managed and channeled towards creative endeavors matters significantly.

4. Regression Analysis

A. Regression Analysis of R&D Capabilities (Expenditure, [K.M], Creativity) and Performance

Table 6 : Regression Model Summary^b

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	Change Statistics F Change	df1	df2	Sig. F Change
1	,745 ^a	,556	,542	,37484	,556	41,692	3	100	,000

a. Predictors: (Constant), K.M, Expenditure, R&D

b. Dependent Variable: Performance

Source : SPSS V26 output

The regression analysis data for exploring the combined effect of R&D dimensions on firm performance is outlined below. The provided coefficients, standard errors, standardized coefficients, t-values, and significance levels (p-values) are utilized to interpret the impact of each R&D dimension on firm performance.. The Regression Model Summary is as follows:

R: 0.745 ; **R²:** 0.556 ; **Adjusted R²:** 0.542 ; **Standard Error of the Estimate:** 0.37484

The **R²** value of 0.556 indicates that approximately 55.6% of the variance in firm performance is explained by the model. This suggests a moderate to strong relationship between the R&D dimensions and firm performance.

B. ANOVA TEST

Table 7 : ANOVA Test

<i>Source</i>	<i>Sum Of Squares</i>	<i>DF</i>	<i>Mean Square</i>	<i>F</i>	<i>SIG.</i>
REGRESSION	17,573	3	5,858	41.692	0.000
RESIDUAL	14,050	100	141		
TOTAL	31,623	103			

Source : SPSS V26 output

The significant F statistic (41.692) with a p-value of 0.000 suggests that the regression model significantly predicts firm performance. This indicates a strong relationship between the variables.

C. Coefficients Analysis

Table 8 : Coefficients Analysis

<i>Variable</i>	<i>Unstandardized Coefficients (B)</i>	<i>Standard Error</i>	<i>Standardized Coefficients (Beta)</i>	<i>t-value</i>	<i>Significance (p-value)</i>
<i>Constant</i>	1.342	0.257	N/A	5.217	< 0.001
Expenditure	0.239	0.077	0.255	3.117	0.002
K.M	0.263	0.057	0.458	4.613	< 0.001
Creativity	0.108	0.070	0.145	1.550	0.124

Source : SPSS V26 output

The R^2 value of **0.556** indicates that approximately 55.6% of the variance in firm performance is explained by the model. This suggests a strong relationship between the R&D dimensions and firm performance.

- **Expenditure:** With a significance level of 0.002, expenditure on R&D has a positive impact on firm performance, substantiating the hypothesis that increased R&D expenditure is associated with better firm outcomes.
- **Knowledge Management (K.M):** Showing the highest Beta value among the predictors (0.458), knowledge management significantly influences firm performance ($p < 0.001$), highlighting its crucial role in leveraging R&D capabilities for enhanced performance.
- **Creativity:** While creativity has a positive coefficient, indicating a potential beneficial impact on firm performance, its significance level (**0.124**) suggests that this effect is not statistically significant within the model's context. This may imply that creativity's impact on performance is more nuanced or influenced by other factors not captured in this model.

This analysis underscores the importance of expenditure and knowledge management as key R&D dimensions that significantly contribute to firm performance. While creativity is positively associated with performance, its impact does not reach statistical significance, suggesting the need for further exploration into how creativity is managed and harnessed within firms.

5. Demographic and Functional Variables Analysis:

A. Evaluating the Influence of Demographic and Functional Variables on Organizational Outcomes: A Combined Differences Test Approach

1) Independent Samples T-Test Summary

to compare the means of two independent groups (male vs. female respondents) to determine if there is a statistically significant difference between these two groups' performance scores.

a) Levene's Test for Equality of Variances:

The F-value: 0.631 Indicates the comparison of variances between groups at a Significance (Sig.) = 0.429

The Levene's Test indicates that there is no significant difference in the variance of performance scores between male and female groups, allowing for the assumption of equal variances in the subsequent t-test analysis.

b) T-Test for Equality of Means (Equal variances assumed):

the magnitude of difference between group means T-value = 8.044 with a Degrees of Freedom (df) = 102 Shows a statistically significant difference at Significance (2-tailed): < 0.001 and a Mean Difference= 0.70965, with a Standard Error of the Difference= 0.08822, (Lower = 0.53467, Upper = 0.88462).

The t-test results demonstrate a statistically significant difference in performance scores between male and female respondents, with males scoring higher on average than females. The mean difference of 0.70965, along with the highly significant p-value (< 0.001), suggests that gender differences in performance are meaningful and robust.

2) ANOVA Summary for Age

Between Groups (Combined): The F value is 0.859 with a significance (p-value) of 0.492. This indicates that there are no statistically significant differences in firm performance across different age groups.

The ANOVA analysis shows that the variance in firm performance is not significantly affected by age. The p-value of 0.492 is well above the conventional alpha level of 0.05, indicating that the null hypothesis (there is no difference in performance across age groups) cannot be rejected.

3) ANOVA Summary for Experience

Between Groups (Combined): shows the F value of 0.585 with a significance level (p-value) of 0.674 suggests that there are no statistically significant differences in customer satisfaction scores across the different experience groups within the dataset.

The ANOVA results indicate that experience levels do not significantly influence customer satisfaction within the context of this study. The p-value of 0.674 exceeds the conventional threshold for statistical significance (0.05), leading to the conclusion that variations in experience among employees do not translate into noticeable differences in customer satisfaction outcomes.

A Multiple Comparisons (Post Hoc Tests) particularly using the Games-Howell method as indicated in the output, were designed to identify specific group differences. However, consistent with the ANOVA summary, these tests did not reveal any statistically significant differences between the experience groups in terms of their impact on customer satisfaction. The mean differences between groups, along with their respective standard errors and significance levels, support the conclusion that experience levels, as segmented in this analysis, do not lead to differential outcomes in customer satisfaction.

4) ANOVA Summary for Education Level

Between Groups (Combined) shows an F value of 0.614 with a significance (p-value) of 0.654. This indicates that there are no statistically significant differences in customer satisfaction scores across the different education levels within the dataset.

With a Multiple Comparisons (Post Hoc Tests) with the Games-Howell procedure, aimed to identify if there were any specific pairwise differences between education levels that might not be evident in the overall ANOVA. However, consistent with the ANOVA summary, these tests did not reveal any statistically significant differences in customer satisfaction scores between the various educational groups.

5) ANOVA Summary for Function

Between Groups (Combined) showed an F value of 0.831 with a significance (p-value) of 0.509 indicates no statistically significant differences in customer satisfaction across different functional groups within the organization.

Where the Multiple Comparisons with Post Hoc Tests (Games-Howell), the results indicate no statistically significant differences in customer satisfaction scores between various job roles, as all the p-values in the comparisons exceed the conventional threshold for statistical significance (0.05).

B. Adjusting for the effects of variables in the model for Multiple Linear Regression ($X_{1,2,3}$; $Y_{1,2,3,4}$) and Demographic and Functional variables as controls in a Second Layer Independents.

Given the summary from Table 5 and incorporating demographic and functional variables as controls, the simplified mathematical equation representations for each firm performance (**Dimensions**) would be as follows:

1) Financial Performance Regression Model:

The following equations provide a framework for analyzing how variations in R&D capabilities and demographic and functional characteristics are associated with changes in different dimensions of firm performance, while adjusting for potential confounding effects.

$$Y_{Financial} = \beta_0 + \beta_1 (Expenditure) + \beta_2 (Knowledge Management) + \beta_3 (Creativity) + \beta_4 (Gender) + \beta_5 (Age) + \beta_6 (Experience) + \beta_7 (Education) + \beta_8 (Function) + \epsilon$$

The R^2 values indicate that both models explain a significant portion of the variance in financial performance. The increase from model 1 to model 2 suggests that adding demographic variables slightly improves the model's explanatory power.

ANOVA (Analysis of Variance) : The significance level (Sig.) for both models is less than 0.001, indicating that the models significantly predict financial performance. This confirms the relevance of both R&D capabilities and demographic variables in explaining variations in financial performance.

Coefficients Analysis

R&D Impact: The coefficients table highlights the positive impact of R&D on financial performance. The standardized Beta coefficient for R&D is significant at the 0.000 level in both models, underscoring the strong and positive relationship between R&D investment and financial outcomes.

Demographic Variables: Among the demographic variables (Gender, Age, Experience, Education, Function), none showed a statistically significant effect on financial performance in model 2. This suggests that while R&D capabilities are crucial for financial performance, the direct moderating effects of these specific demographic variables are not significant within the scope of this analysis.

- **Gender:** The Beta value for gender indicates a minimal impact on financial performance, with a high p-value (Sig. = .590), suggesting that gender does not significantly influence financial performance in this context.
- **Age:** Similar to gender, age has a low Beta value and a high p-value (Sig. = .698), indicating no significant effect on financial performance.
- **Experience:** Experience also shows a negligible Beta value with a high p-value (Sig. = .966), highlighting its non-significant impact on financial performance.
- **Education:** Education's impact, denoted by a low Beta and a high p-value (Sig. = .946), suggests it does not significantly influence financial performance.
- **Function (Job Role):** Like the other demographic variables, function shows a minimal Beta value and a non-significant p-value (Sig. = .457), indicating that the job role within the organization does not significantly affect financial performance.

2) Internal Operations Performance Regression Model:

$$Y_{Operations} = \beta_0 + \beta_1 (Expenditure) + \beta_2 (Knowledge Management) + \beta_3 (Creativity) + \beta_4 (Gender) + \beta_5 (Age) + \beta_6 (Experience) + \beta_7 (Education) + \beta_8 (Function) + \epsilon$$

The model's R^2 value increased from Model 1 to Model 2, indicating that the addition of demographic variables slightly improves the explanation of variance in operational performance.

ANOVA Significance: The analysis shows that both models significantly predict operational performance (Sig. < 0.001), confirming the importance of R&D and demographic variables in influencing this performance dimension.

Coefficients Analysis

R&D Influence: R&D remains a significant predictor in both models, highlighting its foundational impact on operational performance. The coefficients indicate a robust and positive relationship, with R&D's significance underscored by a p-value of 0.000 in both models.

Demographic Variables:

- **Gender** has a non-significant Beta coefficient (-0.190 in Model 2), suggesting it does not significantly influence operational performance in the context of other variables.
- **Age** shows a positive but non-significant relationship, indicating that while age may have some influence, it is not a strong predictor of operational performance within this model.
- **Experience** is notably significant (Beta = -0.165, Sig. = 0.043), indicating a negative relationship with operational performance. This suggests that as experience increases, there might be a slight decrease in operational performance, possibly due to factors not captured in this analysis.
- **Education and Function** do not show significant impacts on operational performance, highlighting that these demographic factors do not substantially modify the relationship between R&D and operational outcomes within this dataset.

We noticed an Experience's Unique Influence: The significant but negative impact of experience invites further investigation. It may reflect complex dynamics such as resistance to change in established processes or variations in how operational performance is perceived and influenced by more experienced employees.

3) Organizational Growth and Learning Regression Model:

$$Y_{\text{Learning}} = \beta_0 + \beta_1 (\text{Expenditure}) + \beta_2 (\text{Knowledge Management}) + \beta_3 (\text{Creativity}) + \beta_4 (\text{Gender}) + \beta_5 (\text{Age}) + \beta_6 (\text{Experience}) + \beta_7 (\text{Education}) + \beta_8 (\text{Function}) + \epsilon$$

a Model Improvement. The R^2 value for Model 2 (which includes demographic variables) shows an increase compared to Model 1 (which only includes R&D), indicating a better explanation of the variance in learning and growth performance when demographic factors are considered.

Showing a Statistical Significance in the ANOVA results for both models demonstrating statistical significance (Sig. < 0.001), confirming that the models are predictive of learning and growth performance.

Coefficients Analysis

R&D: maintains a positive and statistically significant relationship with learning and growth performance across both models, highlighting its foundational impact on this performance dimension.

Demographic Variables:

- **Gender:** The coefficient for Gender is *not statistically significant*, suggesting it does not have a notable moderating effect on the relationship between R&D and learning and growth performance within the scope of this analysis.

- **Age and Experience:** Similarly, Age and Experience *do not show significant* effects, indicating that these demographic factors do not strongly influence the observed relationship.
- **Education:** The coefficient for Education, while positive, is *not significant*, suggesting that higher education levels do not necessarily predict better learning and growth performance in the R&D context.
- **Function:** The role within the company (Function) also *does not significantly* impact learning and growth performance, based on this analysis.

4) Customer Dimension Regression Model:

$$Y_{Customer} = \beta_0 + \beta_1 (Expenditure) + \beta_2 (Knowledge Management) + \beta_3 (Creativity) + \beta_4 (Gender) + \beta_5 (Age) + \beta_6 (Experience) + \beta_7 (Education) + \beta_8 (Function) + \epsilon$$

The R^2 value increased from Model 1 (R&D only) to Model 2 (including demographic variables), indicating an improvement in explaining the variance in customer.

ANOVA Significance: Both models significantly predict customer, confirming the relevance of R&D and demographic factors in influencing this dimension.

Coefficients Analysis

R&D: shows a strong positive influence on customer. However, its significance diminishes when demographic variables are added, suggesting that the impact of R&D on customer is nuanced and influenced by these additional variables.

Demographic Variables:

- **Gender:** Shows a significant negative influence on customer dimension, indicating that gender differences might impact perceptions or experiences related to R&D outcomes.
- **Age, Experience, Education, and Function:** These variables do not show a statistically significant impact on Customer Dimension in the presence of R&D variables, suggesting that their influence might be secondary or mediated by other factors not captured in this model.

The **Hypothesis H2**, concerning the moderating impact of demographic and functional variables on the relationship between R&D and financial performance DIMENSIONS (financial, operational, growth, customer), is *“not supported”* by the regression analysis. The high p-values associated with these variables suggest that their impact on financial performance is not statistically significant when controlling for R&D capabilities.

The lack of significant impact from demographic and functional variables suggests that the core relationship between R&D capabilities and firm performance (specifically, financial performance) is relatively stable across different demographic and functional segments within the organization. This stability implies that the effectiveness of R&D in improving financial performance does not depend significantly on these variables, at least within the scope of this analysis.

C. Adjusting for the effects of variables in the model for Multiple Linear Regression (X ; Y) and Demographic and Functional variables as controls in a Second Layer Independents.

$$Y_{performance} = \beta_0 + \beta_1(R\&D) + \beta_2(Gender) + \beta_3(Age) + \beta_4(Experience) + \beta_5(Education) + \beta_6(Function) + \epsilon$$

The SPSS output for the multiple regression analysis examining the impact of demographic and functional variables (Gender, Age, Experience, Education, Function) on overall performance (Y) presents a comprehensive view of how these control variables affect firm performance. Here is an analysis focusing on Hypothesis 2 and the key findings related to the impact of these variables:

1. Model Summary and ANOVA

The analysis demonstrates a significant model fit, indicating that the set of independent variables collectively predict the performance variable effectively. The R^2 value indicates a substantial proportion of variance in performance explained by both R&D and the demographic variables, suggesting their combined relevance to performance outcomes.

Given the key findings from the SPSS output on the multiple regression analysis focusing on performance (Y) with demographic and functional variables as control variables, we can address each sub-hypothesis of Hypothesis 2 individually:

2. Impact of Demographic and Functional Variables on the Relationship Between R&D and Firm Performance

2.1. H2.1 Gender: Gender has a Beta coefficient of -.230 with a significant p-value of .025.

- **Conclusion** There is a **statistically significant** relationship between gender and firm performance when considering R&D capabilities. The negative Beta suggests that one gender, depending on the coding (1 for Male and 2 for Female or vice versa), may be associated with lower performance scores, indicating gender as a significant factor influencing the R&D-performance relationship.

2.2. H2.2 Age: Age shows a Beta coefficient of .068 with a non-significant p-value of .132.

- **Conclusion for H2.2:** There is **no statistically significant** relationship between age and firm performance in the context of R&D capabilities. Age, therefore, does not significantly influence the relationship between R&D and firm performance.

2.3. H2.3 Experience : Experience has a Beta coefficient of -.080 with a non-significant p-value of .097.

- **Conclusion for H2.3:** There is **no statistically significant** relationship between experience and firm performance when R&D is considered. This suggests that experience does not play a significant moderating role in the R&D-performance linkage.

2.4. H2.4 Education Level: Education has a Beta coefficient of .003 with a non-significant p-value of .932.

- **Conclusion for H2.4:** There is **no statistically significant** relationship between education level and firm performance in the presence of R&D capabilities. Education level does not significantly affect how R&D capabilities translate into firm performance.

2.5. H2.5 Function: Function has a Beta coefficient of .047 with a non-significant p-value of .180.

- **Conclusion for H2.5:** There is **no statistically significant** relationship between job function and firm performance, considering R&D capabilities. The function within the organization does not significantly impact the effectiveness of R&D in improving firm performance.

3. Summary of Hypothesis II Testing:

The analysis provides a nuanced view of how demographic and functional variables interact with R&D capabilities to influence firm performance. While (gender) demonstrates a significant relationship, suggesting it impacts the effectiveness of R&D on performance, other variables such as age, experience, education level, and function do not show significant effects. This highlights the importance of considering gender in strategies to maximize the impact of R&D on performance, while other demographic and functional variables might not necessitate targeted adjustments within the scope of enhancing R&D-driven performance outcomes.

- **R&D's Impact:** Consistently significant across models, indicating a strong positive relationship between R&D investment and firm performance, aligning with primary expectations of R&D's beneficial impact.
- **Gender:** Shows a statistically significant negative coefficient in the extended model, suggesting that when controlling for R&D and other demographics, there might be differential impacts on performance based on gender. This could reflect underlying dynamics within the firm or industry-specific factors affecting performance perceptions or outcomes based on gender.
- **Age, Experience, Education, and Function:** These variables did not show statistically significant impacts on performance in the extended model, indicating that, unlike R&D, these demographic factors do not have a clear, direct relationship with overall firm performance when other variables are considered.

V. FINDINGS DISCUSSION:

The regression analysis focused on three key R&D dimensions—Expenditure, Knowledge Management (K.M), and Creativity—and their impact on overall firm performance. The model summary indicates a strong explanatory power ($R^2 = 0.556$), demonstrating that these R&D dimensions collectively account for approximately 55.6% of the variance in firm performance.

Hypothesis Testing:

1. **Hypothesis 1.1:** There is a statistically significant relationship between expenditure on research and development capabilities and performance.
 - This Hypothesis is **“Supported”**. The expenditure on R&D activities ($B = 0.239$, $p = 0.002$) positively impacts firm performance, affirming the critical role of investment in R&D for enhancing firm outcomes.
2. **Hypothesis 1.2:** There is a statistically significant relationship between the adoption of knowledge management in the organization and performance.
 - This Hypothesis is **“Strongly supported”**. Knowledge Management (K.M) shows a significant positive effect ($B = 0.263$, $p < 0.001$) on firm performance, highlighting the essential role of effectively managing and leveraging knowledge within R&D processes.
3. **Hypothesis 1.3:** There is a statistically significant relationship between activating creativity among employees and performance.

- This Hypothesis is “**Not supported**”. While creativity shows a positive direction of impact ($B = 0.108$), it does not reach statistical significance ($p = 0.124$) within the model. This suggests that the direct impact of creativity on firm performance, as captured by this model, is not statistically significant, though it does not rule out its potential importance in the broader context of R&D capabilities.
- 4. **Hypothesis 2:** There is a statistically significant relationship between research and development and firm performance due to functional and personal variables.
- This Hypothesis is “**Not Supported**”. Only **gender** stands out as a significant moderator of the R&D-performance relationship. Age, experience, education level, and job role showed no significant moderating effects on the relationship between R&D capabilities and firm performance.

The findings reinforce the notion that R&D capabilities—particularly in terms of expenditure and knowledge management—are vital for firm performance improvement. The significant impact of R&D expenditure and knowledge management underscores their strategic importance in fostering innovation and competitive advantage. The less clear impact of creativity suggests that its role may be more complex or influenced by other factors not captured in the regression model, such as organizational culture, the nature of R&D projects, or external collaboration.

The study's empirical investigation into the relationship between Research & Development (R&D) capabilities and firm performance within the Soidal Pharmaceutical Group has yielded insightful findings that both corroborate and extend existing theoretical propositions from Innovation Theory and the Resource-Based View (RBV) of the firm. This section discusses the implications of these findings, integrating them with the theoretical framework and existing literature, to provide a nuanced understanding of the study's contributions to the field.

The positive correlation between R&D expenditure and firm performance metrics underscores the critical role of financial investment in R&D for driving innovation and enhancing competitive advantage. This finding aligns with Innovation Theory, which posits that investment in innovation is crucial for sustaining competitive advantage. It also resonates with the RBV, highlighting R&D expenditure as a strategic resource that, when effectively managed, contributes significantly to firm performance. This supports the notion that financial resources dedicated to R&D are not mere costs but strategic investments that can yield substantial returns in terms of innovation outcomes and market success.

The significant positive effect of knowledge management practices on firm performance emphasizes the value of effectively managing knowledge as a strategic asset. This aligns with the RBV, which regards organizational knowledge as a key resource that can lead to sustained competitive advantage. It also supports the premises of Innovation Theory by demonstrating how the dissemination and application of knowledge facilitate innovation processes. Reinforces the argument that knowledge management capabilities are crucial for leveraging internal resources to drive innovation and improve performance outcomes.

The positive association of creativity with firm performance, despite not reaching statistical significance, suggests indirect benefits or moderated impacts not fully captured by the study. This finding invites a re-examination of how creativity is conceptualized and measured within R&D contexts, echoing calls from Innovation Theory for fostering organizational cultures that encourage creativity. That Points to the complex nature of creativity as a driver of innovation and its contingent effects on firm performance, suggesting the need for further theoretical exploration.

The identification of gender as a significant moderator, alongside the non-significant moderating effects of other demographic and functional variables, offers a nuanced view of the R&D-performance relationship. This finding is particularly relevant in light of ongoing discussions around diversity and inclusion within the workplace. That Suggests that demographic characteristics, particularly gender, may influence the effectiveness of R&D strategies, indicating areas for further theoretical inquiry into diversity's role in innovation and performance.

VI. CONCLUSION

The study's findings offer compelling evidence of the strategic importance of R&D capabilities in driving firm performance within the pharmaceutical industry. By elucidating the roles of R&D expenditure, knowledge management, and creativity, this research contributes to a deeper understanding of how firms can leverage their R&D capabilities to achieve competitive advantage and organizational growth. Furthermore, the moderating role of gender highlights the significance of diversity and inclusion as factors that influence the outcomes of R&D activities, paving the way for future research and practical initiatives aimed at enhancing the effectiveness of R&D strategies through diversity.

VII. RECOMMENDATIONS:

1. **Strategic R&D Investment:** Firms should adopt a strategic approach to R&D investment, focusing on areas with the highest potential for innovation and market differentiation. This involves conducting thorough market and technological trend analyses to guide R&D expenditure towards projects with the highest return on innovation.
2. **Enhancing Knowledge Management:** Implement state-of-the-art knowledge management systems to facilitate seamless knowledge sharing and collaboration across departments. Investing in digital platforms that promote internal communication and idea exchange can significantly enhance innovation outputs.
3. **Fostering a Culture of Creativity:** Develop organizational policies that actively encourage creativity and innovation among employees. This can include establishing innovation incubators, providing time for creative projects, and instituting rewards for innovative ideas that contribute to firm performance.
4. **Diversifying R&D Teams:** Encourage diversity in R&D teams to leverage varied perspectives and experiences. Research indicates that diverse teams are more likely to produce innovative solutions. Creating cross-functional teams can also enhance the development of holistic and market-ready solutions.

VIII. FUTURE RESEARCH:

1. **Exploring the Role of Digital Transformation in R&D:** Future studies should examine how digital transformation and the adoption of advanced technologies (e.g., AI, IoT, Blockchain) within R&D departments influence firm performance. This research could provide insights into the most effective strategies for integrating technology into R&D processes.
2. **Impact of Organizational Culture on R&D Effectiveness:** Investigate the influence of organizational culture on the effectiveness of R&D activities. Studies could explore how

different cultural attributes (e.g., openness, risk tolerance, and collaboration) impact the creativity and productivity of R&D teams.

3. **Longitudinal Analysis of R&D Investment Returns:** Conduct longitudinal studies to assess the long-term impacts of R&D investments on firm performance. This research could provide a deeper understanding of the time horizon required for R&D investments to yield significant performance improvements.
4. **Cross-Industry Comparative Studies:** Comparative studies across different industries could elucidate industry-specific factors that influence the relationship between R&D and firm performance. This would help tailor R&D strategies to industry-specific dynamics and challenges.

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