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Original Research Article

Characteristics of Industrial Technological Innovation: An Exploratory Study

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Abstract: The main aim of this exploratory paper is to examens the key characteristics of technological innovation in a sample of industrial organizations in Jordan. Gathering data from 45 Jordanian industrial companies through a questionnaire-based approach, the research aims to understand different aspects of their innovation practices. Six important domains are explored: the performed functions by R&D departments or units, the primary sources of technological innovations, the announced objectives leading innovation activities, the principal obstacles faced during the innovation process, the main causes of innovation failures, and the critical factors contributing ti innovation success declared by the companies. Each one of the areas was evaluated through multiple-choice items. The findings from this study provide a descriptive overview of the current state and challenges of technological innovation faced by Jordanian industrial companies, offering insights for both academic understanding and practical strategies aimed at enhancing industrial growth and competitiveness in the Jordanian environment.

Keywords: Technological Innovation, Jordan, R&D Entity Functions, Innovation Sources, Innovation goals, Innovation barriers, Innovation Success Factors.

1. RESEARCH METHODOLOGY

1.1 Problem Statement

Although it is well known and recognized the importance of technological innovation for industrial growth, competitiveness, and economic development, there is a limited awareness of its main characteristics and attributes of its dynamics within the organizations of the industrial sector of Jordan. Companies frequently face challenges in starting, implementing, and sustaining, and commercializeing innovation efforts, leading to encountering real obstacles, suffering failures, and unexploited hidden potential. Without a clear comprehension of how R&D functions, where innovations come from, what drives them, what barriers impede them, what are their failure causes, and what makes innovations succeed in the Jordanian industrial organizations, effective strategies for promoting and enhancing innovation cannot be developed correctly or targeted. This gap in knowledge hinders both theoretical understanding of innovation in developing economies and practical attempts to improve the Jordanian industrial performance.

1.2 Significance of the Study

This paper offers significant theoretical and practical contributions. In its theoretical part, it provides insights to the body of knowledge on technological innovation, specially by presenting empirical data from a such developing economy context like Jordan, which is often not covered enough in existing literature and research. It offers a theoretical base for future comparative studies and model building related to innovation drives beyond highly developed industrial countries. Practically, the outcomes will provide valuable indicators for various stakeholders. For example, for industrial organizations in Jordanian environment, it offers a benchmark scale with which they can evaluate their innovation activities, identify common mistakes to avoid, and enhancing success factors. For policymakers and government agencies, it helps in discovering the most needy and critical areas where technical, legal, or administrative support is required, such as R&D

infrastructure, dealing with specific innovation barriers, and developing targeted incentives' systems. For consultants and industry associations, it provides data-driven insights to design more effective training programs and support services directed to enforcing innovation capabilities and decreasing failure rates within the Jordanian industrial sector, finaly contributing to greater national competitiveness and more diversied economy.

1.3 Objectives of the Study

The main objectives that this paper try to fulfill are the following

1. Identifying and reviewing the main activities of Research and Development (R&D) units in a sample of Jordanian industrial companies.
2. Discovering the principal sources leading to technological innovations taken place in industrial companies in Jordan.
3. Determining the major goal and essential objectives that lead technological innovation activities within the research sample companies.
4. Finding out the main important obstacles encountered by Jordanian industrial organizations when they trying to achieve technological innovations.
5. Exploring the prominent causes of innovatie initiatives failure of in the mentioned enterprises.
6. Detecting the critical factors considered as crucial for the success of technological innovation in Jordanian industrial companies.

1.4 Research Sample

A randomly chosen sample of large and medium-sized Jordanian industrial companies was selected (the number of employees was used as a criterion). The diversity of the sample in terms of the industrial sector in which they operate is taken in account by the researcher. The questionnaire was directed to the production manager or the research and development manager, considering that these two departments are closest to technological innovation activity of various types (some of the companies have no independent R&D department, but there are units for that purpose). Following is a table that illustrate some of the attributes of the study sample in terms of industrial sector. All the surveyed companies have achieved at least one or more of the foure innovations considered in this research: new product, product improvement, new process, and process improvement.

Table No. 1-1: Research Sample by Industrial Sector

No.	Sector	No. of Companies	%	Cumulative %
1	Mechanical	6	13.3	13.3
2	Food	9	20	33.3
3	Pharmaceutical	10	22.2	55.5
4	Chemical	9	20	75.5
5	Textile	4	8.9	84.4
6	Building and Construction	2	4.4	88.9
7	Communications	1	2.2	91.1
8	Furniture	1	2.2	93.3
9	Printing and Publishing	1	2.2	95.5
10	Other	2	4.4	100
11	Total	45	100	

2. THEORETICAL FRAMEWORK

Introduction

Today, technological innovation acts as a main leader of economic growth, competitiveness, and sustainable industrial progress in the 21st century for all nations (Schumpeter, 1934; Porter, 1990). It is of huge importance, in a gradually globalized and knowledge-intensive economy, the power and ability of industrial companies to create, adopt, and combine new technologies is of great importance or vital for their survival and prosperity (Drucker, 1985, P.147), Innovation enables enterprises to foster productivity, generate new products and services, improve operational efficiency, and adapt to quickly changing market dynamics and demands (Tidd & Bessant, 2013, P. 12). In less developed countries, specially those who are seeking to make their industrial base more diverse and lessen dependence on traditional sectors, enhancing technological innovation is not just an alternative but a strategic choice to bridge economic variances and assure future growth (UNCTAD, 2014, P. 30).

Industrial companies, as the enablers of production and manufacturing, are at the vanguard of this innovation imperative. Being able to innovate marks their rank in global value chains and their share in national GDP (OECD, 2005, P. 45). However, the process of technological innovation is naturally highly complex and full of challenges, involving considerable investments in research and development (R&D), dealing with organizational change, facing market

uncertainties, and overcoming different barriers (internal and external) (Christensen, 1997, P. 6). Understanding the characteristics of this process – from its origins and objectives to its barriers and factors of success or failure – is viatal for both understanding theoretical advancement and practices in policymaking.

Jordan's economy is characterized by a growing and progressive industrial sector, yet it confronts some obstacles such as limited natural resources, regional geopolitical instability, and the need to enhance its technological infrastructures (World Bank, 2018, p. 60). While the significance of innovation is well known at a policy level, practical indicators of how Jordanian industrial organizations actually do, manage, and deal with technological innovation remain relatively scarce (Al-Refaie & Al-Tarawneh, 2019, p. 102). Former researches mostly focus on some economic aspects or small set of sectors, leaving a gap in detailed organizational-level comprehension of innovation characteristics.

Based on the above, our exploratory research's goal is addressing this knowledge gap by shedding light on diverse sides of technological innovation taking some of Jordanian industrial organizations as a sample. To be more specific, the paper explores the current functions of their R&D departments, the main sources of technological innovations achieved, the core goals leading their innovation efforts, the important barriers they face working on the innovation process, the principal factors of the failure of their innovation projects, and the critical factors that drive to their innovation successes. By systematically examining these key characteristics, this paper looks at providing a whole understanding descriptive overview that can inform both academic discourse on innovation in developing contexts and practical strategies for enhancing industrial competitiveness and fostering a more robust innovation ecosystem in Jordan.

2.1 Technological Innovation: Concepts and Definitions

All countries all over the world look at Technological innovation as a foundation of modern economic driving factor and competitive advantage, leading progress across the economic sectors and societies. Acknowledging its importance globally, the concept and definitions of technological innovation have developped gradually over time, because of changes taken place in technological capabilities, organizational structures, and economic growth and diversification. Rooted in the famous work of Schumpeter, who was the first who linked innovation to "creative destruction" and economic cycles (Schumpeter, 1934, P.55), contemporary literature and research show more nuanced and expansive points of view. For example, Crossant and Apaydin defined innovation as: "production or adoption, assimilation, and exploitation of a value-added novelty in economic and social spheres; renewal and enlargement of products, services, and markets; development of new methods of production; and establishment of new management systems. It is both a process and an outcome "(Cossant and Apaydin, 2010,P. 1158).

OECD, in its manual on technological innovation, stated that "its most cornerstone, envolves the creation and adoption of new or significantly improved products, processes, services, or methods of organization that leverage scientific and technological knowledge" (OECD/Eurostat, 2018, P.20). This definition of the technological innovation concept, repeatedly cited in research on the same terminology, contains two critical elements: novelty and application. The "newness" can range from incremental or gradual adjustments to radical breakthroughs, and its potential value "lies in its successful implementation and diffusion within an economic or social context" (Crossan & Apaydin, 2010, P.1158). Modern research moves beyond a purely linear model of innovation, focusing on its systemic, iterative, and often disruptive nature (Fagerberg, 2017, P.5).

Technological innovation nature is changed totally today, literature underscores that it is not only just breakthroughs or changes in goods or physical products. For example, process innovation, which focuses on new or improved methods of production or delivery, aquired a significant attention because of the role it plays in improving efficiency, enhancing costs reduction, and promoting quality (Damanpour & Acar, 2017,P 249). This includes progress in manufacturing techniques and styles, logistical activities, and internal operational dynamics. In addition to manufacturing, the progress of digital technologies has stimulate extensive research into service innovation, where new value propositions are created through novel service delivery models, often enabled by data analytics, AI, or platform technologies (Chesbrough, 2011,P.160 ; Gallouj & Djellal, 2010, P.15). These new definitions and different understanding lead the expansion of the scope of innovation beyond tangible products wider to encompass intangible services that open new horizons and reshaping industrial sectors.

Moreover, researchers increasingly contemplate technological innovation through the point of view of ecosystems and networks, acknowledging that its seldom occurance in isolation. Often, it is the overcome of combined collaborative activities of many actors—firms, research institutions, governments, and even users—co-creating and co-evolving technologies (Adner, 2017,P.25; Nambisan, 2017, p.45). Chesbrough, made popular the open innovation model, emphasizes the significance of external knowledge collaboration and flows in leading technological progress, challenging old closed R&D paradigms (Chesbrough,2003,P.10). Likewise, the concept of user innovation, where end-users play an important role in developing and reshaping products or services, blurs the boundaries of where innovation took place (von Hippel, 2005, P.15).

Technological innovation' definitions also graps with its inherent disruptive potential. Christensen's, pioneering research on disruptive innovation, differenciate between innovations that improve existing products or services in expected modes "sustaining innovation" and those that open new markets and value networks, eventually replacing actual market leaders (Christensen, 1997, P.6). Today' studies continue to discover the subtle distinctions of disruption, focusing on strategic challenges and opportunities it presents for incumbent organizations and new competitors (Govindarajan & Kopalle, 2016, p.3). All the mentioned, shows that understanding technological innovation entails not just diagnosting what is new, but also evaluating its potential effects on industrial organizations' structures and competitive positions and its dynamics.

At it is shown above, recent definitions are fundamentally recognizing the important role that digitalization and new emerging technologies playing in formulating innovation concepts, such as digital innovation, emphasize the exclusive traits of innovation during digital era like its rapid fluidity, high generativity, and natural scalability, normally driving to repeated and continuous development (Nambisan, 2017, p.45). Also, integrating artificial intelligence, blockchain, and big data analytics is the main factor of altering the way products are conceived, processes are optimized, and services are delivered, expanding the very notion of what constitutes technological innovation in the modern era (Manyika *et al*., 2013, p.10 ; Iansiti & Lakhani, 2020, p.35).

Finally, the concept of technological innovation has developed from a focus on discrete inventions to a more comprehensive understanding containing other elements like products, processes, services, and organizational innovations. Today's literature emphasizes its systemic, network-driven, and often disruptive nature, affirming the significant roles of collaboration, user involvement, and the transformative capability of digital technologies. The mentioned evolving definitions show the effective and dynamic interaction among technological progress, market forces, and organizational abilities, presenting a frutful framework for comprehension and enhancing innovation in different contexts.

2.2 Main Characteristics of Technological Innovation

Based on the preceded theoretical understanding of the concept and nature of technological innovation and its different definitions, this paper's empirical part examines six specific areas very important for characterizing innovation actions within Jordanian industrial organizations. Those fields were recognized through a comprehensive literature review and are designed to provide an easy understanding of the way technological innovation is manifested and managed in reality. The following, is showing the detailed findings for the mentioned areas, with the descriptive statistical analyses of data gathered from the surveyed companies, to support the study results. Those areas are:

1. Functions of R&D Departments or Entities Responsible for its Activities

Perceiving the roles and efforts achieved by R&D departments is vital to describe a company's innovation orientation, commitment, and capabilities. "Those units are often central to generating new knowledge, developing prototypes, and improving existing products or processes, acting as critical internal drivers of technological advancement" (e.g., Hossain *et al*., 2021, p. 345). This section investigates the specific functions that R&D departments or units assumes within the surveyed Jordanian industrial organizations, starting with basic research to quality control and technical support. The outcomes highlight the strategic orientation and operational scope of R&D activities in the local environment.

2. Sources of Technological Innovations

It is of importance to assure that innovation does not occure in isolation; it often combines knowledge and ideas from diverse sources, some are internal and others are external. Identifying these main sources gives a clear insight into a company's style of knowledge acquisition, collaboration, and open innovation strategies (e.g., Bogers *et al*., 2019, p. 310). This section searches whether Jordanian industrial companies primarily depend on internal R&D, customer feedback, supplier collaborations, competitor analysis, academic partnerships, or other courses for their technological innovations. Comprehending these sources is critical for consolidating environments leading to idea generation and knowledge flow.

3. Objectives of Innovation

organizations works heavily on technological innovation having some specific strategic goals in mind, ranging from promoting market competitiveness and reducing costs to get better product quality or boosting sustainable practices (e.g., Camisón & Villar-López, 2019, p. 115). This field of research's goal is to find out the main objectives that lead innovation efforts within the studied organizations. Identifying these objectives is of special significance for evaluating the strategic alignment of innovation tasks and understanding the priorities of industrial firms in Jordan within their competitive environment.

4. Innovation Obstacles

Achieving technological innovation is normally full with challenges. Identifying the most common difficulties helps a lot in providing important information for both organizations and local policymakers facilitate innovation (e.g., Coad *et al*., 2022, p. 55). This section explores the most important barriers faced by Jordanian industrial organizations,

which might include financial problems, shortage of skilled staff, uncertainties in the market, new regulatory changes, or resistance to organizational change. The early overcoming of these impediments is vital for developing targeted support mechanisms and prevailing systemic limitations in the innovation ecosystem.

5. Reasons for Innovation Failure

Innovation is an innate risky effort, and not all initiatives started succeed. Checking and analyzing the causes why innovations fail gives critical lessons for future activities and support alot in mitigating risks (e.g., Li & Zhang, 2020, p. 480). Here, the fundamental factors driving to the interrupting or unsuccessful implementation of innovation projects in the surveyed organizations are explored, such as poor market research, technical barriers, weak project management, or little internal organizational support. Insights into failure mechanisms and knowing the reasons of incompetence are invaluable for improving next innovation processes and enhancing learning within the industrial companies.

6. Factors of Innovation Success

On the contrary, comprehending what contributes to successful innovation is equally significant for replicating positive results and building strong innovation capabilities (e.g., Saunila, 2020, p. 132). Finally, this section discusses the main factors that Jordanian industrial organizations recognize as vital for the success of their technological innovations' efforts. Those reasons of success and winning the game might contain strong leadership support and commitment, effective internal and external collaboration, access to adequate financing, a clear strategic vision, or a supportive organizational culture that adopts experimentation. Diagnosting these success causes offers actionable insights for best practices and strategic investments.

Each of these six areas was examined with multiple-items choices question in the study survey list (Appendix 1), presenting a wide range of choices to the companies to best describe their own experiences in this field. Responses for each question are presented in details in the following tables, presenting the empirical part for this paper's results and discussion.

3. Empirical Focus: Results and Discussion

This part of the paper includes six questions that provide important information related to technological innovation in Jordanian industrial organizations. Respondents were asked to rank certain choices, which vary in number for each question. To calculate the ranking importance of the choices, we used an equation to derive a weighted value for the ranking. Some companies might rank the first choice in the third or fourth position, while other companies might rank the fifth choice in the first or second position. Thus, the data was organized to reflect the number of companies that ranked a choice in a specific position. The weighted value was calculated based on the number of choices in the question. For example, the first question contains nine choices, so the weighted value for a choice when placed in the first position is 9, in the second position is 8, in the third is 7, and so on, with the value for the last position being 1. Then, we sum the product of the number of companies that ranked the choice in a certain position and its weighted value, and divide it by the number of companies that included this choice in their selection. The equation for the first question will be:

(number of companies that ranked the choice in the first position ∗ 9)+(number of companies that ranked the choice in the second position ∗ 8)+…+(number of companies that ranked the choice in the ninth position ∗ 1) } / { number of companies that included the choice in their selection}

We will apply this equation to the results of the first question as an example of how to derive the weighted ranking of the answers.

3.1 Functions of the Research and Development Department:

This question asked respondents to rank the functions of the research and development department in their company or the entity responsible for research and development if there is no specific department named R&D. Below, we find the distribution of answers for the first question.

Table 3-1: Responses of the study sample to the question regarding the functions of the research and development department

Choice	First	Second	Third	Fourth	Fifth	Sixth	Seventh	Eighth	Ninth	Total Companie
1. Improving existing products	11	5	4	2	0	1	3	2	0	28
2. Developing new products	5	9	3	4	1	1	3	0	0	26
3. Analyzing competitors' products	1	2	4	2	4	5	3	2	1	24
4. Analyzing the existing production process	4	2	4	9	5	0	2	0	0	26
5. Providing technical services to other departments	1	0	2	1	4	5	2	6	1	22
6. Developing new processes	2	0	5	3	4	6	2	1	2	25

7. Quality control	2	9	0	2	2	3	4	1	0	23
8. Finding new applications for existing products	0	1	1	2	2	2	2	4	1	16
9. Finding uses for by-products and production waste	2	0	0	0	1	3	1	3	9	18

To derive the weighted ranking values for each function, we apply the aforementioned equation as follows:

Weighted Ranking Value for the Function of Improving Existing Products:
｛(11×9)+(5×8)+(4×7)+(2×6)+(0×5)+(1×4)+(3×3)+(2×2)+(0×1)｝/ 28 = 7 weighted points

After performing the same calculations for the other functions (choices), we get the following Table (3-2):

Table 3-2: functions of the R&D department according to the study sample's perspective

Functions of the R&D Department	Weighted Ranking Value	Ranking by Importance	Number of Companies that Indicated the Function	Percentage to Total
1. Improving existing products	7	First	28	62.2%
2. Developing new products	6.73	Second	26	57%
3. Improving the existing production process	6.35	Third	26	57%
4. Quality control	6.0	Fourth	23	51%
5. Analyzing competitors' products	5.0	Fifth	24	53.3%
6. Developing new processes	5.0	Fifth	25	55.5%
7. Providing technical services to other departments	4.0	Sixth	22	49%
8. Finding new applications for existing products	3.69	Seventh	16	35.5%
9. Finding uses for by-products and production waste	2.94	Eighth	18	40%

From the above table, we find that the function of improving existing products ranked first. This indicates that the efforts of employees in the research and development department primarily focus on making modifications to products, ranging from major changes to minor adjustments related to the packaging and presentation of the company's current products. Although developing new products ranked second, this shows a theoretical assumption from the study sample's perspective, as we will see later, did not check any significant impact of the measured factors on new products. Thus, the respondents' belief and assumption differ from reality. The functions of improving the existing production process and quality control follow the top two functions, as fierce competition necessitates special attention to these functions. The functions ranked eighth and ninth received less attention, as shown in Table (3-2), despite the fact that finding new applications for existing products requires less effort than developing new products. However, due to the nature of the products of the companies in the study sample, these functions ranked last. Additionally, environmental standards are not yet mature enough to compel companies to deal with production waste and by-products.

3.2 Sources of Technological Innovation:

The answers in Table (3-3) indicate that the most important sources leading to technological innovation in Jordanian industrial companies are marketing, customers and their suggestions, analyzing competitors' products, and the company's research and development department. Lastly, industrial and trade exhibitions were also noted. The remaining three sources recorded significantly lower importance compared to the top five. External experts and consultants, technological and research institutes, and published patents were not considered primary sources of technological innovation, unlike in developed countries. This could be because most of the achieved innovation was largely an imitation of other products or licenses from foreign companies. It is important to note that collaboration with universities, other academic entities, and research centers can provide industrial companies with technological innovations that can offer competitive advantages in the market. However, companies might be reluctant to engage with these entities due to the unwillingness to take risks and the desire to avoid waiting for long-term results, preferring instead to achieve immediate profits through licensing and imitating existing products.

Table 3-3: Sources of technological innovation from the perspective of the study sample

Source	Number of Companies Indicating It	Percentage to Total (%)
1. Marketing	34	75.5
2. Customers	31	68.8
3. Analyzing competitors' products	29	64.4
4. Research and development department	28	62.2
5. Industrial and trade exhibitions	25	55.5
6. External experts and consultants	6	13.3

7. Technological and research institutes	2	4.4
8. Published patents	3	6.6

3.3 Objectives of Technological Innovation:

The responses to the third question of the second part of the questionnaire are shown in Table (3-6) below:

Table 3-4: Objectives of technological innovation from the perspective of the study sample

Objective	Weighted Ranking Value	Ranking by Importance	Number of Companies Indicating the Objective	Percentage to Total (%)
1. Reducing costs	8.60	First	35	77.7
2. Improving product quality	8.11	Second	33	73.3
3. Increasing sales volume	7.91	Third	32	71.1
4. Retaining or increasing market share	7.63	Fourth	37	82.2
5. Opening new markets	7.47	Fifth	32	71.2
6. Expanding product range	5.57	Sixth	35	77.7
7. Improving the company's image in the market	5.44	Seventh	32	71.1
8. Increasing production process flexibility	5.24	Eighth	30	66.6
9. Replacing old products with new ones	5.04	Ninth	29	64.4
10. Finding new uses for existing products	4.04	Tenth	27	60
11. Motivating employees	3.35	Eleventh	28	62.2

By examining the table above, we discover that the objectives pursued by the industrial organizations from achieving a specific technological innovation focus mostly on cost reduction, improving product quality, then increasing sales volume, and retaining or increasing market share when possible. Opening new markets follows these objectives. Although other objectives were noted by a large number of companies, they did not record high ranking importance because they were given lower or secondary priority compared to the top five objectives. There should be greater attention given to objectives such as replacing old products with new ones, finding new uses for current products, and focusing on increasing production process flexibility. Competition requires the industrial organization to diversify its production and respond to market supply and demand changes quickly. Interestingly, employee motivation ranked last despite being indicated by 28 companies. This shows that it was given very little importance compared to other objectives. It should be considered that the human factor can be an important source of technological innovation when there are sufficient incentives.

3.4 Obstacles to Achieving Technological Innovation:

By reviewing the data results and calculating the weighted ranking value for each obstacle hindering technological innovation according to the perspectives of the companies in the research sample, the obstacles were ranked as follows:

Table 3-5: Obstacles to technological innovation according to the research sample

Obstacle	Weighted Ranking Value	Ranking by Importance	Number of Companies Indicating the Obstacle	Percentage to Total (%)
1. Financial difficulties	9.42	First	31	68.8
2. Lack of time allocated for innovation projects	9.29	Second	28	62.2
3. General economic conditions affecting the sector	8.18	Third	24	53.3
4. External regulations and laws	7.29	Fourth	21	46.6
5. Difficulty adapting the current production system	7.05	Fifth	25	55.5
6. Low expected short-term returns from innovation	6.68	Sixth	26	57.7
7. Lack of consumer interest in our new products	4.73	Seventh	18	40
8. Lack of support from top management for innovation projects	4.56	Eighth	23	51.1
9. Lack of coordination between different departments in the company	4.36	Ninth	18	40
10. Insufficient employee motivation and enhancement of technical skills	4.08	Tenth	20	44.4
11. Lack of information on global technological developments in our sector	3.55	Eleventh	18	40

It is clear from the results in the table that the lack of primary resources, namely financial allocations and time, occupied the first and second positions among the obstacles, despite the fact that the primary goal of technological innovation, as indicated by the sample's answers to the third question, is cost reduction. This presents a paradox, as money and time must be allocated to achieve cost reduction through technological innovation. Additionally, the prevailing general economic conditions affecting the sector in which the enterprise operates pose an obstacle, as the recession or near-recession that the economy is suffering from as part of the economic cycle reflects on technological innovation projects due to the fear that the returns will not cover the costs of these projects. In the fourth position, external regulations and laws were identified as obstacles to technological innovation according to the research sample. Consequently, various legislations and regulations pertaining to industrial companies and the facilities granted to them need to be re-examined to align with global changes such as globalization, free trade agreements, and transparency. The private sector might view government procedures as bureaucratic and non-transparent even if the legislation itself is mature and geared towards improvement and development in industrial conditions. Additionally, the difficulty in adapting the current production system for technological innovation was deemed relatively significant (7.05) and ranked fifth, perhaps because most production systems are characterized by inflexibility and are traditional both technically and organizationally. Despite the fact that the lack of support from top management for research and development projects did not constitute a major barrier for industrial companies, as its ranking importance was 4.56. It is also notable that the lack of employee motivation is not considered an obstacle to technological innovation, although the human resource plays a significant role in fostering technological innovation activities.

3.5 Reasons Leading to Technological Innovation Failure:

It should be noted here that these reasons relate to technological innovation after its achievement, not obstacles to technological innovation projects as in the previous question. The main reasons leading to the failure of technological innovation from the perspective of the research sample are shown in Table (3-6) below:

Table 3-6: Reasons Leading to Technological Innovation Failure

Reason	Weighted Ranking Value	Ranking by Importance	Number of Companies Indicating the Reason	Percentage to Total (%)
1. Technical problems with equipment and machinery	3.64	First	36	80
2. Lack of market acceptance for innovations	3.46	Second	32	71.1
3. New product not outperforming existing products	3.32	Third	30	66.6
4. Quick imitation by competitors of our innovation	3.10	Fourth	28	62.2
5. Inefficient sales and distribution systems	2.10	Fifth	28	62.2

Since the question includes an option asking respondents to mention other reasons if any, some companies indicated the following reasons, which can be summarized as follows:

1. Lack of advanced promotional means.
2. Lack of specialized technicians.
3. Lack of new markets for these products.
4. Insufficient time available for innovation for company employees.
5. Difficulty in obtaining licenses to sell new products.
6. High costs.

In general, a quick look at these reasons reveals that technical problems rank first, as any improvement in the product or process or any development of both requires additional equipment and other machinery to achieve innovation. Similarly, the lack of specialized technicians indicates a lack of attention to the human resource as a source of technological innovation, whether in terms of insufficient motivation as inferred from the answers to previous questions or in terms of training and linking with research centers and universities.

3.6 Factors for the Success of Technological Innovation:

The research sample believes that the most crucial factor for the success of technological innovation is the adequacy of resources. These resources are identified as financial resources and material resources, such as equipment and machinery. Previously, a lack of these main resources (money and time) was identified as a reason for the failure of technological innovation projects. Additionally, support from top management is considered a fundamental pillar for the process of technological innovation, as shown in Table (3-7).

Table 3-7: Factors for the Success of Technological Innovation from the Perspective of the Research Sample

Factors	Weighted Rank Value	Rank by Importance	Number of Companies Indicating the Factor	Percentage of Total Companies
1. Adequacy of resources	8.54	First	28	62.2%
2. Support from top management	8.47	Second	32	71.1%
3. High expected returns from innovation	6.79	Third	23	51.1%
4. Presence of a large number of researchers and technicians	6.52	Fourth	24	53.3%
5. Good reputation of our company in the market	5.74	Fifth	27	60%
6. Long-standing presence and longevity of our products in the market	5.0	Sixth	28	62.2%
7. Availability of equipment, machines, and computers	4.61	Seventh	22	48.8%
8. Continuous awareness of technological advancements	4.58	Eighth	21	46.6%
9. Tax facilities and government regulations	4.0	Ninth	25	55.5%
10. Close relationships with universities and research centers	3.32	Tenth	27	60%

It is clear that the expected returns from technological innovation are a significant factor in its success, as the research sample gave it high importance (ranked third). However, it should be noted that focusing on quick returns in the short term can greatly hinder the success of technological innovation programs. Additionally, close relationships with universities and research centers were not given much importance, as they ranked tenth, indicating an incorrect current state of the relationship between industrial establishments and research centers and universities. Developing awareness of the importance of ties between these two sectors is necessary.

4. CONCLUSIONS, RECOMMENDATIONS, LIMITATIONS, AND FUTURE AREAS OF RESEARCH

4.1 CONCLUSIONS

This research paper, presented a descriptive view of the main characteristics of technological innovation in a sample of Jordanian industrial organizations, highlighting their R&D efforts, innovation processes, and challenges faced. The outcomes show an environment where the mentioned enterprises are actively achieving innovation with different objectives, driven by both internal abilities and external knowledge origins. Particularly, the paper showed that R&D departments or entities responsible for R&D activities incur a combination of foundational and applied functions, working as a crucial internal motivator. While multiple sources contribute to innovation, the interaction between internal actions and external collaborations is obvious. Organizations' goals for innovation are various, extending from market-oriented objectives to efficiency improvements. Nevertheless, these activities are always faced with significant barriers and obstacles, with financial constraints and market uncertainties rising as prominent difficulties and hard challenges. The identified reasons for innovation failure underscore the importance of thorough planning and risk management. On the contrary, supporting leadership, strategic alignment, and efficient resources allocation are perceived as critical for successful innovation results. In general, the research assures that while Jordanian industrial enterprises are involved in innovation, they are working in a complex and challenging environment that needs targeted continues support and strategic vision.

4.2 Recommendations: According to the results shown in the tables above, some recommendations are suggested as follows:

4.2.1. For Jordanian industrial organizations:

- Strengthen Working seriously on strengthening internal R&D abilities, while external sources are significant, investing in and clearly determining the internal R&D departments' duties can foster proprietary innovation and adaptive capacity.
- More diversified innovation sources is necessary, so it is vital for all the sample study companies or other organization in the industrial sector, actively seek out and formalize collaborations with universities, research institutions, suppliers, and customers are important to sustain the flow of ideas and technological knowledge. Also, it is of high significance to embrace principles of open innovation where feasible.
- Goals strategic alignment, companies must be sure that innovation' aims are well defined and stricktly aligned with the business strategy in the organization, assuring, by this way, enhancement and fostering a coherent and purposeful approach to R&D.

- Barriers Management proactively: it is necessary to pay more attention practicing risk assessment and mitigation strategies to deal with common financial, market, and human resource-related barriers identified. Also, dedicated innovation budgets and talent development programs must be of high priority.
- Active feedback and learning from failures:perform a systematic review with deep analyses for not succeed innovation projects to discover root causes, extract lessons learned, and get use of these insights into innovation activities in the future work.
- Refine and invest the success factors by prioritizing strong leadership commitment, enhancing ad developing an organizational culture that promotes experimentation and risk-taking, and ensuring all types of resource allocation for innovation projects.

4.2.2. For Policymakers and Government Agencies in Jordan:

- Boosting funding and incentives: developing or expanding plans for financial incentives (e.g., grants, tax breaks, low-interest loans) to dominate or specifically targeted at fostering industrial R&D and innovation supporting by this way companies control or at least aliviate financial barriers.
- Innovation ecosystem empowerment: invest in national R&D infrastructure, facilitate technology collaboration and transfer from academic institutions to industry, and consolidate platforms for industry-academia interaction to make innovation sources more diversified.
- Reviewing continuously regulations: simplify and repeatedly simplify regulatory scopes that might accidentally affect innovation processes, making it easier for industrial organizations to develop, use, and commercialize new technologies.
- Training and empowerment of human resources: adapt initiatives that aim at building real specialized skills necessary for technological innovation, through industrial training programs, university-industry partnerships, and incentives for retaining skilled labor.
- Paying more attention to market support mechanisms: create and maintain programs to support industrial organnizations with market research, intellectual property protection, and entering to new markets, dealing with the common market-related obstacles and enhancing opportunities of success and innovation commercialization.

4.3 Limitations

Because it is exploratory in nature, this study is subject to several limitations. First, the sample size of 45 Jordanian organizations of industrial nature, this means that they are offering primary insights, and may not be totally representative of the industrial sector in Jordan entirely. Second, the study depends on self-reported data gathered through questionnaires, this gives the opportunity to be subject to response biases. Third, the cross-sectional design nature represnts a snapshot in time and does not allow for doing the the analysis of cause-and-effect relationships or the dynamic evolution of innovation characteristics over time. Fourth and finally, the focus is only on industrial organizations in Jordan, limiting the possibility of generalization of findings to other economic sectors or countries.

4.4 Future Areas of Investigation

Based on the foundations laid by this study, several areas for future research are suggested to better understanding and developing the status of technological innovation in industrial companies:

1. Conducting larger-scale quantitative studies (longitudinal studies): with more diversified samples across different industrial sub-sectors in Jordan to improve generalizability. Those longitudinal studies would be of great value to track continuously changes in innovation characteristics, barriers, and innovation success factors over time.
2. Performing comparative research: compare the main innovation characteristics between organizations in idustrial Jordanian sector and those in other developing or developed countries to find out unique regional attributes and the possibility of transfering and adapting the best practices.
3. Employing qualitative methods (qualitative in-depth analyses, for example, case studies, in-depth interviews) to check the nuances of innovation processes, the dynamics of R&D entities, and the subjective experiences of facing and eliminating barriers or achieving success.
4. Studies dedicated for the impact of digital transformation: research how the accelerating digital transformation affect the origins, objectives, obstacles, and success factors of technological innovation in Jordanian industrial companies, given the increasing importance of digital technologies.
5. Explaining the relationship among factors: inferential statistical analyses must be conducted to explore the relationships among various characteristics identified (e.g., how specific R&D functions impact success factors, or how certain obstacles can forecast the potential case of failure), moving beyond descriptive outcomes' insights.
6. Doing sector-specific studies and analyses:carrying out studies concentraiting on specific industrial sub-sectors in Jordan (e.g., food processing, chemicals, machinery, pharmacetical, mechanical, etc…) to explore carefully sector-specific innovation dynamics and take enhancing steps in that field.

Apendix 1: Questions List

1.1 What are the main functions of R&D department or unit in your company ?
1. Improving existing products
2. Developing new products
3. Analyzing competitors' products
4. Analyzing the existing production process
5. Providing technical services to other departments
6. Developing new processes
7. Quality control
8. Finding new applications for existing products
9. Finding uses for by-products and production waste

2. What are the main resources of technological innovation in your company ?
1. Marketing
2. Customers
3. Analyzing competitors' products
4. Research and development department
5. Industrial and trade exhibitions
6. External experts and consultants
7. Technological and research institutes
8. Published patents

3. What are the main objectives Of technologial innovation in your company ?
1. Reducing costs
2. Improving product quality
3. Increasing sales volume
4. Retaining or increasing market share
5. Opening new markets
6. Expanding product range
7. Improving the company's image in the market
8. Increasing production process flexibility
9. Replacing old products with new ones
10. Finding new uses for existing products
11. Motivating employee
4. What are the main obstacles technological innovations faces in your company ?
1. Financial difficulties
2. Lack of time allocated for innovation projects
3. General economic conditions affecting the sector
4. External regulations and laws
5. Difficulty adapting the current production system
6. Low expected short-term returns from innovation
7. Lack of consumer interest in our new products
8. Lack of support from top management for innovation projects
9. Lack of coordination between different departments in the company
10. Insufficient employee motivation and enhancement of technical skills
11. Lack of information on global technological developments in our sector

5. What are the main reason of technological innovation failure in your company?
1. Technical problems with equipment and machinery
2. Lack of market acceptance for innovations
3. New product not outperforming existing products
4. Quick imitation by competitors of our innovation
5. Inefficient sales and distribution systems

6. What are the critical success factors of technological innovation in your company ?
1. Adequacy of resources
2. Support from top management
3. High expected returns from innovation
4. Presence of a large number of researchers and technicians
5. Good reputation of our company in the market
6. Long-standing presence and longevity of our products in the market
7. Availability of equipment, machines, and computers
8. Continuous awareness of technological advancements
9. Tax facilities and government regulations
10. Close relationships with universities and research centers

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