Revue Française d'Economie et de Gestion
ISSN : 2728- 0128
Volume 7 : Numéro 1

Technological innovation and human capital a necessary process for the competitiveness of the Moroccan agri-food SMEs

L'innovation technologique et le capital humain, un processus nécessaire à la compétitivité des PME agroalimentaires marocaines

JERMOUNI Fadwa
Doctorante
Faculté d'Economie et de Gestion
Université Ibn Tofail-Maroc
Laboratoire des Sciences Economiques et Politiques Publiques

EL KADIRI Kenza
Professeur chercheur
Faculté d'Economie et de Gestion
Université Ibn Tofail-Maroc
Laboratoire des Sciences Economiques et Politiques Publiques

Date de soumission : 29/11/2025

Date d'acceptation : 30/12/2025

Pour citer cet article :

JERMOUNI. F. & EL KADIRI. K. (2026) « Technological innovation and human capital a necessary process for the competitiveness of the Moroccan agri-food SMEs », Revue Française d'Economie et de Gestion « Volume 7: Numéro 1 » pp: 319- 336.

Abstract

Technological innovation and human capital are increasingly becoming the keys to success for increasing the competitiveness of SMEs in a context characterised by strong national and international competition.

Therefore, to be creative and innovative, every company must be a place of creativity that integrates its human capital into the innovation process in order to increase productivity and improve the quality of its products and services. The use of hypothetico-deductive reasoning is essential to test the theoretical framework with the hypotheses formulated. In addition, we administered a questionnaire to 100 Moroccan agri-food SMEs. The main objective of this work is to analyse the role and interaction of human capital and technological innovation in (SMEs) and the need for this process to ensure their survival.

The results of this article confirm that technological innovation and human capital have a positive and significant impact on the competitiveness of SMEs in Morocco.

Keywords: SME; Technological innovation; Human capital; Competition; Competitiveness.

Résumé

L'innovation technologique et le capital humain deviennent de plus en plus une clé de réussite pour accroitre le degré de la compétitivité des PME dans un contexte caractérisé par une forte concurrence à l'échelle nationale et internationale.

Ainsi, afin d'être créative et innovante, chaque entreprise doit être un lieu de créativité qui intègre son capital humain dans le processus de l'innovation afin d'augmenter sa productivité, améliorer la qualité de ses produits ou de ses services. Le recours au raisonnement hypothético-déductif est capital pour tester le cadre théorique avec les hypothèses formulées. En outre, nous avons administré un questionnaire auprès de 100 PME Agroalimentaires marocaines. L'objectif principal de ce présent travail consiste à analyser le rôle et l'interaction du capital humain et de l'innovation technologique dans (les PME) ainsi que la nécessité de ce processus pour assurer la survie de cette dernière.

Les résultats de cet article confirment que l'innovation technologique et le capital humain ont un apport positif et significatif sur la compétitivité des PME au Maroc.

Mot clé : PME ; Innovation Technologique ; Capital Humain ; concurrence ; compétitivité.

Introduction

Small and medium-sized enterprises (SMEs) face numerous challenges when attempting to innovate. For a long time, technological innovation has been regarded as a key element in the development of SMEs, and today it occupies a central position in the growth of firms. Indeed, every company is affected by technological revolutions, issues related to climate change, and increasing competitive pressure from customers who have become more informed and more demanding than ever. In this context, innovation has become vital for meeting customer needs and is now a decisive factor in firm performance.

In recent years, Morocco has engaged in a process of trade liberalisation that has placed SMEs in a situation of intense competition, thus raising the issue of their competitiveness. In the quest for this essential competitiveness, innovation has become increasingly critical.

Innovation has become an unavoidable process for firms in general, and SMEs in particular, as it enables them to ensure their growth and development. Moroccan SMEs have specific characteristics (innovation capacity, job creation, etc.) that differentiate them from large enterprises. In fact, Moroccan SMEs are predominantly private companies. According to the Ministry of Finance, by the end of 2019, more than 95% of all SMEs were private, with the remainder belonging to the public sector.

To meet market needs and respond to competitive pressures, firms have implemented a wide range of actions and strategies. This process is based on a relationship between the firm and its environment, whether internal or external. Therefore, a good understanding of the innovation process and a deep knowledge of the firm itself are necessary to enable managers to manage these dynamics effectively and adapt to the challenges and changes in their environment.

Managing this complex relationship requires dealing with large amounts of resources, knowledge, and interrelationships, while also harmonising information, resources, and available technology. Through these efforts, firms aim to successfully implement their strategies and, consequently, become more competitive.

A process-based perspective of technological innovation in a competitive context has thus become a central dimension for ensuring competitiveness. To be truly innovative, the firm must foster a creative environment in order to acquire new technologies through which companies can, thanks to human capital, increase their productivity, improve the quality of their products and services, and strengthen their sustainable performance.

The objective of this research is to clarify the relationship between two vital elements for the firm—technological innovation and human capital—and to examine their role in enhancing business competitiveness.

To better address the problem raised in this study, we seek to answer the following question: **How can technological innovation and human capital ensure the competitiveness of SMEs?**

To this end, our research structure focuses first on presenting a literature review on the foundations of technological innovation and human capital in relation to the competitiveness of SMEs; we then highlight the research methodology adopted for our study; and finally, we present an analysis of the validity and reliability of the results of our study on the impact of technological innovation and human capital on the competitiveness of Moroccan industrial SMEs.

1. Literature Review: Foundations of Technological Innovation and Human Capital in Moroccan Industrial Firms

1.1. Definition and Role of Innovation and Competitiveness

Innovation plays a key role in the different stages of a firm's development and has a decisive influence on the pace of its growth. Effective innovation management contributes directly to a firm's competitiveness.

Competitiveness is a widely discussed and omnipresent term in economic research. Many economic phenomena are now evaluated using the criterion of competitiveness, that is, according to whether they are competitive or non-competitive. It is a complex concept that constantly evolves with market conditions and transformations, as well as with the level of analysis adopted (macro-, micro- or meso-economic). Competitiveness is therefore not static: it is subject both to national and international determinants, and several models and frameworks have been proposed to identify its sources and factors.

Moreover, competitiveness is a polysemic concept. According to the most common definition, competitiveness refers to *"the ability to withstand competition and to occupy a strong position in the market"*. This notion may apply to a firm, an economic sector, or a national economy (Bialès et al., 1999, pp. 105–106)[1].

In 1912, J. Schumpeter placed innovation at the centre of his economic analysis in order to explain the phenomenon of economic growth. He considered innovation to be the primary

[1] Bialès, M. (1999). *Dictionnaire d'économie : faits économiques et sociaux contemporains*. Paris: Foucher.

source of growth. The word *innovation* comes from the Latin *innovatus*, meaning "to change" or "to renew". This definition can be interpreted in two distinct ways:

- **To change**: the act of creating something new, such as a product, a service, etc.;
- **To renew**: the act of modifying what already exists, for example under the effect of changes in market conditions, the emergence of a new technology, or the implementation of a continuous improvement system.

Innovation may also involve *"the introduction of a new manufacturing process, a new tool or operating method, the discovery of a new market, a change in organisational structure, or the conquest of previously untapped sources of raw materials"*. For Schumpeter, the innovation process has the primary mission of energising the economy by enabling the emergence of new productive combinations. Innovations are the main manifestation of technological progress and are the result of the entrepreneur's innovative efforts aimed at seeking profit. In the same vein, (Schumpeter,1934)[2] distinguishes five types of innovation:

- The manufacture of a new good or the attribution of a new quality to an existing good that makes it different;
- The introduction of new methods of production;
- The opening of new markets;
- The conquest of a new source of raw materials;
- The implementation of a new organisational form.

Over the years, the understanding of the innovation cycle has had to evolve or be revised in order to take into account the evolution of the product beyond the design and development phases, the growing number of constraints, as well as the difficulties encountered by the firm during production.

Many factors—such as the product life cycle, time-to-market, corporate strategy and supply conditions—are essential prerequisites for launching a new product, which is a highly strategic decision for any firm. To ensure success and secure a genuine competitive advantage, the firm must innovate, that is, differentiate itself from its competitors. Two main situations may arise: either the firm is able to increase the price of the product (through differentiation), or it improves its production process to achieve superior performance and thereby reduce its costs below those of its competitors (this corresponds to a cost leadership strategy).

[2] Schumpeter, J. A. (1934). *The Theory of Economic Development: An inquiry into profits, capital, credit, interest, and the business cycle*. Cambridge, MA: Harvard University Press.

1.2. Technological Innovation as a Source of Sustainable Competitive Advantage

Technological innovation—also referred to as technical innovation—refers to the introduction of new technologies or the improvement of existing ones for use in the firm's products or projects. It also relates to the consideration of new uses for existing products, as well as to the identification and satisfaction of new needs. At this stage, it is important to distinguish between the terms *technique* and *technology*.

- In a broad sense, *technique* refers to the way of doing things in order to achieve a result. It is particularly used in the industrial field and denotes the set of procedures and practical means specific to an activity and intended for production.
- *Technology*, by contrast, is broader than technique, as it encompasses both production processes and the knowledge mobilised to implement them.

Within a firm, two main types of technologies can be identified, essentially characterised by their function[3]:

- **Management technology**: its role is to support managers in their activities, that is, to organise the collection, storage, communication and processing of information. Organisational information systems (OIS) fall into this category.
- **Production technology**: its role is to determine the feasible combinations of production factors used to produce goods. It is this second type of technology that is at the core of our research.

Stricto sensu, technological innovation is the transformation of an idea into a product (new or improved) that can be marketed. It concerns both industrial and commercial activities. According to the OECD, there are two main types of technological innovation:

- **Technological product innovation**, which consists in offering consumers a more efficient product, with new or improved functionalities or associated services;
- **Technological process innovation**, which refers to the use of new or significantly improved production or distribution methods. This may involve changes in equipment, human resources, or working methods.

In the technological innovation process, technology is a key component of both innovation activities and outcomes. Technological innovation is considered both the result of the innovation process and its main input. In reality, however, the true wealth of technological

[3] Trott, P. (2017). *Innovation Management and New Product Development* (6th ed.). Pearson.

innovation lies in human capital. The human resources made available to the firm, along with their skills and commitment to work, constitute a major asset for its competitiveness.

The third-generation innovation process model, also known as the collaborative innovation process, focuses mainly on the design phase of product innovation. It adopts an approach based on quality function deployment, with a strong emphasis on modelling the value needs of different stakeholders.

Among the works that have shed light on the technological innovation process are those of William J. Abernathy and James M. Utterback (*Patterns of Industrial Innovation*, 1978)[4]. Their theory proposes a set of general propositions on technological strategy, in connection with the innovation process over the life cycle of a product and its underlying technology. Each phase is associated with specific priorities: in the emergence phase, marketing strategy is dominant and focuses on innovation or improvement in product quality; in the maturity phase of the technology, innovation should concentrate on cost reduction and service improvement. It should be noted that each firm has its own innovation process, which depends on several variables.

Firm performance is generally measured in terms of competitiveness, that is, the firm's ability to differentiate itself from competitors and achieve high production volumes. To this, one may add the role of accelerated technological progress in improving productivity: innovation and competitive advantage thus constitute the foundations of corporate profitability. The firm must always anticipate solutions and improve its environment through an innovation strategy that can be characterised as a strategy of idea creation, product creation and market anticipation. Several factors can determine the level of innovation, including demand, technological capabilities, consumer income and firm sales at both national and international levels. From a Schumpeterian perspective, technological innovation depends first and foremost on firm size. Numerous studies have shown that large firms are better positioned to meet the requirements of innovation. It also depends on scientific progress and on the existence of a monopoly situation in the market (i.e., firms that create a new product and temporarily hold exclusive control over its distribution).

[4] Abernathy, W. J., & Utterback, J. M. (1978). Patterns of industrial innovation. *Technology Review*, 80(7), 40–47.

1.3. Technological Innovation as a Competitive Advantage

(Hamel and Birkinshaw, 2006)[5] focused on product and process innovation and their capacity to create sustainable competitive advantage in a context marked by the accelerated circulation of ideas and technologies. In the same vein, these authors reviewed more than 1,200 scientific articles on technological innovation, compared with just over 100 on managerial innovation.

If innovation plays a fundamental role in the creation of competitive advantage, it is also subject to several constraints, including global competition and the firm's ability to remain attractive by offering new products that meet the needs of demanding and well-informed customers. This requires acting rapidly and flexibly with regard to processes, methods and products. Innovation is not the exclusive prerogative of large firms; small and medium-sized enterprises can also benefit from it to strengthen their competitiveness.

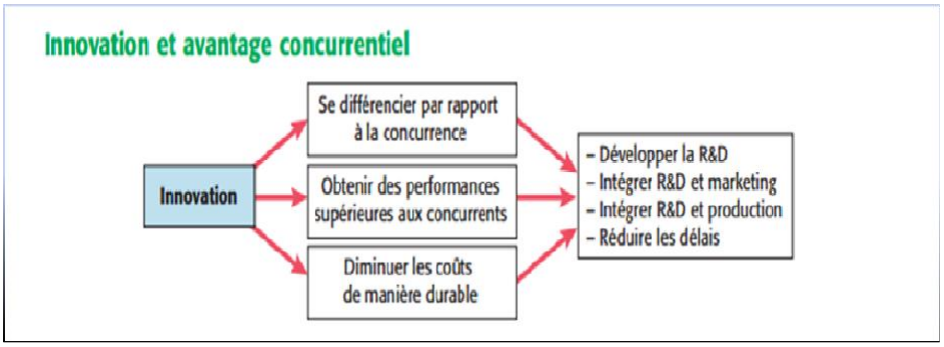
SMEs account for nearly 98% of Moroccan firms, concentrate 40% of private investment and generate 31% of Morocco's exports. Aware of the crucial role they play in the national economy, the Ministry of Industry, Investment, Trade and the Digital Economy considers improving SME competitiveness a key lever for accelerating economic development and has made it a pillar of the *Industrial Acceleration Plan*. This strategy aims, among other things, to improve access to finance and investment, support process digitalisation and foster innovation in SMEs, with the goal of enhancing their productivity and competitiveness in international markets.

The use of high-performance technologies in the innovation process can help firms improve their competitive positioning by reducing costs—thereby increasing profitability in price-constrained markets—and by differentiating themselves from competitors to maintain a sustainable competitive advantage. Two main scenarios arise: first, large firms increasingly invest in R&D in order to maintain their market leadership and remain at the forefront of innovation; second, SMEs attempt to introduce new technologies to strengthen their capabilities and differentiate themselves from competitors.

Every firm seeks to satisfy customer needs and create value, but the use of more advanced or new technology can only be truly beneficial if it is supported by appropriate distribution channels, brand image and marketing capabilities. In general, innovation is considered a key factor in global economic growth and performance. It gives rise to new technologies and new products that meet worldwide demand (OECD, 2007)[6], as illustrated in:

[5] Hamel, G., & Birkinshaw, J. (2006). The future of management. *MIT Sloan Management Review*, 47(2), 75–82.
[6] OECD. (2007). *OECD Reviews of Innovation Policy: Morocco*. Paris: OECD Publishing.

Figure N°1: Innovation and Competitive Advantage



Source: OECD (2007). Innovation and Growth – Synthesis Report

1.4. Human Capital Management as a Key Driver of Performance and Value Creation

A firm that seeks to innovate—both in terms of its products and its ways of working—requires creative individuals and teams, as well as an environment that channels this creativity through three main groups of variables: organisational structure, corporate culture and human resource management practices.

In an environment marked by fierce competition, every firm seeks to meet major challenges: maximising production, optimising costs, innovating and improving competitiveness. At this level, human capital plays a crucial role in the development of economies in general and firms in particular.

The theory of human capital can be summarised in a logical sequence comprising the following elements:

Figure N°2: The Theory of Human Capital

Source: Poulain, 2001

Human capital refers to the set of knowledge and skills acquired by an individual throughout schooling, training and professional experience.

(Zula and Chermack, 2007)[7] define human capital as a coherent set of elements—namely recruitment, selection and training—that are aligned with the medium- and long-term objectives set by the firm, thereby fostering the development of competitive advantage and generating a

[7] Zula, K. J., & Chermack, T. J. (2007). Human capital planning: A review of literature and implications for human resource development. *Human Resource Development Review*, 6(3), 245–262.

return on investment above average. Human capital management therefore has a direct impact on firm competitiveness.

Furthermore, human capital is a central component of firm competitiveness. A greater stock of human capital is associated with faster growth, and firm performance is positively related to the quality of human capital. Human capital embodies both knowledge and technological know-how.

In a rapidly changing global economic context, firms—whether small, medium or large—are compelled to anticipate market needs in order to grow and survive. The accelerated pace of technological, market and competitive change benefits firms that rapidly integrate information flows into their innovation processes, which often require the acquisition of new skills, particularly strategic and technical competencies.

The implementation of training programmes within the firm enables employees to acquire new skills and helps strengthen individual and organisational capabilities that are necessary to meet innovation requirements. Moreover, increasing employee motivation enhances the firm's innovation capacity and helps it achieve its objectives through greater employee commitment, improved efficiency, active participation in innovation and continuous development, Several studies have shown that employee participation has a positive impact on innovation, whether in terms of improving existing products, developing new products or supporting R&D, and this in various ways.

The literature also indicates that the success of innovation depends on a series of actions, including task analysis, training, motivation and improvement of working conditions. Good personnel management thus makes a significant contribution to building a competent, satisfied and motivated workforce.

Human capital management is based on three essential pillars: selection, training, and the development and deployment of expertise and talent. These pillars must align with the firm's overall strategy to enable it to benefit from a sustainable competitive advantage.

The qualification of a firm's human resources is determined by the type of competitiveness sought by management, whether cost competitiveness or quality competitiveness (Michie & Sheehan, 2005)[8]. Depending on the average qualification level of employees and the intensity of human capital in the production mix, Professor Michel Ferrary identifies four categories of firms:

[8] Michie, J., & Sheehan, M. (2005). Business strategy, human resource management and corporate performance. *International Journal of Human Resource Management*, 16(4), 517–535.

- **Technology-intensive firms**: characterised by low human capital intensity and the recruitment of low-skilled employees. These firms invest little in R&D and minimise labour costs to improve cost competitiveness;
- **Labour-intensive firms**: characterised by high human capital intensity but the recruitment of low-skilled employees. They also focus on cost competitiveness, primarily through the use of physical capacities;
- **Technology-driven firms**: characterised by low human capital intensity but the recruitment of highly skilled employees. These firms seek quality competitiveness by mobilising technologies and innovating in products and processes;
- **Knowledge-intensive firms**: characterised by high human capital intensity and the recruitment of highly skilled employees. Their competitiveness depends largely on their innovation capacity and the quality of their products.

Human capital is thus the key driver of both firm competitiveness and innovation. It comprises a set of elements such as know-how, experience and skills. These capabilities make it possible to use and combine the firm's resources effectively. They are structured around a core of knowledge and know-how, particularly in the field of technological innovation, and enable the firm to differentiate itself from competitors and achieve sustainable competitive advantage.

The knowledge constitutes the main internal resource of an organisation, as it fulfils the four criteria of a resource capable of generating competitive advantage.

In a knowledge-based economy, innovation is considered an essential and indispensable factor for enhancing firm competitiveness. It enables firms to increase their turnover and gain market share by selling in greater volumes. Innovation also allows firms to improve the quality of their products and adapt them to market needs. However, to stimulate innovation, firms must attract highly qualified human capital and encourage knowledge sharing and interaction.

Within the framework of human capital management, the resource-based view (RBV) identifies those high-quality resources which can provide the firm with a competitive advantage over its rivals and improve its performance. In the same line, the work of Wright, leads to an integrative model that links the firm's dynamic capabilities with knowledge and human capital, distinguishing between intellectual capital, intangible capital and human capital (KADIRI. K & JERMOUNI. F, 2023)[9].

[9] EL KADIRI. K & JERMOUNI. F (2023) « L'impact de l'innovation sur la performance des PME industrielles au Maroc », African Scientific Journal « Volume 03, Numéro 17 » pp: 317 – 330.

- **Human Capital Measurement from a Managerial Perspective**

Measuring human capital is a prerequisite for assessing the current and future usefulness of a firm's personnel. It consists in evaluating the present and future value added generated by each individual within the organisation.

The ratio used to assess a firm's human capital is often expressed as value added divided by the number of direct employees:

VA / Workforce = Gross Human Capital

This ratio varies from one firm to another depending on its size, strategy and sector of activity. In Anglo-Saxon accounting practice, the following indicator is commonly used:

EBITDA / Workforce (in full-time equivalents)

This ratio measures the potential operating cash flow generated by each employee.

Given the irreducible complexity of human capital, there is no single way to measure it. The clearest and simplest approach consists in calculating the return on investment (ROI) of the firm's human capital, using the following formula:

Total organisational benefits / Investments in human capital

The *"total organisational benefits"* correspond to the profits generated by the firm after covering all expenses, while *"investments in human capital"* refer to the financial resources devoted to developing human capital.

Building on empirical evidence that highlights the positive relationship, first, between technological innovation and firm competitiveness and, second, between human capital management and competitive advantage (Zula & Chermack, 2007)[10], we propose the following hypotheses:

- **H1:** Technological innovation has an impact on the competitiveness of Moroccan industrial firms.
- **H2:** Competitive advantage in Moroccan industrial firms depends on human capital.

2. Research Methodology

The primary purpose of research is to build knowledge. Epistemology can be defined as a science or a branch of philosophy whose aim is the study of theories of knowledge. In general, this discipline is based on different paradigms that may be classified according to the reasoning approaches of various authors.

[10] Zula, K. J., & Chermack, T. J. (2007). Human capital planning: A review of literature and implications for human resource development. *Human Resource Development Review*, 6(3), 245–262.

Referring to the three main types of epistemological reasoning—positivist, interpretivist, and constructivist—we opted for the **positivist paradigm**. The positivist approach relies on the examination of social reality and focuses on uncovering truth by verifying the existence of relationships or causal links between observed facts. This verification is carried out using empirical methods (Henning, Van Rensburg & Smit, 2004)[11].

Positivism is distinguished by two central principles:

- **Reality possesses an objective essence**, and
- **Reality is governed by universal laws**.

For this reason, positivist researchers rely on scientific methods as the means for generating knowledge.

The objective of our study is to verify the existence of a relationship or causal link between technological innovation and the competitiveness of Moroccan industrial SMEs, as well as between the latter and human capital.

We adopted a deductive reasoning approach, grounded in the hypothetico-deductive method. An empirical field study was conducted using a questionnaire administered to 100 agri-food SME**s** located in the Rabat–Salé–Kénitra region. To test our research hypotheses, we used the chi-square (χ^2) test of independence and analysis of variance (ANOVA).

The chi-square test of independence is a statistical method used to determine whether the selected variables—namely technological innovation and SME competitiveness, as well as competitiveness and human capital—indicate the existence (or absence) of a relationship or causal link. As for ANOVA, it is a statistical model that assesses whether statistically significant differences exist within the studied population.

Furthermore, we recall that competitiveness refers to the ability of a firm, sector, or country to withstand competition, and that competitive advantage enables a firm to differentiate itself from its competitors and generate profit. It therefore depends on the firm's ability to create value for its customers. On the other hand, technological innovation refers to both product innovation and process innovation, whereas human capital rests on the combination of innovation capacity, adaptability, and learning ability.

3. Empirical Study Results

This section is dedicated to examining the relationship between **technological innovation** and the **competitive advantage** of small and medium-sized enterprises (SMEs), as well as

[11] Henning, G., Van Rensburg, A. C., & Smit, P. J. (2004). Finding and creating knowledge: Making KM work in practice. *South African Journal of Information Management*, 6(2), 1–9.

analysing the relationship between **human capital** and competitive advantage. To this end, we conducted an empirical study based on a survey administered to a sample of **100 agri-food SMEs** from the Rabat–Salé–Kénitra region.

3.1. Relationship Between Technological Innovation and Competitive Advantage

To analyse the relationship between technological innovation and competitive advantage, we used the **chi-square (χ^2) independence test**. A survey was conducted among 100 agri-food SMEs to determine whether technological innovation influences the evolution of their turnover. The results are summarised in the table below:

Table N°1: The Impact of Technological Innovation on Revenue Growth

Innov. / Turnover Growth	Medium-sized enterprises (50–249 employees)	Small enterprises (10–49 employees)	Micro-enterprises (<10 employees)	Total
Yes	56	14	5	75
No	–	10	15	25
Total	**56**	**24**	**20**	**100**

Source: Survey conducted among 100 agri-food SMEs.

The expected frequency table is as follows:

Table N°2: Expected Frequency Table

Innov. / Turnover Growth	Medium-sized enterprises	Small enterprises	Micro-enterprises
Yes	42	18	15
No	14	6	5

Source: Author's own elaboration

We then calculated the chi-square distance for each cell. For medium-sized enterprises that affirmed the existence of an impact of technological innovation on turnover, the distance is:$\chi 2 = \frac{(56-42)^2}{42} = 4{,}66$. The full chi-square table is presented below:

Table N°3. Chi-square Distance per Subcategory

Innov. / Turnover Growth	Medium-sized enterprises	Small enterprises	Micro-enterprises
Yes	4.66	0.88	6.66
No	14	0.66	2

Source: Author's own elaboration

The total chi-square distance is: $X^2 = 4{,}66 + 0{,}88 + 6{,}66 + 14 + 0{,}66 + 2 =$ **28,86**

Since **28.86 > 5.99**, we **reject H0**: the two variables are not independent. We therefore conclude that there is a **significant dependency** between technological innovation and turnover growth.

♦ **Interpretation**

Given the size of the surveyed agri-food enterprises, we observe that:

- **56 medium-sized enterprises** affirm that technological innovation has an impact on turnover growth;

- **58% of small enterprises** state that technological innovation influences turnover growth, while **42% claim the opposite**;
- **Only 5 micro-enterprises** confirm the existence of a relationship between turnover growth and the introduction of technological innovation in their production process.

Furthermore, small and micro-enterprises invest less in technological innovation compared to medium-sized enterprises.

3.2. Relationship Between Human Capital and Competitive Advantage

Analysis of variance (**ANOVA**) is a statistical technique used to test the existence of a significant relationship between two variables. Specifically, it assesses whether the explanatory variable influences the dependent variable. In this study, we tested the effect of **human capital** on one dimension of competitive advantage: **product quality**. The results obtained are as follows:

Table N°4. Effect of Human Capital on Product Quality

Human Capital / Quality	Medium-sized enterprises	Small enterprises	Micro-enterprises
Low	9	8	7
Medium	27	12	11
High	20	4	2

Source: Survey conducted among 100 agri-food SMEs.

The hypotheses tested are:

- **H0:** Human capital does not influence product quality.
- **H1:** Product quality in medium-sized enterprises is more influenced by human capital.

The ANOVA results are presented below:

Table N°5. ANOVA: Two-Factor Analysis with Replication

Detailed Report

Detailed Report	Low	Medium	High	Total
Sample size	3	3	3	9
Sum	9	27	20	56
Mean	3	9	6.666667	6.222222
Variance	0	7	8.333333	10.69444

Medium-sized Enterprises

Detailed Report	Low	Medium	High	Total
Sample size	3	3	3	9
Sum	8	22	4	34
Mean	2.666667	7.333333	1.333333	3.777778
Variance	0.333333	24.33333	0.333333	13.69444

Small Enterprises

Detailed Report	Low	Medium	High	Total
Sample size	3	3	3	9
Sum	7	11	2	20
Mean	2.333333	3.666667	0.666667	2.222222
Variance	0.333333	1.333333	0.333333	2.194444

Overall Total

Detailed Report	Low	Medium	High
Sample size	9	9	9
Sum	24	60	26
Mean	2.666667	6.666667	2.888889
Variance	0.25	13.75	10.36111

Analysis of Variance (ANOVA)

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F	Probability	Critical Value
Sample	73.18519	2	36.59259	7.779528	0.003674	3.554557
Columns	90.96296	2	45.48148	9.669291	0.001406	3.554557
Interaction	37.03704	4	9.259259	1.968504	0.142699	2.927744
Within groups	84.66667	18	4.703704	—	—	—
Total	285.8519	26	—	—	—	—

Source: Author's own elaboration

♦ **Interpretation**

We observe that the **Fisher index F = 7.77** is greater than the **critical value of 3.55**, confirming that the test is significant. This indicates an **interdependence between human capital and the product quality** of the surveyed Moroccan SMEs.

- **Medium-sized enterprises:** 9 report that human capital has a low impact on product quality; 27 confirm a moderate impact; 20 indicate that their products achieve high quality through the effective use of human capital skills.
- **Small enterprises:** Only 8 report that human capital does not influence product quality, while **16 state the opposite**.
- **Micro-enterprises:** 13 affirm the existence of a relationship between human capital and product quality, while 7 believe otherwise.

Conclusion

In conclusion, the study provides clear and convincing evidence that knowledge management practices exert a positive and statistically significant influence on competitive advantage, thereby contributing to the overall improvement of organizational performance. Knowledge management emerges not merely as an operational tool, but as a strategic pillar that enables

firms to structure, mobilize, and capitalize on their intellectual assets in a sustainable manner. Its centrality within organizational structures reflects its essential role in supporting firms as they navigate increasingly dynamic and competitive environments.

Furthermore, the combined effects of globalization and rapid technological progress have compelled organizations to rethink their strategic orientations and adopt more sophisticated approaches to managing knowledge. Companies today must respond to accelerated innovation cycles, intensified competition, and the growing complexity of markets. As a result, the integration of knowledge management into corporate strategy is no longer optional; it has become a critical requirement for ensuring long-term survival and growth.

Knowledge, in this perspective, is understood as a strategic resource capable of generating lasting value. It enables organizations to enhance their decision-making processes, foster creativity and innovation, strengthen internal capabilities, and develop differentiated offerings that are difficult for competitors to replicate. By effectively capturing, sharing, and exploiting knowledge, firms are better positioned to maintain and reinforce their competitive advantage, while continuously improving their performance and adaptability.

Ultimately, the findings reaffirm that organizations which adopt structured and proactive knowledge management practices are more likely to seize new opportunities, respond to uncertainty, and cultivate a culture of continuous learning, thereby securing a more sustainable and resilient competitive position.

BIBLIOGRAPHY

- Abernathy, W. J., & Utterback, J. M. (1978). Patterns of industrial innovation. *Technology Review*, 80(7), 40–47.
- Bialès, M. (1999). *Dictionnaire d'économie : faits économiques et sociaux contemporains*. Paris: Foucher.
- Chow, W. S., & Wu, S. (2003). The relationship among trust, organizational commitment, and knowledge-sharing behavior in Taiwan. *International Journal of Manpower*, 24(5), 590–605.
- El Kadiri, K., & Jermouni, F. (2023). L'impact de l'innovation sur la performance des PME industrielles au Maroc. *African Scientific Journal*, 3(17), 317–330.
- Hamel, G., & Birkinshaw, J. (2006). The future of management. *MIT Sloan Management Review*, 47(2), 75–82.
- Henning, G., Van Rensburg, A. C., & Smit, P. J. (2004). Finding and creating knowledge: Making KM work in practice. *South African Journal of Information Management*, 6(2), 1–9.
- Michie, J., & Sheehan, M. (2005). Business strategy, human resource management and corporate performance. *International Journal of Human Resource Management*, 16(4), 517–535.
- OECD. (2007). *OECD Reviews of Innovation Policy: Morocco*. Paris: OECD Publishing.
- Schumpeter, J. A. (1934). *The theory of economic development*. Cambridge, MA: Harvard University Press.
- Trott, P. (2017). *Innovation management and new product development* (6th ed.). Pearson.
- Zula, K. J., & Chermack, T. J. (2007). Human capital planning: A review of literature and implications for human resource development. *Human Resource Development Review*, 6(3), 245–262.