Utilization of intellectual property rights by enterprises during COVID-19

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Abstract— ***In Morocco, and since the beginning of the pandemic, various innovations have emerged through coordinated initiatives involving all stakeholders, aiming to introduce new products, new organizational methods, and new marketing channels, driven by the context of the health crisis. This dynamic has raised awareness among regional actors about the crucial importance of the local economy and territorial competitiveness based on innovation, creativity, and the protection of intellectual property rights, notably patents. At the national level, since 2019, there has been a significant increase in patent filings, rising from 190 in 2018, before the pandemic, to 296 in 2021, during the pandemic. Based on this, our article aims to assess the ability of Moroccan companies to file invention patents through a field study involving 56 companies selected based on their geographical location and sector of activity, using a non-probabilistic convenience sampling method. The results indicate that a high percentage, 86%, of the studied companies stand out for their innovative character in their respective fields. Moreover, these companies ensure the protection of their innovations by resorting to intellectual property rights, with 78% opting for intellectual property protection. Patent protection represents 13% of the cases, with 83% of these patents being filed by companies in the industrial sector. This analysis provides a crucial insight into the behavior of regional companies regarding innovation and technology, underscoring the growing importance of these aspects in the context of the pandemic.***

Keywords— Intellectual Property, patent, innovation, companies, pandemic, Covid 19

I. INTRODUCTION

Innovation plays an essential role in stimulating economic growth by promoting development and technological advancements. Major transformations such as electrification, motorization, the advent of the Internet, and artificial intelligence illustrate this dynamic. These changes are also observed following financial crises, such as the emergence of new crowdfunding platforms following the 2008 financial crisis, as well as during health crises, such as the development of vaccines and the emergence of telemedicine during the COVID-19 pandemic. These transformations are key elements of business strategies, involving investment decisions aimed at creating new products or improving efficiency, often accompanied by substantial organizational reorganization. In environments where direct competition is limited, these initiatives can generate relatively high profits. Thus, businesses are encouraged to adapt to global developments and place particular emphasis on innovation, especially during crises.

Morocco is a country that has followed this wave of change and innovation linked to the health crisis, notably that of COVID-19. Thus, the Moroccan government launched a new industrial strategy to encourage local production. In 2020, a new strategy based on the introduction of an import substitution policy was implemented. As part of this initiative, a project bank with a unit called "War-Room," consisting of more than 25 dedicated individuals and several central directors, was established within the Ministry of Industry to support project leaders in various phases of their development. In addition, the government implemented financial mechanisms to support this new strategy and assist national companies in developing innovative products that address international health issues.

According to data from the Moroccan Ministry of Industry and Trade, during the COVID-19 period, the Moroccan industrial sector demonstrated the ability to show creativity and innovation on an international level by rapidly and effectively producing new products through innovative industrial processes. This included: 1) the production of over 340 million protective masks, 2) the development of domestic products at highly competitive prices compared to imports: PCR kits, sampling kits, infrared thermometers/cameras, mask production machines, face shields, backpacks, etc., 3) The creation of a 100% Moroccan respirator and the production of 500 respirators in record time, and 4) The manufacturing of a 100% Moroccan intensive care bed meeting safety and performance standards.

These innovations emerged through concerted efforts and initiatives bringing together industrialists, researchers, administrators, and society as a whole to propose new products such as masks and face shields, as well as new forms of organization such as the digitization of administrative procedures, telecommuting, and webinars. In addition, new marketing methods were adopted, such as delivery services and virtual orders. Thus, given the circumstances of this pandemic, regional and national stakeholders are now

increasingly aware of the crucial importance of the local economy and territorial competitiveness, centered on innovation and creativity of all economic, social, and political actors.

This technological dynamic has been supported by strong utilization of intellectual property (IP) protection. In particular, the Moroccan Office of Industrial and Commercial Property (OMPIC) implemented special measures to meet the needs of creators in terms of industrial property. Among these measures, an online service was launched for the filing of all IP titles, with payment possible via online banking services. Dedicated platforms were also created: www.directompic.ma and www.directinfo.ma. Furthermore, OMPIC offered a new value-added support service for invention patents in the fight against COVID-19, aimed at stimulating technological innovation in this field. During the health emergency, and free of charge, OMPIC provided value-added services to inventors, companies, and researchers in universities and R&D centers. These services included granting a legal status report on patents in Morocco, conducting prior art searches for inventors, assisting with patent filings, and accelerating the examination procedure for filed patents.

Thanks to this initiative, patent filings experienced a remarkable increase during the COVID-19 pandemic. Indeed, these IP rights allow inventors to benefit from exclusive rights to an invention, giving them the power to prevent anyone from using, manufacturing, or selling the invention without permission, and enabling them to profit from their innovation and recover R&D costs.

In our paper, we will examine the evolution of patent filing activity of Moroccan origin between 2004 and 2022, focusing on the differences in behaviors among universities, research centers, businesses, and individuals. Thus, analyzing patent filings by type of applicant will, on one hand, provide a better understanding of who the key innovation actors are in a given territory, and consequently obtain valuable information on strengths, current trends, and future developments. We will also analyze the evolution of filings according to significant periods at the national level, notably the period of the entry into force of Law 17-97 on the protection of industrial property in Morocco in 2004 [1]. The period of the enactment of Law 23-13 amending Law 17-97 in 2014 marked a turning point in the national industrial property system [2]. Furthermore, the period of COVID-19, which was accompanied by reinforced online procedures to stimulate IP in Morocco.

A descriptive field research was carried out to investigate the use of intellectual property (IP) rights by Moroccan enterprises during the COVID-19 era, with a particular focus on patent filings, building on the examination of data regarding patent filings in Morocco. The ability of positivist epistemology to clarify empirical facts, identify underlying linkages, and conduct empirical observations of phenomena served as the impetus for its adoption. The study focused on the Fes-Meknes region, where industrialists, researchers, administrators, and other stakeholders worked together to create a variety of technologies in response to the pandemic. The study focused on companies operating in the region that were involved in commerce, industry, services, outsourcing, agriculture, and renewable energy.

Convenience sampling, a type of non-probabilistic sampling, was used since, during the COVID-19 epidemic, there was no distinct population of innovative enterprises at the regional level. The selection of sampling units was based on factors such as legal status, industry, and location. A questionnaire that was issued to 125 companies representing various economic sectors was used to assist the collection of data, and 56 companies responded. We used descriptive statistics to examine the information gathered.

Therefore, our document consists of three main sections: 1) A literature review highlighting the importance of IP rights and the factors that can influence the importance of IP rights protection, 2) a national monograph on the filing of invention patents between 2004 and 2022, focusing on the differences in activity among businesses, research centers, universities, and individuals, and 3) the results of a territorial study conducted among Moroccan companies, including individual businesses, startups, SMEs, large companies, and multinationals.

II. REVIEW OF THE LITERATURE

A. *Factors influencing patenting by companies*

A company's invention and innovation activity depends to some extent on links with sources of information, knowledge, technologies, practices and human and financial resources [3].T hese links create wealth for the company, whether in terms of product, process, marketing or organisational innovation, and consequently generate the creation of intangible assets for the company through the protection of these innovations by IP rights.

a) Research and Development (R&D)

Innovative activity is often associated with technological advancements [4], primarily driven by investments in R&D [5]. Companies that heavily invest in R&D are generally more innovative, not only because it enables them to develop new products and processes but also because they are better positioned to leverage market technological advancements [6]. R&D enhances a company's ability to assimilate new technological knowledge and other types of knowledge [3]. However, obtaining data on R&D is complex, costly to produce, and easily imitable [7]. R&D expenditure is considered a direct indicator of innovation and inventiveness [3], although its measurement is complex, involving both R&D spending and personnel [5].

R&D spending generally does not capture all the efforts made by companies to promote innovation [8]. Although R&D is crucial for innovation, it alone is not sufficient to promote innovation [9], as it primarily measures innovation inputs rather than actual innovations [10]. Investments in R&D strengthen companies' skills and learning capacity to introduce new innovations and exploit research results from other companies [11]. However, to carry out R&D activities successfully, companies must have sufficient investment capacity, which depends on their strategic motivations and financial capability, including their size, which influences their financing capacity [12].

b) Use of Information and Communication Technologies (ICT) and advanced technologies (AT) by companies

A wide range of economic activities, including the production and employment profiles of software and

hardware, are influenced by ICT [3]. First, regarding hardware, the Oslo Manual suggests determining when a company innovates by bringing in technologically advanced or new ICT equipment, as well as the percentage of ICT that enters its overall equipment stock, including later acquisitions of new machines that are identical to the original model. Secondly, because software creation, production, adaption, and use are so widespread in the economy, they pose a more complex issue.

For developing countries it is a question of analyzing the role of ICT in innovation related to both front-office such as (Sales and marketing-oriented applications, Self-service, Web portals, Call centers, The common point is a high level of employee/customer interaction and back-office services such as (Tasks necessary for the operation of the company itself, Internal operations within an organization that maintain essential processes and are not accessible or visible to the general public, Applications that support or automate critical activities or processes) [3].

On the other hand, at the level of these countries, characterized by an unequal level of development according to the territories composing them, companies usually resort to primitive tools and technologies such as web pages, digital brochures and catalogs, accounts in social networks, ...), rather than AT that allow the automation of processes, computerized simulation, statistical performance of firms and so on. Moreover, holding competencies provides the firm with a competitive advantage over its competitors [13] and can, therefore, push firms to increase their innovation capacity [8], [13]. The greater the variety of AT used in firms, the more likely they are to innovate. Thus, firms that constantly increase the variety of knowledge incorporated in the AT used are more likely to innovate than their counterparts [8].

The authors propose a number of skills that can be analyzed in the context of developing countries [8], [13], [14]. For example, Graphic arts, layout, advertising, Design of objects or services, Multimedia, Web site design, Computer aided design/engineering, manufacturing resource planning, Computers that control plant operations, etc. The analysis of this axis in the case of these countries, does not only allow to boost innovation but essentially, to individualize the situations, especially as the context is characterized by flagrant divergences between firms of similar or different categories: The Oslo manual cites the case of SMEs or GEs, some of which use powerful technologies, while others lack a consolidated management system, the absence of which is a serious obstacle to improving performance in the various sectors of the company [3].

Moreover, although individualization allows us to identify the characteristics of firms in middle-income developing countries compared to those in industrialized countries, and to specify the relationships between ICT and innovation, on the one hand, and ICT and productivity, on the other, this level of analysis is still less practiced by researchers given its complexity in the context of developing countries [3].

B. General property rights

It is commonly acknowledged that the creation of scientific and technological information is the primary means of producing innovations, despite its high cost. As a result, there is a significant risk of opportunistic behavior and disregard for producers' rights. Thus, a framework of protection for ideas created by inventors is required. This system serves as a safeguard as well as a motivator for innovation and scientific inquiry.

According to the OCDE, if companies cannot protect their innovations, they will be less motivated to innovate, in other words, this protection constitutes the fruit of their efforts in terms of innovation. However, according to the same source, protection through the different IP rights can be a brake on the development of new ideas and knowledge, since it increases the price of products and slows down the dissemination and circulation of useful information for the creation of new products and processes.

Without a favorable legal environment of protection to appropriate the fruits of R&D efforts [7]; the incentive to innovate is considerably weakened. According to a study of Moroccan companies, protection by IP rights has a positive impact on innovation capacity and cooperation behavior [9]. The study showed that firms that adopt an IP strategy and in particular "patenting" better develop scientific cooperative relationships and innovate more. Firms are more motivated to invest in innovation if they have the means to protect it [15].

Economic work has focused, over the last thirty years, on a tool for protecting innovations that is based on property rights to the creation of knowledge, in particular, patents: the propensity and incentive of the inventor to innovate will be strengthened by the existence of the patent system [11]. Patent protection improves the firm's ability to innovate in the product rather than in the process and vice versa, product innovation encourages firms to use patents [16].

Other forms of IP exist: plant varieties, copyrights, trademarks, industrial designs, geographical indications. In practice, these rights are complementary. Thus, an innovation can be protected by several IP rights at the same time. In addition, there are innovations protected by a multiplicity of patents while others are not even patented [3]

It should also be recalled that, according to the OCDE, public authorities can contribute to the design of legal methods for protecting inventions in order to optimize the economic and social benefits of IP rights [3]; the main methods suggested are Patents, Design registration, Trademarks relating to the company or a range of products, Copyrights, Confidentiality agreements and trade secrets, innovation patents or utility model patent. OECD presents also some informal methods, such as the secrets not covered by legal agreements, complexity in the design of the product, advantage in time-to-market compared to competitors.

Some firms prefer to keep their technological advances secret. Secrecy is a major tool that producers have developed for a very long time, although it does not allow for a secure protection and limits the diffusion of knowledge; secrecy allows for the defense of profits after innovation, it ensures exclusivity through innovation and therefore promotes a monopoly position [11].

This exclusivity on the innovation ensured by secrecy can last as long as possible (exemplified by Coca Cola); however, the patent only ensures exclusivity for a limited period of time (20 years in certain countries), thus allowing other users to access the patented invention.

For financial or cooperation reasons, IP rights on innovations can be collectively appropriated by companies and other actors, notably research laboratories or other companies. Indeed, innovative firms can organize themselves in the form of collective structures, which generally pose many problems of governance and regulation, and can thus share costs, results, the market, coordination within standardization bodies, etc [7].

a) Patent system

A patent is "a monopoly exploitation right recognized by society to a private entrepreneur" [7]. According to the authors, the filing of a patent defines the extent of the legal protection that the applicant will obtain, providing protection against extensions by others of the initial patent and a temporal protection of the invention relative to the date of filing and the duration of validity.

The filing of a patent is of major utility for the company and its territory. Thus, there is a close relationship between the acceleration of industrialization and the development of IP rights, particularly patent law [9], [11]. The company that files a patent can adjust its development and commercialization efforts based on these expenditures since it has a deep understanding of the R&D expenses it has incurred [7]. This patent-holding company benefits from the exclusive right to exploit its invention in the market, allowing it to seek exclusion of competitors and take legal action against any infringers [7]. On the other hand, filed patents may have high or low technological value depending on the produced innovation [3]. Consequently, the company has the option to protect its products nationally or internationally based on the degree of its invention. In this case, protection enables companies to grant licenses and access foreign markets where entry is contingent on granting operating licenses to indigenous companies [7].

The patent system allows companies to acquire property rights that strengthen their position in negotiations or litigation settlement [7]. Patenting an invention thus becomes a factor of power and a driving force for research for companies because if competitors can easily imitate and reproduce their inventions, companies will have little incentive to innovate. Companies seek to enrich their patent portfolios, which reflect the level of their inventive activity. This portfolio becomes a means of controlling the work of research teams, a signal of dynamism sent to customers, suppliers, and bankers, as well as a source of documentary information for public authorities that distribute grants, tax credits, and tax breaks related to research activity [7].

Consequently, companies that file a large number of patents can introduce innovations to the market, whether radical or incremental, based on the relevance of the filed patents. This trend also provides insight into the dynamics and technological performance of these companies, and by extension, of the countries where these patents have been developed [3]. The patent system also provides some indications regarding the directions of technological progress through the examination of patented technologies [3].

However, it should be noted that it is not easy to demonstrate a positive effect of the patent system on the technological and scientific progress of a country [17], [18]. This influence is often conditioned by context. For example, in Great Britain during the Industrial Revolution, only a minority of major and radical inventions were patented, even though the protection system existed since 1624 [19].

However, the patent system has certain limitations [3], [7]. Firstly, the need to publicly disclose all valuable information acquired by the innovator implies that the protection against imitation offered by the patent is often incomplete. Secondly, the patent system can cause inefficiencies upstream and downstream. Upstream, it encourages duplication of certain expenses in companies in technological competition, thus incentivizing investment in R&D to obtain patents for similar innovations. Downstream, by granting the exclusive right to exploit an invention monopolistically, the patent creates inefficiency in the functioning of markets where these inventions are exploited. For example, this may reduce competition stimulation, as it is necessary to recognize a monopolistic exploitation right over information that could be used by many companies. Moreover, by rewarding the scientific and technical efforts of the inventor with gains that depend mainly on their commercial skills, the patent system creates unbalanced incentives. However, it is important to note that most patents can be assigned or licensed, allowing those who are good inventors but poor traders to exploit the know-how and sales skills of their licensees.

On the other hand, data extracted from patent databases can sometimes be misleading. Indeed, a large number of innovations are not necessarily associated with patented inventions; many patents have never led to real innovation, and few of them possess significant technological and economic value [3]. Furthermore, the high quantity of patents does not necessarily guarantee a high technological level or significant innovation potential since the primary goal of innovations is often to improve human quality of life rather than simply produce knowledge [10]. Additionally, the interconnection of patents, which results in the filing of numerous patents on superficial technologies or minor variations of original patents, often aims to block the path to a competitor seeking to circumvent the original patent [10].

Finally, we can consider sectoral variation as a major limitation of the patent system. Indeed, products obtained by recombination, in the field of biotechnology, are not patentable because they already existed in nature, however, their obtaining process can be protected [7]. On the other hand, patents would not have the same importance in all sectors of activity. Indeed, patents are important and useful only in the pharmaceutical industry and the chemical industry [7], [20]. However, they are less valued in other sectors, particularly those characterized by strong technological opportunities, significant learning effects, and rapid imitation, as well as those characterized by very costly or lengthy imitation [7]. Empirical results prove the effectiveness of patents in incentivizing innovation, subject to certain variations between fields of activity [9].

This sectoral variation is explained firstly by the fact that the patent does not allow for total appropriation of the invention since it is possible to introduce peripheral inventions if the company has not properly drafted its claims. Moreover, patents do not always enable successful legal action against a distracted or dishonest competitor due to the formulation of the claims. Additionally, since patented technological information is a public good, it will be easily copied in certain sectors, although the imitator may always be lagging behind, especially if the time required to imitate the invention exceeds the time allowing the patent holder to significantly improve their initial invention [7]. Consequently, companies prefer to resort, in some cases, to other forms or tools of rights protection that are more effective than patents, such as the use of trade secrets, the development of complex industrial designs, or being the first to enter the market [21].

b) International patent system during the Covid 19

8,050 COVID-19-related patent applications, including those on diagnosis, treatments, vaccines, and other topics pertaining to the SARS-CoV-2 virus or COVID-19 disease, have been published throughout 49 patent offices since 2020. Of them, 30 patent offices received 1,298 patent applications pertaining to the development of COVID-19 vaccines, while 44 offices received 4,787 applications pertaining to COVID-

19 treatments. By the end of September 2022, about 597,057 scientific literature articles—including those found in books, journals, and meeting proceedings—had been published in addition to the 8,050 patent applications that have been published since the start of 2020 [22].

It was revealed that 21 countries filed patent applications, with the Intellectual Property 5 (IP5)—the US, Korea, China, Japan, and Europe—representing 97% of all applications [21]. 8880 COVID-19-related patent applications were filed in 21 countries, while 8610 patent applications were filed to them alone by IP5 countries [23].

Regarding COVID-19-related vaccine and therapeutic patent applicant profiles, we observe that, when taking applicant profiles into account, the dataset distribution is comparable in the vaccines and therapeutics domains. The majority of registrations in both categories (52% of vaccine filings and 49% of medicines) are made by corporate applicants, or companies. While independent inventors were more active in the field of therapeutics (12%) than in vaccinations (6%), universities and public research groups contribute similarly to both categories (42% of the vaccine dataset and 38% of the therapeutics) [22]

The renowned companies' vaccine- and treatment-related patents, which include 12 patents from Pfizer (New York, NY, USA), 1 patent from Moderna (Cambridge, MA, USA), 4 patents from AstraZeneca (Cambridge, UK), 12 patents from Janssen (Beerse, Belgium), and 3 patents from Novavax (Gaithersburg, MD, USA) [23].

During the COVID-19 pandemic, there was a notable surge in the utilization of ICT and digital technologies, and these sectors were perceived as crucial to mitigating the problem. Thus, four of the top 20 worldwide IT companies filed eleven COVID-19-related patent applications: Apple (Cupertino, CA, USA) submitted one patent, Microsoft (Redmond, WA, USA) submitted two, Samsung Electronics (Suwon, Republic of Korea) submitted seven, and Facebook (Menlo Park, CA, USA) submitted one [23].

Thus, Samsung Electronics filed seven patent applications, the most of which focused on lone innovations. They have patents in the fields of digital technology and ICT. For its flagship goods, Samsung Electronics filed for patents in the realm of infectious diseases rather than concentrating on smartphone technology. Microsoft's technology was developed to boost telecommuting and other remote work procedures, such as contactless work, which saw a sharp rise in productivity during the pandemic. While Apple created the iPhone to monitor temperature on-the-go, Facebook built predictable cryptography technology.

III. MONOGRAPHY AND CONTEXTE

A. Overview of the Evolution of Patent Applications of Moroccan Origin

The analysis of the evolution of patent applications of Moroccan origin reveals a marked trend over the years. In 2004, the number of filings reached its lowest level, but from 2005 onwards, a significant increase of 15% was recorded. This growth is partly explained by the entry into force of Law 17-97 on the protection of industrial property in Morocco, marking a turning point in the history of industrial and commercial property in the country [2]. That year, OMPIC launched a program aimed at promoting industrial and commercial property, leading to increased awareness among Moroccan companies about the importance of protecting their IP rights. This initiative also strengthened cooperation among the various stakeholders involved in the protection of industrial property, contributing to the increase in patent filings in 2006. Although filings fluctuated between 2006 and 2014, a notable upward trend emerged from 2011 onwards, peaking in 2014 with 353 filings. However, from 2015 onwards, a gradual decline was observed, reaching its lowest point in 2017 with only 185 patents filed. Despite a period of stagnation thereafter, a significant increase was observed in 2020 and 2021, the post-COVID-19 period. However, in 2022, the trend began to decline again, recording a decrease of 5% in filings compared to 2021 (Figure 1). It should be noted that all data published by OMPIC on its official website have been included in the figure.

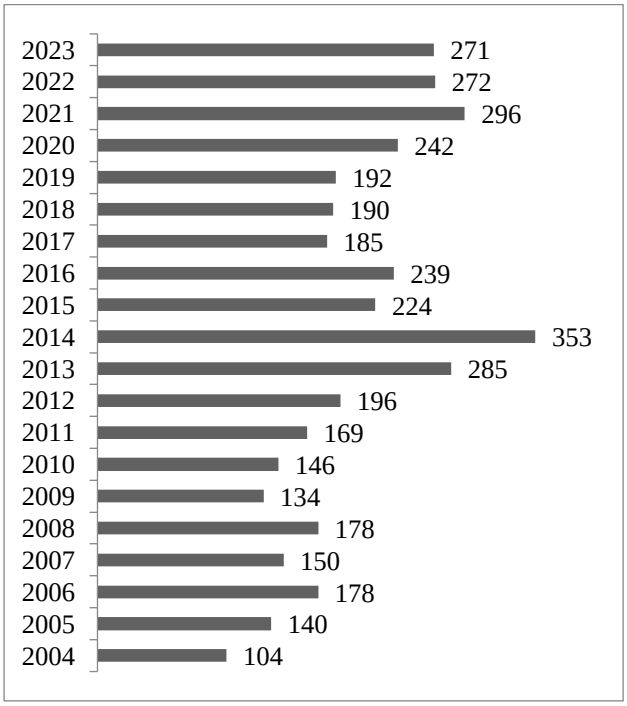

Fig. 1. Evolution of moroccan patent filings between 2004 and 2023

Thus, we have compared the evolution of patent filings of Moroccan origin with those filed in Morocco but by foreigners, based on OMPIC data (Figure 2). The number of foreign patent applications filed in Morocco has shown remarkable growth since 2004. This trend has become more pronounced since 2016, with a total of 1003 foreign patents filed in Morocco. From this date onwards, a new exponential evolutionary curve has marked the Moroccan landscape.

Based on figure 2, we can clearly see that the evolution of national filings is more closely correlated with foreign filings than Moroccan ones. The latter are lagging alarmingly behind domestic filings, which is a wake-up call for Moroccan managers and decision-makers to further strengthen their policies dedicated to promoting IP in Morocco, particularly patent filings.

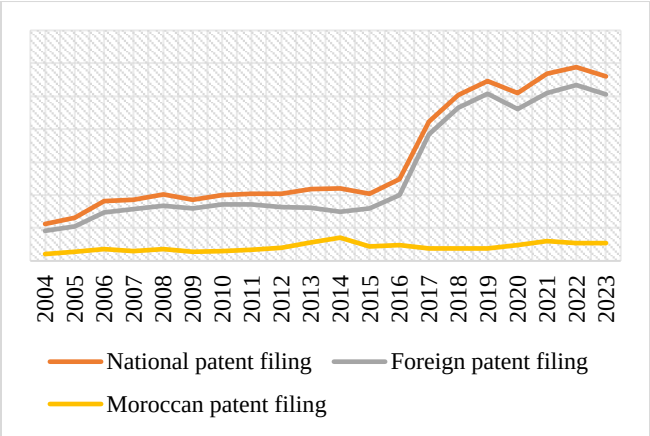

Fig. 2. Evolution of national patent filings between 2004 and 2023

B. Evolution of patent filings by type of applicant

The nature of these national filings varies depending on the type of applicant. According to OMPIC, between 2009 and 2023, Moroccan-origin applications were dominated by filings from universities (1584 applications), followed by individuals (1121 applications). Companies (440 applications) and research centers (278 applications) lag behind in terms of filings. The figure 2 shows the evolution of filings by type of applicant based on OMPIC statistics [1], [24]–[30], which allow the identification of three distinct periods related the global Covid-19 crisis and the implementation of the "Contract Objectives - Industrial and Commercial Property: Horizon 2015" by OMPIC, which introduced the system of patent examination filed before their publication: 1) the period before the implementation of the "PI Objectives Contract" (2009-2012); 2) the period after the implementation of the "PI Objectives Contract" (2013-2019); and 3) the Covid-19 period (2020 and 2023).

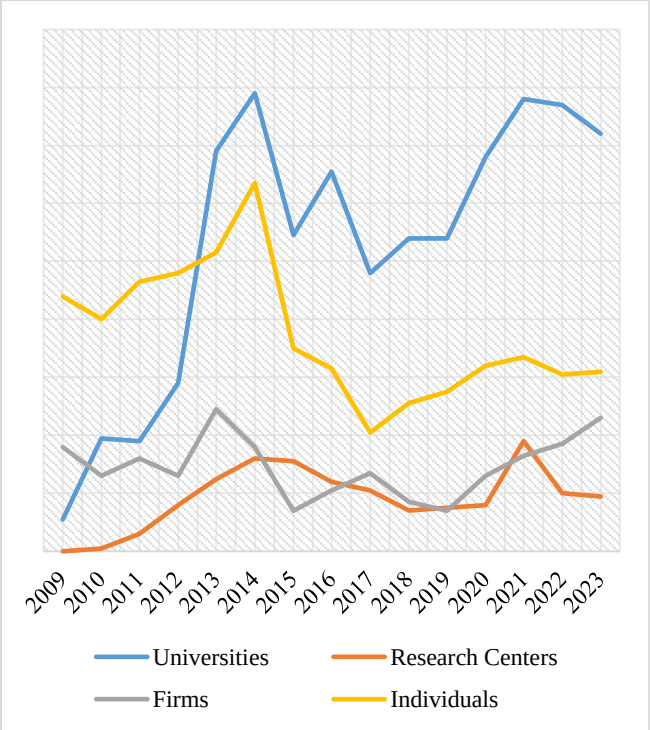

Fig. 3. Evolution of patent filings by type of applicant

a) 2009-2012: Before the implementation of the "Intellectual Property Objectives Contract"

During this period, individuals were the main patent applicants. This period is marked by a notable peculiarity in 2009, where companies filed more patents than universities.

The high number of patent filings by individuals compared to universities and companies can be attributed to several factors. Firstly, it may be due to personal reasons. Filing a patent can be used to establish recognition for the inventor and their work. Individuals may be motivated by a desire to protect an invention, ensuring temporary monopoly over its exploitation and gaining economic advantage. On the other hand, improved access to information on patent filing procedures and increased awareness among individuals about IP have also influenced the number of filings.

The government has also played a crucial role through the implementation of incentive policies to encourage individuals to file patents, notably through the launch of revised industrial policies and innovation promotion policies, particularly the "National Pact for Industrial Emergence" in 2009, the "Morocco Innovation Strategy" in 2009, and the "Strategy for the Development of Advanced Technologies" in 2010.

b) 2013-2019: After the implementation of the "Intellectual Property Objectives Contract"

During this period, the university became the primary actor and maintained a high number of annual filings compared to other applicants, throughout this period. The increase in the number of patent filings by universities could be explained by strengthened public policies in favor of research and innovation, as well as increased awareness of the importance of IP in global economic competition. Universities may have also implemented mechanisms to support research and valorization of research results, which favored patent filings.

We also believe that this increase is directly linked to the implementation of the "Objectives Contract - Industrial and Commercial Property: Horizon 2015" by OMPIC in 2012 [31]. Consequently, awareness has been instilled within universities, especially as they are often involved in research projects funded by public or private funds. Universities often have significant resources, such as research laboratories and teams of scientists, often motivated to file patents to protect their IP and prevent their research from being exploited without their authorization. Patents can also generate revenue for universities through licenses and technology transfer agreements with companies, which pushes these institutions to file in bulk.

According to the activity report for the year 2013 published by OMPIC, "the year 2013 marks the beginning of a new stage in the evolution of the national system. Indeed, the reform of the law on the protection of IP has passed the stage of the government council and has been submitted to parliament. The outcome of this reform, which aims to strengthen the patent system and consolidate the trademark and industrial design systems, will elevate the national system to the highest standards in the field" [26]. According to the same source, we note that the proportion of patent applications of Moroccan origin experienced a strong rate of growth, which is over 60% compared to foreign filings (315 patent filings of Moroccan origin against 803 foreign filings). This was reflected in the patent filings of the year 2014, which reached a peak for universities and individuals, and were also marked by a significant increase in filings made by research centers compared to previous years.

On the other hand, the year 2014 was marked by the promulgation, in November 2014, of Law 23-13 amending Law 17-97 relating to the protection of industrial property, thus marking a turning point in the national industrial property system, 10 years after the first major reform undertaken in 2004 [2]. The 2014 reform aimed to enhance the quality of invention patents through the evaluation of patentability criteria by the Moroccan Office of Industrial and Commercial Property (OMPIC). During that year, Morocco was ranked 51st in terms of national patent filings [26].

In 2015, there was a significant decrease in the number of invention patent applications filed, especially by individuals (44%) and companies (over 70%), compared to 2014. This may be due to the launch of online patent filing in Morocco.

This decrease can also be attributed to the fact that since 2015, OMPIC has introduced substantive examinations for patent applications, which has led to some reluctance among applicants to submit their applications. At the same time, regulatory reform has led university researchers, who were mainly individual applicants, to now submit their applications through the universities to which they are affiliated. These factors explain the increase in university filings and the decrease in filings by individuals.

Thus, although online patent filing can offer several advantages for applicants, such as a faster and more efficient process as well as access to online information and resources, it is likely that a transition period could lead to a temporary decrease in patent applications filed, as applicants may need time to adapt to new online systems and processes. Additionally, applicants may be reluctant to adopt new online systems if they have concerns about data security or the confidentiality of their inventions.

From 2015 onward, the number of patent filings began to decrease, reaching its lowest level in 2017 for universities (96 filings) and individuals (41 filings), in 2018 for research centers (14 filings), and in 2019 for businesses (14 filings).

It is observed that the involvement of businesses in patent filing is significantly lower than that of universities and individuals. Businesses, typically focused on commercial objectives, seek to protect innovations crucial to their revenue and profitability. In contrast, universities tend to prioritize the protection of scientific discoveries and the dissemination of knowledge through the publication of research results. Furthermore, businesses may not have the same orientation towards R&D as universities, where research is often valued for its own sake rather than as a means to achieve commercial objectives.

In Morocco, it is indeed observed that few companies have dedicated R&D laboratories and teams, even among large enterprises. This situation can be attributed to various factors, such as a lack of financial resources to support R&D activities, a shortage of qualified and trained personnel in the field of scientific research, as well as a deficit in the culture of innovation within companies.

c) 2019-2023: During and post-COVID-19

During this period, there was an increase in the number of filings by all stakeholders, including universities, research centers, businesses, and individuals. Moroccan expertise has demonstrated to the world the Kingdom's capability in exhibiting responsiveness, agility, and efficiency. Moroccan industrialists have showcased their proficiency in manufacturing products and equipment that adhere to international standards, catering to both local demand and export markets. According to the Ministry of Industry and Trade of Morocco, notable achievements include: 1) Production of over 340 million protective masks. 2) Development of domestic products at highly competitive prices compared to imports, such as PCR kits, Sampling kits, IR Thermometers/Cameras, Mask production machines, Face shields, Backpacks, and more; 3) Creation of a 100% Moroccan respirator and swift production of 500 respirators within a record timeframe; 4) Manufacturing of a 100% Moroccan intensive care bed that meets stringent safety and performance standards.

This has fostered a national momentum around innovation as a solution for the global crisis. It has facilitated collaborations between businesses, universities, and research centers, consequently contributing to the increase in patents filed during this period. As a result, the number of filings increased, reaching 158 deposits for universities, 38 for research centers, 33 for businesses, and only 67 for individuals in 2021, despite the ongoing effects of the health crisis that continue to impact the vast majority of sectors

However, this increase was followed by a slight decrease of 5% in 2022. This decline was particularly noticeable among universities, individuals, and especially research centers. Conversely, patent applications from businesses saw a 12% increase [27]. In 2023, the number of filings made by businesses also increased, reaching a total of 46 filings, the highest figure since 2013 [28].

Could this signify the beginning of a revitalization of the industrial private sector triggered by the crisis, positioning it as an innovative sector and a key player in the national innovation system? The next statistics published by OMPIC will prove or disprove this hypothesis.

It is also notable that the industrial sector recorded its highest number of filings in 2013 (49 filings), the year of the launch of the "Objectives Contract - Industrial and Commercial Property: Horizon 2015", and in 2022 (37 filings), following the pandemic. This observation highlights the impact of the efforts established by the government through OMPIC and in collaboration with all stakeholders. In conclusion, it is evident that the industrial sector requires catalysts to stimulate its excellence and creativity.

IV. METHODOLOGY

A. Méthodologie de recherche

The collection of patent data can be perceived as an indicator of a company's innovation activity, as well as the outcomes of its research activities [3]. According to [32], the use of published patents allows for the measurement of innovation output, as defined by Schumpeter, in terms of new practices. Furthermore, patents can serve as a more reliable indicator of innovation as a product than mere R&D [10]. Therefore, the analysis of technology inherently requires the use of patent statistics, considered as indicators of the output of invention activities [3]. Thus, to collect patent data in an uncertain context such as that of the pandemic, we adopted a positivist epistemological approach as it allows for explaining the laws of reality on the ground, understanding underlying relationships, observing facts empirically, establishing invariable laws, describing immutable relationships between observable and scientifically measurable facts, and confronting empirical data with theoretical postulates [33]–[35].

Our research focused on the Fes-Meknes region, where, since the onset of the pandemic, various innovations have emerged thanks to the concerted efforts and initiatives of industrialists, researchers, administrators, and many other stakeholders. These initiatives have led to the creation of new products such as masks and face shields, new organizational methods such as the digitalization of administrative procedures, telecommuting, and webinars, as well as new marketing approaches such as delivery services and virtual orders. In the current context of the pandemic, regional actors are now realizing the crucial importance of the local economy and territorial competitiveness based on the innovation and creativity of all economic, social, and political actors.

Thus, due to all these concerted efforts during the pandemic, regional businesses have demonstrated remarkable innovation capability. They have been able to offer solutions to the country's health challenges, while some global leaders have struggled to adapt and transform to address the global health emergency. For example, regional businesses in the textile and leather sector quickly responded by engaging in the production of sanitary masks, despite tight deadlines and global stress conditions.

Building on this observation and recognizing the importance of industrial and commercial innovation, our study focused on businesses operating in various sectors such as industry, trade, services, offshoring, agriculture, and renewable energies in the region. We sent surveys to 125 economic actors in the region. To select our sample, we opted for the non-probabilistic method by conducting convenience sampling. This approach was chosen because the population of innovative businesses during the COVID-19 pandemic was not clearly defined at the regional level, and also due to constraints such as availability, budget, and lockdown conditions.

Two methods of data collection were used. First, an online survey was conducted by administering the questionnaire via email and through social networks. Follow-up and support were provided to the participating companies in this survey. Then, a telephone survey was conducted by directly contacting business managers to collect their responses.

We received a total of 56 responses. Our choices of units analyzed were guided by three criteria: geographical location, sectors of activity, and legal status. Therefore, our sample consisted of sole traders, startups, small and medium-sized enterprises, large companies, and multinational corporations. Before starting our on-the-ground analysis, we conducted an initial exploratory phase by examining the databases of the Moroccan Office of Industrial and Commercial Property (OMPIC) concerning patent filings made by businesses in the Fes-Meknes region since 2009. The results of this analysis are presented in the section.

B. Impact of Covid on Moroccan Companies

The Haut-Commissariat au Plan conducted a qualitative survey in 2020 among 4,000 Moroccan companies operating in various sectors such as manufacturing, construction, energy, mining, fishing, trade, and non-financial merchant services to assess the impact of the Covid-19 pandemic on these enterprises[36]. According to the survey results, at the beginning of April, nearly 142,000 companies, accounting for 57% of the total surveyed, reported either permanent or temporary cessation of their activities. Among them, over 135,000 companies had to suspend their operations temporarily, while 6,300 companies were forced to cease their activities permanently. Authors explain that Small and Medium-sized Enterprises (SMEs) are more affected compared to large Moroccan companies, as Moroccan SMEs have experienced a significant impact as the crisis intensifies, which could ultimately exacerbate vulnerabilities affecting their financial stability [37].

The sectors most affected by this crisis are the accommodation and catering industry, with 89% of companies ceasing operations, followed by the textile and leather industries and the metal and mechanical industries, affecting 76% and 73% of enterprises, respectively. The construction sector has also been severely impacted, with nearly 60% of companies halting their activities.

As for the companies that continued to operate despite the crisis (43% of the total surveyed), half of them had to reduce their production to adapt to the imposed conditions. Among them, 81% reduced their production by 50% or more. Very Small and Medium-sized Enterprises accounted for 49% of the active companies during the survey period, of which 40% experienced a reduction of 50% or more in their production. By sector of activity, 62% of companies in the construction sector had to reduce their production. Other sectors were also affected, including accommodation and catering (60%), chemical and para-chemical industries (52%), transportation and warehousing (57%), as well as the textile and leather industry (44%).

Furthermore, a study conducted by the company Inforisk estimated that Moroccan companies expected a significant decrease in their turnover by 32% in the year 2020, resulting in a total loss of 400 billion dirhams in terms of revenue for all Moroccan companies (as cited by [38]). On the other hand, an empirical study by [39], based on a sample of 54 operating Small and Medium-sized Enterprises (SMEs) in Morocco, demonstrated a significant impact of Covid-19 on various aspects of their businesses. This impact was reflected in the decrease of their revenue, challenges in maintaining employment, extended payment delays from clients, financial difficulties, solvency issues with suppliers, and the risk of mandatory or voluntary complete closure. Other difficulties highlighted by the authors included marketing challenges, supply chain disruptions, and additional expenses related to the implementation of health measures.

V. RESULTS OF THE DESCRIPTIVE STUDY

A. Descriptions of participating companies

The survey involved a wide range of companies of different sizes and sectors and covering a wide range of activities and products. Our choice to cover several sectors is intended to ensure that the results of the study are not influenced by the specific characteristics of one sector or type of company. Thus, the study reached 66% of companies belonging to the industrial sector, 20% of service companies, 11% of high-tech companies and only 3% of companies in the renewable energy sector.

Regarding the industrial sector, it should be noted that respondents are distributed as follows: the food industry (35%), textiles and leather (32%), chemicals and parachemistry (14%), metal and mechanical industry (11%) and electrical and electronic industry (8%).

Of the companies surveyed, only 18% are certified, of which 80% are industrial units and 20% are active in the service sector. Thus, three companies are ISO 9001 certified, two are ISO 22000 certified, one is Moroccan Standard and HACCP Halal (Hazard Analysis and Critical Control Point) certified, and one has social compliance certification.

The survey covered different age categories of companies. Thus, the category of companies having less than two years or those having more than 15 years of existence represent almost 27% each of the studied fabrics, the category of companies having 2 to 5 years of existence represent 23% of the studied fabrics, the category of companies having 5 to 10 years of existence represent 12% of the studied fabrics, the category of companies having 10 to 15 years of existence represent 11% of the studied fabrics.

The survey involved companies with different legal forms. Thus, 57% of the companies surveyed are SARLs, 12% are SARL AUs, 11% are self-employed, 9% are natural persons, 9% are SAs, and only 2% are subsidiaries of foreign companies. The responses received come from the three cities of Fes, Meknes and Sefrou, with a large representation of the city of Fes (84%).

Our study covered large companies (more than 500 employees) (3%), medium-sized companies (50 to 500 employees) (13%), small companies (10 to 50 employees) (25%), very small companies (5 to 9 employees) (25%) and startups (less than 5 employees) (34%).

B. Innovative behavior of participating firms

Among the companies surveyed, 86% stated that they had introduced innovations in their field of activity during the COVID-19 period. These innovations are distributed as follows: 21% are product innovations, 19% are service innovations, 20% are process innovations, 18% are organizational innovations, and 22% are commercial innovations. To enrich our study and give it more relevance, we have examined the nature of the innovations practiced and developed by the companies in the region.

Table 1 *:* Type of innovation practiced by the surveyed companies

Type of innovation	Number of companies
New or significantly improved products	36
New or significantly improved services	33
Significant new or improved methods of manufacturing or producing goods or services	30
Significant new or improved methods of logistics, supply, or distribution of raw materials, goods, or services	18
Significant new or improved support activities for your processes, such as maintenance systems or purchasing operations, accounting	21
Significant modifications to the design or packaging of a good or service	25
Use of new techniques or media for promoting goods or services New methods (or significant modifications to methods) of sales or distribution	26
Use of new techniques or media for promoting goods or services New methods (or significant modifications to methods) of sales or distribution	27
New pricing strategies for your products (goods or services)	26
New operating modes in procedure organization	19
New methods of organizing work and decision-making	26
New methods of organizing external relationships with other companies or organizations	21

Source: Field study results

C. Use of ICT and AT

For the Use of ICT and AT by companies and according to the literature, we recall that the greater the variety of ICT and AT used in companies, the more likely they are to innovate. Thus, for the ICT variable, more than 89% of the companies studied confirmed their use of ICT, including: graphic art, layout, advertising, design of objects or services, multimedia, website design, software development, mathematics, statistics, and finally database management (Fig. 4).

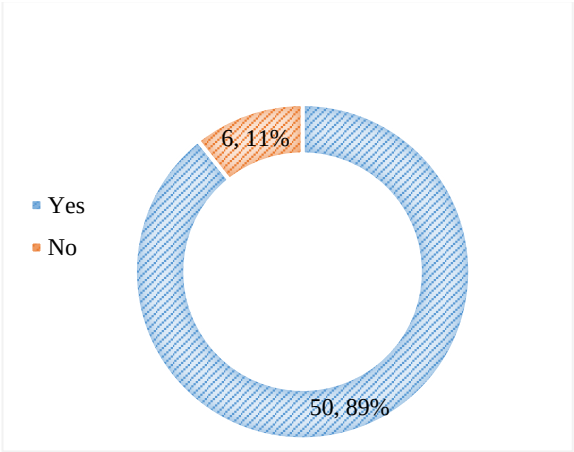

Fig. 4. Use of ICT by companies

Our study also focused on the AT used by companies in the region as an effective means of learning and improving company performance. The human resources of firms improve their ability to innovate by using these AT. As a result, the process of innovation in the company is improved and strengthened. Thus, 55% of the participating companies use AT, in particular artificial intelligence, 3D printing, manufacturing 4.0, E-commerce (electronic commerce), S-commerce (social commerce), blockchain, the use of drones, and big data activities (Fig. 5).

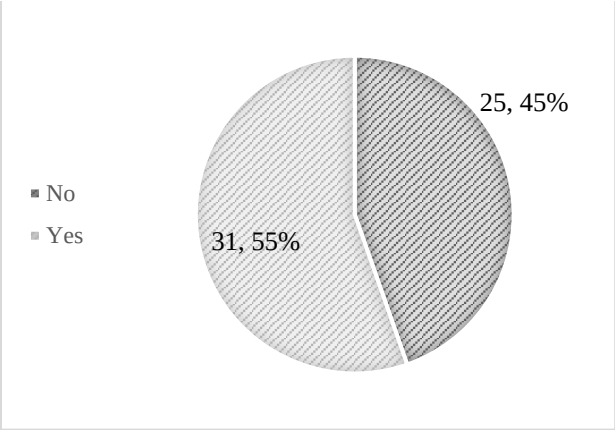

Fig. 5. Use of AT by companies

D. Cooperation and R&D activity

The [3] pointed out several determinants related to the links that companies can have with their changing environment. The source recommends considering a matrix with multiple interfaces, including actors such as universities, technical and vocational training institutions, technology centers, testing laboratories, suppliers, customers, headquarters, group companies, other companies, consultants, R&D companies, public S&T agencies, and types of links with and between these actors, including sources of freely accessible information, knowledge and technology acquisition, innovation cooperation, access to new sources of funding and business information.

In the context of our study, companies rely on cooperation to the extent of 77% (Figure 6). In this context, the main local actors most sought after by companies for innovative projects include the Delegation of Commerce and Industry (DPCI), the Chamber of Industry, Commerce and Services (CICS), the French Chamber of Commerce and Moroccan Industry (CFCIM), the General Confederation of Moroccan Enterprises (CGEM), the Regional Investment Center (CRI), the Innovation City of Fes, the Council of the Fes Meknes Region, Municipalities (Tableau 2).

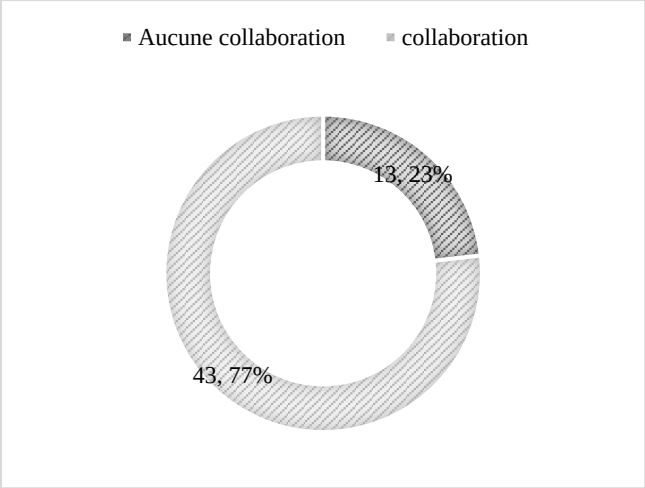

Fig. 6. Utilization of cooperation by companies during Covid-19

Table 2 : Main Cooperation Partners

Local actors	Number of companies
DPCI	**22**
CRI	**16**
CICS	**13**
Council of the Fes Meknes Region	**10**
Innovation City of Fes	**9**
CGEM	**8**
Municipalities	**6**
CFCIM	**5**
Other (Public and Private Research Laboratories, Chamber of Crafts, Fine Arts Institute, Regional Environmental Delegation, Vocational Training Delegation	**8**

Source : Result

Several studies have shown that the application of IP rights fosters collaboration between companies, universities, and the wider economic community, which in turn strengthens the capacity of companies to innovate [9], [40], [41]. An analysis of 364 Moroccan businesses revealed that the protection of IP rights increases cooperative behavior and the possibility for innovation [9]. This study shows that businesses that use IP tactics, especially patenting, form cooperative scientific alliances and generate more creative work. Furthermore, as some authors have noted, the integration of new technology and the strengthening of collaborative approaches, specifically in R&D [42], [43], have been linked to an enhancement of businesses' capacity for innovation [43]–[45].

It should be noted that companies rarely declare their R&D expenses in their annual financial statements [9], especially among SMEs where these expenses are difficult to measure [9]. That is why we chose to analyze the extent to which participating companies engage in R&D activities. However, more than half of the companies studied (52%) do not conduct any R&D activities, only 25% resort to R&D but in an ad hoc manner and depending on opportunities, and only 23% engage in R&D through a dedicated team on a permanent basis (Figure 6). Among these companies engaging in R&D, 20% outsource it externally and only 25% of these allocate a budget to R&D (Figure 7). This is mainly linked to the size of the companies and their ability to finance this costly and risky activity. This is mainly related to the size of the companies and their ability to finance this costly and risky activity [5], [9], [46], [47]. Large companies are better positioned to carry out R&D activities as they typically have R&D laboratories equipped with a dedicated innovation team [46]. This resource enables them to address the technical and technological challenges associated with the production and manufacturing process, continuously improve product quality, significantly optimize product characteristics or production processes, and ultimately create new innovative products or industrial processes.

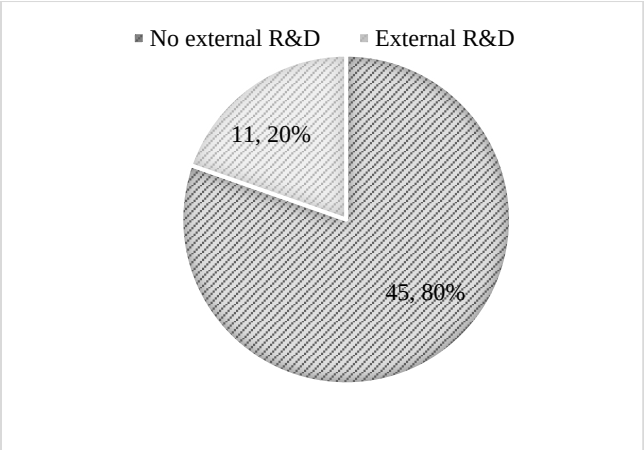

Fig. 7. Utilization of R&D by companies during Covid-19

This is consistent with the findings of [48] who demonstrated how R&D spending influences innovation and raises export intensity in the Moroccan environment through their study of 446 Moroccan SMEs. This is in line with earlier research from emerging environments. [11], [49]–[51]**.**

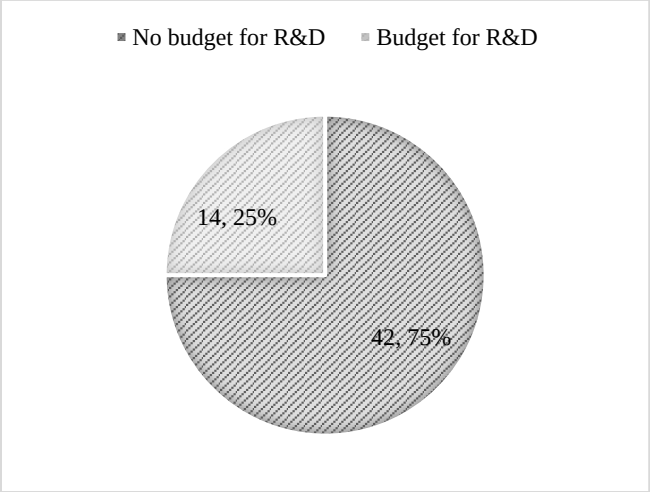

Fig. 8. Companies allocating budget for R&D

E. Intellectual Property Rights Protection

Due to concerted efforts during the pandemic, regional enterprises have demonstrated remarkable capacity for innovation. They have been able to offer solutions to the country's health challenges, whereas some global leaders struggled to adapt and transform to address the global health emergency. For example, companies in the textile and leather sectors promptly responded by engaging in the production of sanitary masks, despite tight deadlines and global stress conditions.

Figure 9 illustrates the sectoral variation of filers. Specifically, the agri-food sector leads in patent filings, followed by the energy efficiency and metallurgical sectors.

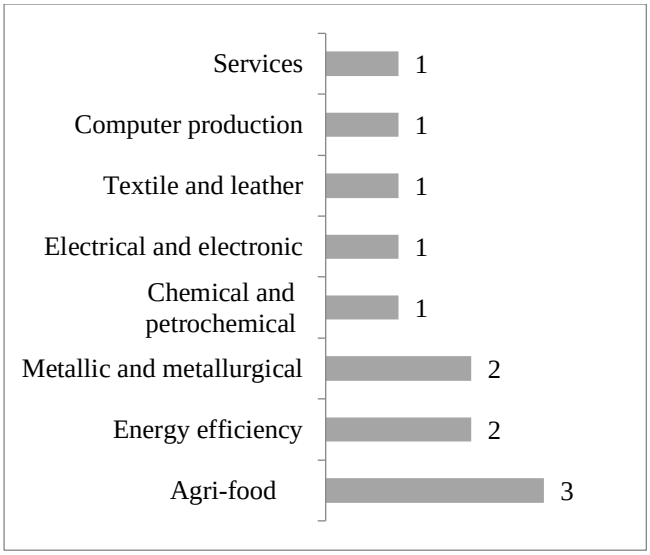

Fig. 9. Industrial sector

The distribution of patent filers during the Covid period can be characterized as very satisfactory when compared to the national average. Indeed, industrial companies dominate the filings (83%), while the service sector represents only 17% of patent filings (Figure 10).

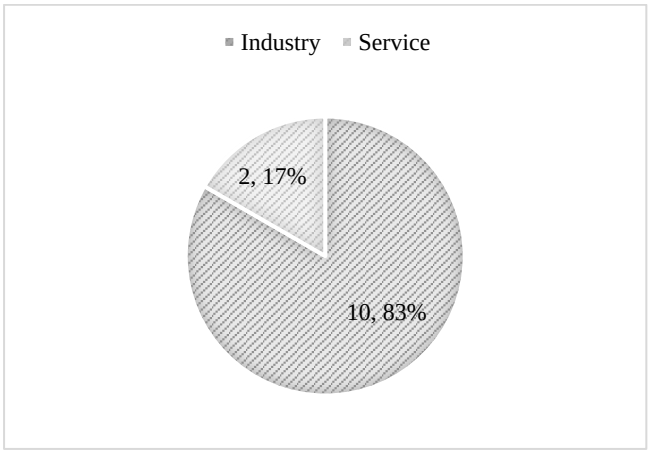

Fig. 10. Industrial sector

This was accompanied by a significant increase in terms of IP rights filings. Indeed, the results of our descriptive study show that during the pandemic, regional enterprises protected their industrial creations through various IP rights. Only 9% of companies do not protect their innovations through IP rights. 78% of participating companies resort to protection through trademarks (37%), industrial designs (26%), patents (14%), trade secrets (14%), and copyrights (9%) (Figure 11).

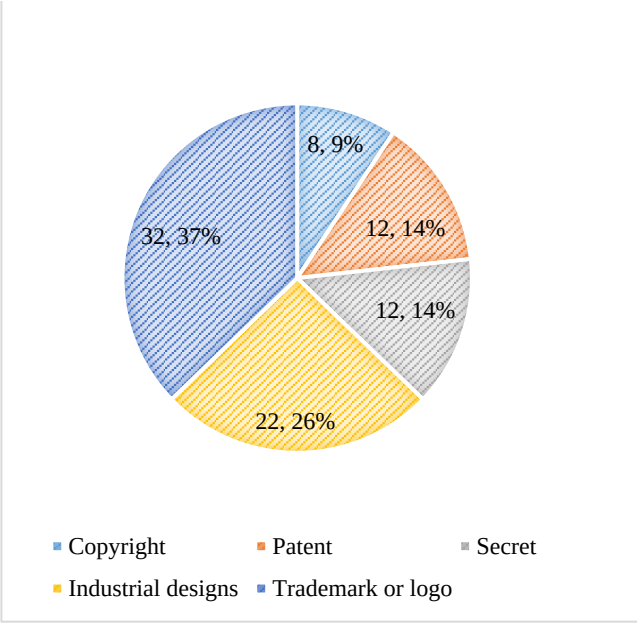

Fig. 11. IP protection by regional companies

We notice that patent protection is the least utilized by firms, which is in line with the findings of an exploratory study conducted at the same regional level [46]. The use of patent filing in developing countries is affected by the lack of resources to conduct R&D activities and initiate filing procedures, which are typically costly [3], [7], [9], [10].

On the other hand, the patent application process requires a substantial investment of time and resources in R&D activities over an extended period. However, it is important to note that this endeavor can lead to success, with the acquisition of a patent protecting an innovation. Nevertheless, there is also a risk of failure, where R&D efforts do not result in a patentable or market-competitive invention. This inefficiency is often highlighted in the literature, notably by [7], who introduce the concept of upstream inefficiency. They explain that the patent system, by rewarding the completion rather than the beginning of the research process, may encourage duplication of expenses among competing enterprises or laboratories. Several competing companies may conduct similar research without all resulting in a patent application, which is reflected in the number of patent filings by these entities.

However, companies prefer trademark protection because they see it as a public commitment to quality associated with a certain level of performance, thus providing a guarantee to consumers. Trademarks represent an essential strategic tool that can be financially valued when resold, for example [52]. They also favor protection through industrial design and model rights, on one hand, because it is the least financially costly right, and on the other hand, it enhances the export potential of products and competitive position in the market.

We believe that this is thanks to the efforts of bringing together investors and administration, especially by the OMPIC. OMPIC offered a new value-added support service related to invention patents in the fight against COVID-19 to stimulate technological innovation in areas related to combating the COVID-19 coronavirus. Indeed, during the state of health emergency and free of charge, OMPIC provided value-added services to inventors, companies, and researchers in universities and R&D centers, such as: providing a report on the legal status of patents in Morocco, conducting prior art searches for inventors, assisting with the application process, and expediting the examination procedure for filed patents. Fethermore, Morocco is among the countries that had time limit options available during the COVID-19 pandemic, especially the extended option [22]. Morocco is also among the countries that had fee relief options available during the COVID-19 pandemic [22].

VI. Implication

We think that the primary managerial relevance of our study is Moroccan authorities' recognition of the role that IP plays in enhancing corporate competitiveness. The findings shed light on how government officials and business executives may create laws and other initiatives that will enhance Moroccan enterprises' utilization of IP rights.

To increase their competitiveness, make it easier for them to expand their operations overseas, and enhance their global operations, business executives should support the use of IP rights [48]. They ought to share their IP strategy in order to attract talent and stimulate the creation of original ideas. In order to preserve a competitive edge, management should support this strategy by incorporating IP into the business's routine operational procedures while striking a balance with more radical inventive activities. The company's employees' abilities must be strengthened in order to do this. As a result, supervisors must implement focused training initiatives to foster an IP culture, enhance staff members' IP competencies, and actively stimulate the creation of novel ideas that will be covered by IP rights, spetially patents.

Furthermore, it is recommended that Moroccan business executives leverage the knowledge gained about innovation and the safeguarding of IP rights during the Covid-19 era. This can be achieved through internal company initiatives or collaborations with other partners, particularly academic institutions. [53] advocate the establishment of databases including creative suggestions put forth by the employees. Managers can also look through international patent databases to find inventions that could be advantageous to their companies.

Through operating permits and know-how transfer contracts, executives can also access international knowledge and technologies that are registered in Morocco by non-Moroccans. According to [48], policymakers should support the licensing of foreign inventions. This makes it easier for firms to adopt licensed foreign technologies, which promotes technological innovation [48]. It also encourages Moroccan firms to learn from foreign applicants, which in turn motivates them to make more inventions and submit Moroccan patents.

VII. Conclusion

Our study of the economic sector during the pandemic reveals that Moroccan companies heavily rely on innovation during the COVID period. The diversity of regional innovations translates into advancements in products (21%), services (19%), processes (20%), organizations (18%), and business practices (22%). Innovative companies primarily prioritize the protection of their IP. The analysis of the results has highlighted three distinct periods regarding patent filings in Morocco. The first period, from 2009 to 2012, was characterized by the predominance of individuals in terms of patent filings. The second period, from 2013 to 2019, saw universities take the lead and maintain a high number of annual filings compared to other filers. As for the period between 2019 and 2023, it was characterized by an increase in the number of filings by all actors, including universities, research centers, businesses, and individuals. During this period, regional companies also protected their creations

through IP rights, including trademarks (37%), industrial designs (26%), patents (14%), trade secrets (14%), and copyrights (9%).

These results reflect the growing importance of IP in the modern economy and underscore a significant evolution in the innovation landscape in Morocco in recent years. However, the exact reasons for these variations remain difficult to determine without more specific data on the context of each period and without specific studies involving key players in the Moroccan patent system.

Moroccan businesses encountered many difficulties during the COVID-19 epidemic, such as alterations in demand, tighter budgetary limits, and supply chain disruptions. They had to immediately adjust and come up with creative ideas in order to stay competitive. Some of these solutions included creating medical and health solutions, switching to producing in-demand goods and services, and adopting digital technology for online sales. They were able to satisfy the demands of the health crisis and carry on with operations despite the disruption thanks in large part to innovation. Therefore, in light of our findings, we advise those involved in the productive sectors to: increase R&D spending; encourage cooperation between businesses, academic institutions, and research centers; facilitate financing access; support training and skill development; and, lastly, implement policies that streamline and expedite the processes involved in protecting IP, especially patents.

The results of this analysis suggest that universities are playing an increasingly crucial role in the development of innovation and IP in Morocco, and it is now time for businesses to take the lead. Therefore, it is essential for authorities to strengthen awareness efforts in the regional economic sector regarding the importance of these technologies in improving the competitiveness of companies and territories.

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