ISSN: 2658-8455
Volume 5, Issue 11 (2024), pp. 454-464.

IJAFAME
International Journal of Accounting, Finance, Auditing, Management & Economics

The Impact of Industry 4.0 on Industrial Competitiveness: A Bibliometric Analysis of Challenges and Opportunities

Ikrame HAI, *(Doctoral Student)*
Interdisciplinary Laboratory for Resarch and Study in Economics, Finance and Management of Organisation (LIREFMO),
Faculty of Legal, Economic and Social Sciences,
University Sidi Mohammed Ben Abdellah FES, Morocco

Mohammed ABDELLAOUI, *(Full Professor)*
Interdisciplinary Laboratory for Resarch and Study in Economics, Finance and Management of Organisation (LIREFMO),
Faculty of Legal, Economic and Social Sciences,
University Sidi Mohammed Ben Abdellah FES, Morocco

Correspondence address :	Faculty of Legal, Economic and Social Sciences BP 42 A Fez, Morocco 0653215258 fsjes@usmba.ac.ma
Disclosure Statement :	Authors are not aware of any findings that might be perceived as affecting the objectivity of this study and they are responsible for any plagiarism in this paper.
Conflict of Interest :	The authors report no conflicts of interest.
Cite this article :	HAI, I., & ABDELLAOUI, M. (2024). The Impact of Industry 4.0 on Industrial Competitiveness: A Bibliometric Analysis of Challenges and Opportunities. *International Journal of Accounting, Finance, Auditing, Management and Economics*, *5*(11), 454-464. https://doi.org/10.5281/zenodo.14115194
License	**This is an open access article under the CC BY-NC-ND license**

Received: October 17, 2024 *Accepted: November 10, 2024*

The Impact of Industry 4.0 on Industrial Competitiveness: A Bibliometric Analysis of Challenges and Opportunities

Abstract:

This article explores the evolution of industry through successive industrial revolutions, from mechanization in the 18th century to the current digital revolution marked by the advent of Industry 4.0. This transition signifies a profound metamorphosis in how industries engage with technology. Using a systematic literature review methodology, this study conducts an empirical analysis of public perception of this revolution, based on indicators such as online searches, academic production, and startup investments. The findings reveal three major trends: Firstly, public interest in Industry 4.0 has significantly increased, indicating a growing awareness of its transformative potential. Secondly, academic research on the subject is thriving, with over 200,000 articles published in the last decade, highlighting the dynamism of this field. Finally, investments in startups dedicated to Industry 4.0 have surged by over 300% in the last decade, attesting to investors' conviction in the capacity of these technologies to revolutionize industries and create new business opportunities. In summary, Industry 4.0 emerges as a major transformative force, sparking growing interest and fueling significant advancements in research and startup funding.

Keywords: Industry 4.0, Digital Revolution, Mechanization, Industry Evolution, Technological Transformation
Classification JEL: O23.
Paper type: Theoretical Research

ISSN: 2658-8455
Volume 5, Issue 11 (2024), pp. 454-464.

IJAFAME
International Journal of Accounting, Finance, Auditing, Management & Economics

1- Introduction :

Since the First Industrial Revolution, the industry has undergone major transformations, each marked by technological innovations that have profoundly reshaped economies and societies. The successive industrial revolutions have enabled the transition from mechanization in the 19th century to mass production and automation in the 20th century. We are now in the era of Industry 4.0, characterized by advanced digitization and the interconnectivity of industrial systems, which significantly alters production processes and the skills required across various sectors. In this context, Industry 4.0 is not merely a new technological paradigm but also a potential driver of competitiveness for economies that succeed in adopting and integrating these technologies into their national industries.

The transition to Industry 4.0 presents specific challenges for developing countries like Morocco, whose industrial strategies must adapt to remain competitive in a rapidly changing global economy. In Morocco, the industrial sector is a pillar of the national economy, and authorities have implemented various policies to stimulate modernization and attract investment. However, these strategies must incorporate the technologies of Industry 4.0, such as artificial intelligence, the Internet of Things (IoT), and cyber-physical systems, to enhance productivity and competitiveness on the international stage. In this framework, it is essential to understand the impact of Industry 4.0 on economic development and to analyze the dynamics of public interest, academic production, and investment in startups related to this transition.

The central problem of this research is, therefore, the following: to what extent does Industry 4.0 influence economic and social dynamics in Morocco, and how can this influence be optimized to strengthen the competitiveness of the national economy? More specifically, this study aims to analyze the evolution of public interest, scientific production, and investments in startups linked to Industry 4.0, highlighting the opportunities and challenges for the Moroccan economy. This research is based on the hypothesis that Industry 4.0 has transformed public interest and stimulated investments but that there are still obstacles to overcome for Morocco to fully benefit from this industrial revolution.

The objectives of this research are twofold. First, it seeks to evaluate the impact of Industry 4.0 on the dynamics of public interest, academic production, and investments in startups, using Morocco as a case study. Second, this study aims to provide recommendations for public policymakers and industrial actors in Morocco to leverage Industry 4.0 technologies in their economic and industrial development strategies.

This study is justified by the increasing importance of Industry 4.0 for the economies of developing countries like Morocco, where digital transformation can play a decisive role in enhancing competitiveness. As developed countries increasingly adopt these new technologies, it is crucial for Morocco to integrate these advancements to remain attractive for foreign direct investment (FDI) and to increase the added value of its industrial sector. The potential benefits of Industry 4.0 on employment, skills, and value creation are determining factors for the success of Moroccan industrial strategies.

To achieve these objectives, this research adopts a methodology based on a systematic literature review, combined with an analysis of empirical data on trends in public interest (online searches), academic production (scientific publications), and investments in startups. This approach allows for the cross-referencing of various data sources to provide a comprehensive overview of the impact of Industry 4.0 while identifying specific dynamics and perceptions within the Moroccan context.

The article is structured as follows: the first section presents a literature review, highlighting the main theories and existing works on the impact of Industry 4.0 on economic development and competitiveness. The second section describes in detail the research methodology adopted, while the third section analyzes the results obtained. The fourth section discusses the

implications of these results for Morocco and proposes recommendations. Finally, the conclusion summarizes the main findings of the study and suggests avenues for future research.

2- Conceptual Review

2.1 Definition of industry

Industry 4.0 represents the fourth industrial revolution, characterized by the integration of digital technologies into manufacturing and industrial processes. This transformation influences not only production but also industrialization strategies on a global scale. This literature review examines previous studies on the impact of Industry 4.0 on innovation, competitiveness, and business models.

2.2 Evolution of industry 4.0

- **Industry 1.0**

In the 18th century, farmers relied on animals for their work, but around 1765, the emergence of water and steam-powered machines marked the beginning of a transition to enhance salaried labor efficiency (KEMPEGOWDA et al., 2019). This evolution significantly increased production capacity, fostering market diversification to meet the needs of individual business owners and their neighbors. Owners became managers, employing their families to serve clients. However, with the formation of several related organizations, environmental concerns began to emerge (SHIN et al., 2019).

- **Industry 2.0**

Limited access to energy posed a major challenge in the industrial sector (WILLUMS et al., 1975). In the early 20th century, electricity emerged as a revolutionary energy source, propelling industry and business into a new era (KLIMESCH, 1976). New machines were designed to be more mobile, while the integration of technology into vehicles, transportation means, and even machines led to increased dependence on oil, highlighting environmental concerns (KELLER, 1970).

The new administrative approach, initiated by FAYOL, introduced management systems aiming to increase efficiency in factories by optimizing the division of labor. Each task was executed optimally, and strict procedures were put in place to ensure optimal quality. This industrial revolution sought to address environmental issues by promoting sustainable use of natural resources (ARTURO and IVONE, 2014).

- **Industry 3.0**

Electricity paved the way for the invention of electronic devices, replacing vacuum tubes with transistors, and eventually integrating electronic circuits into integrated circuit chips (HAGGERTY, 1968). Calculation tools evolved from simple abacuses to calculators, and then to customized machines meeting consumer needs (SHUEY, 1975).

During this time, the automation of mechanical machines became possible. Computers replaced typewriters, allowing for more precise planning of raw material needs, exploration of alternative resources, work programming, and monitoring of production flows. This evolution contributed to optimizing paper usage and solving various environmental problems.

Administratively, this period was characterized by high labor costs, prompting factories to relocate activities to low-cost regions. Simultaneously, environmental concerns became a major issue, with pollution from production machines and untreated industrial waste (TANTAWI et al., 2019).

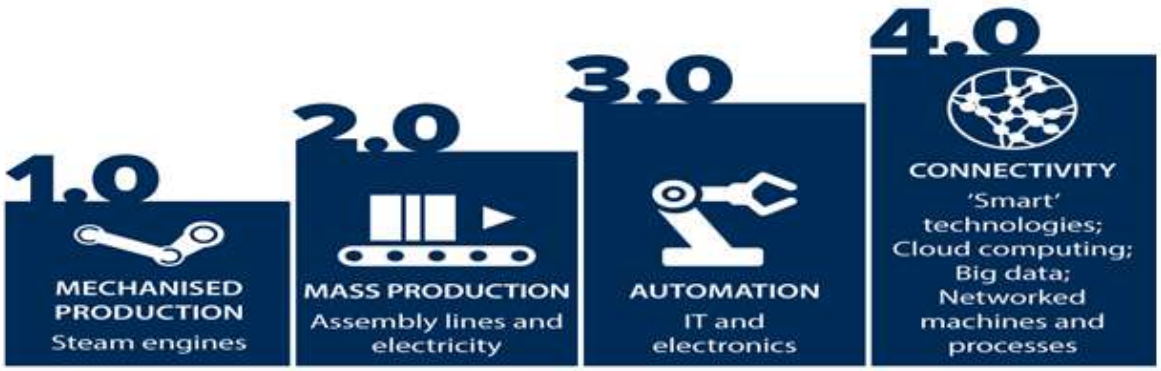
ISSN: 2658-8455
Volume 5, Issue 11 (2024), pp. 454-464.

IJAFAME
International Journal of Accounting, Finance, Auditing, Management & Economics

- **Industry 4.0**

The term "Industry 4.0" symbolizes a radical transformation of the industry through the integration of emerging technologies. The goal of Industry 4.0 is to create smart factories capable of producing in a more ecological and efficient manner (RUBMANN et al., 2015).
Intelligent and autonomous robots are at the heart of Industry 4.0, offering benefits such as increased productivity, reduced errors, and handling of high-risk tasks (FITZGERALD and QUASNEY, 2017). In the future, these robots will be able to manage a variety of objects of different sizes and shapes more quickly and efficiently. They will also possess intelligent and precise decision-making capabilities (KARABEGOVIC and HUSAK, 2018). Companies can thus be managed through computers, coordinating and controlling all stages from the supply chain to distribution (RODIC, 2017).

Fig. 1. The stages of industrial development



Source : Oxford Analytica

2.3 Advantages of industry 4.0:

Industry 4.0 is the fourth industrial revolution, characterized by the integration of new technologies, such as artificial intelligence (AI), machine learning (ML), the internet of things (IoT), augmented reality (AR), and virtual reality (VR). These technologies enable companies to create smart factories that are more efficient, productive, and adaptable.
The literature on the advantages of Industry 4.0 is vast and constantly evolving. However, some key advantages have been identified, including:

Table 1: Benefits of Implementing Industry 4.0 According to Identified Dimensions

Dimensions and Key	Authors Main Conclusions
Technical Dimension: GRIECO et al., 2017; MORTYL et al., 2017; LU, 2017; LEYH et al., 2017; PERUZZINI et al., 2017; WEYER et al., 2015; (KOCH et al., 2014); MCKINSEY and COMPANY (2015)	-Significant increase in productivity and operational efficiency. -Interconnection and communication between machines and humans through the Internet of Things and the Internet of Services. -Speed of data collection and analysis, and information processing. -Virtualization of the real world by connecting sensor data. -Increase in yield relative to incurred costs. -Reduction of overproduction.
Logistics Dimension: YASANUR (2018)	-Reduction of logistics costs (transportation, storage, inventory, and administrative costs). -Optimization of execution timelines (cycle). -Fast delivery: avoiding transportation delays. -Improvement of logistics service quality. -Reduction of transportation costs.

Environmental and Human Dimension: (DALENOGARE et al., 2018; KARRE et al., 2017; PEREIRA & ROMERO, 2017; WAIBEL et al., 2017); (FITZGERALD et QUASNEY, 2017)	-Reduction of production waste. -Decrease in energy consumption. -Preservation of natural resources. -Reduction of errors. -Acquisition of new skills. -Reduction of workers' complaints. -Facilitation of the execution of high-risk tasks.

Source: Authors

2.4 Challenges in Implementing Industry 4.0

The implementation of Industry 4.0, despite its undeniable advantages for businesses, is hindered by various significant obstacles that cannot be ignored. Although this transition may boost revenue growth, the initial cost of this transformation is exceptionally high, according to a 2015 study by MCKINSEY and COMPANY. Furthermore, the clarity of the return on investment remains uncertain, posing a major financial challenge.

The limited structure of businesses can also prove to be a hindrance, manifesting in difficulties integrating new technologies and gaps in infrastructure, as highlighted by the study conducted by RAJ et al. in 2020.

On the other hand, the ubiquitous connectivity of objects exposes networks to increased security risks. The constant and instantaneous sharing of data creates a potential vulnerability to cyberattacks, thus constituting a serious threat (ALCACER & CRUZ MACHADO, 2018; KIEL et al., 2017).

The successful adoption of new technologies also depends on the open-mindedness of the company's personnel. However, this essential quality is not universally acquired, impeding progress, as emphasized by KIEL et al. in 2017 and RAJ et al. in 2020.

Finally, one of the major challenges in the transition to Industry 4.0 lies in the lack of qualified workforce and adequate training for employees. Studies by KIEL et al. in 2017, MAMAD in 2018, and RAJ et al. in 2020 highlight this critical gap that limits the full realization of the potential benefits of the fourth industrial revolution.

3- Literature Revue

3.1. Impact on Innovation

Kagermann, H., Wahlster, W., & Helbig, J. (2013) emphasize that Industry 4.0 fosters innovation through the integration of the Internet of Things (IoT), cyber-physical systems, and data analytics. They assert that these technologies enable the creation of smarter products and services, thereby increasing companies' capacity for innovation.

Lee, J., Kao, H. A., & Yang, S. (2014) also explore how IoT and big data are crucial for the development of new business models. Their study shows that real-time data analysis enhances decision-making and allows for greater customization of products, which is essential for remaining competitive in a rapidly changing industrial environment.

3.2. Competitiveness and Performance

Brettel, M., Friederichsen, N., Keller, M., & Rosenberg, M. (2014) examine how Industry 4.0 impacts the performance of supply chains. They find that companies adopting advanced technologies, such as 3D printing and robotics, can reduce costs and improve operational efficiency. This research demonstrates a direct link between the adoption of Industry 4.0 technologies and competitiveness in the global market.

Wang, Y., Wan, J., Li, D., & Zhang, C. (2016) discuss the implementation of "smart factories" as a key element of Industry 4.0. Their study highlights that smart factories improve not only production efficiency but also flexibility and responsiveness to market demands. These improvements contribute to enhancing the competitiveness of companies on a global scale.

ISSN: 2658-8455
Volume 5, Issue 11 (2024), pp. 454-464.

IJAFAME
International Journal of Accounting, Finance, Auditing, Management & Economics

3.3. Emerging Business Models

Pereira, A. C., & Romero, F. (2017) analyze how Industry 4.0 transforms traditional business models. They identify trends toward service-based models, where companies shift from merely selling products to offering integrated services and solutions. This requires a reassessment of the skills and resources necessary to succeed in this dynamic environment.
Industry 4.0 represents a significant opportunity for companies seeking to innovate and enhance their competitiveness. Previous studies clearly demonstrate that the adoption of advanced technologies can transform not only manufacturing processes but also business models. It is imperative for policymakers and companies to consider these changes to remain relevant in the global economy.

4. Methodology of Data Collection

In order to analyze the impact of Industry 4.0, a systematic approach was adopted for data collection. The following key terms were identified and used for searching relevant literature and data:

- **Key Terms**: "Industry 4.0," "Industrial IoT," "Smart Manufacturing," "Cobots," "Additive Manufacturing," "Digital Twin," and "Machine Vision."
- **Databases Searched**: Data were collected from several academic databases, including:
  - ✓ Google Scholar
  - ✓ Scopus
  - ✓ Web of Science
  - ✓ IEEE Xplore
  - ✓ ScienceDirect

These databases were selected for their comprehensive coverage of academic literature in engineering and industrial management.
The methodology also included the use of Google Trends for public search interest, tracking the search volumes for the identified key terms over the specified period (2011-2021). Additionally, the funding data for startups was collected from financial news reports and investment tracking platforms.

5. Result and discussion

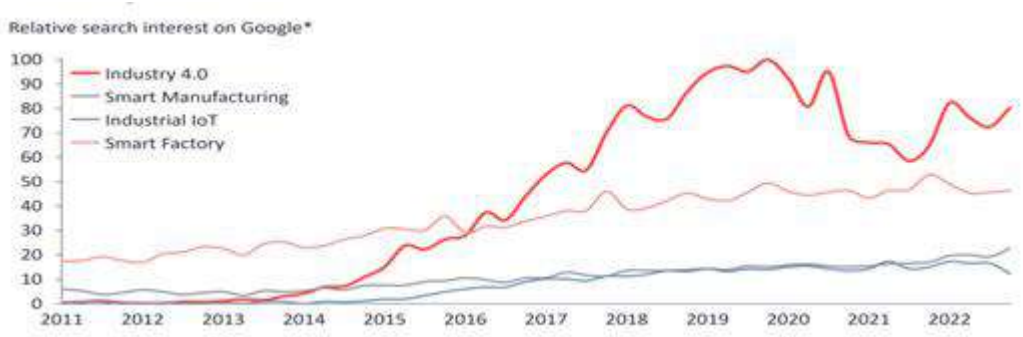
5.1 Data analysis

The analysis considered three indicators: Public search interest, academic papers, start-up funding.

1-Public search interest: 140 times higher

In 2022, Google searches for Industry 4.0 experienced a remarkable surge, reaching 140 times the level recorded during its initial introduction and public unveiling in 2011. This extraordinary growth underscores the escalating interest in this revolutionary approach to industrial production.
Simultaneously, related terms such as Industrial IoT (IIoT) and Smart Manufacturing also witnessed substantial increases in search volumes over the same period. Searches related to IIoT surged by 32 times, demonstrating the ongoing momentum of this technology that integrates connected devices within industrial processes. Likewise, searches for Smart Manufacturing grew by 3.5 times, highlighting the escalating adoption of innovative and automated production methods. These figures reflect the swiftly evolving industrial landscape, where the pursuit of advanced and interconnected solutions is gaining prominence, and Industry 4.0, IIoT, and Smart Manufacturing are emerging as key areas of research and development.

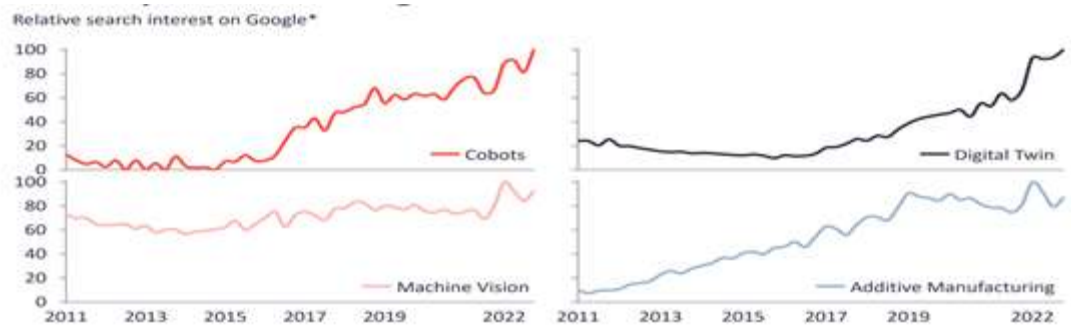
Fig. 2. Industry 4.0 and related terms search interest – from 2011 to 2022



Source: IOT analytics, Research 2022, Google trends

Industry 4.0 encompasses various advancements in the manufacturing sector. The image below illustrates the concurrent rise in popularity of four key technologies supporting Industry 4.0.

Fig. 3. Industry 4.0 technologies search interest – from 2011 to 2022



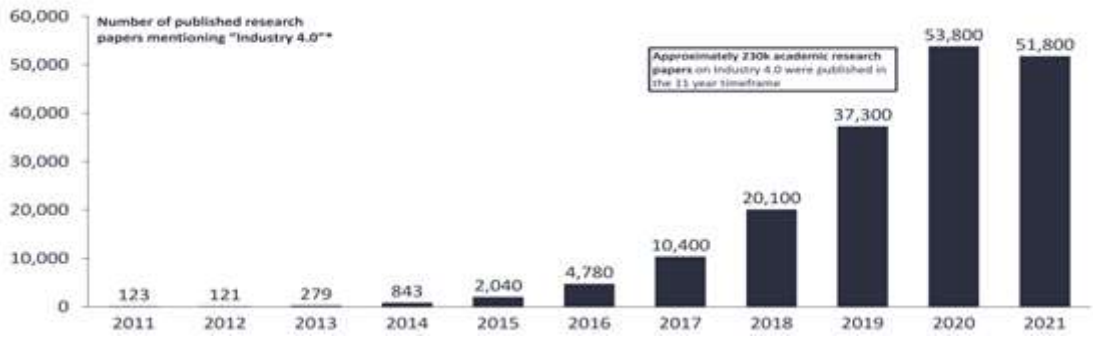
Source: IOT analytics, Research 2022, Google trends

The search interest in "Cobots" has surged over 10-fold since 2011, "Additive Manufacturing" has seen an almost ninefold increase, "Digital Twin" has risen more than fourfold, and "Machine Vision" has grown by 1.3 times. These technologies not only reflect heightened interest but also serve as indicators for the popularity of various other Industry 4.0-related technologies.

2- Academic papers: 200,000+ papers published

Over 50,000 academic papers on Industry 4.0 were published in the years 2020 and 2021, contributing to a total of over 200,000 papers in the past decade. Clearly, extensive research is underway in the field of Industry 4.0, and within this wealth of knowledge, there's the potential for one of these ideas to emerge as the "next big thing," propelling the subject further.

Fig. 4. Academic research papers mentioning "industry 4.0"



Source: IOT analytics, Research 2022, Google trends

Based on Google Scholar, the three most cited papers relating to Industry 4.0 are:

ISSN: 2658-8455
Volume 5, Issue 11 (2024), pp. 454-464.

IJAFAME
International Journal of Accounting, Finance, Auditing, Management & Economics

Table 2: most cited papers relating to Industry 4.0

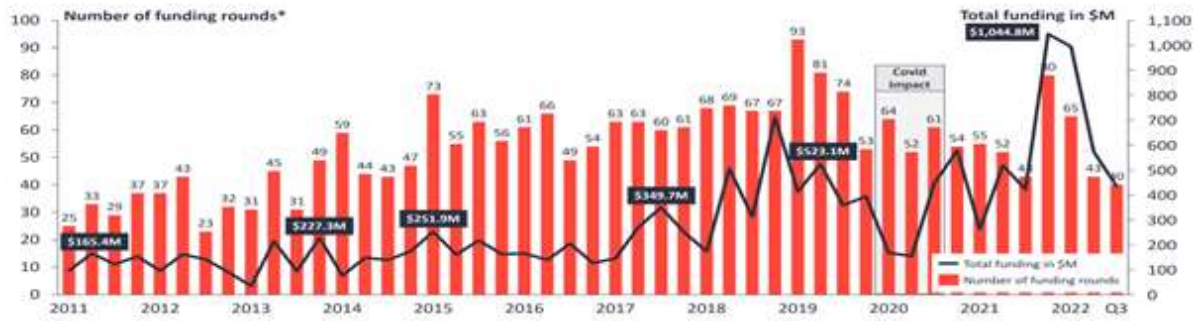
	Title	Publishing year	Number of citations	Journal	Key authors
#1	Industry 4.0	2014	4167	*Business & Information Systems Engineering*	Lasi, Heiner, et al.
#2	Industry 4.0: State of the art and future trends	2018	2185	*Intl. Journal of Production Research*	Xu, Li Da, Eric L. Xu, and Ling Li
#3	Industry 4.0 technologies: Implementation patterns in manufacturing companies	2019	1466	*Intl. Journal of Production Economics*	Frank, Alejandro Germán, Lucas Santos Dalenogare, and Néstor Fabián Ayala

Source: Authors

3-Funding: 2,513 deals since 2011

The yearly funding for start-ups engaged in Industry 4.0 has surged by +319% from 2011 to 2021. In 2021 alone, a substantial $2.2 billion was invested in emerging companies developing technology associated with Industry 4.0, with a total of 2,513 deals announced over the 11-year period. However, the total number of funding rounds experienced a decline during the onset of COVID-19 in 2020 and has recently faced challenges with a slowdown linked to inflation and war-related concerns

Fig. 5. Funding of Industry 4.0 Startups – From 2011 to 2021



Source: IOT analytics, Research 2022, Google trends

Significant investment rounds comprised a $179 million Series A for BrightMachines in 2018, a $100 million Series C for Tulip Interfaces in 2021, and a $75 million Series E for Xometry in 2020.

5-2 Discussion of the analysis

Industry 4.0: A fascinating overview of a technological revolution

Public interest

The first key takeaway from the analysis is that public interest in Industry 4.0 is growing rapidly. The number of online searches for Industry 4.0-related terms has increased by 140 times since 2011. This suggests that people are beginning to understand the potential of this technological revolution to transform our lives.

There are several factors that could contribute to this increase in public interest. Growing media coverage of Industry 4.0, industry successes such as the use of robots and other advanced technologies in manufacturing, and specific technological breakthroughs such as the development of 3D printing could all play a role.

Academic research

The second key takeaway from the analysis is that academic research on Industry 4.0 is also booming. Over 200,000 academic papers have been published on Industry 4.0 in the last decade. This suggests that Industry 4.0 is a thriving field of research with immense potential for future progress.
Academic research on Industry 4.0 covers a wide range of topics, including the design and use of Industry 4.0 technologies, the economic and social impacts of Industry 4.0, and the ethical implications of Industry 4.0.

Start-up funding

The third key takeaway from the analysis is that investments in Industry 4.0 start-ups are also increasing. Over the last decade, investments in Industry 4.0 start-ups have increased by more than 300%.
This increase in investment reflects the commercial viability and promising economic potential of Industry 4.0. Investors are convinced that Industry 4.0 technologies have the potential to transform industries and create new business opportunities.

Outlook

Based on these three conclusions, it is clear that Industry 4.0 is a burgeoning technological revolution. It has the potential to transform various sectors and reshape our future.
However, it is important to remain aware of the challenges that accompany Industry 4.0. For example, it is important to ensure that Industry 4.0 technologies are developed and used responsibly. It is also important to ensure that the benefits of Industry 4.0 are distributed fairly.

6. Conclusion :

This study has explored the strategic role of industrialization in economic development, focusing on the evolutions through industrial revolutions, particularly the impact of Industry 4.0. The findings revealed that industrialization plays a key role in stimulating economic growth, supported by investments in innovation and increased research dynamics. The synthesis of the works highlights the main data collected, emphasizing the significant correlations between industrialization and economic competitiveness.
However, theoretical and empirical limitations remain. Theoretically, the diversity of approaches to industrialization and economic development requires a deeper exploration of conceptual frameworks. Empirically, access to data and contextual variations may influence the results, thereby limiting the generalizability of the conclusions.
As a result, recommendations are made for policymakers and practitioners:

1. Strengthen initiatives that support innovation to foster a competitive industrial ecosystem.
2. Promote public-private partnerships to optimize resources and knowledge in the field of industrialization.
3. Encourage interdisciplinary research to better understand the dynamics between industrialization, innovation, and economic development.

These recommendations aim to maximize the impact of industrialization on economic development while considering the identified challenges and limitations.

ISSN: 2658-8455
Volume 5, Issue 11 (2024), pp. 454-464.

IJAFAME
International Journal of Accounting, Finance, Auditing, Management & Economics

References:

(1). Alcácer, V., & Cruz-Machado, V. (2018). Scanning the Industry 4.0: A literature review on technologies for manufacturing systems. *Engineering Science and Technology, an International Journal*.
(2). Arturo, V. R., & Ivone, O. G. (2014). The salmon industry 2.0 in Chile: A perspective from the viewpoint of environmental governance. *Revista de Derecho Ambiental*, 19(65).
(3). Benghozi, P. J., Bureau, S., & Massit-Folea, F. (2008). L'Internet des objets : Quels enjeux pour les Européens? *La documentation française*.
(4). Brettel, M., Friederichsen, N., Keller, M., & Rosenberg, M. (2014). How virtualization technology impacts the supply chain. *International Journal of Physical Distribution & Logistics Management*, 44(1), 3–4. https://doi.org/10.1108/IJPDLM-11-2012-0302
(5). Dalenogare, L. S., Benitez, G. B., Ayala, N. F., & Frank, A. G. (2018). The expected contribution of Industry 4.0 technologies for industrial performance. *International Journal of Production Economics*, 204, 383–394. https://doi.org/10.1016/j.ijpe.2018.08.019
(6). Kagermann, H., Wahlster, W., & Helbig, J. (2013). Recommendations for implementing the strategic initiative INDUSTRIE 4.0. Final report of the Industrie 4.0 Working Group. Acatech.
(7). Karabegovic, I., & Husak, E. (2018). The role of industrial and service robots in the fourth Industrial Revolution with focus on China. *Journal of Engineering and Architecture*, 6(1), 67–75.
(8). Karre, H., Hammer, M., Kleindienst, M., & Ramsauer, C. (2017). Transition towards an Industry 4.0 state of the LeanLab at Graz University of Technology. *Procedia Manufacturing*, 9, 206–213. https://doi.org/10.1016/j.promfg.2017.04.013
(9). Keller, C. (1970). Transfer dies in the appliance industry SME, Creative Mfg Semi.
(10). Kempegowda, S. M., & Chaczko, Z. (2019). Industry 4.0 complemented with EA approach: A proposal for digital transformation success. In *Proceedings of the 26th International Conference on Systems Engineering (ICSEng 2018)*.
(11). Lee, J., Kao, H. A., & Yang, S. (2014). Service innovation and smart analytics for Industry 4.0 and big data environment. *Procedia CIRP*, 16, 3–8. https://doi.org/10.1016/j.procir.2014.02.001
(12). Mamad, M. (2018). Challenges and benefits of Industry 4.0: An overview. *International Journal of Supply and Operations Management (IJSOM)*.
(13). McKinsey and Company. (2015). Industry 4.0: How to navigate digitization of the manufacturing sector. Technical report. McKinsey and Company.
(14). Pereira, A. C., & Romero, F. (2017). Smart manufacturing systems: A new perspective on Industry 4.0. *Journal of Manufacturing Systems*, 39, 65–77. https://doi.org/10.1016/j.jmsy.2016.12.019
(15). Wang, Y., Wan, J., Li, D., & Zhang, C. (2016). Implementing smart factory of Industrie 4.0: An outlook. *International Journal of Distributed Sensor Networks*, 12(1), 1–10. https://doi.org/10.1177/1550147716702231
(16). Xu, L. D., Xu, E. L., & Li, L. (2018). Industry 4.0: State of the art and future trends. *International Journal of Production Research*, 56(8). https://doi.org/10.1080/00207543.2018.1447630
(17). Yasanur, K. (2018). Sustainability impact of digitization in logistics. In *Proceedings of the 15th Global Conference on Sustainable Manufacturing* (Vol. 21, pp. 782–789).