

Midocean University
College Of Management
Masters of Management



**The Impacts of Digital Transformation Evolving Tech
On Manufacturing Industry in Saudi Arabia**
آثار التحول الرقمي وتطور التكنولوجيا في القطاع الصناعي في المملكة العربية السعودية

A Research Paper

Prepared By:

أديب محمد ال معتيق (221000695) Adeeb Mohammad Al Mutiq
محمد ظافر الشهري (221000677) Mohammed Dafer Alshehri

Supervised By:

الدكتور وليد سليمان Dr. Walid Sulaiman

1445/ 2023

Acknowledgements:

We communicate my profound appreciation to the people who have offered significant help, direction, and consolation during making of this research paper for studying impacts of digital transformation evolving tech on manufacturing industry in Saudi Arabia.

We would like to extend our sincere thanks to our supervisor, Dr. Walid Sulaiman, for his help and direction all through this. Their skill, productive criticism, and sagacious ideas have been instrumental in forming this shaping this study and guaranteeing its quality.

We also want to share my genuine thanks to our friends who have been a steady wellspring of motivation and inspiration during the development of this paper.

Finally, we want to offer our thanks to our family for their enduring help and understanding all through this journey their confidence in us and their ceaseless consolation have been my driving force. We are genuinely thankful to every one of the individuals who have added their support in this journey. Their help and direction have been essential, and we are honored to have the chance to work with such surprising people.

Much obliged to everyone.

Adeeb Mohammad Al Mutiq

Mohammed Dafer Alshehri

Table of Contents:

1. Abstract -----	07
Theoretical Framework of the study	
2. First Chapter: Problem of the study and its importance -----	08
2.1. Research Title	
2.2. Research Overview	
2.3. Research Objectives	
2.4. Research Importance	
2.5. Research Problem	
2.5.1. Research Questions	
2.5.2. Research Hypothesis	
3. Second Chapter: First variable of the study -----	14
3.1. Digital Transformation	
3.2. Digital Transformation and Saudi Arabia	
3.3. Digital Transformation and Saudi Arabia Manufacturing Industry	
4. Third Chapter: Second variable and the correlation between variables -----	25
4.1. Manufacturing Industry of Saudi Arabia	
4.2. Impacts of Digital Transformation on Manufacturing Industry in Saudi Arabia	
4.3. Digital Transformation in Manufacturing Industry Influence on Nation's Economy	
Practical study and its methodological procedures	
5. Fourth Chapter: Methodological procedures -----	33
5.1. Study Tool	
5.2. Study Population	
5.3. Study Sample Size	
5.4. Building the Study Tool	
5.5. Design the Study Tool	
5.6. Validity & Reliability	
5.7. Scale Application	
5.8. Statistical Methods Used	
6. Fifth Chapter: Field Results -----	40
6.1. Findings Overview & Interpretations	

7. Sixth Chapter: Results and Proposal Analysis -----	49
7.1. Proposal Analysis	
7.2. Research Results	
7.3. Recommendations	

References and Appendices

8. References -----	52
9. Appendices -----	55

List of Figures:

Figure I: Research Model.....	9
Figure II: Vision 2030 of digital transformation.....	16
Figure III: Saudi Arabia Digital Transformation Market Size (Tech, 2022).....	18
Figure IV: Market Size (Intelligence, 2023).....	23
Figure V: Digital Transformation by region in manufacturing (Intelligence, 2023).....	24
Figure VI: Distribution of the study population	41
Figure VII: Distribution of the study population as per education level	41
Figure VIII: Distribution as per nationality	42
Figure IX: Distribution as organization type	43

List of Tables:

Table 1: Pearson Coefficient for the Correlation with the Total Score	37
Table 2: Cronbach's alpha coefficient to measure the reliability of the study tool.....	37
Table 3: The distribution of the study population according to the variable of the age	40
Table 4: Distribution of the study population as per education level	41
Table 5: Distribution as per nationality	42
Table 6: Distribution as organization type.....	42
Table 7: The responses of the study individuals to the statements of the first topic	43
Table 8: Responses of the study individuals on the topic statements the second	46

Table of Appendixes:

Appendix 1: Questionnaire Paper	55
---------------------------------------	----

1. Abstract

This study aims to investigate the effects of digital transformation evolving techs on the manufacturing sector in Saudi Arabia. The rapid advancement of digital technologies has brought significant changes to industries worldwide, and understanding their impact on the manufacturing sector in Saudi Arabia is essential for informed decision-making. This research employed a questionnaire-based approach to examine the positive and negative impacts of digitalization on manufacturing processes, productivity, competitiveness, and employment. Statistical tests were conducted to analyze the collected data.

The study involved a sample of population from industrial sector of Saudi Arabia, selected through a purposive sampling technique. The questionnaire was designed to capture relevant variables related to digitalization and its effects on the manufacturing sector. Key areas explored included the adoption of digital technologies, changes in production efficiency and supply chain management.

The results obtained from the statistical analysis indicate overwhelmingly positive impacts of digitalization on the manufacturing sector in Saudi Arabia. The respondent's data revealed significant improvements in production efficiency, enhanced supply chain management, and increased competitiveness due to the adoption of digital technologies. Furthermore, the findings highlight positive effects on product quality, reduced waste, and improved sustainability practices within the manufacturing sector.

The study's outcomes support the notion that digitalization has a substantial influence on the manufacturing sector in Saudi Arabia. The positive impacts identified through the questionnaire responses and statistical tests underscore the need for continued investment in digital technologies and the development of supportive policies to foster a thriving digital manufacturing ecosystem. This research contributes to the existing knowledge on the effects of digitalization on the manufacturing sector, specifically in the context of Saudi Arabia. It provides valuable insights for policymakers, manufacturing industry professionals, and researchers, guiding strategic decision-making processes and potential future research directions.

Theoretical Framework of the Study

This part covers the theoretical framework to study the effects of digitalization on the manufacturing sector in Saudi Arabia, focusing on the problem of the study, its importance, as well as the variables of the study.

2. Chapter one: Problem of the Study and its Importance

In this chapter, we will discuss about the problem that leads to this study and the importance of this research. The problem statement will help identify a gap in knowledge, understanding, or practice within a specific field or subject area. It highlights an issue or problem that needs to be addressed through research. By clearly defining the problem, we can contribute to filling that gap and advancing knowledge in the field.

2.1. Research Title

The Impacts of Digital Transformation Evolving Tech on Manufacturing Industry in Saudi Arabia.

2.2. Research Overview

Every sector in the business world, including manufacturing, has been transformed by digital adoption over the past decade. Digital technologies are being implemented across departments and businesses in Saudi Arabia as well because of digital transformation. It has made new business processes, enhanced conventional tasks, empowered developments and offered superior encounters to engage in with clients (Ali, 2022).

Digitization at manufacturing sector is one of the vital mainstays of Saudi Arabia's industrial improvement plan. The Saudi Industrial Property Authority is assuming a basic part in working with digitization and accomplishing the change and modernization vision of the industrial sector (IDC, 2020). Saudi industry sector aims to keep up with the global shifts in manufacturing processes, in which companies use cutting-edge technology like the Internet of Things, robots, augmented reality, virtual reality, 3D printing, and artificial intelligence to increase production efficiency (Accely, 2023).

This research paper examines the profound impacts of digital transformation evolving technologies on the manufacturing industry in Saudi Arabia. The paper explores how advancements in automation, robotics, the Internet of Things (IoT), big data analytics, additive manufacturing, augmented reality (AR), and virtual reality (VR) have revolutionized various aspects of the manufacturing sector. The study investigates the specific implications of these technologies on production processes, supply chain management, operational efficiency, customer experience, and overall competitiveness. By conducting surveys and analyzing case studies, industry reports, and scholarly articles, this research paper provides valuable insights into the transformative potential of digital technologies in the Saudi Arabian manufacturing industry.

In short, in this study, we will discuss how digital transformation has helped manufacturing industries to speed up projects in the last decade by utilizing digital technology to their benefit.

Here is the model of our research:

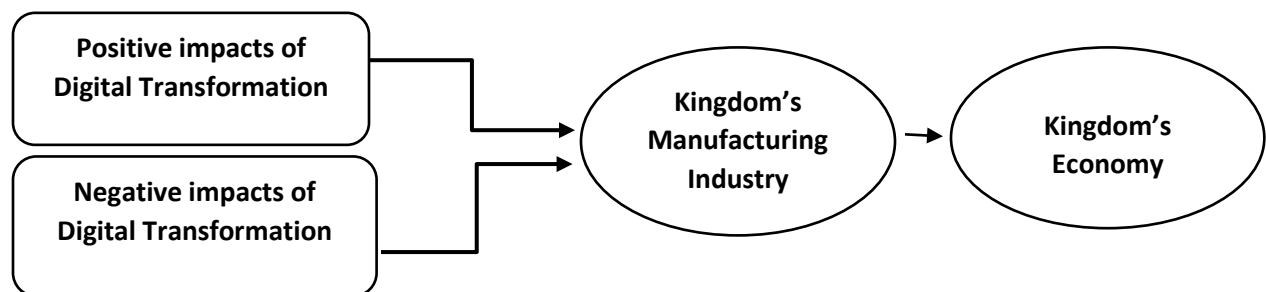


Figure I: Research Model

2.3. Research Objectives

This research paper investigate the need for digital transformation in the manufacturing sector, its major impacts, key drivers and discuss the challenges in the digital transformation process. In addition, this paper identifying steps taken towards provision of digital transformation in the manifesting sector of Saudi Arabia.

Briefly, the general purpose of this study is to analyze the need for digital transformation in manufacturing industry. In addition, we will investigate that either digital transformation in manufacturing sector effects the Kingdom's economy or not.

Beside these, we study in our course journey that Digital Transformation is important in organizations and industries for several reasons, thus we want to study and analyze it practically through our research and understand the main effects of it.

2.4. Research Importance

This research holds significant importance for several key stakeholders in the manufacturing industry in Saudi Arabia and they are:

- **Industry Practitioners and Decision-Makers:**

The study provides valuable insights into the transformative potential of digital technologies and helps industry practitioners understand how to adopt and leverage these technologies to enhance productivity, efficiency, and competitiveness.

Decision-makers can gain a comprehensive understanding of the specific impacts and benefits of digital transformation, enabling them to make informed strategic choices and investments in technology adoption.

- **Policymakers and Government Authorities:**

The research paper offers policymakers a deeper understanding of the implications of digital transformation on the manufacturing industry in Saudi Arabia. This knowledge can guide the development of policies, regulations, and initiatives that support the adoption and implementation of digital technologies.

Policymakers can also identify potential barriers and challenges hindering the widespread adoption of digital technologies in the manufacturing sector, allowing them to develop targeted interventions and support mechanisms.

- **Researchers and Academics:**

The study contributes to the body of knowledge on digital transformation evolving technologies in the manufacturing industry, specifically within the context of Saudi Arabia.

Researchers and academics can build upon the findings of this research to further investigate specific areas of interest, such as the impact of digitalization on employment, the role of data analytics in supply chain optimization, or the challenges of cybersecurity in the digital manufacturing landscape.

- **Economic Development and Diversification:**

Understanding the impacts of digital transformation on the manufacturing industry is crucial for Saudi Arabia's economic development and diversification goals.

By embracing digital technologies, the manufacturing sector can reduce its reliance on oil revenues, foster innovation, attract foreign investments, and contribute to a more diversified and sustainable economy.

- **Global Competitiveness:**

The research paper helps Saudi Arabian manufacturers identify opportunities to enhance their global competitiveness through digital transformation.

By adopting advanced technologies and optimizing their operations, manufacturers can improve productivity, quality, and responsiveness, positioning themselves as innovative and efficient players in the global market.

The study's significance lies in its ability to shed light on the impacts of digital transformation evolving technologies in the manufacturing industry of Saudi Arabia. By addressing the problem at hand, the research paper provides valuable insights and practical recommendations that can drive informed decision-making, policy formulation, and strategic actions to maximize the benefits of digitalization in the sector.

2.5. Research Problem

The Vision 2030 of Saudi Arabia is a road map to the future. It was unveiled in 2016 and is a transformative and extremely ambitious plan to create a diverse, innovative, and world-leading nation to unlock the Kingdom's vast potential for the benefit of future generations. Digital transformation is one of the objective of this vision for a vibrant society and a more sustainable future.

When we talk about digital transformational in the manufacturing sector of Saudi Arabia, many impacts it is having on the industry. As per the assumption, one of the most significant impact is the speed up in manufacturing process. So, the study is required to investigate the impacts of Digital Transformation Evolving Tech on Manufacturing Industry in Saudi Arabia.

The problem addressed in this research paper is the need to understand the impacts of digital transformation evolving technologies on the manufacturing industry in Saudi Arabia. With the rapid advancement of technologies such as automation, IoT, data analytics, additive manufacturing, and AR/VR, it is crucial to examine how these innovations are shaping the industry and identify the challenges and opportunities they present. By investigating the specific implications of digital transformation, the study aims to provide insights that can guide policymakers, industry practitioners, and researchers in effectively harnessing the potential of these technologies.

2.5.1. Research Questions

- How has digital transformation affected the overall productivity and efficiency of the manufacturing industry in Saudi Arabia?
- What are the specific impacts of automation and robotics on production processes and workforce dynamics in Saudi Arabian manufacturing?
- What are the benefits and challenges associated with the implementation of digitalization in manufacturing operations in Saudi Arabia?
- What are the implications of digitalization on the production capabilities and supply chain dynamics of Saudi Arabian manufacturers?

- How does digital transformation improve the customer experience in the manufacturing industry of Saudi Arabia, and what are the key factors influencing customer satisfaction?
- What are the future trends and potential developments in the adoption and utilization of digital technologies in the manufacturing industry of Saudi Arabia?

These research questions will serve as a starting point for further exploration and analysis of the impacts of digital transformation evolving technologies on the manufacturing industry in Saudi Arabia. They cover various aspects of digitalization, technological advancements, operational improvements, and their implications for the industry stakeholders.

2.5.2. Research Hypothesis

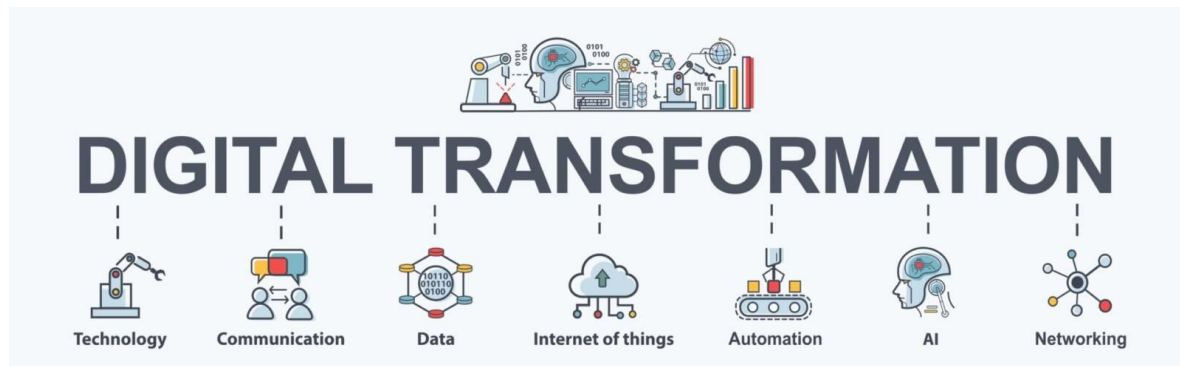
H0: There is no significant influence of digital transformation evolving tech on manufacturing industry in Saudi Arabia.

H1: There is significant influence of digital transformation evolving tech on manufacturing industry in Saudi Arabia.

There is two variables in the hypothesis and they are “Digital Transformation” and “Manufacturing Industry”.

3. Chapter Two: First Variable of the Study

The first variable of this study is “digital transformation”. The variable "digital transformation" refers to the process of integrating digital technologies, tools, and strategies into various aspects of an organization's operations, processes, and business models. In the context of the research paper on the influence of digital transformation evolving technologies on the manufacturing industry in Saudi Arabia, "digital transformation" can be considered the independent variable or the focus of the study.



By studying the variable "digital transformation" in this research paper, we will gain insights into its influence on the manufacturing industry in Saudi Arabia, contributing to the understanding of the role of digitalization in transforming and shaping the sector.

3.1. Digital Transformation

According to the Digital Economic Report 2019, the term "digital transformation" refers to the revolutionary ways in which the technological revolution is altering value chains and providing new opportunities for value addition and structural change. The report characterizes it as a feature of economic output got exclusively or principally from digital innovations with a plan of action in light of computerized labor and products characterized by effortlessness as the extent of monetary result got from broad mechanical inputs, for example, "PC abilities, PC gear (equipment, programming, and interchanges hardware), and middle person computerized labor and products. Such broad undertakings are the foundations of the digital transformation (Report, 2019).

Digitalization has the potential to boost global economic expansion. Beside this, it is normal that more prominent effectiveness underway because of advanced change would prompt lower costs and expanded efficiency (IBM, 2023). This would lead to higher aggregate demand, higher employment, and potentially higher wages, thus making up for the underlying interruption. Since countless firms and industries are embracing high level advanced innovations to reshape action plans, digital advancements expect labor forces to have an extensive variety of skill, like as self-direction, critical thinking, correspondence skills, and web management. With the appearance of digitalization, certain parts of the businesses have gone through monstrous changes. These progressions sought after for abilities and business made bound work vanish. These changes in demand for skills and employment caused bound employment to disappear. This changed the positions of companies in terms of development, market capitalization, and many more. In the innovative era, the most effective strategies are still in progress or uncertain (Ping, He, & Gao Yao Ying, 2018).

Thus, Digital adoption in the last decade has transformed every industry, and manufacturing is no exception. Digital transformation in manufacturing entails incorporating digital technology into manufacturing processes and products to boost productivity and quality. One study says that this transformation has two parts: the technology they offer and the components they're improving. Digital transformation in manufacturing focuses primarily on diminishing expenses and working on functional proficiency, keeping a top notch of finished items, embracing quicker to fluctuating business sector prerequisites and customer requirements (Joshi, 2022).

3.2. Digital Transformation and Saudi Arabia

Digital transformation in Saudi Arabia refers to the process of integrating digital technologies, tools, and strategies across various sectors and industries within the country (Srivastava, 2023). Saudi Arabia has been actively investing in digital transformation initiatives to diversify its economy, enhance competitiveness, and drive economic growth in line with its Vision 2030 plan as shown in the image below.



Figure II: Vision 2030 of digital transformation

Here are some key points regarding digital transformation in Saudi Arabia:

- **Vision 2030:**

Digital transformation is a central pillar of Saudi Arabia's Vision 2030, a long-term plan aimed at reducing the country's dependence on oil and transitioning to a diversified, knowledge-based economy. The vision emphasizes the importance of digital technologies in driving innovation, improving government services, fostering entrepreneurship, and creating job opportunities (Gupta, 2023).

- **National Digital Transformation Strategy:**

The Saudi Arabian government has developed a National Digital Transformation Strategy to guide and accelerate the digital transformation efforts across various sectors. The strategy focuses on areas such as e-government services, digital infrastructure development, cybersecurity, digital skills enhancement, and fostering a digital innovation ecosystem (Gupta, 2023).

- **Smart Cities:**

Saudi Arabia is investing in the development of smart cities, such as NEOM, Qiddiya, and the King Salman Energy Park (SPARK). These smart cities are designed to leverage digital technologies and sustainable practices to provide advanced infrastructure, efficient services, and a high quality of life for residents and visitors (SCJ, 2023).

- **E-Government Services:**

The Saudi government has made significant progress in digitizing government services to improve efficiency, transparency, and accessibility. Initiatives such as the "Absher" platform and the "Saudi National Single Window" have simplified administrative procedures, reduced paperwork, and enhanced citizen-government interactions (Srivastava, 2023).

- **Digital Infrastructure:**

Saudi Arabia has been investing in enhancing its digital infrastructure, including expanding broadband internet connectivity, 5G networks, and data centers. These infrastructure investments support the implementation of emerging technologies, such as IoT, cloud computing, and big data analytics (Gov, 2023).

- **Startups and Innovation:**

The Saudi government has been promoting entrepreneurship and innovation through initiatives like the "Misk Innovation" program, startup accelerators, and funding support. These efforts aim to cultivate a vibrant startup ecosystem and foster the development of innovative digital solutions (Gov, 2023).

- **Digital Skills Development:**

To support digital transformation, Saudi Arabia is focusing on enhancing digital skills and capabilities among its workforce. Initiatives like the "Saudi Digital Academy" and partnerships with leading technology companies aim to upskill and reskill individuals in digital technologies and future-oriented skills (Accely, 2023).

- **Industry-Specific Transformation:**

Various sectors in Saudi Arabia, such as healthcare, finance, manufacturing, and transportation, are undergoing digital transformation. This involves adopting technologies like telemedicine, fintech, automation, and smart logistics to improve operational efficiency, enhance customer experiences, and drive sectoral growth.

All these initiative are driving the Saudi Arabia Digital Transformation. Have a look at the figure below to see the market share of digital transfromation in Saudi Arabia.



Figure III: Saudi Arabia Digital Transformation Market Size (Tech, 2022)

Digital transformation in Saudi Arabia presents opportunities for economic diversification, job creation, and improved public services. It also poses challenges related to digital literacy, data privacy, cybersecurity, and ensuring inclusive access to digital technologies across all segments of society. Here are some key points regarding the opportunities and challenges of digital transformation in manufacturing industry of Saudi Arabia:

The opportunities includes:

- **Streamline Operations:**

Digital transformation enables manufacturers to streamline and automate their processes, resulting in improved operational efficiency, reduced cycle times, and increased productivity.

- **Data-Driven Decision Making:**

With digital technologies, manufacturers can collect and analyze vast amounts of data in real-time. This data-driven approach allows for better decision making, predictive maintenance, optimized production planning, and improved supply chain management.

- **Smart Manufacturing:**

Digital transformation enables the implementation of smart manufacturing practices, such as the Internet of Things (IoT), robotics, and automation. These technologies enhance connectivity, communication, and collaboration between machines, systems, and processes, leading to agile and responsive manufacturing operations.

- **Product Innovation and Customization:**

Digital technologies facilitate product innovation and customization by enabling rapid prototyping, digital design, and virtual simulations. Manufacturers can respond to customer demands more effectively by offering personalized products and services.

- **Supply Chain Optimization:**

Digital transformation enables better visibility and coordination across the supply chain. Technologies like blockchain, cloud computing, and advanced analytics improve inventory management, logistics, and demand forecasting, leading to a more efficient and resilient supply chain.

The challenges includes:

- **Cost and Investment:**

Implementing digital transformation in manufacturing requires significant investments in technology infrastructure, software systems, and employee training. Manufacturers need to carefully assess the costs and benefits of adopting digital technologies.

- **Workforce Skills and Training:**

Digital transformation demands a skilled workforce capable of utilizing and managing digital technologies effectively. Manufacturers need to invest in training programs to upskill their employees and ensure they have the necessary expertise to work with new technologies.

- **Cybersecurity Risks:**

As manufacturers become more connected and reliant on digital systems, they face increased cybersecurity risks. Protecting sensitive data, intellectual property, and ensuring the integrity of manufacturing processes becomes crucial to mitigate cyber threats.

- **Integration and Interoperability:**

Digital transformation involves integrating various systems, machines, and software applications. Ensuring compatibility and seamless integration between different technologies and legacy systems can be complex and challenging.

- **Legacy Infrastructure and Culture:**

Manufacturers with outdated infrastructure and traditional work cultures may face resistance to change when implementing digital transformation initiatives. Overcoming traditional mindsets and legacy systems can be a significant challenge.

- **Data Management and Privacy:**

The abundance of data in digital transformation requires robust data management practices, including data storage, data privacy, and compliance with regulations such as the General Data Protection Regulation (GDPR).

Addressing these challenges requires a strategic approach, strong leadership commitment, collaboration with technology partners, and continuous monitoring and adaptation of digital transformation initiatives. Manufacturers that successfully navigate these challenges can unlock the potential of digital transformation and gain a competitive advantage in the evolving manufacturing landscape.

3.3. Digital Transformation and Saudi Arabia Manufacturing Industry

Digital transformation is playing a significant role in shaping the manufacturing industry in Saudi Arabia. The government and businesses in the country are actively embracing digital technologies and strategies to enhance productivity, competitiveness, and innovation within the manufacturing sector.

Here are some key points regarding digital transformation in the Saudi Arabian manufacturing industry:

- **Industry 4.0 Adoption:**

Saudi Arabia is aligning its manufacturing industry with the principles of Industry 4.0, which refers to the integration of advanced digital technologies into manufacturing processes. The adoption of technologies such as automation, robotics, artificial intelligence, IoT, cloud computing, and data analytics is transforming traditional manufacturing practices and enabling smart factories.

- **Increased Productivity and Efficiency:**

Digital transformation initiatives are helping Saudi Arabian manufacturers improve their productivity and operational efficiency. Automation reduce manual labor, minimize errors, and accelerate production cycles. Real-time data analysis enables

better decision-making, optimization of processes, and predictive maintenance, leading to higher overall efficiency.

- **Supply Chain Optimization:**

Digital transformation is enhancing supply chain management in the Saudi Arabian manufacturing industry. Technologies such as blockchain, IoT, and data analytics improve visibility, traceability, and coordination across the supply chain, resulting in streamlined logistics, reduced lead times, and improved inventory management.

- **Enhanced Product Innovation:**

Digital transformation empowers Saudi Arabian manufacturers to innovate and develop new products and services. Advanced design tools, virtual simulations, and rapid prototyping enable faster product development cycles and customization to meet customer demands.

- **Workforce Transformation:**

Digital transformation is reshaping the roles and skills required in the Saudi Arabian manufacturing industry. The workforce needs to adapt to new technologies, acquire digital skills, and embrace a culture of continuous learning. Upskilling and reskilling programs are being implemented to enable employees to thrive in the digital era.

- **Government Support:**

The Saudi Arabian government is actively supporting and promoting digital transformation in the manufacturing industry. Initiatives such as the National Industrial Development and Logistics Program (NIDLP) and the National Digital Transformation Strategy are providing frameworks, funding, and incentives to drive digital transformation initiatives in the manufacturing sector.

- **Entrepreneurship and Innovation:**

Digital transformation is fostering entrepreneurship and innovation within the Saudi Arabian manufacturing industry. Startups and small businesses are leveraging digital

technologies to disrupt traditional manufacturing models, introduce new business models, and develop innovative solutions for the industry.

Since 2006 Saudi Arabia has had an established plan for digitization, called the National Strategy for Digital Transformation. All the Saudi Arabia business organizations supporting the Saudi Vision 2030 and manufacturing industry of Saudi Arabia marking its path toward digital transformation. However, experts always discuss how the kingdom can take advantage of the opportunities associated with digital transformation in manufacturing industry as the application of new digital and automated technologies contributed to production processes and service delivery and also because this industry has a great impact on the Kingdom's economy (Flanders, 2021). Have a look at the market size of digital transformation in Saudi Arabia manufacturing sector.



Figure IV: Market Size (Intelligence, 2023)

The Digital Transformation in manufacturing is supposed to develop from USD 307.87 billion of every 2023 to USD 733.75 billion by 2028, at a CAGR of 18.97% during the estimated time frame (2023-2028) (Intelligence, 2023).

Have a look at the image below to see the digital transformation growth rate in manufacturing market by region.



Figure V: Digital Transformation by region in manufacturing (Intelligence, 2023)

4. Chapter Three: Second Variable and the Correlation Between Variables

The second variable of this study is the controllable variable called “manufacturing industry”. Studying the manufacturing industry as a variable, we will focus on understanding the first variable impacts on it.

4.1. Manufacturing Industry of Saudi Arabia

The manufacturing industry in Saudi Arabia holds significant importance for the country's economic diversification and development goals. Here are some key points about the manufacturing industry in Saudi Arabia:

- **Economic Contribution:**

The manufacturing sector in Saudi Arabia contributes to the country's GDP and employment generation. It plays a vital role in reducing dependence on oil revenues and promoting economic diversification. The government has been actively promoting the growth of the manufacturing industry as part of its Vision 2030 initiative.

- **Industrial Clusters:**

Saudi Arabia has established several industrial clusters and economic cities to foster the growth of the manufacturing industry. These include the King Abdullah Economic City, Jazan Economic City, and the Plastics Valley. These clusters aim to attract domestic and foreign investments, promote local industries, and enhance export capabilities.

- **Petrochemicals and Refining:**

The petrochemicals and refining sector is a key component of the manufacturing industry in Saudi Arabia. The country has abundant oil and natural gas reserves, which serve as inputs for producing a wide range of petrochemical products, plastics, and refined petroleum products. Saudi Arabia is one of the world's largest producers and exporters of petrochemicals.

- **Steel and Metal Fabrication:**

The steel and metal fabrication sector is another significant segment of the manufacturing industry in Saudi Arabia. The country has invested in steel production capacity to support infrastructure development and construction projects. Steel plants and metal fabrication facilities are instrumental in supplying materials for various industries, including construction, automotive, and machinery.

- **Food Processing:**

Saudi Arabia has been focusing on developing its food processing industry to reduce dependence on food imports and enhance food security. The country has invested in modernizing and expanding food processing facilities, including meat, dairy, beverage, and grain processing. This sector contributes to local food production and value addition.

- **Automotive and Machinery:**

The manufacturing industry in Saudi Arabia includes the production of automotive components, vehicles, and machinery. The government has been actively supporting the growth of the automotive sector through joint ventures, investments, and policy incentives. The aim is to develop a local automotive industry and encourage localization of manufacturing operations.

- **Industrial Diversification:**

Saudi Arabia aims to diversify its manufacturing industry beyond traditional sectors such as petrochemicals and refining. Efforts are being made to promote high-value-added and knowledge-intensive industries, including pharmaceuticals, medical devices, electronics, renewable energy, and advanced materials.

- **Technological Transformation:**

The Saudi Arabian manufacturing industry is embracing digital transformation and advanced technologies. Initiatives such as the Fourth Industrial Revolution (4IR)

Center and the National Industrial Development and Logistics Program (NIDLP) focus on promoting digitalization, automation, and innovation within the sector.

- **Local Content Development:**

The Saudi government has been emphasizing the development of local content in the manufacturing industry. This involves encouraging the localization of manufacturing operations, promoting local sourcing of inputs and services, and fostering partnerships between international and local companies.

- **Export-Oriented Approach:**

Saudi Arabia aims to increase the export of manufactured goods to diversify its sources of revenue. The government provides support to manufacturing companies to enhance their export capabilities and participate in international trade fairs and exhibitions.

The manufacturing industry in Saudi Arabia continues to evolve and expand, driven by government initiatives, investments, and a focus on economic diversification. The growth in the manufacturing market in Saudi Arabia is projected to amount to US\$156bn in 2023 (Statista, Statista Market Forecast, 2023). The country's strategic location, availability of resources, and supportive policies create opportunities for both domestic and international companies to participate in the manufacturing sector.

4.2. Impacts of Digital Transformation on Manufacturing Industry in Saudi Arabia

The impacts of digital transformation on the manufacturing industry in Saudi Arabia have been significant, driving innovation, efficiency, and competitiveness. Here are some key impacts of digital transformation in the Saudi Arabian manufacturing industry:

- **Enhanced Operational Efficiency:**

Digital technologies such as automation, robotics, and Internet of Things (IoT) have improved operational efficiency in manufacturing processes. These technologies

enable real-time monitoring, data collection and leading to optimized production workflows, reduced downtime, improved quality control, and increased productivity.

- **Adoption of Advanced Manufacturing Technologies:**

Digital transformation has facilitated the adoption of advanced manufacturing technologies in Saudi Arabia, including additive manufacturing (3D printing), advanced materials, and advanced robotics. These technologies enable the production of complex and customized products, reduce lead times, and enhance manufacturing capabilities.

- **Improved Supply Chain Management:**

Digital transformation has revolutionized supply chain management in the manufacturing industry. Advanced analytics, cloud computing, and block-chain technologies are being used to enhance visibility, traceability, and efficiency in supply chain operations. This allows for better inventory management, demand forecasting, and coordination with suppliers and customers.

- **IoT-enabled Smart Factories:**

Saudi Arabia has been investing in the development of smart factories, leveraging IoT technologies. IoT sensors and connectivity enable real-time data collection and analysis, enabling predictive maintenance, remote monitoring, and optimization of manufacturing operations. Smart factories enhance process control, reduce costs, and enable agile and responsive production.

- **Data-driven Decision Making:**

Digital transformation has facilitated data-driven decision making in the manufacturing industry. Advanced analytics, machine learning, and artificial intelligence (AI) technologies enable the analysis of large volumes of data to gain insights, optimize processes, and improve product quality. Data-driven decision-making enhances operational efficiency, reduces waste, and enables continuous improvement.

- **Skills Development and Workforce Transformation:**

Digital transformation has led to a shift in the required skill sets and workforce capabilities in the manufacturing industry. There is a growing demand for skills in data analysis, programming, automation, and digital technologies. The Saudi government has been focusing on skills development initiatives to ensure the availability of a skilled workforce to drive digital transformation in the manufacturing sector.

- **Product Innovation and Customization:**

Digital technologies have enabled product innovation and customization in the manufacturing industry. Through digital design tools, simulation, and virtual prototyping, manufacturers can develop and test product concepts more efficiently. This allows for faster time-to-market, greater product variety, and meeting specific customer demands.

- **Collaboration and Connectivity:**

Digital transformation has facilitated collaboration and connectivity among stakeholders in the manufacturing industry. Cloud computing, collaborative platforms, and digital communication tools enable seamless collaboration among manufacturers, suppliers, and customers. This enhances coordination, enables real-time information sharing, and fosters innovation and partnerships.

- **Sustainable Manufacturing Practices:**

Digital transformation has also contributed to the adoption of sustainable manufacturing practices in Saudi Arabia. Through data analysis and process optimization, manufacturers can identify energy inefficiencies, reduce waste, and minimize environmental impact. Digital technologies enable monitoring and control of energy consumption, emissions, and resource utilization, supporting sustainable manufacturing objectives.

Overall, digital transformation has had a transformative impact on the manufacturing industry in Saudi Arabia, driving efficiency, innovation, and competitiveness. The adoption of digital technologies and the ongoing focus on digital skills development position the industry for continued growth and resilience in the future.

4.3. Digital Transformation in Manufacturing Industry Influence on Nation's Economy

Digital transformation in the manufacturing industry has a significant influence on Saudi Arabia's economy. Here are some key ways in which digital transformation affects the Saudi Arabian economy:

- **Economic Diversification:**

Saudi Arabia aims to diversify its economy beyond oil dependence, and digital transformation in the manufacturing industry plays a crucial role in achieving this goal. By adopting digital technologies, the manufacturing sector expands its capabilities, explores new markets, and develops high-value-added products and services. This diversification reduces reliance on oil revenues, enhances economic resilience, and promotes sustainable economic growth.

- **Job Creation and Workforce Development:**

Digital transformation in the manufacturing industry creates job opportunities and drives workforce development in Saudi Arabia. The adoption of digital technologies requires skilled workers proficient in areas such as data analytics, automation, and advanced manufacturing technologies. This stimulates the development of a skilled workforce and increases employment opportunities, contributing to economic and social development.

- **Increased Productivity and Efficiency:**

Digital transformation improves productivity and efficiency in the manufacturing industry, leading to economic gains. Advanced technologies such as automation, robotics, and IoT enable streamlined processes, reduced downtime, and optimized

resource utilization. The improved productivity translates into higher output, cost savings, and increased competitiveness, benefiting the overall economy.

- **Export Growth:**

Digital transformation enhances the export capabilities of the Saudi Arabian manufacturing industry. By leveraging digital technologies, manufacturers can produce high-quality products, customize offerings for specific markets, and respond swiftly to changing customer demands. This enables Saudi manufacturers to access global markets, increase exports, and contribute to the country's trade balance and foreign exchange earnings.

- **Technological Innovation and Entrepreneurship:**

Digital transformation fosters technological innovation and entrepreneurship within the Saudi Arabian manufacturing industry. Advanced technologies facilitate product customization, rapid prototyping, and the development of new value-added offerings. This encourages manufacturers to innovate, explore emerging markets, and contribute to economic diversification and competitiveness.

- **Foreign Direct Investment (FDI):**

Digital transformation in the Saudi Arabian manufacturing industry attracts foreign direct investment (FDI) into the country. A strong digital infrastructure, skilled workforce, and advanced manufacturing capabilities make Saudi Arabia an attractive investment destination for multinational corporations. FDI inflows contribute to job creation, technology transfer, knowledge sharing, and overall economic development.

- **Sustainable Manufacturing Practices:**

Digital transformation promotes sustainable manufacturing practices in Saudi Arabia. By leveraging data analytics and process optimization, manufacturers can identify energy inefficiencies, reduce waste, and minimize environmental impact. This aligns with Saudi Arabia's sustainability goals and contributes to the country's efforts in achieving a greener and more sustainable economy.

- **Economic Resilience:**

Digital transformation enhances the resilience of the manufacturing industry and the Saudi Arabian economy as a whole. The adoption of digital technologies enables manufacturers to adapt quickly to changing market dynamics, supply chain disruptions, and economic uncertainties. This adaptability strengthens the economy's ability to withstand shocks and ensures sustained growth and competitiveness.

Thus, digital transformation in the manufacturing industry has a profound influence on the Saudi Arabian economy, driving economic diversification, job creation, productivity gains, export growth, innovation, and sustainability. Embracing digital technologies positions Saudi Arabia to be at the forefront of the global digital economy and ensures long-term economic prosperity.

Certainly! Here are some examples of specific digital technologies that are being adopted in the manufacturing industry in Saudi Arabia:

- Industrial Automation and Robotics
- Internet of Things (IoT)
- Artificial Intelligence (AI) and Machine Learning (ML)
- Additive Manufacturing (3D Printing)
- Big Data Analytics
- Augmented Reality (AR) and Virtual Reality (VR)
- Cloud Computing and Digital Twins

These are just few examples of the digital technologies being adopted in the manufacturing industry in Saudi Arabia. The country is actively embracing digital transformation to enhance productivity, efficiency, and competitiveness across various sectors of the economy.

Practical Study and Its Methodological Procedures

In this section, we will discuss the practical methodologies used in the research, which include the research design, data collection methods, and analysis and interpretation. These components are crucial for understanding how the study was conducted and how the collected data was analyzed to derive meaningful insights.

5. Chapter Four: Methodological Procedures

This chapter tackles the methodology of the study; the study of population as well as its sample, the tool used in collecting data in the study were all identified. Along with a detailed presentation of the calculation of the coefficients of reliability and validity of the study tool, in addition to the statistical methods used in the data analysis.

The objective of the present study is to identify the impacts of digital transformation evolving tech on manufacturing industry in Saudi Arabia from the point of view of a sample of executive managers and engineers working in the industrial sector in Saudi Arabia. To achieve the objectives of the study, we have conducted primary research using an analytical descriptive approach. The analytical descriptive approach is defined as describing the phenomenon to be studied and collecting descriptions and information about it (Lawton, 2022). This approach focuses on analyzing and interpreting the collected data to provide a detailed description of the research topic while also uncovering patterns, relationships, or associations among variables. With this approach, we will try to compare, interpret, and evaluate in the hope of reaching meaningful generalizations that increase the balance of knowledge on the subject.

Here is the stepwise description of employing an analytical descriptive approach in our practical study:

5.1. Study Tool

We have used the questionnaire as a tool for collecting information, as it is the appropriate tool for obtaining information in the field of study. This study tool, as mentioned by Al-Qahtani (2004), is defined as the means by which the data collection process is carried out with the aim of selecting research hypotheses or answering its questions (Qahtani, 2004).

5.2. Study Population

The study population of our study consists of executive managers and engineers working in the industrial sector in Saudi Arabia. Their expertise and experiences can contribute to a comprehensive understanding of various aspects related to industrial operations in KSA.

5.3. Study Sample Size

The objective of each researcher is to reach sound conclusions about the community to be studied and from which the problem stemmed. We have distributed (56) questionnaire randomly to executive managers and engineers working in the industrial sector in Saudi Arabia.

5.4. Building the Study Tool

For building the questionnaire, we have relied on the following sources:

- References related to the subject of the study or part of the study problem.
- Previous research and studies that dealt with some of the study topics.
- The academic supervisor and the opinions of the arbitrators to whom the questionnaire were presented in its initial form.
- Interviewing some specialists in the field of study, and benefiting from their opinions about the scale used in the study and the method of formulating its statement in line with the objectives of the study.

5.5. Design the Study Tool

For designing the questionnaire, a five-point Likert scale was used. The scale scores were distributed (from 1 to 5) so that the respondent shows whether he absolutely disagrees, disagrees, neutral, agrees, or strongly agrees.

For the questions in the questionnaire, we have formulated an initial formulation of the questionnaire statements. All the statements based on the subject, objectives and questions of the study after careful reading and review of the literature and previous studies related to the problem of the study and the researcher's practical experience. After this, we have started polling a sample of the study community, then presented it to the academic supervisor to

express his opinion about the statements of the questionnaire, then the researcher made the amendments necessary according to the directives and observations of the scientific supervisor, and after approval, the questionnaire consisted of two parts as follow:

- **The First Part: Primary Data of the Respondents:**

This part relates to the independent variables of the study, which includes variables related to the personal and functional characteristics of the study individuals represented in five variables, namely: Gender- Age – Education- Nationality – Industry- Organization Type.

- **The Second Part: The Study Topics:**

This part includes the topics of the study. In preparing the topics, we have adopted the closed form that determines the possible responses to each question with five-graded Likert method.

This second part further consists of two topics. The first topic is the impacts of digital transformation from the point of view of Executive managers and engineers working in the industrial sector in Saudi Arabia. This topic includes (6) statements. The second topic is the influence of evolving technology on the manufacturing industry, this topic includes (6) statements.

Each question of the questionnaire corresponds to a list bearing the following statements (strongly disagree, disagree, neutral, agree, strongly agree), because it is easy to prepare and apply, and gives the respondent the freedom to define his position and the positive and negative degree of this position in each statement. Each of the statements was given scores according to the five-point Likert scale, and we have adopted the closed form in the numbers of the topics, which determines the possible answers for each question.

5.6. Validity & Reliability of Study Tool

Validity and reliability are crucial considerations when assessing the quality and credibility of a study tool, here is an explanation of validity and reliability of our study tool

“Questionnaire” that includes the apparent validity of the tool and the reliability and validity of the internal consistency of the tool, as follows:

- **The Apparent (External) Validity of the Study Tool:**

The validity of the scale or tool is according to the questionnaire’s inclusion of all the elements that must be included in the analysis on the one hand, and the clarity of its paragraphs and vocabulary on the other hand, so that it is understandable to everyone who uses it. What degree will the scale measure what it was designed to measure and nothing else?” In addition, the validity of the questionnaire means making sure that it will measure what it was intended to measure (Assaf, 2017).

To assess the apparent validity of the questionnaire, we obtained feedback from faculty members who served as arbitrators. They evaluated the clarity of the questionnaire’s statements and their suitability for the intended purpose. Based on their observations, we made modifications to improve the questionnaire. This included deleting and revising wording in certain paragraphs that did not align with the study’s questions. The final version of the questionnaire incorporated the topics, paragraphs, and expressions that received consensus among the majority of the arbitrators.

- **The Internal Validity And Reliability of the Study Tool:**

The reliability of the study tool means to what degree does the scale give close readings each time it is used, or what is the degree of its consistency, consistency, and continuity when it is used repeatedly at different times and on different sample individuals” (Qahtani, 2004).

To ensure internal consistency, we have calculating the Pearson correlation coefficient to find out the internal validity of the questionnaire, where the correlation coefficient was calculated between the degree of each statement of the questionnaire and the total degree of the topic to which the statement belongs. In addition, to measure the reliability of the study tool (questionnaire), Cronbach’s alpha coefficient was used as shown in the following tables:

The table 1 below shows the Pearson coefficient for the correlation of the paragraphs with the total score for each topic.

Table 1: Pearson Coefficient for the Correlation with the Total Score

The Impacts of Digital Transformation		Influence of Evolving Technology on the Manufacturing Industry	
Paragraph number	Topic correlation coefficient	Paragraph number	Topic correlation coefficient
1	**0.569	1	**0.577
2	**0.596	2	**0.627
3	**0.621	3	**0.697
4	**0.565	4	**0.572
5	**0.697	5	**0.653
6	**0.725	6	**0.514

** A function at the 0.01 significance level

It is clear from Table No. (1) That all statements are statistically significant at the function level (0.01), which gives an indication of high internal consistency coefficients, and indicates high and sufficient validity indicators that can be trusted in the application of the study tool.

The table no. 2 below shows the reliability coefficient of the topics of the study tool.

Table 2: Cronbach's alpha coefficient to measure the reliability of the study tool

Topics and dimensions of the resolution	Number of statements	Topic reliability
A The Impacts of Digital Transformation	6	0.691
Influence of Evolving Technology on the Manufacturing Industry	6	0.649
General reliability	12	0.765

Table No. (2) Shows that the study tool has statistically acceptable reliability, as the general reliability of the study was (0.765), while the reliability coefficients of the study tool ranged between (0.691, 0.649), which are high reliability coefficients that can be trusted in the application of the study tool.

5.7. Scale Application (Study Tool):

After collecting the study data, we performed a review to prepare it for computerized statistical analysis. During this process, we encoded the responses, converting verbal responses into numerical values. The scale used was a five-point Likert scale, ranging from "strongly agree" (5) to "strongly disagree" (1).

To determine the length of each cell on the scale, we calculated the range by subtracting the lowest value (1) from the highest value (5), resulting in a range of 4. We then divided this range by the number of cells on the scale (5), which yielded a cell length of 0.80. To establish the upper limit of each cell, we added the cell length of 0.80 to the lowest value of the scale (1). This process determined the upper limit of each cell, resulting in the following cell lengths:

- Cell 1: 1.00 - 1.80
- Cell 2: 1.81 - 2.60
- Cell 3: 2.61 - 3.40
- Cell 4: 3.41 - 4.20
- Cell 5: 4.21 - 5.00

By calculating the cell lengths based on the scale range, we established the boundaries of each response category, allowing for accurate analysis and interpretation of the study data.

5.8. Statistical Methods Used in Data Analysis

To achieve the study objectives and analyze the collected data using the study tool, several appropriate statistical methods were employed using the Statistical Package for the Social Sciences (SPSS) program. The following methods were utilized:

- **Frequencies and Percentages:**

Calculated to determine the personal and functional characteristics of the study sample and to identify the responses towards the key statements in the study tool.

- **Mean and Standard Deviation:**

Calculated to assess the average responses of the study sample to the study questions. This helps in organizing the statements based on their highest weighted arithmetic mean.

- **Pearson's Correlation Coefficient:**

Used to determine the degree of correlation between each question in the study. This analysis provides insights into the relationships between variables.

- **Cronbach's Alpha Coefficient:**

Employed to test the reliability of the study tool. Cronbach's alpha assesses the internal consistency or reliability of the measurements in the tool.

By applying these statistical methods, we have gains insights into the characteristics of the study sample, the average responses, correlations between variables, and the reliability of the study tool.

6. Chapter Five: Field Results

This chapter deals with presenting and discussing the results of the study by presenting the answers of the executive managers and engineers working in the industrial sector in Saudi Arabia.

6.1. Findings Overview & Interpretations

The study examined the personal data of the respondents (56) in order to address the research questions and objectives. We have discussed our interpretations in to three parts as follow:

- Respondent's personal details analysis
- First variable analysis
- Second variable analysis

The following presents an overview of the respondent's personal details and categorizes the participants as follows:

Age: Table no. 3 and Figure no. VI below shows the distribution of the study population according to the variable of the age. The results show that (12.5%) were 21-30 years old, while (69.6%) were 31-40 years old, (14.3%) were 41-50 years old and (3.6%) were over 50 years old.

Table 3: The distribution of the study population according to the variable of the age

Age	Repetition	Ratio
21 – 30	7	12.5
31-40	39	69.6
41-50	8	14.3
More than 50 years	2	3.6
Total	56	100.0

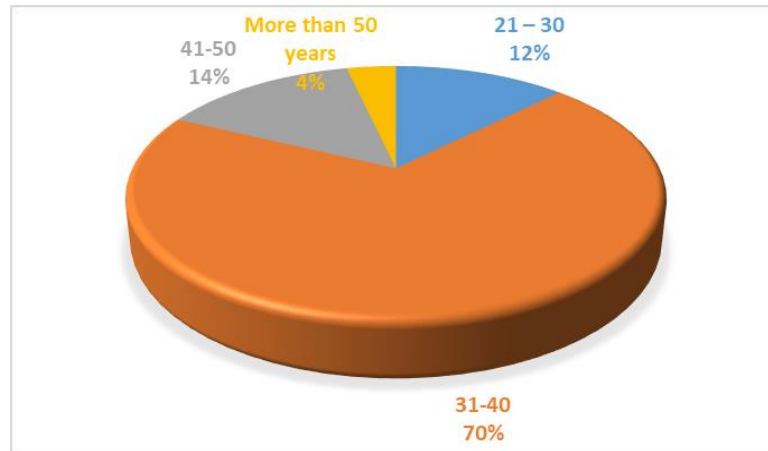


Figure VI: Distribution of the study population

Educational level: Table no. 4 and Figure no. VII shows the distribution of the population as per their educational level. The results shown in the above table show that (83.9%) their level of education was a bachelor's degree, the largest category in the study sample, and that (16.1%) their level of education was a master's degree.

Table 4: Distribution of the study population as per education level

Educational level	Repetition	Ratio
Bachelor's degree	47	83.9
Master's degree	9	16.1
Total	56	100.0

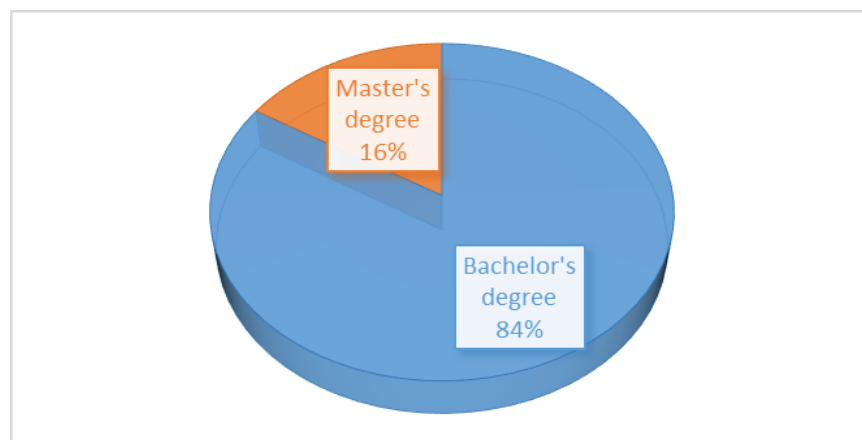


Figure VII: Distribution of the study population as per education level

- **Nationality:** Table no. 5 figure no. VIII below shows the distribution of the study population according to the nationality variable. Findings show that (53.6%) their nationality was Saudi, the largest category in the study sample, while (46.4%) their nationality was non-Saudi.

Table 5: Distribution as per nationality

Nationality	Repetition	Ratio
Saudi	30	53.6
Non-Saudi	26	46.4
Total	56	100.0

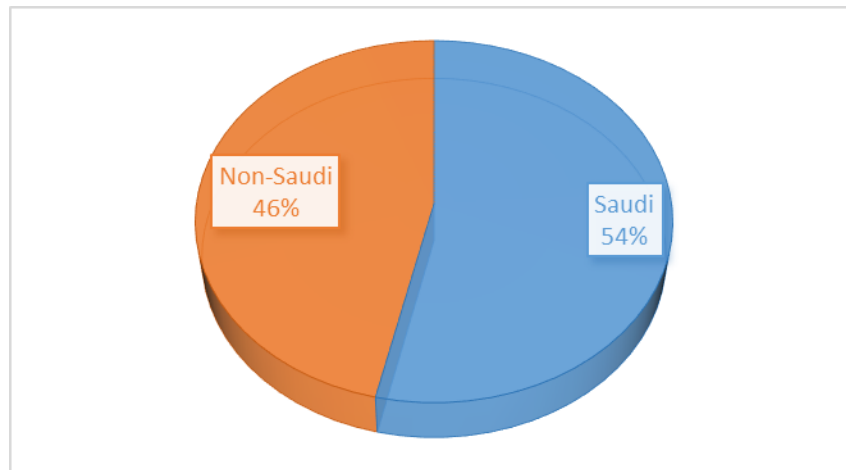


Figure VIII: Distribution as per nationality

- **Organization type:** Table No. 6 and figure IX below shows the distribution of the study population according to the organization type variable. The results in the above table show that (89%) of the total study sample was the type of organization private, while (11%) of the total study sample was the type of organization they worked for in public.

Table 6: Distribution as organization type

Organization type	Repetition	Ratio
Private	50	89.3
Public	6	10.7
Total	56	100%

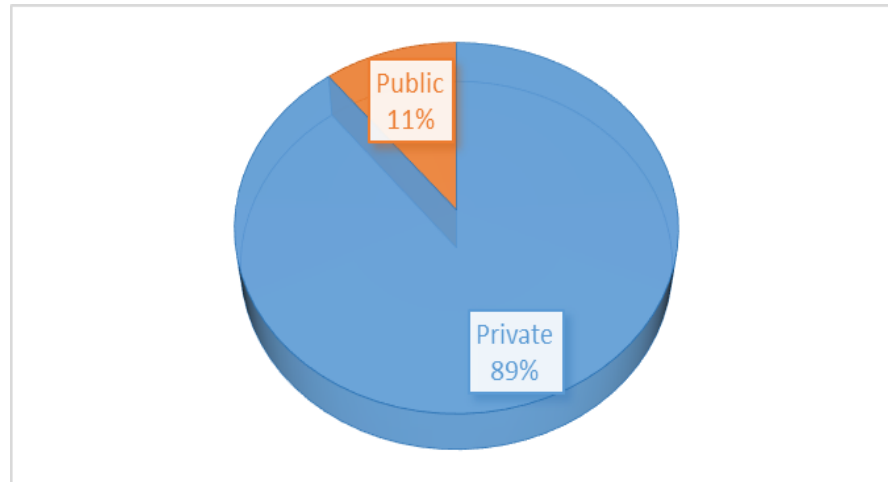


Figure IX: Distribution as organization type

The second part of the analysis is based on the first variable “Digital Transformation”. In order to assess the impact of digital transformation perspectives from executive managers and engineers working in the industrial sector in Saudi Arabia, we have analyzed the responses to the phrases related to the impacts of digital transformation. The analysis involved calculating frequencies, percentages, arithmetic averages, standard deviations, and ranks. The table no. 7 below shows the results of the study's responses.

Table 7: The responses of the study individuals to the statements of the first topic according to the averages of agreement

S	Statements	Repetition	Degree of approval							Average	Standard deviation	Rank
			Ratio %	Strongly agree	Agree	Neutral	Disagree	Strongly Disagree				
1	Digital transformation has improved operational efficiency in the Saudi Arabian manufacturing industry.	K	34	18	4	0	0	4.54	0.63	1		
		%	60.7	32.1	7.1	0	0					
2	The adoption of digital technologies has enhanced product quality in the	K	28	26	2	0	0	4.46	0.57	2		
		%	50	46.4	3.6	0	0					

	manufacturing industry in Saudi Arabia.									
4	Digital transformation has accelerated decision-making processes in the manufacturing industry in Saudi Arabia.	K	31	20	4	1	0	4.45	0.71	3
		%	55.4	35.7	7.1	1.8	0			
5	The integration of digital technologies has fostered collaboration among employees in the manufacturing industry in Saudi Arabia.	K	28	18	10	0	0	4.32	0.76	4
		%	50	32.1	17.9	0	0			
6	Digital transformation has enhanced customer satisfaction in the manufacturing industry in Saudi Arabia.	K	27	20	8	1	0	4.30	0.78	5
		%	48.2	35.7	14.3	1.8	0			
3	Digital transformation has increased the competitiveness of manufacturing companies in Saudi Arabia.	K	26	19	8	3	0	4.21	0.88	6
		%	46.4	33.9	14.3	5.4	0			
The overall mean of the topic								4.38	0.45	

According to the results in Table (7), the response of the study individuals came with a degree of strong agreement towards the statements of the impact of digital transformation, with an arithmetic mean of (4.38). Continuous review from the point of view of the executive managers and engineers, where the averages of their approval ranged between (4.54 to 4.21), which are averages located in the fifth categories of the five-scale. The five-scale indicate the level of (strongly agree) on the axis statements, which indicates the discrepancy in points of view In terms of the response of the study individuals to the impact of digital transformation from the point of view of Executive managers and engineers working in the industrial sector in Saudi Arabia, which was arranged according to the following:

- Statement number (1) came, which is: "Digital transformation has improved operational efficiency in the Saudi Arabian manufacturing industry." Ranked first in terms of the study's response to it with a response degree indicating I strongly agree, with a mean of (4.54).
- The statement (2) which is "(The adoption of digital technologies has enhanced product quality in the manufacturing industry in Saudi Arabia)" The second rank in terms of responding to it by the study individuals with a degree indicating strongly agree with a mean of (4.46).
- The statement (4) Which "Digital transformation has accelerated decision-making processes in the manufacturing industry in Saudi Arabia." In the third rank in terms of the response of the study individuals indicating strongly agree with an arithmetic average of (4.45).
- The statement (4) Which "The integration of digital technologies has fostered collaboration among employees in the manufacturing industry in Saudi Arabia" In the four ranks in terms of the response of the study individuals indicating strongly agree with an arithmetic average of (4.32).
- Statement (6) and it "Digital transformation has enhanced customer satisfaction in the manufacturing industry in Saudi Arabia." ranked penultimate in terms of the response of the study individuals to it with a response degree I strongly agree with a mean (4.30).
- The statement (3) which is "Digital transformation has increased the competitiveness of manufacturing companies in Saudi Arabia." ranked last in terms of the study's response to it with a degree of response strongly agree with an arithmetic mean (4.21).

The third part of the analysis is based on the second variable "Manufacturing Industry". To identify the influence of evolving technology on the manufacturing industry, Frequencies, percentages, arithmetic averages, standard deviations, and ranks were calculated for the responses of the study individuals to the statements on the influence of evolving technology on the manufacturing industry from the point of view of executive managers and engineers working in the industrial sector in Saudi Arabia.

The results are shown in the following table no.8.

Table 8: Responses of the study individuals on the topic statements the second is by approval ratings

S	Statements	Repetiti Ratio%	Degree of approval					Average	Standard deviation	Rank
			Strongly agree	agree	Neutral	Disagree	Strongly Disagree			
1	To what extent do you agree that the adoption of emerging technologies (such as robotics, artificial intelligence, or IoT) has enhanced productivity in the manufacturing industry in Saudi Arabia?	K	26	24	4	2	0	4.32	0.76	1
		%	46.4	42.9	7.1	3.6	0			
4	3D printing technology has enabled faster prototyping and reduced time-to-market in the manufacturing industry in Saudi Arabia	K	21	25	6	4	0	4.13	0.87	2
		%	37.5	44.6	10.7	7.1	0			
2	Evolving technologies like artificial intelligence and machine learning have improved predictive maintenance practices in the manufacturing industry in Saudi Arabia.	K	20	24	7	5	0	4.05	0.92	3
		%	35.7	42.9	12.5	8.9	0			
3	Evolving technologies have facilitated the development of smart factories in the manufacturing industry in Saudi Arabia.	K	18	24	11	3	0	4.02	0.86	4
		%	32.1	42.9	19.6	5.4	0			
5	Evolving technologies like blockchain have improved transparency and traceability in the supply chain of the manufacturing industry in Saudi Arabia.	K	20	18	13	4	1	3.93	1.02	5
		%	35.7	32.1	23.2	7.1	1.8			
6	Augmented reality (AR) and virtual reality (VR) technologies have enhanced training and skills	K	12	21	14	8	1	3.63	1.03	6
		%	21.4	37.5	25	14.3	1.8			

development in the manufacturing industry in Saudi Arabia.									
The overall mean of the topic								4.01	0.55

Through the results shown in table (8), it is clear that the response of the study respondents agrees with a degree of strongly agree about the influence of evolving technology on the manufacturing industry, with an arithmetic mean of (4.01). It is clear from the results shown above that there is a discrepancy in the response of the study individuals about the influence of evolving technology on the manufacturing industry from the point of view of the executive managers and engineers working in the industrial sector in Saudi Arabia. The averages of their agreement ranged between (4.32 to 3.63) that are refer to (strongly agree- agree) on the topic statements, which explains the variation in the response of the study individuals about the influence of evolving technology on the manufacturing industry, which were arranged according to the following:

- The statement (1) came, which is" to what extent do you agree that the adoption of emerging technologies (such as robotics, artificial intelligence, or IoT) has enhanced productivity in the manufacturing industry in Saudi Arabia" Ranked first in terms of the study's response to it with a response degree indicating I strongly agree, with a mean of (4.32).
- The statement (4) which is (3D printing technology has enabled faster prototyping and reduced time-to-market in the manufacturing industry in Saudi Arabia)" The second rank in terms of responding to it by the study individuals with a degree indicating agree with a mean of (4.13).
- The statement (2) Which "Evolving technologies like artificial intelligence and machine learning have improved predictive maintenance practices in the manufacturing industry in Saudi Arabia" In the third rank in terms of the response of the study individuals indicating agree with an arithmetic average of (4.05).
- The statement (3) Which "Evolving technologies have facilitated the development of smart factories in the manufacturing industry in Saudi Arabia" In the four ranks in terms

of the response of the study individuals indicating agree with an arithmetic average of (4.02).

- Statement (5) and it "Evolving technologies like blockchain have improved transparency and traceability in the supply chain of the manufacturing industry in Saudi Arabia" ranked penultimate in terms of the response of the study individuals to it with a response degree I agree with a mean (3.93).
- The statement (6) which is "Augmented reality (AR) and virtual reality (VR) technologies have enhanced training and skills development in the manufacturing industry in Saudi Arabia" ranked last in terms of the study's response to it with a degree of response strongly agree with an arithmetic mean (3.63).

7. Chapter 6: Results and Proposal Analysis

In this chapter, we will present the research results and provide interpretations based on the proposed hypotheses. The primary objective is to analyze the data collected from the study population, which includes executive managers and engineers working in the industrial sector in Saudi Arabia. By examining this data, we aim to test the hypotheses formulated earlier and draw meaningful conclusions from the findings.

7.1. Proposal Analysis

If we look at our propose hypothesis of our research, we reject the null hypothesis and accept the alternative hypothesis that is “There is significant influence of digital transformation evolving tech on manufacturing industry in Saudi Arabia” as the respondents results are supporting this statement. The mean of 4.38 (first variable) and 4.01 (second variable) represents the average response of the study participants to the statements related to the impacts of digital transformation on the manufacturing industry in Saudi Arabia. Since the mean is relatively high (closer to the upper end of the scale), it suggests that the participants strongly agreed with the statements.

7.2. Research Results

The participants of the study responded with a high degree of agreement towards the statements related to these topics. Here is an overview of the findings:

Impacts of Digital Transformation:

- The study participants strongly agreed (mean = 4.38) that digital transformation has improved operational efficiency in the Saudi Arabian manufacturing industry.
- They also strongly agreed that the adoption of digital technologies has enhanced and accelerated the decision-making processes, fostered collaboration among employees, and increased the competitiveness of manufacturing companies in Saudi Arabia.

Influence of Evolving Technology:

- The study respondents agreed (mean = 4.01) with a strong degree of agreement regarding the influence of evolving technology on the manufacturing industry.

- They agreed that the adoption of emerging technologies (such as robotics, artificial intelligence, or IoT) has enhanced productivity.
- The participants also acknowledged that 3D printing technology has enabled faster prototyping and reduced time-to-market in the manufacturing industry.
- They agreed that evolving technologies like artificial intelligence, machine learning, and block chain have improved various aspects of the manufacturing industry, including predictive maintenance practices, development of smart factories, and transparency and traceability in the supply chain.
- Additionally, they recognized that augmented reality (AR) and virtual reality (VR) technologies have enhanced training and skills development in the manufacturing industry.

Overall, the study findings indicate a positive perception among the participants regarding the impacts of digital transformation and the influence of evolving technology on the manufacturing industry in Saudi Arabia. The findings suggest that digital transformation has brought improvements in operational efficiency, product quality, decision-making processes, collaboration, customer satisfaction, and competitiveness. Furthermore, the adoption of evolving technologies has shown positive effects on productivity, prototyping, predictive maintenance, smart factories, supply chain transparency, and training and skills development in the manufacturing industry, which in return will greatly affect the Saudi Arabia's Economy as the performance and stability of the manufacturing sector have a significant impact on Saudi Arabia's economy. The manufacturing sector contributes to various aspects of economic growth and development, and any fluctuations or changes in its performance can have far-reaching effects.

7.3. Recommendations

Based on the study's findings, the following recommendations can be made:

- **Embrace Digital Transformation:**
Companies should view digital transformation as an imperative rather than an experimental endeavor. It is crucial for companies to adapt and leverage digital technologies to remain competitive in today's business environment.

- **Focus on Successful and Fast Implementation:**

The success and speed of implementing digital transformation technologies can be a key differentiating factor for companies. Organizations should prioritize efficient and effective adoption of digital technologies to gain a competitive edge.

- **Implement Real-Time Improvement Systems:**

To enhance profitability, companies should integrate production process control systems with production planning processes. Real-time improvement systems allow for better monitoring and control of production processes.

- **Utilize Artificial Intelligence in Control Systems:**

Applying artificial intelligence in traditional control systems can significantly improve the efficiency of production processes. AI technologies can optimize operations, enhance decision-making, and drive productivity gains in manufacturing.

- **Adopt Predictive Maintenance Solutions:**

To improve equipment reliability and reduce breakdowns, companies should implement predictive maintenance solutions based on artificial intelligence and machine learning technology. These solutions allow for proactive identification of maintenance needs, minimizing downtime and optimizing production.

- **Leverage Predictive Analysis:**

Predictive analysis, which involves using historical data from multiple locations, can play a crucial role in the industrial sector. It enables companies to predict equipment malfunctions before they occur, allowing for proactive maintenance and minimizing disruptions.

These recommendations aim to guide companies in effectively leveraging digital transformation technologies to enhance their competitiveness, improve production processes, and optimize overall performance in the manufacturing sector.

References and Appendices

This chapter presented a comprehensive list of all the sources cited in the study along with the study abstract. The abstract serves as a concise summary of the study, providing an overview of its objectives, methods, key findings, and implications. It is designed to provide readers with a preview of the research conducted.

8. References

Accely. (2023). Digital Transformation Services- Empower Digitilization. Retrieved from <https://www.accely.com/sa-en/digital-transformation/>

Ali, H. (2022). Digital transformation, development and productivity in developing countries: is artificial intelligence a curse or a blessing? Retrieved from <https://www.emerald.com/insight/content/doi/10.1108/REPS-11-2019-0145/full/html>

Arabia, S. (n.d.). National Transformation Program. *Vision 2030*. Retrieved from <https://www.vision2030.gov.sa/v2030/vrps/ntp/>

Articles, E. Y. (2023). Technological innovation in Saudi manufacturing. *Interview*. Retrieved from <https://theenergyyear.com/articles/technological-innovation-in-saudi-manufacturing/>

Assaf, A. (2017). Guidelines for developing, translating, and validating a questionnaire.

Bittanica. (n.d.). Manufacturing Industry of Saudi Arabia. Retrieved from <https://www.britannica.com/place/Saudi-Arabia/Manufacturing>

Economics, T. (2023). Saudi Arabia - Manufacturing. Retrieved from <https://tradingeconomics.com/saudi-arabia/manufacturing-value-added-percent-of-gdp-wb-data.html>

Flanders. (2021). Manufacturing and Industry Sector in Saudi Arabia. Retrieved from https://www.flandersinvestmentandtrade.com/export/sites/trade/files/market_studies/2021-Saudi%20Arabia%20Manufacturing%20Industry%20Sector_0.pdf

Gov. (2023). Vision 2030. Retrieved from <https://www.vision2030.gov.sa/>

Group, O. B. (n.d.). Saudi Arabia leverages disruptive technologies to solve pressing challenges.

Gupta, A. (2023). Saudi Arabia is achieving fast digital transformation, digitizing 97% of government services. Retrieved from <https://fastcompany.com/news/saudi-arabia-is-achieving-fast-digital-transformation-digitizing-97-of-government-services/>

How digital transformation is changing the fabric of a nation - Saudi Arabia. (n.d.). Retrieved from https://www.ey.com/en_ae/digital/how-digital-transformation-is-changing-the-fabric-of-a-nation

IBM. (2023). Digital Transformation. Retrieved from <https://www.ibm.com/topics/digital-transformation>

IDC. (2020). Factory Digitization in Saudi Arabia. Retrieved from <https://www.ge.com/digital/lp/idc-factory-digitization-saudi-arabia#:~:text=Manufacturing%20digitization%20is%20one%20of,vision%20of%20the%20industrial%20sector.>

Intelligence, M. (2023). DIGITAL TRANSFORMATION IN MANUFACTURING INDUSTRY SIZE & SHARE ANALYSIS - GROWTH TRENDS & FORECASTS (2023 - 2028). Retrieved from <https://www.mordorintelligence.com/industry-reports/digital-transformation-market-in-manufacturing>

Joshi, R. (2022). Digital Transformation and Manufacturing.

Lawton, G. (2022). Descriptive analytics. Retrieved from <https://www.techtarget.com/whatis/definition/descriptive-analytics#:~:text=Descriptive%20analytics%20is%20a%20type,visualizations%20that%20are%20easily%20understood.>

News, A. (2023). Saudi Arabia's digital transformation quickens. Retrieved from <https://www.arabnews.com/node/2303836/business-economy>

Ping, He, & Gao Yao Ying. (2018). Comprehensive view on the effect of artificial intelligence on employment. Topics in Education, Culture and Social Development. *Google Scholar*.

Qahtani, A. (2004). Qualitative Research: Data Collection, Analysis, and Management.

Report, D. E. (2019). Value Creation and Capture. Retrieved from <https://unctad.org/publication/digital-economy-report-2019>

Sarabdeen, M., & Hind Alofaysan. (2022). Digital Transformation on the Labor Market in the Era of Changing Digital Transformation Dynamics in Saudi Arabia. Retrieved from <https://doi.org/10.3390/economies11010012>

Saudi Arabia steps up drive to localise industry. (n.d.). Retrieved from <https://country.eiu.com/article.aspx?articleid=1673280950&Country=Saudi+Arabia&topic=Economy>

SCJ. (2023). Saudi Arabia implements Data Driven-Government to realise digital economy as part of the Vision 2030. Retrieved from <https://www.thesmartcityjournal.com/en/events/saudi-arabia-implements-data-driven-government-to-realise-digital-economy-as-part-of-the-vision-2030>

Srivastava, A. (2023). Digital Transformation: The Key to Success for Saudi Vision 2030.

Statista. (2023). Statista Market Forecast. Retrieved from <https://www.statista.com/outlook/io/manufacturing/saudi-arabia>

Statista. (n.d.). Manufacturing - Saudi Arabia | Statista Market Forecast. 2022. Retrieved from <https://www.statista.com/outlook/io/manufacturing/saudi-arabia#:~:text=Value%20Added%20in%20Manufacturing%20market,US%24156bn%20in%202023.>

Tech. (2022). Digital Transformation Market - KSA. Retrieved from <https://www.techsciresearch.com/report/saudi-arabia-digital-transformation-market/15365.html>

9. Appendices

The appendix 1 below represents the questionnaire paper of the research conducted.

Appendix 1: Questionnaire Paper

أثر التحول الرقمي والتكنولوجيا المتطورة على القطاع الصناعي في المملكة العربية السعودية

The Impacts of Digital Transformation Evolving Tech on Manufacturing Industry in Saudi Arabia

المستوى التعليمي Education *

- ☐ ثانوية عامة High School
- ☐ بكالوريوس Bachelors
- ☐ ماجستير Masters
- ☐ دكتوراه PHD

العمر Age *

- ☐ أقل من 20 سنة Below 20
- ☐ 21-30
- ☐ 31-40
- ☐ 41-50
- ☐ أكثر من 50 سنة Above 50

نوع المنظمة Organization Type *

- ☐ عام Public
- ☐ خاص Private

الجنسية Nationality *

- ☐ سعودي Saudi
- ☐ غير سعودي Non-Saudi

The Impacts of Digital Transformation أثر التحول الرقمي

* أدى التحول الرقمي إلى تحسين الكفاءة التشغيلية في القطاع الصناعي في المملكة العربية السعودية.

Digital transformation has improved operational efficiency in the Saudi Arabian manufacturing industry.

- ☐ Strongly agree موافق بشدة
- ☐ agree موافق
- ☐ Neutral محايد
- ☐ Disagree غير موافق
- ☐ Strongly Disagree غير موافق بشدة

* أدى اعتماد التقنيات الرقمية إلى تحسين جودة المنتجات في القطاع الصناعي في المملكة العربية السعودية.

The adoption of digital technologies has enhanced product quality in the manufacturing industry in Saudi Arabia.

- ☐ Strongly agree موافق بشدة
- ☐ agree موافق
- ☐ Neutral محايد
- ☐ Disagree غير موافق
- ☐ Strongly Disagree غير موافق بشدة

* أدى التحول الرقمي إلى زيادة القدرة التنافسية لشركات التصنيع في المملكة العربية السعودية.

Digital transformation has increased the competitiveness of manufacturing companies in Saudi Arabia.

- ☐ Strongly agree موافق بشدة
- ☐ agree موافق
- ☐ Neutral محايد
- ☐ Disagree غير موافق
- ☐ Strongly Disagree غير موافق بشدة

* أدى التحول الرقمي إلى تسريع عمليات اتخاذ القرار في القطاع الصناعي في المملكة العربية السعودية.

Digital transformation has accelerated decision-making processes in the manufacturing industry in Saudi Arabia.

- ☐ Strongly agree موافق بشدة
- ☐ agree موافق
- ☐ Neutral محايد
- ☐ Disagree غير موافق
- ☐ Strongly Disagree غير موافق بشدة

* تكامل التقنيات الرقمية ساهم في تعزيز التعاون الداخلي بين الموظفين في القطاع الصناعي في المملكة العربية السعودية.

The integration of digital technologies has fostered collaboration among employees in the manufacturing industry in Saudi Arabia.

- ☐ Strongly agree موافق بشدة
- ☐ agree موافق
- ☐ Neutral محايد
- ☐ Disagree غير موافق
- ☐ Strongly Disagree غير موافق بشدة

* أدى التحول الرقمي إلى تعزيز رضا العملاء في القطاع الصناعي في المملكة العربية السعودية.

Digital transformation has enhanced customer satisfaction in the manufacturing industry in Saudi Arabia.

- ☐ Strongly agree موافق بشدة
- ☐ agree موافق
- ☐ Neutral محايد
- ☐ Disagree غير موافق
- ☐ Strongly Disagree غير موافق بشدة

Influence of Evolving Technology on the Manufacturing Industry

* إلى أي مدى توافق على أن اعتماد التقنيات الناشئة (مثل الروبوتات أو الذكاء الاصطناعي أو إنترنت الأشياء) قد عزز الإنتاجية في القطاع الصناعي في المملكة العربية السعودية؟

To what extent do you agree that the adoption of emerging technologies (such as robotics, artificial intelligence, or IoT) has enhanced productivity in the manufacturing industry in Saudi Arabia

- ☐ موافق بشدة Strongly agree
- ☐ موافق agree
- ☐ محايد Neutral
- ☐ غير موافق Disagree
- ☐ غير موافق بشدة Strongly Disagree

* أدت التقنيات المتطورة مثل الذكاء الاصطناعي والتعلم الآلي إلى تحسين ممارسات الصيانة التنبؤية في القطاع الصناعي في المملكة العربية السعودية.

Evolving technologies like artificial intelligence and machine learning have improved predictive maintenance practices in the manufacturing industry in Saudi Arabia.

- ☐ موافق بشدة Strongly agree
- ☐ موافق agree
- ☐ محايد Neutral
- ☐ غير موافق Disagree
- ☐ غير موافق بشدة Strongly Disagree

* سهلت التقنيات المتطورة تطوير المصانع الذكية في القطاع الصناعي في المملكة العربية السعودية.

Evolving technologies have facilitated the development of smart factories in the manufacturing industry in Saudi Arabia.

- ☐ موافق بشدة Strongly agree
- ☐ موافق agree
- ☐ محايد Neutral
- ☐ غير موافق Disagree
- ☐ غير موافق بشدة Strongly Disagree

* مكنت تقنية الطباعة ثلاثية الأبعاد من إنشاء نماذج أولية أسرع وتقليل الوقت اللازم للتسويق في القطاع الصناعي في المملكة العربية السعودية

3D printing technology has enabled faster prototyping and reduced time-to-market in the manufacturing industry in Saudi Arabia

- ☐ Strongly agree موافق بشدة
- ☐ agree موافق
- ☐ Neutral محايد
- ☐ Disagree غير موافق
- ☐ Strongly Disagree غير موافق بشدة

* أدت التقنيات المتطورة مثل blockchain إلى تحسين الشفافية وإمكانية التتبع في سلاسل التوريد الخاصة بالقطاع الصناعي في المملكة العربية السعودية.

Evolving technologies like blockchain have improved transparency and traceability in the supply chain of the manufacturing industry in Saudi Arabia.

- ☐ Strongly agree موافق بشدة
- ☐ agree موافق
- ☐ Neutral محايد
- ☐ Disagree غير موافق
- ☐ Strongly Disagree غير موافق بشدة

* عززت تقنيات الواقع المعزز (AR) والواقع الافتراضي (VR) التدريب وتنمية المهارات في القطاع الصناعي في المملكة العربية السعودية.

Augmented reality (AR) and virtual reality (VR) technologies have enhanced training and skills development in the manufacturing industry in Saudi Arabia

- ☐ Strongly agree موافق بشدة
- ☐ agree موافق
- ☐ Neutral محايد
- ☐ Disagree غير موافق
- ☐ Strongly Disagree غير موافق بشدة

---End of Project---

---Special Thanks to Dr. Walid Sulaiman---