Dimensions of Artificial Intelligence and Data Strategies in Industrial Enterprises and Achieving Sustainable Leadership: A Reading in the Saudi Industrial National Strategy 2016-2030

أبعاد استراتيجيات الذكاء الاصطناعي والبيانات في المؤسسات الصناعية وتحقيق الريادة المستدامة: قراءة في الاستـراتيجية الوطنيـة للصناعـة السعودية 2016–2030

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Abstract:

It is very difficult to imagine an industry that will not be significantly impacted by data and artificial intelligence, contributing to enhancing economic performance, reducing costs, and improving operational efficiency. Artificial intelligence is expected to increase the global Gross Domestic Product (GDP) by approximately 14%, which is equivalent to around 58.9 trillion Saudi Riyals by 2030. It is anticipated that the Kingdom of Saudi Arabia will be a leader in the Middle East region in the artificial intelligence and big data market. Artificial intelligence plays a vital role in the future of the automation sector in the country. According to the Digital Riser 2020 report by the European Center for Digital Competitiveness, Saudi Arabia ranked first among the G20 countries. This substantial investment in artificial intelligence indicates that the contours of the industrial sector will change radically in the future. This study aims to elucidate the dimensions of artificial intelligence and data strategies in industrial enterprises and achieve sustainable leadership, with an analysis of the Saudi Industrial National Strategy 2016-2030.

Key words: *Artificial Intelligence, Big Data, Industry, Sustainable Leadership.*

ملخص:

من الصعب جدا التفكير في صناعة لن يكون للبيانات وللذكاء الاصطناعي تأثير قوي عليه، ما يسهم في تعزيز الأداء الاقتصادي، وتقليل التكاليف، وتحسين كفاءة الأعمال، ومن المتوقع أن يزيد الذكاء الاصطناعي الناتج المحلي الإجمالي العالمي GDP بنسبة، 14% أي ما يقارب 58.9 تريليون ريال سعودي بحلول 2030. من المتوقع أن تكون المملكة العربية السعودية من الدول الرائدة في منطقة الشرق الأوسط في سوق الذكاء الاصطناعي والبيانات الضخمة، يلعب الذكاء الاصطناعي دورًا حيويًا في مستقبل قطاع الأتمتة في البلاد. وفقًا لتقرير $Digital\ Riser\ 2020$ الصادر عن المركز الأوروبي للتنافسية الرقمية، احتلت المملكة العربية السعودية المرتبة الأولى بين دول مجموعة العشرين، هذا الاستثمار الهائل في الذكاء الاصطناعي، يؤشر على ان معالم القطاع الصناعي ستتغير جذريا في المستقبل، تهدف هذه الدراسة الى محاولة تبيان ابعاد استراتيجيات الذكاء الاصطناعي والبيانات في المؤسسات الصناعية وتحقيق الريادة المستدامة مع قراءة في الاستـراتيجية الوطنية للصناعـة السعودية 2016–2030.

الكلمات المفتاحية: الذكاء الاصطناعي، البيانات الضخمة، الصناعة، الريادة المستدامة.

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1. INTRODUCTION

The world is experiencing a new era in human history called the Fourth Industrial Revolution, a period marked by the use of artificial intelligence and data technology. This involves the ability of computer systems to use intelligence to enhance the quality and efficiency of systems and computer processes in various sectors of the economy such as healthcare, education, transportation, industry, and energy. Artificial intelligence is used in a wide range of industries and affects almost every aspect of innovation. The growth of artificial intelligence is boosted by the availability of large amounts of training data and advancements in high-performance computing at an acceptable cost.

The concept of the Fourth Industrial Revolution, which emerged from Germany a few years ago, revolves around industrial automation and reducing the workforce, limiting human roles in the industry to supervision. This necessitates the use of scientific capabilities to possess an advanced technological and digital infrastructure. The new revolution will be a double-edged sword: with many positives and negatives affecting everyone, including advanced societies. Countries around the world are racing to integrate artificial intelligence technologies across various economic sectors and government departments to increase the efficiency and productivity of their economies. In the Middle East region, it is clear that many countries are striving to compete in this field, especially Saudi Arabia, the United Arab Emirates, Kuwait, Jordan, and Turkey.

Thanks to rapid progress in this type of technology in recent years, studies by PWC anticipate that artificial intelligence will contribute to 45% of the total increase in economic profits resulting from the development of goods and services by the year 2030. It is also expected that the contribution of artificial intelligence to the global economy will reach approximately $15.7 trillion by that year.

Saudi Arabia has been relying on Vision 2030 since 2016, which includes a wide range of plans and national programs aimed at transforming the Kingdom into a global investment powerhouse, moving away from its reliance on oil as a primary economic driver. As part of this vision, the Kingdom developed the National Strategy for Data and Artificial Intelligence, aimed at integrating artificial intelligence technologies and data analysis with all plans related to each economic sector.

Saudi Arabia has achieved first place globally in the Government AI Strategy Index, one of the global rankings of artificial intelligence by "Tortoise Intelligence" (a global company with an advisory board of experts in artificial intelligence from around the world), measuring over 60 countries worldwide.

It is expected that Saudi Arabia will be one of the leading countries in the Middle East in the artificial intelligence and big data market due to increased government investments in new technologies. Therefore, artificial intelligence plays a vital role in the future of the automation sector in the country. According to the Digital Riser 2020 report by the European Center for Digital Competitiveness, Saudi Arabia ranked first among the G20 countries. This massive investment in artificial intelligence indicates that the contours of the industrial sector will change radically in the future, especially with the evolution of complementary fields such as big data and the Internet of

Things. Future factories will need to transform into digital companies to maintain their competitiveness, given the declining costs of implementing artificial intelligence, contributing to the increased efficiency and quality of production.

The state demonstrates its readiness to embrace artificial intelligence, and the presentation of the Saudi Vision 2030 is considered a significant advancement in the value of data as a public asset. Approximately 70% of the 96 strategic goals within the Vision 2030 framework are linked to data and artificial intelligence.

1.1 Study problem

The problem of this study can be formulated in the following main question:

To what extent do artificial intelligence and data strategies contribute to sustainable leadership in industrial institutions? With a reading in the Saudi Industrial National Strategy 2016-2030.

1.2 Study objectives

- An attempt to understand the applications of artificial intelligence and data as an approach to developing the industry in its various sectors, and an attempt to shed light on the stages of the development, emergence, and importance of artificial intelligence and its impact on the industry.
- Attempting to diagnose the state of artificial intelligence globally and rank the countries in the Global Artificial Intelligence Index. Also, understanding the rankings of Arab and Saudi Arabian countries, especially on a global scale.
- Understanding the national strategy of Saudi Arabia for data and artificial intelligence, aiming to integrate artificial intelligence technologies and data analysis with all plans related to each economic sector.

1.3 Study importance

The importance of the study lies in:

- The fundamental concepts of artificial intelligence and data and their importance.

- Attempting to understand the applications of artificial intelligence and data that can be used in the industry.

- How artificial intelligence strategies can be utilized in industry development.

- Attempting a reading of the Saudi Industrial National Strategy 2016-2030.

1.4 Study Structure

To address the aforementioned issue, we will delve into the following aspects:

- The theoretical framework and concepts of artificial intelligence and big data.
- The Global AI Index by Tortoise Intelligence and the strategic direction for the Kingdom.

- The Saudi National Industrial Strategy Vision 2030.
- The contribution of artificial intelligence and data strategies to achieving sustainable leadership in industrial institutions.

2. The Theoretical Framework and Concepts of Artificial Intelligence and Big Data

2.1 Concepts About Artificial Intelligence

2.1.1 History of Artificial Intelligence:

Key events and milestones in the development of artificial intelligence include the following:

- **1950:** Alan Turing publishes "Computing Machinery and Intelligence." In this paper, Turing, famous for breaking the Nazi ENIGMA code during World War II, poses the question "Can machines think?"

- **1956:** John McCarthy coined the term 'Artificial Intelligence' at the first-ever AI conference at Dartmouth College.

- **1980s:** Neural networks using backpropagation algorithms to train themselves became widely used in artificial intelligence applications.

- **2011:** IBM Watson outperforms champions Ken Jennings and Brad Rutter in the Jeopardy! challenge.

- **2015:** Baidu's Minwa supercomputer uses a special type of deep neural network called Convolutional Neural Network (CNN) to recognize and classify images with a higher accuracy rate (MOOC, 2019).

- **2016:** DeepMind's AlphaGo program, powered by a deep neural network, defeats Lee Sedol, the world champion Go player, in a five-game match. This victory is significant due to the immense number of possible moves as the game progresses (over 14.5 trillion after just four moves!).

2.1.2 Concepts About Artificial Intelligence

Financial technology can be applied to any financial innovation in how individuals conduct business in payments, as well as in the use of ATMs in their current traditional form.

As for artificial intelligence, since its inception in 1956, it has been defined as the intelligence exhibited by machines and software that mimics human mental abilities, such as the ability to learn, reason, and react. It is the machine's ability to simulate human thinking and how it works, such as its ability to think, discover, and learn from past experiences.
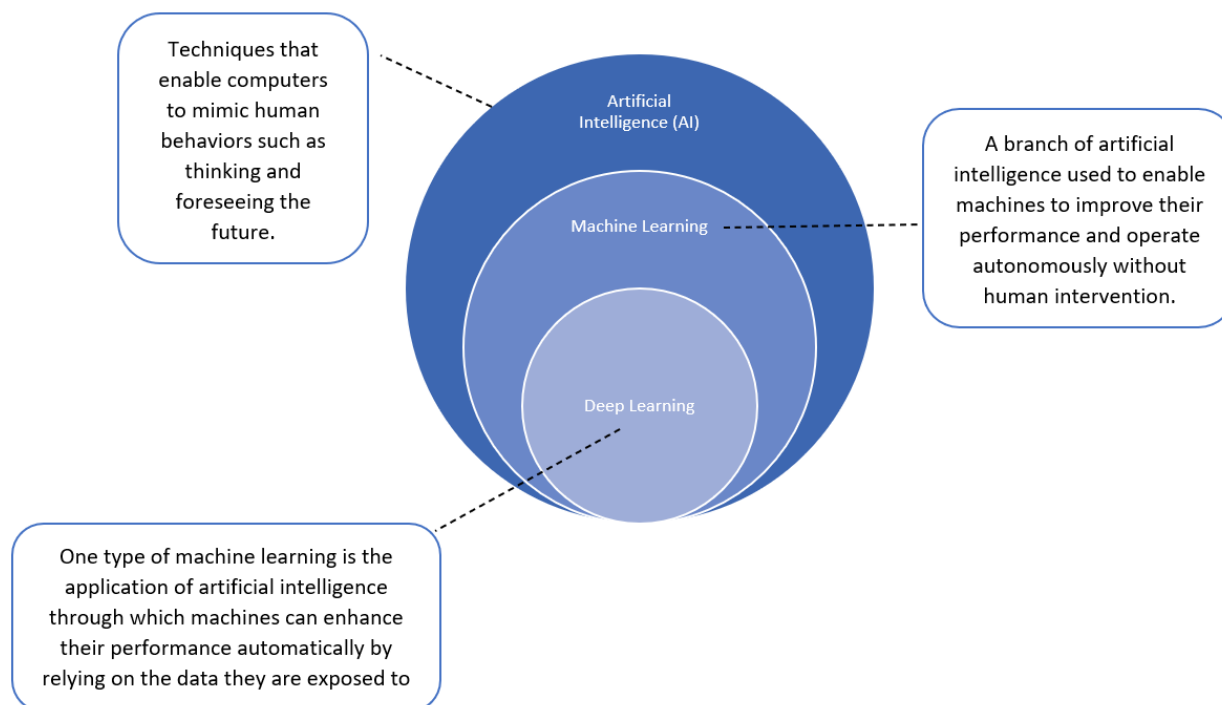
The use of artificial intelligence in banking and financial services can reduce operating costs and improve the performance and profitability of financial institutions. Therefore, most institutions strive to invest in modern financial technology applications and artificial intelligence.

Here are some examples of using artificial intelligence in financial services:

- Assessing the creditworthiness of customers.

- Communicating with customers through ChatBot chatbots.

- Assessing Key Performance Indicators (KPI).

The above clarifies what financial technology and artificial intelligence are (IBM, 2021).

Fig.1. Areas where artificial intelligence is employed to achieve specific goals


Techniques that enable computers to mimic human behaviors such as thinking and foreseeing the future.

Artificial Intelligence (AI)

A branch of artificial intelligence used to enable machines to improve their performance and operate autonomously without human intervention.

Machine Learning

Deep Learning

One type of machine learning is the application of artificial intelligence through which machines can enhance their performance automatically by relying on the data they are exposed to

Source: United Nations Educational, Scientific and Cultural Organization (UNESCO) 2020

It is expected that the banking sector will benefit significantly from artificial intelligence systems, as specialized reports indicate the expected role of artificial intelligence techniques in enabling the banking community to achieve savings exceeding 1 trillion dollars by 2030 (UNESCO, 2021). In contrast, PwC Middle East expects technology to contribute $320 billion to the total GDP in the Middle East during the same period. Given the immense potential of artificial intelligence technologies in the face of increasing demand for high-tech banking services by technology-savvy clients, many financial institutions have turned to adopting artificial intelligence as part of their relentless pursuit of leadership in the digital age, where automation represents one of its prominent features.

Global development is closely linked to the use of artificial intelligence and big data. Artificial intelligence can contribute up to $15.7 trillion to the global economy by 2030, which is more than the current combined GDP of China and India (PWC, 2017).

2.1.3 Reasons for adopting artificial intelligence

Fig.2. Reasons for adopting artificial intelligence
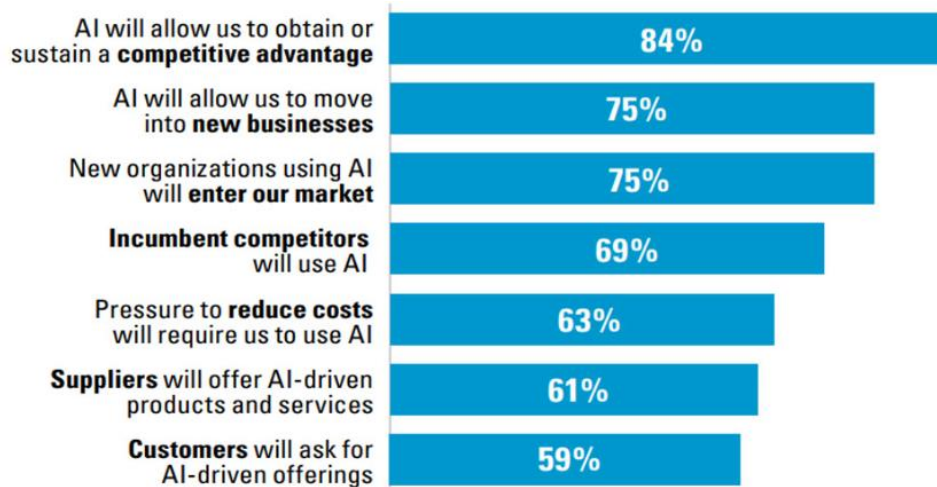
Source: *(Stellar Consulting, 2017)*

As shown in the figure, there are multiple reasons for adopting artificial intelligence in organizations, as it contributes to cost reduction, thus supporting competitiveness.

The global artificial intelligence market in the financial technology sector was estimated to be around 7.91 billion U.S. dollars in 2020 and is expected to reach 26.67 billion U.S. dollars by 2026. The market is also expected to witness a compound annual growth rate of 23.17% during the forecast period (2021 – 2026).

Table 1. Artificial Intelligence as a Service

Technology Companies	Artificial Intelligence as a Service	Company Description
Alibaba	Cloud Computing	Cloud-based artificial intelligence tools to support business requirements, global internet network sites, or applications: https://www.alibabacloud.com
Amazon	Amazon Web Services	Pre-trained artificial intelligence service for computer vision, language, recommendations, and predictions. It can rapidly create, train, and deploy machine learning models at scale or build custom models with support for all major open-source frameworks: https://aws.amazon.com/machine-learning
Baidu	Easy Deep Learning	Allows customers to build high-quality custom artificial intelligence models without programming: https://ai.baidu.com/easydl
Google	Stream Motor	An open-source, comprehensive core system for machine learning, including an ecosystem of tools, libraries, and community resources that enable researchers to share the latest technology advancements in machine learning and developers to easily build and deploy machine learning-powered applications: https://www.tensorflow.org/
IBM	Watson	Enables users to bring artificial intelligence tools and applications to the data wherever it resides, regardless of the underlying host system: www.ibm.com/watson
Microsoft	Azure	Includes over 100 services to build, deploy, and manage applications: azure.microsoft.com
Tencent	WeStart	Empowers professional capabilities, talents, and industry resources in support of launching or boosting startups. It connects industry partners and implements and applies artificial intelligence technology across various industry sectors: https://westart.tencent.com/ai

Source: *(UNESCO, 2021)*

Fig.3. Market value of assets managed by robot advisors between 2015/2020 in trillions of dollars
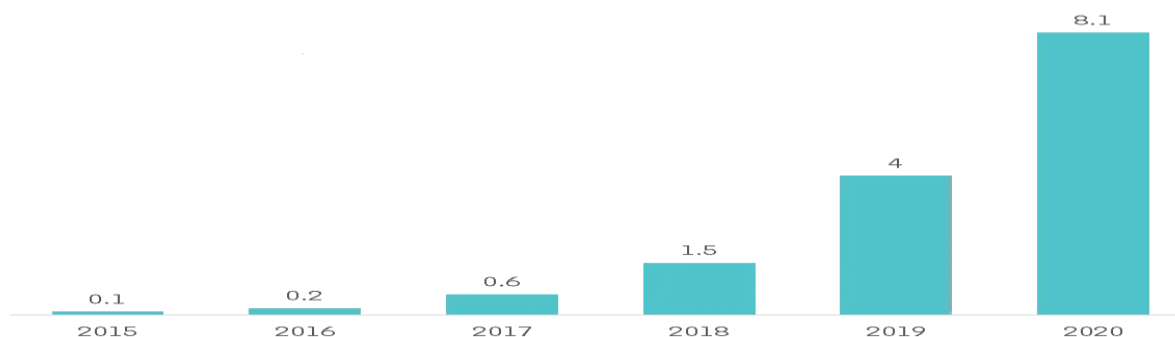
Source: *(Business Insider, 2020)*

2.2 Concepts about Big Data

2.2.1 History of Big Data

Although the concept of big data is relatively new, the foundations of large datasets can be traced back to the 1960s and 1970s when the world of data was just beginning with the first data centers and the development of relational database. Around 2005, people began to realize the amount of data users generate through platforms like Facebook and YouTube. Hadoop (an open-source framework created specifically for storing and analyzing large datasets) was developed around the same time. NoSQL also began gaining popularity during this period. The development of open-source frameworks like Hadoop (and more recently Spark) was crucial for the growth of big data as they made working with big data easier and cheaper in terms of storage. In the years following, the volume of big data skyrocketed. Users continued to generate massive amounts of data, not only humans. With the advent of the Internet of Things (IoT), more objects and devices are connected to the internet, collecting data about customer usage patterns and product performance. The emergence of machine learning has also contributed to the production of more data. Although big data has come a long way, its benefits are only beginning to unfold. Cloud computing has expanded big data further. The cloud provides true elastic scalability, allowing developers to easily create custom datasets for testing subsets of data. Graph databases have also gained increasing importance due to their ability to display massive amounts of data in a way that makes analysis fast and comprehensive (Bragazzi, Damiani, & Martini, 2019, p. 03).

2.2.2 Key Information about Big Data

Almost every department in a company can benefit from the insights derived from analyzing Big Data, but dealing with the chaos and noise can lead to challenges.

Big Data is often stored in computer databases and analyzed using software specifically designed to handle large and complex data sets. Volume, variety, velocity, and veracity are some characteristics of Big Data. Big Data is a large quantity of diverse information that is growing in size and speed faster than ever.

Improved customer service, better operational efficiency, and better decision-making are some

advantages of Big Data. Big Data can be organized (often digital, easy to format and store) or unstructured (less formatted, less quantifiable). Big Data can be 1) structured, 2) unstructured, 3) semi-structured. Big Data can be collected from publically shared comments on social networks and websites, voluntarily collected information from electronic devices and personal applications, surveys, product purchases, electronic logins, and other sources.

2.2.3 The Future of Big Data and Key Players

Big Data is not a passing trend. In terms of usage, there is a need to work on data more deeply to create value, along with technological skills that were not available in the past. However, given the evolving technologies that show no signs of fading away, we cannot speak of a real standard or standards in the field of Big Data.

Many Big Data applications are still in their infancy, and we can expect to see unexpected uses in the future. In a way, Big Data is a turning point for institutions, as important as the advent of the internet in its time. Therefore, every business should start embracing Big Data now. Otherwise, there is a risk that they will realize in a few years that the competition has surpassed them. Governments and public bodies address this issue through open data. The Big Data sector has attracted many. This sector is rapidly evolving in various industries. In the information technology sector, we find major suppliers of IT solutions such as Oracle, HP, SAP, and IBM. There are also web players like Google, Facebook, or Twitter. For specialists in data and Big Data solutions, we can cite MapR, Teradata, EMC, or Hortonworks. CapGemini, Sopra, Accenture, and Atos are integration companies and are always major players in Big Data. In the analytics industry, BI editors include SAS, Micro-Strategy, and Qliktech. This sector also includes specialized analytics providers such as Datameer or Zettaset. In addition to these major participants, many small and medium-sized companies specializing in Big Data have emerged across the value chain in the sector (Brauer, Castillo-Chavez, & Castillo-Chavez, 2012, p. 508).

Fig.4. The Future of Big Data
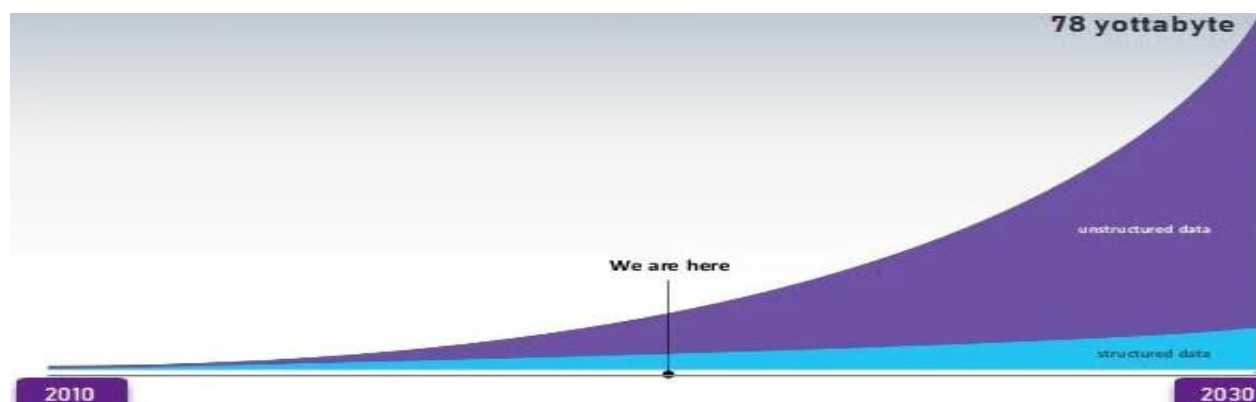
Source: IDC Data Age 2025

### 2.3 The Relationship Between Artificial Intelligence and Big Data

The ability of artificial intelligence to operate in a manner that meets the requirements of big

data analysis is the main reason that makes artificial intelligence and big data inseparable in many applications. Big data is the lifeblood of artificial intelligence; it needs to learn from it to perform its function, to be more intelligent. On the other hand, big data becomes more valuable when used in artificial intelligence algorithms.

The world was submerged in massive amounts of data, not realizing its potential, until the term "big data" emerged. Everyone then realized that their stored data represents a huge wealth that can be utilized to gain new insights and make informed decisions in the industry to which this data belongs. This created the need to develop artificial intelligence algorithms to accomplish this task (Bragazzi, Damiani, & Martini, 2019).

Fig.5. The Relationship Between Artificial Intelligence and Big Data
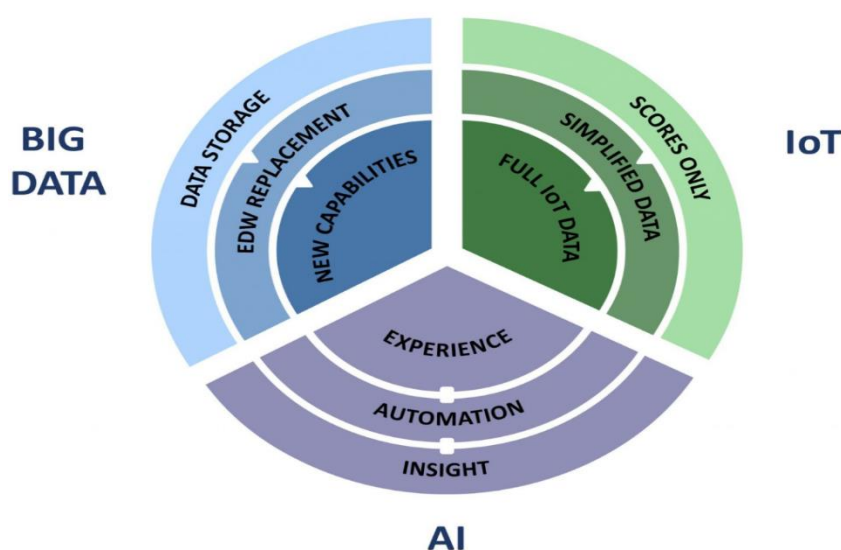
Source: *(Chan, 2020)*

3. Global AI Ventures and the Strategic Direction of the Kingdom

3.1v Tortoise Intelligence:

A global perspective on artificial intelligence investments and adoption has been taken by the Gulf Cooperation Council (GCC) countries. The United Arab Emirates (UAE) has been a notable leader in this endeavor, launching a national strategy for artificial intelligence and an autonomous transportation strategy. The UAE also appointed its first Minister of Artificial Intelligence, estimating that AI could contribute $182 billion to the economy by 2035. The UAE initiative aims to improve government performance, foster an innovative culture, and create a productive business environment. Integrating artificial intelligence into the fabric of society is a fundamental pillar of the UAE's broader UAE Vision 2071 goals, aiming to position the UAE among the world's best and most innovative countries.

In Saudi Arabia, the National Transformation Strategy for Saudi Vision 2030 has been developed, highlighting digital transformation as a key enabler, with artificial intelligence holding immense economic potential. At the GCC level, it is expected that artificial intelligence will

contribute $15.7 trillion to the global economy by 2030 and $320 billion to the Middle East's economy, specifically constituting 11% of the GDP during the 2008-2018 period. The UAE invested $2.15 billion in artificial intelligence during this time frame. Additionally, Saudi Arabia invested in AI-led technology companies through its stake in the SoftBank Vision Fund and the Public Investment Fund.

Table 2. Key Indicators Related to the Development of the Artificial Intelligence Industry and its Market in the Gulf Cooperation Council (GCC) Countries Influencing It

Country	Artificial Intelligence Readiness Index	Ranking in the Artificial Intelligence Index	Research and development expenditure as a percentage of Gross Domestic Product (GDP)	Gross Domestic Product (GDP)
Bahrain	54.709	43	0.1	38.47
Oman	52.099	48	0.17	76.33
Qatar	56.78	37	0.47	146.37
Saudi Arabia	56.226	38	0.07	700.12
United Arab Emirates	72.375	16	0.7	421.14
Kuwait	Not applicable	Not applicable	0.3	136.2

Source: *(PWC, 2018)*

**Fig.6.** Contribution of World Countries to Artificial Intelligence by 2030
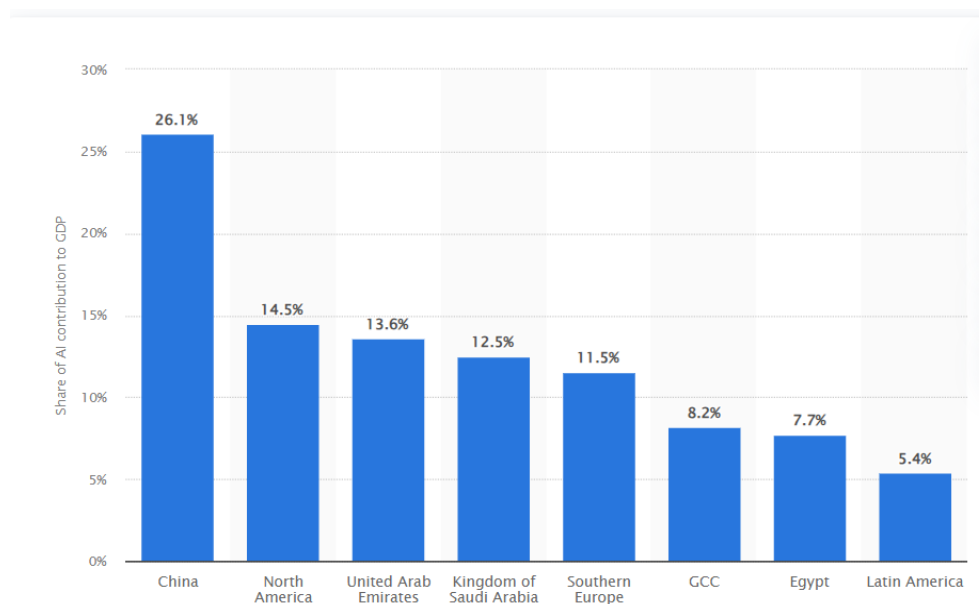
Source: *(Statista, 2023)*

Among the six GCC countries, Saudi Arabia is expected to maximize its movement towards artificial intelligence with an expected contribution of $135.2 billion to its economy. The UAE will benefit with a contribution of $96.0 billion, while the remaining four countries are expected to share

a combined growth of $45.9 billion. Concerning the GDP of each country, the contribution of artificial intelligence to the UAE's economy is expected to be the highest, constituting 14% of the GDP.

Fig.7. Economic Contribution of Artificial Intelligence in the Gulf Cooperation Council (GCC) Countries by 2030
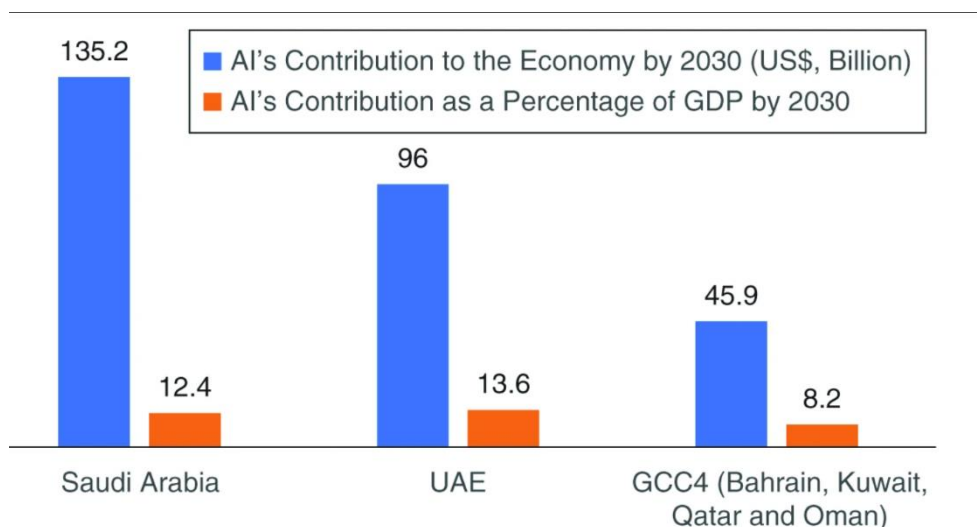
*Source:* *(Mamduh, Hanafi, & Sharma, 2021)*

Considering the aforementioned indicators regarding artificial intelligence in the Gulf countries, and in alignment with around 70% of the population in the GCC countries being under the age of 30, the youth are likely to be more open and comfortable with AI-based solutions. This creates opportunities for new business models for AI companies. The large percentage of youth in the Gulf countries acts as a driving strength for these countries to advance in the world of artificial intelligence. According to a McKinsey study, 62% of participants in the GCC countries reported using artificial intelligence in at least one work function in their organizations.

3.2 Saudi Arabia's Strategy in Artificial Intelligence

Saudi Arabia has achieved the top global ranking in the Government Strategy Index for Artificial Intelligence, an indicator by "Tortoise Intelligence," a global company with a high-level advisory board comprising AI experts from around the world. This index evaluates over 60 countries globally. Germany secured the second position, and China stood at the third position in the Government Strategy Index. The UAE ranked 36th globally, followed by Qatar at 42nd, Bahrain at 50th, Tunisia at 53rd, Morocco at 57th, and Egypt at 58th. The global AI index assesses over 143 criteria across seven indicators: Government Strategy, Research, Development, Skills, Infrastructure, Business Environment, and Trade. Saudi Arabia achieved a 100% score in the index criteria. Key aspects include having a dedicated and approved national strategy for artificial intelligence, a dedicated governmental body, specific funding and budget for artificial intelligence, and setting and monitoring national targets related to artificial intelligence. Saudi Arabia has shown interest in artificial intelligence since 2019, establishing the Saudi Data and Artificial Intelligence Authority

(SDAIA) to be the national reference for all aspects related to them in terms of regulation, development, and dealing.

Fig.8. Vision - Saudi Arabia's Strategy
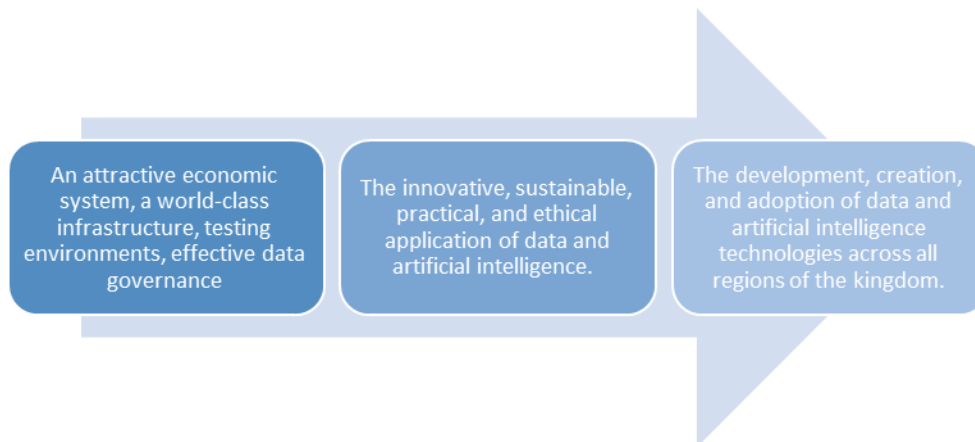
Source: (Tortoisemedia , 2021)

The SDAIA, in line with the national direction for data and artificial intelligence, has worked to achieve the targets of "Vision 2030" and developed the national strategy for data and artificial intelligence to unify efforts and launch national initiatives in data and artificial intelligence and maximize their benefit.

In Saudi Arabia, the National Transformation Strategy for Saudi Vision 2030 was prepared, identifying digital transformation as a key enabling factor. The Kingdom granted Saudi citizenship to an artificial intelligence-powered robot, "Sophia," expressing its strong interest in the transition towards artificial intelligence. In August 2019, a royal decree was issued to establish a national authority for data and artificial intelligence. In October 2020, Saudi Arabia hosted a virtual global summit on artificial intelligence, the largest of its kind, underlining its commitment to advancing in the field of artificial intelligence.

4. National Industrial Strategy Vision 2030

Saudi Arabia is undergoing an economic transformation journey aimed at enhancing the capabilities of the national economy and diversifying its sources of income. This transformation is based on the Kingdom of Saudi Arabia's Vision 2030, which outlines its executive programs, shaping the outlines of our future. The industrial sector is at the forefront of the sectors relied upon to support economic growth and stimulate it, directly and significantly contributing to lifting the indicators of the overall economy. The Kingdom aims to increase the industrial sector's contribution to the total GDP, create job opportunities, attract quality investments, boost exports, and improve the balance of payments. Over the past five years, the industrial sector in Saudi Arabia has kept pace with the positive changes introduced by Vision 2030, interacting with several achievements that included the transfer and localization of strategic industries and the development of industrial cities.
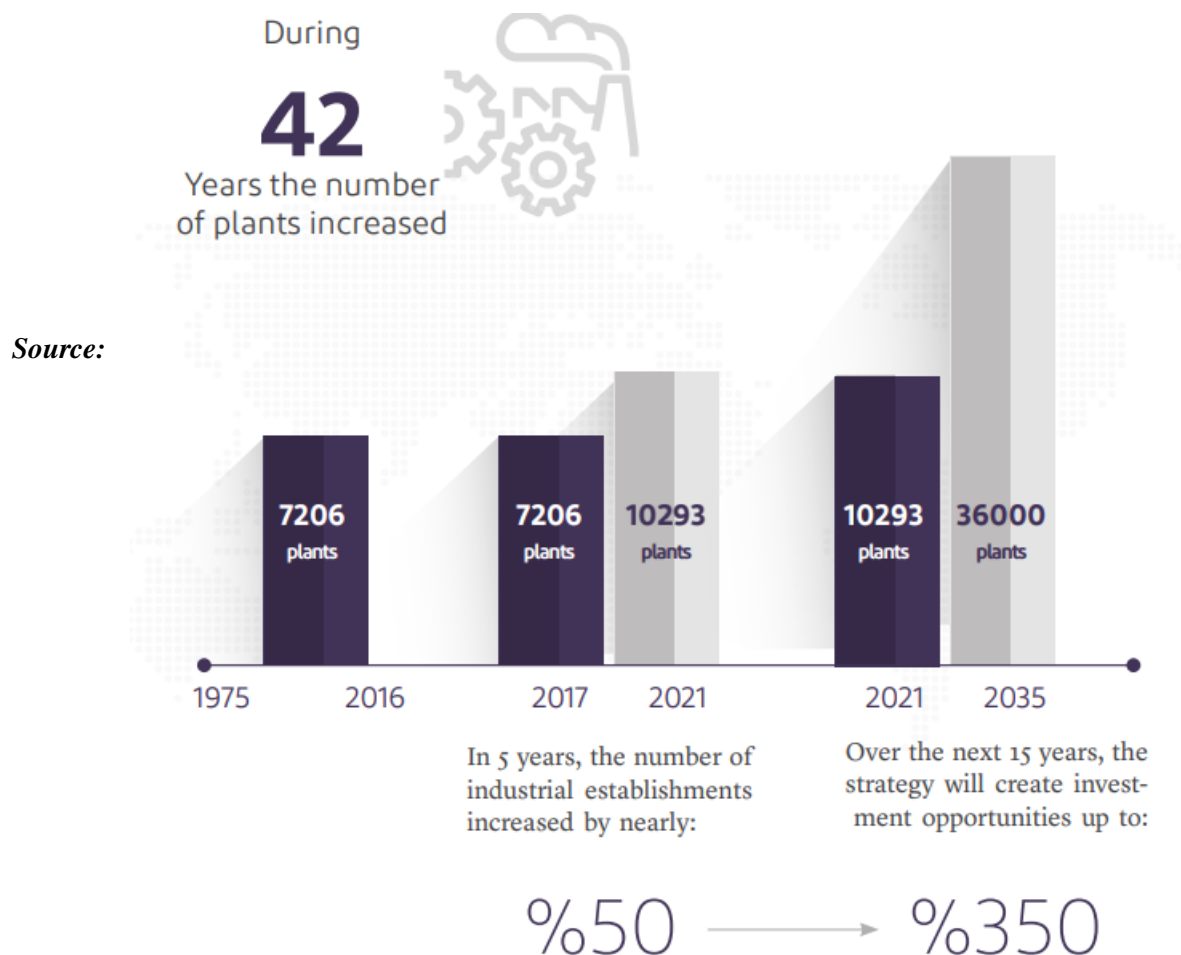
Vision 2030 focuses on enhancing and improving the systems and legislations, adopting significant reforms in various fields (including the economic sector) through launching a package of initiatives aimed at achieving the strategic goals and the presence of the Kingdom. The vision aims to achieve a thriving and sustainable economy with a vital and sustainable industrial sector capable of competing, relying on exports to achieve Vision 2030. The industrial sector is the main driver to achieve an increase in non-oil exports and attract foreign investments.

The National Industrial Strategy aims to be a comprehensive roadmap that accelerates and diversifies industrial development in the Kingdom, aiming to achieve its vision. It was constructed by aligning with global trends and studying the trajectory of industrial advancement in several leading industrial nations, drawing significant lessons from them. The strategy didn't only focus on industrial clusters that the Kingdom can succeed in but went beyond to identify a range of selected industrial goods within these industrial sectors, requiring the Kingdom's resources to be focused on.

The National Industrial Strategy is based on 3 strategic objectives:

- Building a flexible and adaptable national industrial economy capable of adapting to changes by increasing national industrial self-sufficiency through increasing local manufacturing, and reducing the risks of disruptions in supply chains by entering strategic agreements to ensure the continuity of access to essential goods for the welfare of citizens and the sustainability of economic activity.
- Establishing a comprehensive regional industrial hub to meet the demand by utilizing the local market size and regional markets through an economic integration model in the value chains and associated products to create a competitive capability that forms the basis of a regional industrial hub contributing to transforming the region into a major and competitive industrial center.
- Achieving global leadership in the industry of a selected group of industrial goods that require the adoption of a set of technologies of the fourth industrial revolution, focusing on research, development, and innovation areas. This is achieved through the development and attraction of talent, preserving them, and developing an innovative culture to lead the world in the industrial sector.

Fig.09. Industrial Development Path 1975-2035

Source:

During

42

Years the number
of plants increased

| 7206 plants | | 7206 plants | 10293 plants | | 10293 plants | 36000 plants |

| 1975 | 2016 | 2017 | 2021 | 2021 | 2035 |

In 5 years, the number of
industrial establishments
increased by nearly:

Over the next 15 years, the
strategy will create invest-
ment opportunities up to:

%50 ⟶ %350

(Ministry of Industry and Mineral, 2022)

The sources of competitiveness for the Kingdom, in the face of economic changes, provide a brief overview of the industry, giving a clear explanation. Therefore, the competitiveness situation can be divided into two dimensions. This would help identify specific areas for improvement, while retaining a framework that integrates all dimensions of the eight competitiveness aspects.

Fig.10. General Framework for Competitiveness
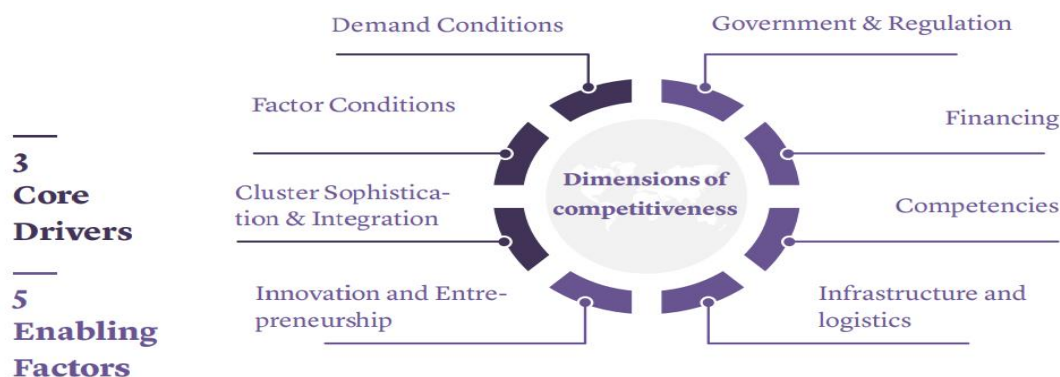
Source: *(Ministry of Industry and Mineral, 2022)*

Enhancing a conducive business environment, improving by 30 positions in one year in the World Bank's Doing Business report for 2020, and a 100-position improvement in the World Bank's Ease of Doing Business Index for 2020. Achieving the best improvement globally in the Women, Business, and the Law index issued by the World Bank. The focus of the National Industrial Strategy revolves around: building an industrial economy characterized by flexibility, sustainability, and competitiveness, led by the private sector.

Fig.11. Main Aspects of the National Industrial Strategy Vision
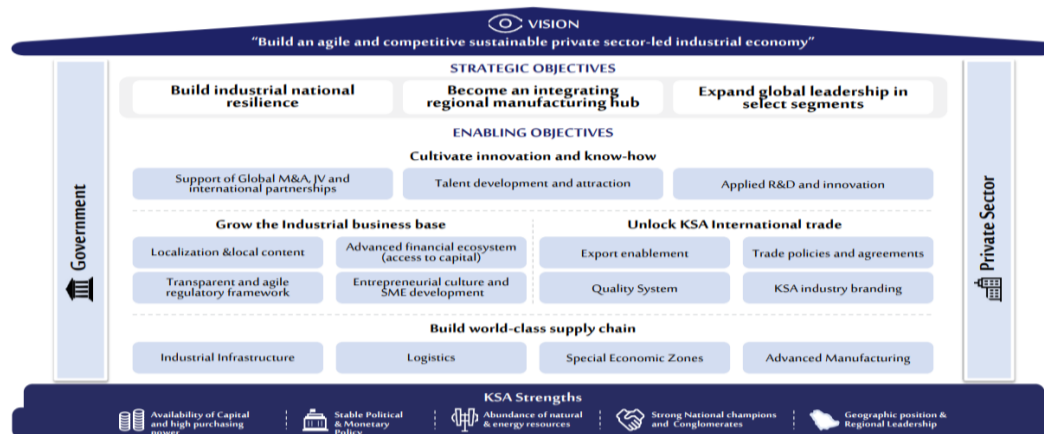
Source: *(Ministry of Industry and Mineral, 2022)*

5. Contribution of Artificial Intelligence and Data Strategies to Achieve Sustainable Leadership in Industrial Enterprises

Given the potential of deploying artificial intelligence that will bring about radical changes for purely economic reasons, the possibility of achieving gains estimated at around 136 billion in the services and commerce sector, for example, played a significant role in prioritizing tourism as a sector of priority. It is likely that artificial intelligence in the direct services provided to consumers will have ripple effects on other service sectors. It contributed about 91 billion to the resources and facilities sector in prioritizing the energy sector, just as 19 billion did in the logistics services sector. Estimates of global economic gains from automation technology, ranging from 0.3-2.2% in annual compound productivity, are intriguing. Using this type of productivity gain modeling from year to

year, estimates from PwC suggest that artificial intelligence will contribute around 353 billion UAE dirhams to the GDP by 2030, equivalent to about 13.6% of the GDP. These gains surpass the performance increase resulting from the replacement of human labor with machines in some sectors, which will play a significant role in the youthful and resource-rich economies in the Middle East. For example, it is likely that 85% of the gains in the oil and gas sector will be concentrated on performance rather than labor replacement. This is similar to what happened in the restructuring of the automotive industry or the significant changes we are witnessing in consumer marketing strategies.

Spending on artificial intelligence is also an important economic factor. Estimates by the International Data Corporation indicate the possibility of annual spending on artificial intelligence in the Middle East and Africa reaching about 419.54 million UAE dirhams by 2021, with an annual increase of approximately 32%. Using national statistics for the United Arab Emirates, the absolute potential for increasing economic productivity was calculated based on current technological capabilities rather than focusing on annual productivity growth and assuming full automation application in each sector. There are potential gains of up to 335 billion UAE dirhams as increased economic output for the United Arab Emirates, equivalent to an increase of about 26%.

There are some indicators showing a large sub-group of individuals who combine technical and business skills. Data from job seekers on the Bayt.com job opportunities website in the Middle East and South Asia show that business analysts with technical skills often have advanced skills related to artificial intelligence. About 21% of the skills identified for this group were related to business intelligence software such as "IBM Cognos" or "Microsoft Power BI", while 20% were related to experience in data operations such as "Hadoop" or "Apache Pig", and 8% were related to machine learning and statistical modeling tools such as Neural Networks.

Saudi Arabia has a significant competitive advantage in terms of the percentage of university graduates specializing in science, technology, engineering, and mathematics, with a rate of 22% compared to 61% in the United States. Graduates have the essential skills related to artificial intelligence (computer science, programming, and statistical analysis), making them qualified to acquire advanced skills and prepare for work in the field of artificial intelligence.

5.1 Trends in the Machinery and Equipment Industry and Their Potential Effects on the National Industrial Strategy

The global production of machinery and equipment reached 3.7 trillion US dollars in 2019, with Asia, the Pacific Rim countries, Western Europe, and North America dominating the market. The primary reasons for this growth are the increasing demand from industries heavily reliant on machinery and equipment, such as mining, construction, and agriculture. Additionally, the rapid demand growth across various sectors in fast-growing economies like China and major global projects requiring significant quantities of machinery and equipment for construction and operational processes have contributed to this growth. Furthermore, there is a growing focus on establishing flexible supply chains. Engines, turbines, pumps, compressors, and automation systems are the major industrial goods that dominate this market, relying heavily on innovation in the manufacturing of industrial machinery and its operational processes, such as the Internet of Things,

3D printing, and sensors. Global production is expected to increase by approximately 4% between 2019 and 2030, despite a decline post-2030.

Forecasts indicate a 3% annual growth in the local machinery and equipment market between 2021 and 2040, creating a significant opportunity to meet the increasing demand for equipment. The demand will continue to focus on the three main industrial goods: stationary equipment, rotating equipment, and electrical equipment, driven by sectors like oil, gas, and services in the Kingdom's market. Ambitious government investments in major projects like Neom further encourage the machinery and equipment industry. Additionally, sectors such as aviation, automotive, transportation, logistics services, food, agriculture, and construction provide additional incentives to the machinery and equipment industry.

Fig.12. Machinery and Equipment Market Indicators in the Kingdom (in Billion Saudi Riyals)
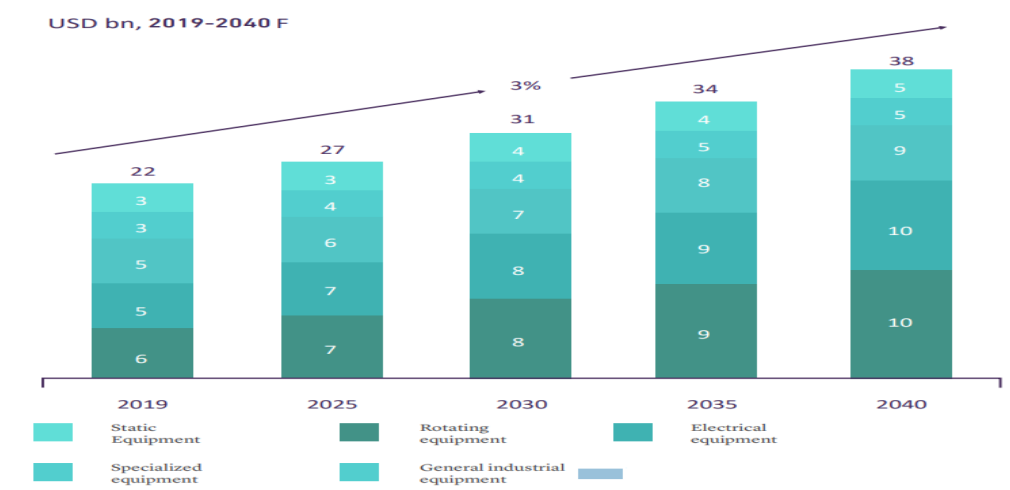
Source: (Ministry of Industry and Mineral, 2022)

Improvements in efficiency, error reduction, and product accuracy and quality may require an increase in global competitiveness levels. Focus on developing these capabilities and enhancing skill requirements and capabilities for managing robots/smart equipment is crucial.

The Internet of Things/sensors will impact the type of factories that will rely on the internet in the future, suggesting a new type of highly competitive market where Chinese companies will compete globally in new technologies. Increasing skill requirements and capabilities for managing robots/smart equipment will also be vital.

5.2 Some Examples of Artificial Intelligence Applications in the Industry

Artificial intelligence and big data solutions can improve a wide range of operations in the energy sector to enhance efficiency, reliability, and sustainability.

5.2.1 Gas Flare Monitoring

Gas flare is defined as the release of hydrocarbon gases resulting from pressure build-up in pipelines and processing facilities, which are then burned. Our engineers use big data to rapidly identify sources of gas flare and find potential solutions. Data allows them to visualize the entire gas processing system instantly. There are 18,000 data sources providing information, enabling

monitoring and prediction of gas flare activities. By comparing real-time data with models created using various big data processing methods, the AI systems developed by Aramco can predict when a facility is expected to exceed its maximum gas flare activities, allowing corrective actions to be taken before it happens. The use of big data and artificial intelligence has reduced the company's gas flare by over 50% since 2010, helping maintain a flare rate of less than 1% of crude gas production over the past decade.

5.2.2 Space Out: Drill Pipe Connections Location System Using Cameras

This innovative project in the industrial sector uses an Internet of Things-connected platform to locate drill pipe connections, a crucial element for enabling drilling rigs to rotate below the wellbore. The platform consists of high-resolution, waterproof, and smart wireless cameras and other sensors that use artificial intelligence and machine learning to process and analyze captured videos and images. These technologies automate the process of locating and improving the drill pipe set, a critical step in the drilling of new hydrocarbon wells. It allows for quick and easy closure of the well in case of control issues due to unexpected pressure level changes, by pinpointing the correct location of the drill pipe set. Field trials of this system are currently underway in an operational well, and it is expected to be commercially available on a full scale later in 2022.

5.2.3 Khurais Oil Field

Aramco used 40,000 sensors in the Khurais oil field, one of the company's largest oil fields, to monitor over 500 oil wells, resulting in the creation of the world's first advanced process control system in a conventional oil field. Harnessing the latest advancements in big data analysis, machine learning, smart sensors, and robots, this system achieved several significant gains in the Khurais field. These gains include developing in-house artificial intelligence solutions to reduce fuel gas consumption in boilers, using robots to improve safety during maintenance operations, reducing their costs, and enhancing their efficiency. Additionally, a system to manage pipeline networks was utilized to detect potential leaks using optical fibers as sensors. These digital solutions have increased oil production by 15% and improved response time for fault detection and repair by 100%.

5.2.4 Abqaiq Facility

The Abqaiq facility, in service for over seventy years, is the largest oil processing facility in Aramco and the world's largest crude oil stabilization facility. The digital transformation at the Abqaiq facility has led to significant operational improvements in three key areas. Firstly, leveraging robots and smart drones reduced approximately one-third of routine tasks, minimizing reliance on traditional field inspection rounds. Secondly, the use of machine learning algorithms and artificial intelligence enabled automatic control of the oil stabilization process, enhancing electricity generation and reducing carbon dioxide emissions. Thirdly, extensive use of data, data analysis tools, and predictive modeling helped our engineers predict potential system faults more effectively.

5.2.5 Upstream Innovation Center

The Upstream Innovation Center provides an exceptional environment to leverage the potential of Fourth Industrial Revolution technologies. Digital tools, including artificial intelligence and big data, empower engineers and geologists to improve their plans, develop drilling operations within oil wells, manage produced unwanted water, and reduce carbon dioxide emissions.

5.2.6 Supply Chain Monitoring Center

The Supply Chain Monitoring Center brings about a transformative shift in company supply chains by integrating and automating them. The center uses artificial intelligence solutions that send real-time alerts to prevent disruptions, provide direct logistics tracking of Aramco shipments worldwide, and have the ability to trace the supply chain from supplier to consumer. Advanced analysis enhances logistic services for the supply chains and contributes to reducing carbon emissions (Aramco Saudi Arabia, 2022).

6. CONCLUSION

The Kingdom of Saudi Arabia has been relying on Vision 2030 since 2016, encompassing a wide array of plans and national programs aimed at transforming the kingdom into a global investment powerhouse and reducing its dependence on oil as a primary economic driver. As part of this vision, the kingdom formulated the National Strategy for Data and Artificial Intelligence, aiming to integrate artificial intelligence technologies and data analysis into all relevant sectors' plans.

Within the framework of this strategy, the Saudi Data and Artificial Intelligence Authority were established, tasked with executing the strategy and overseeing all related initiatives. The authority also managed the SDAIA Academy, aimed at equipping employees from both the public and private sectors with the skills to utilize and integrate artificial intelligence within their tasks in government departments and the private sector.

At present, the authority aims to develop big data platforms and analysis tools in coordination with the private sector to adopt artificial intelligence technologies.

Improvements in efficiency, error reduction, and product accuracy require a focus on developing these capabilities, increasing skill and capacity requirements for managing robots and smart equipment.

The Internet of Things (IoT) and sensors will influence the type of factories that will rely on the internet in the future. A new type of factory can be envisaged.

In the future, there will be a highly competitive market, where Chinese companies will compete globally for their share in new technologies.

Given the indicators mentioned above regarding artificial intelligence in the Gulf countries, and in line with about 70% of the population of the Gulf Cooperation Council (GCC) countries being under the age of 30, it is likely that the youth will be more open and comfortable with artificial intelligence-based solutions. This creates opportunities for new business models for artificial intelligence companies. The significant youth population in the GCC is a driving strength for the GCC countries to attain advanced positions in the field of artificial intelligence. According to a study by McKinsey, 62% of participants in the GCC countries stated using artificial intelligence in at least one job function in their organizations.

On the other hand, the economies of GCC countries, including Saudi Arabia, face several

challenges that need to be overcome. The first challenge lies in spending on research and development, as the latest available data from the World Bank shows that GCC countries do not spend on research and development as a percentage of GDP exceeding 0.7%.

Among the most important recommendations to be considered are:

- Providing access to reliable data sources is one of the fundamental requirements for good research and innovation in the field of artificial intelligence.

- Recent rapid advancements in artificial intelligence systems necessitate regulatory interventions by policymakers to strike a balance between the expected benefits to society and the potential threats and risks.

- Adapting local ecosystems to provide sufficient flexibility and incentivize companies to expand the applications of artificial intelligence in their sectors.

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