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# Transforming KSA's local workforce into global talent: An Industry 4.0 and 5.0 initiative leading to vision 2030

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ABSTRACT

This study examines the opinions of 18 experts from various sectors, including managers, executives, and academics across Saudi Arabia. The researchers first organized the interview data into themes and sub-themes and then applied text analysis and text mining to derive findings and conclusions. Using an inductive approach, they explored qualitative data categorized into themes using NVivo 14 software. The research identifies challenges, benefits, and risks associated with workforce development for entrepreneurs and industry practitioners in Saudi Arabia. It emphasizes the advantages of machine-to-machine (M2M) and human-machine interaction (HMI) for enhancing productivity according to industry standards. Additionally, the study discusses technology innovation, government policy development, business model creation, and job generation through smart technology cooperation. It outlines necessary training and skills for managing local talent within the technology framework of the industry. The study also highlights efforts by entrepreneurs and industry professionals to elevate the local Saudi workforce to a global standard and the associated risks of job polarization and income disparity. The findings offer solutions for sectors like manufacturing, energy, environment, healthcare, education, and smart city initiatives, aiming for security, cost reduction, and enhanced production with real-time outcomes aligned with Saudi Arabia's Vision 2030. The implications of the study provide recommendations for corporate managers, entrepreneurs, industry leaders, and the government to transform the local workforce into global talent in step with technological progress and industry standards for machine and human collaboration in Saudi Arabia and beyond.



## 1. Introduction

Human-centric activities play a very significant role in implementing and managing organizations. Therefore, workforce management can be seen as promising in achieving operational performance for industry practitioners and organizations in this digital era (Dhamija and Bag, 2020). If a country has a competent workforce within its companies, it can easily deal with technological change posed by Industry 4.0. Industry 4.0 revolution brought many opportunities and challenges to organizations, which requires workforce management, including skill development, performance management, educational up-gradation, and training programs (Yuriev et al., 2020). Industry 4.0 revolution is the digitalization phase concerned with the Industrial practices of adopting intelligent technologies, processes with increasing global connectivity, analytics, man-machine interaction, and robotics. Through improving the qualification of the workforce, we will be able to adopt the digital changes in production and process and also be able to adopt the latest workforce practices connected with Industry 4.0. It embraces the companies to adopt the latest technologies, transform their workforce with new competencies, and cope with the current scenario (Leticia and García-Reyes, 2021). The integration of Industry 4.0 and sustainability can potentially transform a country's socio-environmental factors (Scavarda et al., 2019). Studies related to the human aspect of Industry 4.0 cover an essential part of the current literature (Obermayer et al., 2022).

Industry 4.0 is in its early stage in the Kingdom of Saudi Arabia and is ready for the investors to digital

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transformation for Saudi enterprises. The Saudi Vision 2030 incorporated the concepts of Industry 4.0 5.0 in transforming its local workforce to global talent. It is an initiative to move the country ahead by emphasizing digitalization and artificial intelligence (AI)-driven technologies by applying Industry 4.0 initiatives and a human-centric approach using Industry 5.0 Initiatives. Industry 5.0 concept supports the human-centric approach within planetary boundaries, leading to sustainability and resilience (Adel, 2022). In the Industry 5.0 vision, the human-robot works together whenever and wherever possible (Demir et al., 2019). Industry 5.0 revolution aims to leverage human creativity with machines to make more creative and user-friendly production processes than Industry 4.0 (Maddikunta et al., 2022). Industry 5.0 revolves around the role of the industry worker. The worker is considered an investment rather than a cost, allowing both the worker and the industry to grow and develop (Xu et al., 2021). The human-machine collaboration aims to empower and engage the workforce more robustly in an industrial environment. The Industry 5.0 skills need to evolve at the pace of fast-moving technologies. It attracts better talent and keeps its collaborations between humans and smart technologies. Industry 5.0 supports the current Industry 4.0 technology model by capturing new advanced devices to enhance workforce competencies and production efficiency.

To take advantage of industry developments, organizations need to change their structure; however, one cannot avoid the fundamental challenges they face. Also, some technical and personal barriers that an organization reveals during a significant change in their existing workforce. Any organization of any size, small, medium, or large, must concentrate on developing its existing workforce. Primarily, there is a need to develop the skills of the current local workforce by providing them with adequate training to use new technologies (Madsen, 2019; Singh et al., 2022a; 2022b). Humans must be given top preferences and put in the center of Industry to be interconnected with products, processes, and technologies. The integration of the industry with KSA's local workforce will help generate global talent and sustainability. The innovative and human-centric approach in Industry 5.0 is viable for corporate entrepreneurs and customer-oriented; it is feasible with corporate venturing and supportive of competitive advantage and economic growth (Aslam et al., 2020). Industry 5.0 gives us a clear message for a change in human capabilities to the next level for achieving personalization and product customization (Paschek et al., 2019).

With technological advancement and rapid digitalization, the local workforce is affected by the adequacy of skills, and the gap between the KSA's local workforce and industry needs is recognized. Digitalization also affects the production process worldwide. There is a need to prepare a skills and competency-based professional database of the local workforce that can mutually satisfy the criteria of Industry 4.0 and Industry 5.0 standards. Technological solutions and choices are accepted by human beings, and we should apply these solutions and choices in our lives in a thoughtful and social manner (Vanderborght, 2020). The research identifies the opportunities and challenges of Industry 4.0 and Industry 5.0 abstractions. The man-machine interaction in the industry has also been analyzed as a gap in the literature. The study highlights the gap between existing local workforce competencies and desired global workforce competencies with Industry 4.0 and Industry 5.0 aspects in Saudi Arabia. The study measures workforce development challenges and advantages for entrepreneurs and industry practitioners to transform Saudi local talent into global talent.

## 2. Review of literature

The fourth industrial revolution (Industry 4.0) relies on adopting digital technologies and transforming machine-based manufacturing to digital manufacturing (Frank et al., 2019; Oztemel and Gursev, 2020). The digitally enabled environment revamped the teaching-learning pedagogy and improved knowledge acquisition speed (Singh and Alshammari, 2021). Digitalization has many advantages for the workforce, e.g., reducing time, increasing the quality of work, minimizing costs, improving collaboration and communication, improving customer relationships, enhancing safety, improving image, improving sustainability, and minimizing waste (Oesterreich and Teuteberg, 2016).

The aspects of Industry 4.0 are more concerned with the linkage of IoT and Cyber-physical systems (CPSs) with autonomous Machine-to-Machine (M2M) interaction performing sensory processes with real-time data without human interaction (Kraft and Mosbach, 2010; Chen and Lien, 2014; Zhou et al., 2017; Sikorski et al., 2017; Amodu and Othman, 2018; Schiele and Torn, 2020). Industry 4.0 transition directly relates to the workforce, as the workforce plays a significant role in getting a competitive advantage and managing the organization over time (Lin and Huang, 2021). Industry 4.0 is concerned with shaping its workforce by acquiring digital technology (Evans, 2019) and dealing with workforce development challenges in organizations (Ozkan-Ozen and Kazancoglu, 2022). Industry 4.0 revolution has changed the future workforce perspectives for organizations, becoming more creative, coordinated, and strategic (Flores et al., 2020). Da Silva et al. (2020) reported barriers to Industry 4.0 that the organization needs to deploy at their workplace, such as infrastructure, financial resources, talented workforce, and managerial and technological integration.

Industry 4.0 revolution is expected to provide social benefits by providing attractive salaries and wages to the existing workforce (Müller, 2019). Establishing integration between men and machines

and utilizing full human capabilities with the Industry 4.0 program is challenging and critical for the success of companies and their workforce (Kong et al., 2019; Obermayer et al., 2022). Having synergy between Industry 4.0 and manufacturing sustainability, companies need to be attentive to economic integration, considering environmental issues to ensure the successful implementation of strategies (Acioli et al., 2021).

Industry 5.0 incorporates modern society's sustainable and resilient vision with a human-centric approach (Adel, 2022). It incorporates corporate social responsibility (CSR) initiatives in the corporations leading to the sustainable development of society (Savaget et al., 2019; Wang et al., 2016). To prepare the resources and infrastructure for the introduction of new technologies, the humans who design and oversee production processes require assistance in knowledge transformation from the virtual to the real world and vice versa in subsequent levels in areas related to technological adaption for people (Zizic et al., 2022). In addition, Industry 5.0 recognizes a human-centric society with economic value and goals of the corporations (Potočan et al., 2020). The goal achievement depends upon infrastructural robustness, technical knowledge and skills of society, stakeholders' readiness, and the technological environment of the country (Nakanishi, 2019).

Kong et al. (2019) proposed a human-centric empowering digital approach to work on real-time interaction between men and machines to transform the industrial workforce and the production system. Demir et al. (2019) discussed human-robot interaction and highlighted the collaboration problem in organizations. The workforce employed in Industry 4.0 setups has to collaborate with machines and perform a fixed number of tasks in given hours, as the work was performed by humans only until the technology does not replace humans altogether. Rutherford and Frangi (2020) underlined a framework to understand the relationship between High-Performance Work Systems (HPWS) and workforce employment with Industry 4.0. Paschek et al. (2019) emphasized the unacknowledged assumptions regarding entrepreneurship and transformation in the context of Industry 4.0 while also discussing the emerging concept of Industry 5.0. Building on this, Maddikunta et al. (2022) provided further insights into Industry 5.0 initiatives and their practical applications. Additionally, Simion et al. (2021) offered a comprehensive analysis of Industry 4.0 and 5.0, considering social, economic, political, ecological, and technical perspectives.

To transform Saudi society towards a sustainable, human-centric, and resilient economy, the government has initiated industrialization through industry initiatives. The industrial structure emphasizing Industry 4.0 earlier emphasizes a human-centric approach by implementing Industry 5.0 along with Industry 4.0 initiatives in the country (Madsen and Slåtten, 2023; Zengin et al., 2021). Saudi government initiatives toward digitalization aimed to enhance social skills and expertise in the form of human capital to support digitalization. Saudi Vision 2030 includes taking the economy toward non-oil revenue generation by inserting innovative technology with human-machine interaction and optimizing industrial processes through digital transformation. The government of Saudi Arabia introduced the "Saudi Digital Authority (SDA)" and higher education programs in the country to train the local workforce using educational technology (Singh and Alodaynan, 2023; Singh and Alwaqaa, 2023). In addition, the digital program of the Saudi government supports robust ICT infrastructure in the country by providing "Saudi Industrial Development Fund (SIDF) and "Saudi Resource Development Fund" which have added value to the existing industrial infrastructure of the country.

The preliminary literature review emphasizes the past studies on technology and innovation in association with Industry 4.0 and 5.0. Secondly, the literature review emphasized Saudi industrialization, concentrating on Industry 4.0 and 5.0. industrial revolution initiatives. Finally, the study considered the literature from many studies, including scientific papers, industry reports, news articles, and published government reports, in deciding the research problem and objectives.

## 3. Theoretical perspective

The researchers applied the Technology Acceptance Model (TAM) given by Davis (1989) to implement Industry initiatives in the Kingdom of Saudi Arabia. The study emphasizes the perceived usefulness for the industry and economy and the perceived ease of use for the KSA workforce (Davis, 1989). Under this model, usefulness is stated as how long it will take to enhance users' performance for the technology. Further, the perceived ease of use is stated as how much the user's efforts require the use of technology effectively (Davis, 1989). Innovation adoption theory emphasizes technology innovation as a societal phenomenon stated and influenced by Immediate events/issues or factors (Rogers, 2003). Bagozzi (2007), in a further study, stated that the theory of technology acceptance provided us with avenues to adopt the TAM and its understanding of the use of the model in the application of technologies. The study related the TAM as an intention to use Industry 4.0 and 5.0 technology for the local workforce of KSA. It changed their behavior regarding their learning of the technology to become experts after perceiving its importance and ease of learning in determining the applicability of the technology for the Kingdom (Singh and Alshammari, 2023). The study also applied the theory of planned behavior (TBP) (Ajzen, 1985), which is stated as the theory of reasoned action (TRA) (Ajzen and Fishbein, 1980) to predict people's behavior to engage in a specific behavior at specific need and their linkage (Venkatesh et al., 2003). The objectives of this research are as follows:

1. To find out the workforce development challenges that KSA's entrepreneurs and industry practitioners face in the digital age.
2. To find out how far the industry benefits help build automatic machine and man collaboration.
3. To find out how far the industry initiatives help transform KSA's local workforce into global talent.

## 4. Research design methodology

The study aims to find out the workforce development challenges for entrepreneurs and industry practitioners and the benefits of Industry 4.0 and 5.0 with automatic man-machine collaboration to transform KSA's local workforce into global talent (Fig. 1). The study primarily reviews the literature on workforce challenges of Industry and the existing workforce development scenario in Saudi Arabia to find the gap in the current literature. Secondly, the researchers designed an interview discussion schedule based on the existing literature. Thirdly, the researchers communicated the interview schedule with three experts, two from Industry and one from academia. After that, the researchers finalized the interview schedule incorporating the experts' recommendations. Fourth, the researchers considered the final version of the interview schedule to conduct the interviews individually, following the availability of the time of the expert(s). Fifthly, the researchers collected the interview data from experts in industry and academia and analyzed it using NVivo qualitative software. Sixthly, the study examined and presented the results of the interview data through qualitative data analysis using NVivo 14 software and incorporated it in the discussion of the results. Finally, the study presented the research conclusions, limitations, and implications for entrepreneurs, industries, researchers, Saudi Arabia, and the rest of the world.

The steps in the research method include the data collection and transcription of interview data into an MS Word text file. The text files were uploaded to NVivo 14 software for coding, and themes and subthemes were created. The themes/ subthemes were interpreted through text mining/world cloud to determine the research outcome.

The research consists of the interviewee's responses about their belief in the particular technology. The study's strength is that available studies related to the present research but lacking in the variables for quantitative study (Voss et al., 2002; Yin, 2009). Therefore, the study adopted the interview method to collect the study data and capture the complete picture of the research. On the other hand, the study did not adopt a quantitative survey method due to the nature of the research, and it would be unjustifiable for the research to capture the complete picture of the respective study when the variables for the study were unknown.

The study uses data triangulation to reduce the study biasesand ensure the validity and reliability of data (Natow, 2020). It consists of literature reviews, experts' opinions, and interviewees' data. The study collected the data at different intervals from varying sources, such as managers, leaders, educationists, executives, and representatives of respective government/private companies (Collis and Hussey, 2014). The interview data was collected to build the theory and concepts concerning Industry 4.0 and 5.0. The study modified the formulation statement and research obligation.

The study uses purposive sampling to choose the interviewees from industries and academia from different locations in Saudi Arabia with adequate knowledge, experience, and expertise in Industry 4.0 and 5.0.

### 4.1. Data collection

The researchers contacted 26 interviewees suitable for interviews about a research problem and finally conducted 18 interviews with managers, executives, academicians, and representatives of various companies in different locations in Saudi Arabia. The total time to contact and conduct first and second-round interviews was five months. Out of eight interviewees, three were denied directly for the interview, while five of them did not respond to conducting the interview. The data collection was performed with the help of a literature review and semi-structured interviews. The study conducted the interviews in two rounds. The first round of interviews was conducted with the help of direct questions, while the second round was conducted with the help of follow-up questions. The interviews were conducted for 30 to 60 minutes, with open-ended questions providing insight into workforce challenges for entrepreneurs and industry practitioners, man-machine collaboration, and the development of the local workforce to global talent. Due to time and distance constraints, most interviews were held via mobile phone.

The interviewer recorded the interview data in the MS Word text file. The text was coded into themes/sub-themes with the help of NVivo 14 qualitative software. The interview data was classified into main themes and subthemes concerning research objectives. The topic and subtopics of particular themes/subthemes were grouped together using Nvivo14 qualitative software to allow the researchers to analyze the quotes to interpret and get relevant outcomes (Azungah, 2018).

Since the industry phenomenon is new in Saudi Arabia, interviewees have different perceptions of it. Therefore, before conducting the interviews, the interviewers explained the objectives and significance of the study to the interviewees. After 45 days of the interviews, the researchers performed the second round of interviews, and the researchers contacted the interviewees again for follow-up questions concerning previous interview questions. The follow-up session mainly featured future investigations into the objectives to explain and refine the research outcome.

### 4.2. Data analysis

The study applied the Inductive (exploratory) approach to record and analyze the interviewees' data in detail (Stebbins, 2001; Creswell and Clark, 2007; Blackstone, 2018; Casula et al., 2021), consisting of themes/subthemes. The respondents' interviews were recorded on paper, then converted into MS Word text files and uploaded into NVivo 14 qualitative software. The researchers identified the key concepts and coded them as themes/subthemes. The researchers interpreted the themes/subthemes using text analysis/text mining to get findings and conclusions.

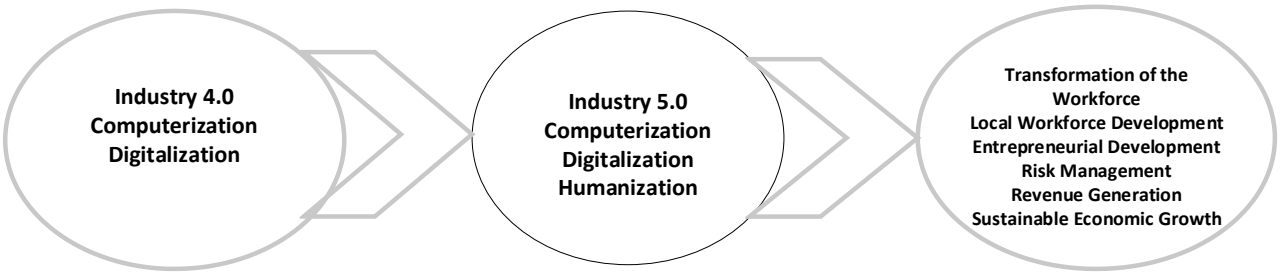
### 4.3. Validity and reliability

The study used data source triangulation to apply different sources of information for validity and reliability (Natow, 2020). First, the study uses a wide range of literature on Industry 4.0 and 5.0, emphasizing technology, innovation, and Saudi industrialization, including scientific papers, industry reports, news articles, and published government reports, to decide the research problem and objectives. Second, the study recorded the opinions of the experts from the industry and academia who are experts in the Industry revolution to ensure that the investigation would cover the most significant aspect in this regard. Thirdly, the study collected data from varying sources, such as managers, executives, and representatives of respective government/private companies at different intervals about the industry revolutions. In addition, the continuous literature review and the linkage between the research's purpose and objectives maintained the study's validity.

The study ensured the confidentiality of the interviewees' data and information given orally or in writing as a contribution to the study on any topic concerning different aspects of corporate or economic importance.

## 5. Findings of the study

Table 1 shows interviewees' (INT-1 to INT-18) information, including their organization, organizational position, type of industry, and relative products and services.




*Perceived usefulness (Adoption of technology) + Perceived ease of use (Education and Training) + Intention to use (Human Development) → Transformation of workforce leading to sustainable economic growth and revenue generation*

**Fig. 1:** Industry 4.0 and 5.0 and transformation of workforce

**Table 1:** Interviewee's personal information

| Interviewees | Organizational position | Organization | Type of industry | Product and service |
|---|---|---|---|---|
| INT-1 | Production leader | Almarai | Manufacturing | FMCG |
| INT-2 | Relationship manager | Saudi Telecom Company (STC) | Service (telecommunication) | IT service |
| INT-3 | Secretary | Ministry of Interior (MOI) | Service | Security |
| INT-4 | Associate professor | University of Hail (UOH), KSA | Education (information systems) | IT education |
| INT-5 | Associate professor | University of Hail (UOH), KSA | Education (information systems) | IT education |
| INT-6 | General commercial censorship officer | Ministry of Commerce | Service | Consumer service |
| INT-7 | Production engineer | Taldeen - tasnee | Manufacturing | HDPE pipes |
| INT-8 | GM of governance | Ministry of Interior | Service | Security |
| INT-9 | Assistant professor | University of Hail (UOH), KSA | Education (engineering) | Engineers |
| INT-10 | Assistant professor | University of Hail (UOH), KSA | Education (engineering) | Engineers |
| INT-11 | Assistant professor | University of Hail (UOH), KSA | Education (Computer Science and Engineering) | IT professionals |
| INT-12 | Relationship manager | Alnima Bank | Service | Customer service |
| INT-13 | Operation manager | SWCC | Manufacturing | Water solutions products |
| INT-14 | Director | National center for privatization and public private partnership (PPP) | Mix of Industries | All type |
| INT-15 | Relationship manager | Nova-Nordisk | Manufacturing (Pharmaceutical) | Medicines |
| INT-16 | Sales engineer | Saudi power procurement company (SSPC) | Manufacturing (Power Procurement) | Solar energy |
| INT-17 | Businessman (proprietor) | Private sector | Sales and service | Management |
| INT-18 | Relationship manager | Nova-Nordisk | Manufacturing (Pharmaceutical) | Drugs and medications |

The study develops three principal themes: Theme 1: "Workforce development challenges for entrepreneurs and industry practitioners," Theme 2: "Industry 4.0 and 5.0 benefits help in building automatic machine and man collaboration," and Theme 3: "Industry 4.0 and 5.0 initiatives in KSA." Every theme consists of subthemes to justify the aim of the main themes. The findings of the themes are based on the interview data of 18 interviews working in different industries.

**Theme 1:** Workforce development challenges for entrepreneurs and industry practitioners

**Subthemes 1.1:** Workforce challenges in implementing Industry 4.0 and 5.0

Subthemes 1.1 consists of the interviewees' main statements regarding workforce challenges in implementing Industry 4.0 and 5.0. The researchers transcribed these statements to give them a presentable form (Fig. 2).

The interviewees' data describes a gap in the workforce's technical skills, education system, and information security. In addition, a considerable amount of investment which is burdensome to the industry and especially the SMEs to adopt, a lack of skills required to work with advanced devices/machines, a lack of strategic knowledge and significance about innovative technologies, human capital development, lack of legislation, business level strategies, the existing business strategy, business models in the Kingdom, earning revenue without any further challenges of adopting Industry 4.0 and 5.0 initiatives, train people who will work in these industries, traditional education, and human resource, handling data, security, huge investment, network/IT security, security of Industrial automation and manufacturing process, resistance to change from workers who are accustomed to traditional methods of work and may be hesitant to adopt new technologies. Skill development is a humongous task, such as training the workforce to adopt advanced and cutting-edge technologies and inducing behavioral change and resistance to change from workers accustomed to traditional work methods and hesitant to adopt new technologies. The primary concern about the challenge is the skilled and knowledgeable workers about emerging technologies such as artificial intelligence, robotics, and automation. Another challenge is continuous training and upskilling to pace with a rapidly moving technological landscape (Madsen, 2019; Singh et al., 2022a; 2022b).

Furthermore, there may be concerns about job displacement due to automation, which can lead to social and economic issues if not appropriately addressed. Therefore, policymakers and industry leaders must develop strategies prioritizing reskilling and retraining programs for affected workers. While Industry offers significant opportunities for growth and innovation in Saudi Arabia's economy, addressing these workforce challenges will be crucial for the successful implementation.

**Subthemes 1.2:** Industry 4.0 and 5.0, its effect on the practitioners/entrepreneurs in managing the workforce

Subtheme 1.2 consists of the interviewees' main statement regarding the industry and its effect on the practitioners/entrepreneurs in managing the workforce (Fig. 2).

The interviewees' results show a problem for SMEs and professional human resources, managing semi-skilled and unskilled workers, engaging local talent vs. global talent, managing waste, coping with Industrial Laws and regulations, and managing with industry 4.0 and 5.0, production process optimization. Entrepreneurs must invest in new technologies and hire skilled workers to manage these systems effectively. The impediments to initiating Industry 4.0 and 5.0 include:

- The high cost of technology adoption.
- Lack of skilled workers.
- Resistance from employees who may fear job loss or feel uncomfortable with new technologies (Müller, 2019).

Overall, practitioners and entrepreneurs in KSA need to carefully consider the benefits and challenges of Industry when managing their workforce and operations. They must be willing to invest in new technologies, reskill their workforce, and adapt quickly to stay competitive in an increasingly digital world (Lin and Huang, 2021).

**Subthemes 1.3:** Workforce developmental risks in implementing Industry 4.0 and 5.0 solution

Subtheme 3 consists of the interviewees' main statement regarding workforce developmental risks in implementing Industry solutions (Fig. 2).

The finding of the interviewees shows that the main risks associated with workforce development in Industry are lack of digital skills with advanced technologies, lack of analytical thinking, and shortage of skilled workforce (Fig. 2). Workers may need to acquire new skills and knowledge to operate and maintain the advanced technologies used in these solutions. As a result, it could lead to a skills gap, where there need to be more workers with the necessary expertise to support these technologies. However, implementing Industry solutions could create new job opportunities and improve productivity and efficiency in various industries. Organizations must invest in training programs and upskilling initiatives for their employees to mitigate these risks and ensure a smooth transition toward these advanced technologies (Madsen, 2019; Singh et al., 2022a). The outcome of the word cloud of Theme 1 (Fig. 2: Subtheme 1.1, 1.2, and 1.3) shows

that technologies, capital, Industry initiatives, knowledgeable and skilled workforce, and training and development are the critical workforce challenges for Industry (Subtheme 1.1). Secondly, the workforce with advanced technological skills to fulfill a skilled workforce demand and train them for intelligence technologies per the industry standards with prevailing completion are the critical significant areas for entrepreneurs and industry practitioners to cope with Industry 4.0 and 5.0 development challenges (Subtheme 1.2). Third, there is risk associated with transforming the existing workforce into knowledgeable, skilled, active, and developing per Industry work environment (Subtheme 1.3).


Subtheme 1.1: Workforce challenges | Subtheme 1.2: Role of entrepreneurs | Subtheme 1.3: Workforce development risks

**Fig. 2:** Word cloud of theme 1: Workforce development challenges for entrepreneurs and industry practitioners

**Theme 2:** Industry 4.0 and 5.0 benefits in building automatic human-machine collaboration

**Subthemes 2.1:** Usability of Machine-to-Machine (M2M), Internet-of-thing (IoT), and human-machine interaction

Subthemes 2.1 consists of the main statement of the interviewees regarding the usability of M2M, IoT, and human-machine interaction (Fig. 3).

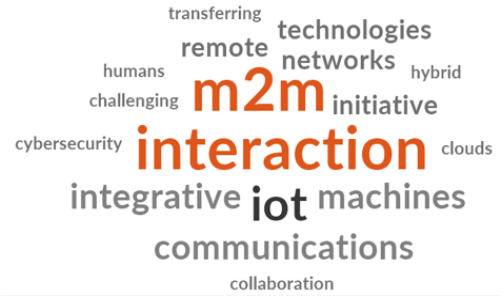
The finding of the interviewees shows that IoT will help businesses using M2M be safer and faster, with safety and security, reduced cost, enhanced productivity, and real-time outcome, teaching simulation courses, better for security and privacy issues, seamless human-machine interactions, with innovative, intelligent, coordinated, integrated cyber-physical industrial production processes, controlling the process, increase productivity, enable lean manufacturing through on-premise (Ejsmont et al., 2020; Ooi et al., 2023), cloud, or hybrid solutions, and it is beneficial for the society.

M2M devices are more secure than personal devices, such as mobile and telephone, and are used mainly for transportation, health services, energy, and many more, exchanging a large amount of information. Usability testing needs not be applied to human interactions alone. M2M communications in IoT are routine and challenging because of the frequent need for an interface. It helps to develop and faster use of machines and technology with human interaction. Some enterprises have already adopted IoT solutions in the Kingdom related to industries such as education, energy environment, manufacturing, smart-city projects, and healthcare; these have already succeeded and have realized improved asset management, safety and security, reduced cost, improved production with the real-time outcome following the vision 2030 of Saudi Arabia.

**Subthemes 2.2:** Industry 4.0 and 5.0 initiative, revenue generation and economic growth

Subthemes 2.2 consists of the main statement of the interviewees regarding Industry 4.0 and 5.0 initiatives, revenue generation, and economic growth (Fig. 3). The findings of the interviewees show that industry initiatives can help establish companies, employees, and government. It will enhance industrial production, employees' knowledge and skills, suppliers through the supply chain, and customers through improved services by linking the devices throughout the globe, resulting in a sustainable economy and revenue generation. It brings new and global investors to work in KSA and opens new jobs, which might result in a strong economy. Moreover, these technologies have opened up new business opportunities to expand their operations globally. Saving resources and generating revenues will lead to GDP growth. It shifts individual technologies to organized and innovative ones, generating KSA growth and revenue. These technological advancements have revolutionized the manufacturing industry by introducing automation, AI, and IoT (Khalifa et al., 2021). These technologies have resulted in greater efficiency, lower costs, and enhanced productivity in manufacturing processes. The initiatives associated with these technologies lead to improved patient care, better supply chain management, and more efficient transportation systems. Industry plays a vital role in a country's economic growth by fostering innovation, boosting productivity, creating new job opportunities, and raising the living standards of its citizens.

The results from the word cloud for Theme 2, which includes Subthemes 2.1 and 2.2, indicate that machine-to-machine communication, human-machine interaction, integrative technologies, communication and networking, and the Internet of Things are key elements in developing human-machine interactions (Subtheme 2.1). Furthermore, innovative and advanced digital technologies, manufacturers' competitive strategies, and successful employment practices are identified as crucial factors for Industry 4.0 and 5.0 in generating revenue. These elements are beneficial for the economic growth of the country (Subtheme 2.2).




Subtheme 2.1: Usability of M2M/Human-machine


Subtheme 2.2: Revenue generation and economic growth

**Fig. 3:** Theme 2: Industry 4.0 and 5.0 benefits in building automatic human-machine collaboration

**Theme 3:** Industry 4.0 and 5.0 initiatives in KSA

**Subthemes 3.1:** Industry 5.0 vs. Industry 4.0 initiatives in terms of Importance

Subthemes 3.1 consists of the interviewees' main statement regarding the importance of Industry 4.0 initiatives vs. Industry 5.0 initiatives (Fig. 4).

The finding of the interviewees' statements shows that Industry are needed in the Saudi market and has a favorable impact on the present industry. Companies should consider adopting Industry 5.0 initiatives as they focus on integrating human skills with cutting-edge technologies. Industry 4.0 revolution is concerned with the effectiveness of automation with less human involvement, while Industry 5.0 emphasizes human involvement with machines; the later revolution is much more important than the previous one. Both approaches emphasized innovative technologies such as IoT, Intelligent systems, smart connectivity, and smart management information systems. The interaction of machines with men will be better for industry and the economy for economic growth and sustainable development. Industry 5.0 is an improved version of Industry 4.0. The conception is that Industry 4.0 has reduced human requirements by introducing intelligent technologies to businesses. The industry is similar but different somehow. Industry 5.0 refined the 4.0 revolution by incorporating humans with productive technology and allowing them to work with machines effectively and efficiently.

**Subthemes 3.2:** What makes Industry 5.0 different from Industry 4.0, the preceding industrial revolution?

Subthemes 3.2 consists of the main statement of the interviewees regarding what makes Industry 5.0 different from Industry 4.0, the preceding industrial revolution (Fig. 4). The finding of the interviewees' statements shows that the Industry 5.0 revolution seeks a more balanced operational approach to the execution of tasks with intelligent systems and human minds than Industry 4.0. Compared to Industry 4.0, Industry 5.0's objective is social empowerment and sustainable economic development by creating jobs and ensuring that these automated technologies will result in enhanced production. Industry 5.0 has a more human-centric collaborative approach than Industry 4.0, leading to more digitalization and minimum human interaction (Kong et al., 2019). Industry 4.0 focuses on the connectivity of the IoT and physical systems. Industry 5.0 builds on the framework of Industry 4.0, promoting machine-to-machine (M2M) and human-machine collaboration. It integrates workforce talent with robotics to develop innovative solutions addressing economic demands for the upcoming decade. Industry 5.0 not only retains all the advantages of Industry 4.0 but also introduces new benefits. While these industrial developments may transform the local workforce and the future of work in Saudi Arabia, they also present significant opportunities for growth and innovation.

**Subthemes 3.3:** Transforming the Saudi workforce to global talent leading to economic growth

Subthemes 3.3 consists of the interviewees' main statement regarding transforming the Saudi workforce into global talent, leading to economic growth (Fig. 4).

In response to rapid digital transformation, the Saudi Arabian government has introduced numerous digital platforms to advance the country's industry and economy. Through the adoption of these technologies, Saudi companies are able to automate repetitive tasks and streamline operations, thereby allowing employees to focus on creativity and innovation. The advent of Industry 5.0 has enhanced human lives, providing greater safety and security and facilitating the transfer of technological know-how with improved productivity compared to Industry 4.0. These initiatives have spurred the creation of new industries, companies, and jobs, contributing to social and economic empowerment. The traditional workforce is evolving to acquire global competencies, facilitated by technologies such as robotics, autonomous transport, mobile internet, and cloud technology, which enhance human interactions. These transformations are developing the necessary technologies and associated human capital. Under Saudi Arabia's "National Transformation Policy Program 2030," human capital is being utilized across various sectors, including manufacturing, healthcare, and information technology, driving economic growth. Consequently, these industry initiatives hold the potential to transform the Saudi workforce into a global talent pool, promoting economic expansion in the Kingdom.


Subtheme 3.1: Industry 4.0 vs. Industry 5.0 initiatives Subtheme 3.2: Industry 4.0 vs. Industry 5.0 Subtheme 3.3: Workforce transformation

**Fig. 4:** Word cloud of theme 3: Industry 4.0 and 5.0 initiatives in KSA

The outcome of the word cloud of Theme 1 (Fig. 4: Subtheme 3.1, 3.2, and 3.3) shows technologies, digitalization, man-machine interaction, and organization of industry (workforce, collaboration, and competition) are the main initiatives of Industry 5.0 with Industry 4.0 initiates in terms of importance (Subtheme 3.1). Secondly, the word cloud shows that technologies, innovation, development (changing), workforce/employee involvement and advancement, and their interaction/ collaboration with digitalization leading to sustainable and societal advancement are significant benefits of Industry 5.0 over Industry 4.0 (Subtheme 3.2). Thirdly, technological advancement, digital innovation and development (changing), social innovation and empowerment, and workforce development are the main factors that will help transform the Saudi workforce into global talent, leading to economic growth (Subtheme 3.3).

## 6. Discussion

The study findings explore that the transformation of Saudi talent from local to global is primarily concerned with a skilled and knowledgeable workforce equipped with emerging technologies such as artificial intelligence, robotics, IoT, data analytics, and automation (Ustundag and Cevikcan, 2017; Wang, 2022). Another challenge is continuous training and upskilling to keep up with the rapidly evolving technological landscape (Madsen, 2019; Singh et al., 2022b). For example, Interviewee 3 replied on workforce challenges: "How do you train people who will work in such an industry? High-skilled operators must familiarize Engineers with more sophisticated machines and processes."

Industry 4.0 emphasizes the significance of automated machines, and Industrial Revolution 5.0 emphasizes the significance of humans with machines. Both revolutions emphasize the importance of advanced technologies with automated devices. Industry 5.0 is the refinement of Industry 4.0, which made people user-friendly and allowed them to work with machines effectively (Xu et al., 2021). The human-centric revolution will be better for the industry and economy as it integrates human skills with advanced technologies (Kong et al., 2019), resulting in effective production processes leading to competitive advantage and sustainable economic development (Lin and Huang, 2021). Industry 5.0 made workers' lives safer and more comfortable with increased productivity compared with Industry 4.0. Industry 5.0 is more concerned with automation with a human-centric approach and societal orientation than Industry 4.0, leading to more digitalization and minimum human interaction (Kong et al., 2019). The aspects of Industry 4.0 are more concerned with the connectivity of IoT and Cyber-physical systems (CPSs) with autonomous M2M communication (Kraft and Mosbach, 2010; Chen and Lien, 2014; Zhou et al., 2017; Sikorski et al., 2017; Amodu and Othman, 2018; Schiele and Torn, 2020). The theme of Industry 5.0 aligns with the Industry 4.0 platform, leading to M2M and human-machine collaboration, which has the concept of a human-centric, sustainable, and resilient aspect of the Industrial Revolution (Adel, 2022). When asked about the usability of M2M, IoT, and human-machine interaction, interviewee 3 replied, "Of course, it will help businesses; using M2M is safer and faster."

The introduction of industrial advancements has created an environment that fosters the development of new ideas, leading to significant improvements in technology and business methods. As described by the eighth interviewee, "Industry 4.0, also known as Industrial IoT, introduces new ways for humans and machines to interact seamlessly. These systems involve smart, interconnected cyber-physical production systems that manage the flow of industrial processes." Furthermore, Industry 5.0 has improved workers' lives by providing technologies that facilitate human interaction, thereby enhancing productivity and competitiveness (Kong et al., 2019; Lin and Huang, 2021). Industry initiatives transformed the traditional workforce into a technically skilled workforce, leading to a global presence. In addition, integrating advanced technologies such as IoT, AI, and robotics in industries increases efficiency and productivity, leading to economic and social empowerment.

Entrepreneurs/practitioners implementing Industry 4.0 and 5.0 need the high cost of technology, the scare of a skilled workforce, and employees' resistance to adopting the technology. In addition, it speeds up the supply chain, minimizes waste, manages the budget, optimizes operations, reskills the existing workforce, aligns with the pace of change, and controls these systems effectively. Furthermore, there may be concerns about job displacement due to automation (Müller, 2019), which can lead to social and economic issues if not appropriately addressed. The development risks are

to train/or acquire the workforce with new skills and knowledge to work in Industry; otherwise, it could result in a skill gap with the required expertise to work on these technologies in the rapid industrial environment. Interviewee-18 told us, "Barriers to implementing Industry include the high cost of technology adoption, lack of skilled workers, and resistance from employees who may fear job loss or feel uncomfortable with new technologies."

The industrial sector greatly influences the workforce and employment in Saudi Arabia. It creates new job opportunities in fields such as data analysis, cybersecurity, and robotics. As these technologies grow in Saudi Arabia, there is a high demand for skilled workers in these areas. Industry initiatives have benefited companies, employees, and stakeholders by linking them to a global digital network, which enhances their revenue opportunities. These initiatives have also enabled businesses to expand internationally and have led to job creation. Technological advancements have transformed manufacturing through the introduction of automation, artificial intelligence, and the IoT (Khalifa et al., 2021). According to Interviewee 6, "This transition from individual to organized and innovative technologies has spurred growth and revenue generation in Saudi Arabia."

## 7. Conclusion

The industry environment is crucial for a country's economic growth as it promotes innovation, enhances productivity, creates new job opportunities, and improves citizens' living standards. Industry 4.0 is an innovative technology with a real-time production system, and it can enhance production capacity, leading to sustainable economic development. Industry 4.0-driven benefits to the industries are automation, real-time data, improved visibility, increased production, and competitive advantage (Lin and Huang, 2021). while Industry 5.0 is concerned with personalizing products and their relation with workers to increase productivity and human value through man-machine collaboration (Xu et al., 2021). It enhances workers' lifestyles and healthcare systems with real-time data. (Alhamad and Singh, 2022). The industry will improve its existing industry with new mechanics and technology. In addition, it will increase workability by adopting new technology. Therefore, industry significantly impacts the local workforce and the future of work in KSA.

Rapid technological advancements in industries require continuous workforce training and development to meet the technological market demand, leading to sustainable economic development (Madsen, 2019; Singh et al., 2022a; 2022b). With the increasing adoption of automation, artificial intelligence, and other advanced technologies in KSA, many jobs humans previously performed may need to be updated or require new skills. Job losses in specific sectors may be short-term as companies adopt more automated processes (Müller, 2019). However, in a long time, these changes will result in increased and efficient production, providing more jobs for people in digital technologies, like programmers, data scientists/analysts, artificial intelligence, and robotics (Khalifa et al., 2021). The study's findings also indicate that if not managed properly, it may result in the polarization of jobs, resulting in skill and income gaps. As these technologies become more prevalent in KSA, the demand for a workforce with specialized skills in these areas is high (Wang, 2022). To prepare for this shift in the workforce, individuals need to invest in education and training programs that will equip them with the technical know-how required for the present digital environment (Madsen, 2019; Singh et al., 2022b). The dynamic demands of the global business environment play a crucial role in comprehending the advanced methodologies and business curricula across the globe (Tapanjeh and Singh, 2015). Industry increases productivity, energy efficiency, and sustainability, and the need to update the present education system and invest in training and learning accordingly (Alam et al., 2022; Singh et al., 2022a).

The study shows that a skilled workforce, technical advancement, innovation and creativity, and digital transformation have precipitated technological unemployment and job polarization at some level (Müller, 2019). To achieve this transformation, Saudi Arabia must invest in education and training programs that equip its citizens with the necessary skills to thrive in an Industry 4.0/5.0 environment. It consists of technical skills with soft skills, collaboration, and problem-solving. Furthermore, businesses must embrace a culture of innovation and experimentation, encouraging employees to take risks and try new approaches. As a result, it will create an environment where new ideas can flourish and lead to breakthroughs in technology and business practices.

### 7.1. Limitations and study implications

The interviewees who participated in the study were male respondents only. The researchers sent the interview requests to female executives but did not receive favorable responses. Some of the interviewees were very curious about their interview. At the same time, some of them attended the discussion with their busy schedule within the time limit. In addition, the study's outcomes delineate the expertise, knowledge, and experience they shared with the researchers.

The study contributes to theory and industry practices by presenting a framework for initiating change in the local Saudi workforce to global talent with Industry standards. It will help to integrate the existing human resource practices and provide a pathway to managing workforce challenges in the digital age, leading to Saudi Vision 2030. Designing a new system per Industry 4.0 and 5.0 and restructuring human resource practices and existing

workforce challenges in the Kingdom will bridge the skill gap and attract the local workforce talent to acquire the required skills and competencies to cope with global talent. In addition, the study will be used to cope with the structural challenge of proposed industry practices. The study will help identify what skills are required to be developed to balance men and machines. Also, it will help enhance production efficiency in the Kingdom with upcoming technological advancements worldwide. The study has further scope to include some women executives to extend the further scope.

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## Compliance with ethical standards

## Conflict of interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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