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"Revolutionizing Supply Chain Education": Integrating Industry 4.0 and IOT into University Curriculum (Opportunities and Challenges)

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Abstract:

With the emergence of Industry 4.0 and the flourishing of IOT, a profound opportunity is set for universities to integrate it within their curriculums. The research aims to evaluate and showcase the beneficial outcomes and the challenges of incorporating Industry 4.0 into a university curriculum, particularly in supply chain management, and how this emergence is a step toward revolutionizing higher education. The research investigates the merits of interconnecting industry 4.0 tools within classes, integrating IOT in developing course materials, and how industry 4.0 concepts align education with modern workforce requirements. The paper uses unstructured interviews with logistics and supply chain experts, lecturers, and students. questionnaires for students that focus on curriculum enhancements to integrate IoT and industry 4.0 technologies and principles, develop criteria to assess the effectiveness of the updated curriculum, encourage the integration of IoT and industry concepts across various engineering and technology disciplines, and conversely showcase potential hurdles in the integration process of industry 4.0 with the higher education sector, within the resources, infrastructure, academic qualifications, and funding. This academic endeavour will serve as a comprehensive guideline for professionals, academics, and institutions. By presenting a real-world application, it will bridge the gap between theoretical knowledge and actual implementation, therefore, ensuring the utilization of the most effective strategies in the academic sector.

Keywords
IoT & Industry 4.0 Integration, University Curriculum, Supply Chain, Education Development, Curriculum Enhancement, Technological Adoption Challenges

1. Introduction

The rapid growth of Industry 4.0 and the expansion of the Internet of Things (IoT) have created an important wave in a variety of industries, including manufacturing, healthcare, and logistics (Sharma et al. 2023). As new technologies reshape business standards, various industries are quickly embracing these new technologies to improve efficiency, productivity, and innovation, which in turn is impacting a range of sectors, such as education. Global education systems need to adapt to the demands of an increasingly technologically advanced society. Conventional education methods, focused on memorization and standardized tests, are facing pressure to equip students with skills suitable for the rapidly evolving Industry 4.0 world. The effects of Industry 4.0 on education are multifaceted. However, it necessitates modifying the curriculum to emphasize problem-solving, critical thinking, digital literacy, and adaptability. Similarly, it also opens up new opportunities for personalized education with the use of AI and data analysis, enabling a more effective and personalized learning process. Furthermore, integrating cutting-edge tools like augmented reality (AR) and virtual reality (VR) into classroom environments offers innovative ways to boost engagement and learning.

Integrating Industry 4.0 and IoT into university courses provides a critical opportunity to improve educational outcomes by connecting them with the skills required by modern enterprises (Ahmad et al. 2024). The growing gap between traditional educational methodologies and the quickly changing, technologically driven environment in which graduates must currently strive to minimize the gap in terms of knowledge and skills to satisfy the logistics and supply chain industry. The literature has highlighted several challenges in higher education, including the lack of standardized frameworks for integrating new technologies, resource limitations that limit effective adoption, and the necessity of developing assessment criteria to measure the success of these curricular enhancements in achieving.

This research will address these issues by suggesting curriculum modifications that incorporate Industry 4.0 and IoT principles, creating a framework for evaluating their effectiveness, and identifying potential barriers to their implementation. A fundamental question arises: How can higher education institutions, particularly universities, prepare the next generation of professionals to thrive in this quickly changing environment? This study is driven by the urgent need to close the gap between academic knowledge and the practical demands of the modern workforce, especially in logistics and supply chain management. Using unstructured interviews with logistics and supply chain professors, experts, and students, as well as guided group discussions. The findings will be useful guidelines for academic institutions looking to match their curricula with the demands of the modern workforce by showcasing the potential challenges of embracing the Industry 4.0 tools within academic farmwork and presenting the merits prevalence over the demerits for ensuring that graduates have the knowledge and skills needed to succeed in an increasingly digital world. The remainder of the paper is organized as follows, section 2 explores further the literature review, section 3 explains the research methodology, section 3 presents the outcome discussion and findings, and finally, section 4 summarises the conclusion and outlines the future work.

1.1 Objectives

Revolutionize and align the educational sector with the evolving demands of the market.
Propose curriculum enhancements that integrate industry 4.0 tools within the academic programs in the form of collective opinions of education shareholders.
To ensure the effectiveness of these enhancements, criteria will be set to assess the impact of the updated curriculums and the willingness of students to embrace them.
Showcase the potential challenges of embracing the Industry 4.0 tools within academic farmwork,
Present the merits prevalence over the demerits, promoting the widespread integration of the Industry 4.0 tools within all educational aspects.

2. Literature review

The growth of Industry 4.0 and IoT, especially in the areas of supply chain management and logistics, has reshaped higher education to embrace its workforce requirements in terms of knowledge and skills. This growth has enabled optimization, flexibility, and efficiency in logistics and supply chain management (Gibson et al. 2005). It also integrates advanced digital technologies and smart automation into the production processes to accelerate growth (Dhika & Destiawati 2017). Such technologies include AI (Artificial Intelligence) and IoT (Internet of Things). Integrating these concepts, adding them to the curricula, and teaching them to future generations will be an important step toward revolutionizing education and development (Noor 2024).

Throughout the years, logistics has taken many different models to align with the industry's requirements and opportunities (Spector, 2015). In recent years, for example, logistics has taken an advanced form known as Logistics 4.0, which was a consequence of the Industry 4.0 revolution, and the development of ICT (Information

and Communication Technologies) that has enabled new ways of exchanging data and horizontal and vertical integration of supply chain components (Gordana and Luka 2019).

The presence of Logistics 4.0 within university curricula became more essential, and its education has become more comprehensive and complex. The current logistics education focuses on specific tasks and activities within transportation, storage, and distribution. However, the logistics 4.0 revolution, for example, has shifted the traditional movement and storage of items to a branched field that includes SCM (supply chain management), IOT (information of things), and global trade (Murphy and Post 2007). Further, the logistics sector evolved to a global scale and became internationally interconnected which require a stronger and more comprehensive academic program to address the new sectors of logistics such as inventory management, operation management, and procurement. (Gibson et al 2005). Preparing students for Industry 4.0 requires a collaborative and proactive approach from educators and institutions. There are techniques for efficiently training students to meet the demands of future employment in supply chain management and the logistics industry (Gibson et al. 2005).

Integrate Industry 4.0 technologies in the classroom.

The educational institution may incorporate Industry 4.0 technology straight into the classroom to keep students current and provide them with hands-on exposure to all of the most innovative manufacturing technologies. According to Kapur (2019), advancements in technology have enabled educators to impart more comprehensive knowledge and enhance students' understanding of concepts. Not only can they explain these concepts, but they can also use visual aids like pictures and images to improve comprehension. This might include, for example, teaching complex ideas using virtual reality simulations or bringing robotics and automation into the curriculum. Further, establishing in-house maker spaces where students can learn to use various hardware and software tools(Hardyanto, 2017). The College of Engineering at the University of Wisconsin–Madison. For example, it initiated a design and innovation Makerspace in 2017, providing students with access to a wide range of outstanding high-tech equipment such as 3D printers, 3D scanners, CNC routers, laser cutters, drones, VR/AR headsets, and more. The makerspace, which is mostly run by students, aims to empower them by fostering a community that is steeped in emerging technologies and dedicated to creating innovative goods (Zhong & Li, 2020). Traditional shop classes are increasingly inadequate for preparing students for the growing demand for highly skilled workers in various industries. Therefore, integrating Industry 4.0 technologies such as additive manufacturing, robotics, and coding into the curriculum is crucial. However, this integration may encounter challenges, including limited internet access, insufficient familiarity with technology, and a lack of technological equipment in schools (Budd 2001).

Collaborate with industry partners and professionals.

Collaboration with local firms and industry experts can give students an important opportunity to obtain real-world experience, learn about the most recent trends and technologies, and receive insights into the skills and competencies required for Industry 4.0 positions (Oosthuizen 2022). To do this, educational institutions can work with industry partners and professionals in a variety of ways. Such ways include inviting industry professionals as guest lecturers to offer hands-on seminars or workshops on Industry 4.0-related topics. This allows students to develop practical skills, and observe career stories that may answer their concerns, scheduling regular visits to factories and production facilities to observe some of the manufacturing processes, and providing students with opportunities to participate in internships or apprenticeships with industry partners to gain real-world experience that will benefit them in their future careers. Silapanad (2013) initiates, for example, a collaborative work-based learning paradigm with a nearby university to create a cooperative education program that allows students to work on projects for up to four months while receiving a stipend.

The Internet of Things (IoT) has transformed the logistics industry by enabling seamless connectivity and communication across the supply chain. IoT devices, such as sensors, RFID tags, and GPS trackers, are installed in vehicles, containers, and products to gather and monitor real-time data. This data enables better decision-making, predictive maintenance, and increased transparency, all of which are necessary for optimizing logistics operations. For example, IoT can monitor the temperature and humidity of perishable items in transportation, ensuring that they meet the necessary conditions. Additionally, real-time shipment tracking reduces delays and improves overall supply chain efficiency. As logistics operations experience the digital revolution, the skills required by graduates evolve. Traditional logistics education may not adequately equip students to meet the demands of a digital supply chain. As a result, including Industry 4.0 tools, such as IoT, in academic curricula is critical to ensuring graduates have the appropriate abilities. Graduates must be skilled in data analysis, understanding IoT ecosystems, and using technology to optimize supply chain processes ((DeFranco & Kassab, 2021). This transition necessitates not only technical expertise but also a thorough understanding of how new technologies influence logistics operations.

To properly prepare graduates for a digitalized logistics environment, academic programs must be revised to include comprehensive courses on IoT, data analytics, and other Industry 4.0 technologies. Research by Yuke et al.(2021) shows that to meet the defined talent training objectives, an aligned curriculum system for the IoT program must be built regarding the top IoT technologies in the university and the IoT industry. These upgrades should be created in consultation with industry experts, instructors, and students to ensure their relevance and practicality. By incorporating real-world IoT applications in logistics, the curriculum can better prepare students to succeed in a modern supply chain.In addition to improving the curriculum, it is critical to develop criteria for measuring the impact of these changes and determining students' readiness to use new technology. Educational institutions should develop a culture of innovation and adaptation among students(Fitria, 2021). Feedback from all stakeholders will be critical in designing the curriculum to match current and future industry demands, ensuring graduates are well-prepared to face the difficulties of a modernized logistics environment.

3. Methodology

To provide a comprehensive understanding of the integration of Industry 4.0 and IoT into university curricula, this study uses a mixed-methods approach that integrates both qualitative and quantitative research methods, allowing for a more comprehensive understanding of the topic, gaining a larger and more valid set of data, and presenting the opportunity of reaching more audience. Questionnaires and recorded unstructured interviews will be used to gather and analyze primary data for the study. The decision to utilize a mixed-methods approach was motivated by the need to address both the depth and breadth of the research topics. In LSCM, the integration of Industry 4.0 and IoT into university curricula includes both quantitative outcomes (e.g., student performance, technology adoption rates) and subjective experiences (e.g., industry experts' perceptions, and educator problems). By combining qualitative and quantitative methodologies, this study can provide a broader perspective of the effectiveness of these curricular changes, identify potential problems, and make evidence-based suggestions.

3.1 Qualitative data collection: Unstructured interviews

Target population:
Students in Higher education institutions
Lecturers in Higher education institutions
Industry experts with exposure to supply chain and industry 4.0 tools
Sampling method:

To gain more reliable and saturated data, a targeted method of sampling is used to select participants who are involved with the supply chain and industry 4.0 sector, both in education and industry. with an emphasis on those with substantial industry experience and expertise with the most recent technology developments. The experts were chosen based on their capacity to offer relevant and perceptive knowledge regarding the demands of the market. The selection of lecturers was based on their involvement in curriculum development and academic expertise. Random sampling was used to select students enrolled in logistics programs to guarantee a variety of perspectives. The interview will be conducted with a minimum of 5 participants from each category (students, lecturers, and experts), Therefore, achieving a wider data generalization and credibility.

Interview Design:
Unstructured interviews will be collected, with open-ended questions related to all aspects of the topic, which are:

- Current overview of the industry 4.0 integration
- Opportunities to integrate Industry 4.0 within the educational sector
- Potential challenges of integrating Industry 4.0
- Proposed enhancement to the educational sector

Interviews will be conducted in person, allowing for a more efficient conversation and exchange of perceptions. Each interview will be approximately 45-60 minutes and will be voice recorded to ensure further analysis of the interview.

3.2 Quantitative Data Collection: Questionnaires

Target population: The questionnaire was distributed to students enrolled in LSCM programs across multiple universities.

Questionnaire Design:
The questions were created using topics discovered in the literature and expert interviews. Questions will address the amount of technological integration in their programs, their willingness to use Industry 4.0 tools and the perceived benefits and problems of these technologies in education.

Data analysis:
The qualitative data from the interviews was analysed using a grounded analysis approach, which aims to highlight the main perceptions of the topic by determining the most frequent responses and answers. While also showcasing the differing views. Therefore, determining the most relevant perspectives of the current situation of our topic.

4. Data collection

The data collection phase of this study systematically gathers qualitative and quantitative data to address the research questions and objectives through interviews with experts, lecturers, and students. As well as a questionnaire for students. Therefore, aimed questions were used, providing essential information for the analysis and interpretation that will follow.

Question Aim	Question
Overview on the current state of integrating Industry 4.0 with the education sector	● Give us your overview on the current implementation of Industry 4.0 within the university curriculum. ● In what ways is the university currently integrating Industry 4.0 into its curriculum? ● What is your perspective on the current state of supply chain education at universities? ● Does the curriculum help you achieve your long-term aims or academic goals? ● Which courses or topics do you think your program prepares you for the technological advancements? ● How would you rate your studying experience in the logistics and supply chain industry so far?
Potential opportunities of integrating Industry 4.0 with the education sector	● What are the potential opportunities that Industry 4.0 will present to the education sector? ● How can a university fully benefit from adopting new technologies? ○ ● How will the exposure to Industry 4.0 tools enhance students learning experience? ● How can industries and universities collaborate to ensure that graduates are well-prepared for the demands of the modern workforce? ● What kind of industry partnerships or collaborations would you like to see as part of your education?
Challenges faced when integrating Industry 4.0 with the education sector	● What are the potential challenges that the university will face when embracing 4.0? ○ ● How capable are the staff to effectively teach using new technologies? ○ ● What are the potential challenges of continuously updating the curriculum to be up-to-date with industry 4.0 advancements? ○

	● In your opinion, to what extent is the university willing to embrace new industry 4.0 tools? ○ ● What are the steps to ensure the best outcomes when adopting 4.0? ● Are there any risks that the integration of these technologies in education could lead to over-specialization, limiting employment opportunities?
Final topic perception	● Do the merits outweigh the demerits of integrating Industry 4.0 within the university? ● How important is collaboration between universities and industry in integrating Industry 4.0 and IoT into the curriculum? ● Are there any changes you would suggest to the way your courses are taught?

5. Results & Discussion

5.1.1 Experts

There is much that needs to be improved in university supply chain education. When asked about the current condition of logistics education, various industry professionals shared their opinions, and they concluded that courses should be more comprehensive and specialized. For example, DHL and the Oman Logistics Association are working together to launch new courses on land freight services and transportation. These courses cover important subjects such as transportation-related health, safety, and the environment (HSE). These programs demonstrate how academic institutions must modify their curricula to better meet the needs of business and better prepare students for the changing demands of the logistics industry.

As IoT and Industry 4.0 continue to influence the employment market, graduates must acquire important abilities that will enable them to compete. When questioned, what are the most critical skills that graduates should possess to be competitive in the industry market, According to a variety of experts, one of the most crucial abilities is the ability to quickly understand new systems and technology, particularly expertise with software skills such as Microsoft. Furthermore, both technical and soft skills are important, as employers value graduates who can adapt to technological advances and efficiently engage workplace dynamics. Each logistical expert noted that graduates frequently have insufficient expertise, due to their experience with systems such as Oracle or SAP, which results in being unfamiliar with Microsoft's software. Additionally, difficulties may develop when working with mechanics. Upskilling, adequate training, and internships are so essential in closing these gaps. When integrating these technologies, some professionals issued that there are some risks, such as less human capital; when relying on technologies it will risk the human workforce; however, others stated that it will help to divert and improve digitalization.As the experts are willing to ensure graduates are adequately equipped, they are eager to engage with universities in providing short courses, internships, and workshops that cover the needs needed in today's demand. There was a huge agreement on companies' engagement with many educational institutions since most colleges's curricula are out of date with advances and updated structures; therefore, it is crucial to contact companies in the field to provide insights into what is occurring in the market and what technology and systems are being introduce. One of the corporations established an innovation center in Dubai to create new technologies and conduct research and development practices.

5.1.2 Lecturers

An interview with lecturers has showcased their perceptions and insights into the current state of Industry 4.0 within the educational sector, revealing that the current journey into integrating Industry 4.0 tools is insufficient and poorly executed. moreover, highlighting potential opportunities and key challenges of integrating Industry 4.0 within a university.

While lecturers emphasized the importance of developing the curriculum to cope with the current industry needs, they stated many flows in the current adaptation and the existing barriers that hindered the process of integrating Industry 4.0 within universities. One of the challenges mentioned by the lecturers is the lack of funding since most universities don't set a budget intended for technology adaptation. Lecturers feel restricted to traditional ways of education. Furthermore, modernizing the curriculum has its monetary cost, such as buying equipment and software, training staff, and getting access to theoretical resources, which is a fundamental tool in the development of a comprehensive curriculum.

5.1.3 Students

By incorporating IoT and Industry 4.0 into university courses and assessing how the structure, content, and pedagogical style of the curriculum contribute to student overall growth and preparedness for their planned profession or academic pursuits. A set of questions were asked to several students from four different universities both privet and government institutions. When students were asked if the curriculum helps them reach their long-term objectives or academic goals, they all agreed that it does. One student stated, "The curriculum helps me to achieve my academic goals because it covers vital topics such as procurement management, operations management, transportation and distribution, warehousing, inventory, and materials management, which are important in the industry." When asked to describe their experience studying logistics and supply chain management, three out of five students stated that it was enjoyable and easy to comprehend. The other two commented that the content was somewhat repetitive and that the courses lacked practical instruction. Furthermore, 80% of students find sales management and operation management topics most engaging because courses are significant in equipping students with the knowledge and skills to manage internal operations and the broader supply chain. However, they have all agreed that the learning environment is generally positive, with a supportive faculty.

When students are asked, "How well do you think your program prepares you for the technological advancements in logistics and supply chain management, such as Industry 4.0 and IoT?" 50% of them responded that the study program includes lessons on modern technology and information systems and also helps them understand how to understand, apply, and manage these technologies. While the other 50% of them stated that they need to apply what they have learned in the curriculum to see how things operate in practice.

Students agreed that practical work in the industry enhances the academic curriculum by providing real-world experience and hands-on abilities that theoretical learning cannot provide. It bridges the gap between academic knowledge and practical application, improving understanding and use of IOT beyond Industry 4.0. There are various companies that offer similar possibilities to students, including ASYAD and the Ministry of Trade and Industry.

Students have proposed several curricular modifications to generate students capable of dealing with the challenges of the industry. Student 1 suggested that including more content related to supply chain sustainability and risk mitigation, strategies will better prepare students for future challenges, while student 2 suggested that the curriculum should include more hands-on experience, courses on emerging technologies, industry internships, and a focus on problem-solving skills." The third one emphasized the need to give students hands-on experience and organize tours to warehouses, facilities, and companies. These changes can help students be more ready for industry challenges.

5.2 Questionnaire Analysis:

The graphical results are ranked on a scale of 1 to 5, with 1 indicating very low, 2 indicating low, 3 indicating neutral, 4 indicating high, and 5 indicating extremely high.

5.2.1 Graphical results

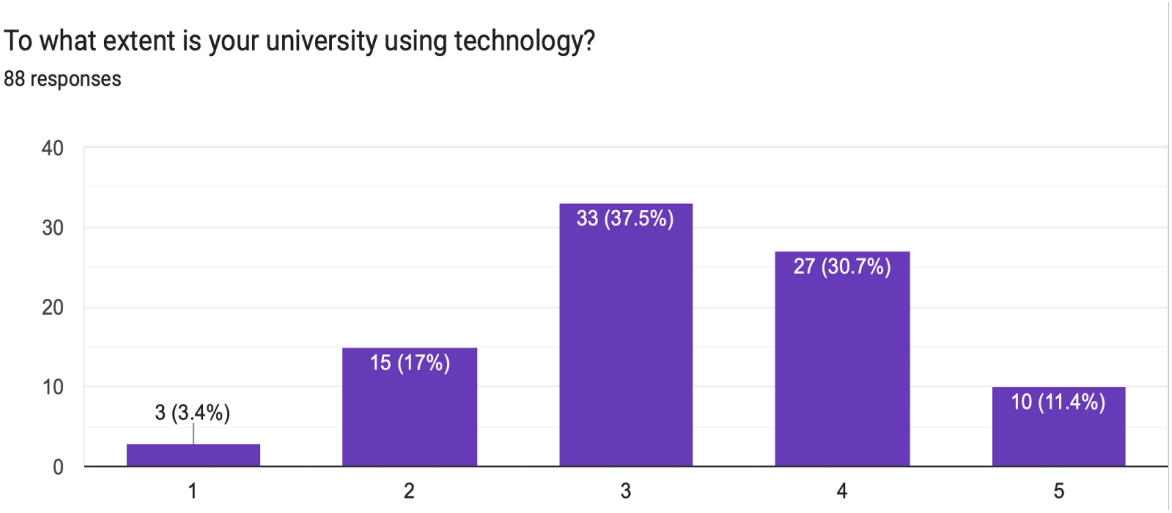

Figure 1. The Extent of Technology Usage

The finding of the graph shows a fluctuation of responses on the extent of technology usage within a university, the most frequent answer which 37.5% of respondents agreed on is 3 resembling the average on a scale of 1-5, which indicated a moderate usage of technology. Therefore, it implies the existence of technology integration, but is not used to its maximum extent. Only 11.4% have selected the highest number on the scale, revealing the highest level of technology embrace. On the other end of the scale. 3.4% of respondents chose a scale of 1, thus stating the minimum to non-existing integration.

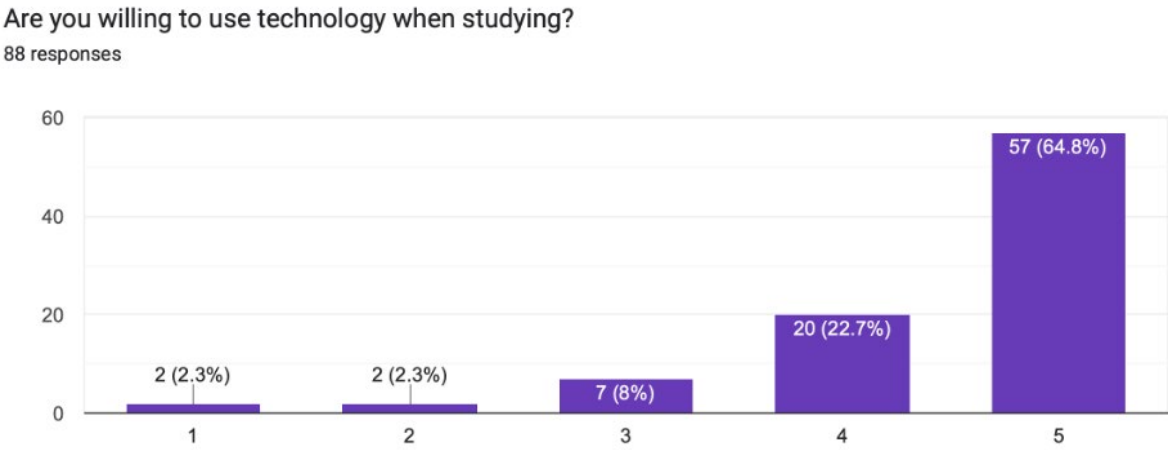

Figure 2. The Willingness to Use Technology When Studying

The rest of the candidates choose 4 and 2 accordingly, which indicates most believe to be above average in using technology, with fewer candidates believe to be below the average point, both indicating there is room for improvement.

The data shows a clear incline, which highlights the fact that the majority of respondents are eager to incorporate technology when studying, with 87.5% of respondents selecting either 4 or 5, indicating the willingness to have a high technology engagement level. This presents universities with an opportunity to modernize their curriculum and learning experience by incorporating industry 4.0 tools. However, 7 respondents had a moderate response by selecting the middle point on the scale. This implies taking an impartial stance, thus suggesting both willingness and reluctance at the same time. Nevertheless, the minority of the research population, which represents 4.6%, are

resistant to using technology, highlighting the fact that although it's a small portion, the opposition against integrating technology exists.

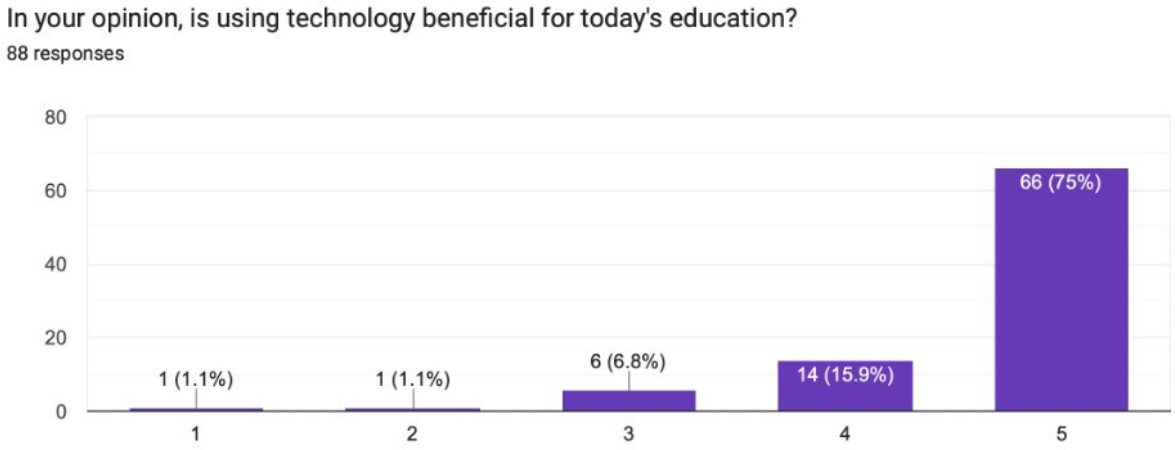

Figure 3. The Benefit of Technology in Modern Education

The data showcases a clear trend of respondents believing that technology will offer today's education a wide set of benefits. This is demonstrated in Figure 3, as 90.9% choose options 5 and 4. Presenting the fact that most respondents are aware of the potential opportunities of integrating education into the academic field, and the role that technology could play in improving the learning experience and enhancing the quality of education received. Nevertheless, 6.8% chose the middle point of the scale and were neither strongly supported nor opposed. That being so, a small percentage of the respondents pool chose 2 and 1, accumulating only 2.2%, indicating minimal disagreement. Therefore, the steep peak at option 5, which highlights that the vast majority are highly in Favor of integrating technology, is a clear indication that the educational sector should seize the full benefit of the current Industry 4.0 tools.

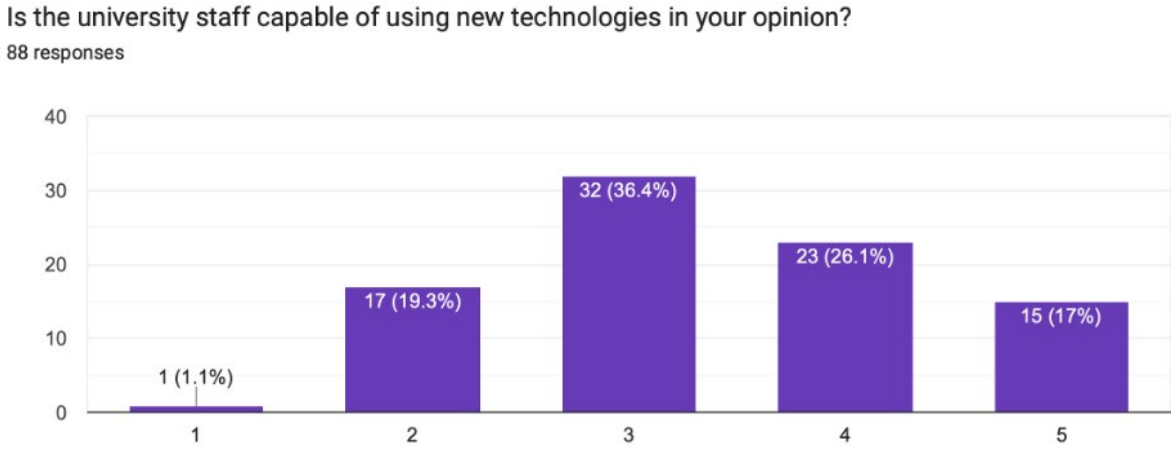

Figure 4. Capability of the University Staff of Using New Technologies

The data presents a differing perception of the capability of staff to operate using new technology. (Figure 4) shows that the highest number of the survey population are taking a neutral stance, with 32 out of 88 participants, suggesting that while they perceive the staff as being capable of embracing new technologies, there is room for improvement. Additionally, 15 respondents are enthusiastic about the capability of staff to fully adapt to new tools, possibly implying the existence of staff who are showing the required skills to effectively use new technology. While there is concentration on the upper end of the scale, there is a significant number of 17 respondents who doubt the competence of the staff to incorporate new technology. Although it's not the dominant response, 23 out

of 88 respondents have a positive perception on the abilities of the staff. In contrast, only 1 respondent fully believes that the staff lack the minimum ability to use new technology. This data expresses the need for educational institutions to start implementing staff training into their programs, thus enhancing their skills and confidence in effectively integrating new technologies across all academic sectors.

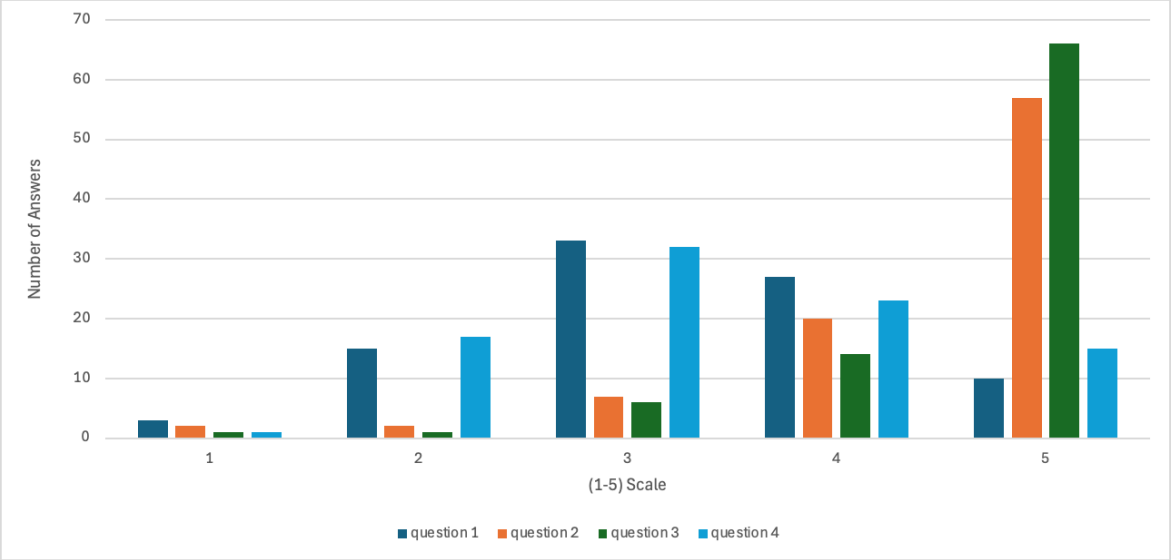

Figure 5. Frequency of Response

The graph (Figure 5) presents the frequency of response of 88 participants in a questionnaire across a scale of 1 to 5, with 5 being the highest. The perceptions of these participants have been examined using four questions, these questions are:

- To what extent is your university using technology?
- Is the university staff capable of using new technologies?
- In your opinion, is using technology beneficial for today's education?
- Are you willing to use technology when you are studying?

The survey results demonstrate that most respondents have a positive view on integrating technology with the educational sector, as shown in (**Figure** 5) the most frequent choice is 5, indicating that the vast majority of respondents are strongly rooting for the adoption of industry 4.0 tools within educational institutions. Furthermore, the data shows that the second most selected options are 3 and 4, with nearly similar frequencies, suggesting that a significant number of respondents have a neutral to optimistic perspective on further integrating technology with education. This implies that respondents are willing to adopt technology to an extent, as they recognize both the potential benefits and the room for improvement. The least frequent option is 1, indicating minimal opposition and dissatisfaction, this suggests that only a negligible amount of respondents believe that the integration of technology with education will be unbeneficial and unjustifiable.

5.3 Proposed improvement

Simulation-Based Learning

Industry-Specific Simulations:

Use software tools that simulate real-world supply chain scenarios like inventory management, transportation logistics, and demand forecasting. This allows students to face practical issues in a controlled context.

Digitalization:

use digital twin technology to create duplicates of supply chain systems, allowing students to test different techniques and see the results in real time.

Practical Work and Hands-On Projects

Lab sessions:

hands-on classes that allow students to interact directly with the technology and tools used in modern supply chains. For example, students could utilize IoT devices such as sensors to monitor the condition of items in transit or RFID tags to track inventory. They may also work with software platforms that collect and analyze data from these devices.

Collaborations with companies and expertise

Universities may collaborate with logistics and supply chain firms that are leaders in Industry 4.0 and the implementation of IoT to provide internships, co-op programs, and real-world case studies. For example, a corporation may allow students to analyze supply chain data and make recommendations on how to improve efficiency through the use of current technologies. This exposes students to innovative industry methods and difficulties, therefore, creating a pool of skilled and knowledgeable graduates, as well as helping them create networks that may lead to future job opportunities. Companies benefit from new insights and possible candidates for recruiting.

Interdisciplinary Courses

Cross-Departmental Collaboration:

Encourage collaboration among departments such as IT Engineering and Business to provide multidisciplinary classes on the technical and management sides of Industry 4.0 and IoT. For example, students could learn about the hardware components of IoT from the engineering department and then apply that knowledge to supply chain optimization in a business context.

Continuous Curriculum Updates

Feedback loops:

Establish a strategy for regularly changing the curriculum based on input from students, graduates, instructors, and industry partners to ensure that it remains relevant to industry demands.

6. Conclusion

By comprehensively exploring the integration of Industry 4.0 and IoT into university curricula, especially in the contexts of logistics and supply chain management. The study found major opportunities, such as improving educational results by aligning academic programs with industry objectives and developing critical skills required for the modern workforce. while also acknowledging the Omani market's particular limitations. Notably, 80%–90% of Oman's industry professionals have yet to embrace Industry 4.0, raising concerns about how educational institutions would implement these technologies. Furthermore, it has offered possible curriculum modifications that embrace advanced technology and encourage collaboration between academia and industry, ensuring that graduates are prepared to face modern issues.

In addition, the research covers potential problems such as financial limits, restricted technological infrastructure, and lecturers' need for ongoing professional development. By identifying these challenges and proposing strategic solutions, the report provides a comprehensive framework for academic institutions to modernize their programs and bridge the gap between theoretical knowledge and practical application. Evaluating not only the state of Industry 4.0 and IoT integration but also offering practical suggestions for resolving the issues that have been identified. The study presented a comprehensive viewpoint on the topic using a mixed-method approach, which includes questionnaires with students and unstructured interviews with lecturers and industry experts. This guarantees that the suggested solutions are both workable and suited to the demands of the educational sector.
Overall, the research makes an important contribution to the field by providing a path for institutions to revolutionize their curriculum and better educate students for the fast-changing demands of the global market. The successful completion of all research objectives emphasizes the study’s relevance and effect, establishing it as a significant resource for academic institutions looking to improve their educational offerings in the age of digital change.

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Biographies

Affan Al-Kharusi is a third-year student at the University of Technology and Applied Sciences, Oman. He's currently pursuing a bachelor's degree in logistics & supply chain management. He holds an international baccalaureate diploma, He's the founder and president of the first "logistics & supply chain" club at the university. He completed courses in Integrated SCM, operation management, transportation and distribution, and procurement. He completed a logistics management internship at A'saffa Foods SAOG. He participated in TRANSOM exposition, AVOD exposition, and ASYAD exposition.

Mazoon Al-Kalbani is currently pursuing a bachelor's degree in Logistics and Supply Chain Management at the University of Technology and Applied Sciences in Muscat, Oman. In addition to her academic pursuits, she serves as the CFO of an emerging company, where she seamlessly blends her theoretical knowledge with practical business experience. Her passion for innovation led her to work with the Ministry of Higher Education on the innovative festival held in February 2024, showcasing her ability to manage complex projects. She also participated in the immersive "Skill to Product" course, a dynamiclogistics experience. She has also dedicated her time to teaching. She served as a primary teacher for a summer course, where she not only shared her knowledge but also inspired young minds.

Noor-al huda Al-Majrafi is a third-year student at Muscat University, Oman. She attended an international school in Malaysia for two years of secondary education. She is currently pursuing a bachelor's degree in the chemical engineering field. She gained experience in the field of engineering and operations through her training at more than one oil company in Oman. She can apply the theoretical concepts gained during her university studies to industrial realities. In addition to her academic pursuits, she was an active member of the University Engineering

Club. She devoted her time to studying until she was included in the dean's list of the most academically outstanding students. She also participated in many courses that encourage self-development and improvement, including the "continuous improvement" CI course and "well-being".

Supervisor

Jowhara Al-Habsi as a lecturer at the University of Technology and Applied Sciences. I have a bachelor's degree in logistics and supply chain management and MBA from University of North Texas, USA. I have academic experience from 3 different institutions. I am also interested in research. I have published papers such as "Knowledge and Skills Gap of Graduates Entry-Level: Perception of Logistics and Supply Chain Managers in Oman," which has been accepted for publication in the esteemed journal, "Higher Education, Skills and Work-Based Learning" indexed in Scopus and Web of Science. The journal is published by Emerald Publishing Australasia, with an impressive impact factor of 0.327 and ABCD ranking B, and is scheduled to be released in (Scopus) Q2 2023, and "Parcel Logistics Improvement in a National Postal Company," and as the author of "Identification of the benefits of the usage of information technology in managing warehouses in Supply Chain". I'm currently working on getting admitted for my PHD.