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Logistics Business Sustainability Incorporating National Logistics Strategy and Industry Revolution 4.0

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ABSTRACT

The Fourth Industrial Revolution (also known as Industry 4.0) is a global strategy that blends various technologies tools by merging the physical and digital world boundaries. While Oman launched the Sultanate of Oman Logistics Strategy (SOLS) in 2015, logistics is one of the vision's pillars. Both strategies have resulted in a divergence in business strategy orientations, resulting in a misalignment of the national target. The purpose of this paper is to investigate the relationship between SOLS 2040 and Industrial 4.0 strategies incorporating an analytic induction method, which is a systematic way of validating the correlation between both strategies. A systematic analysis revealed a positive correlation between the two visions, owing to the importance of technology in achieving the SOLS 2040 vision. The correlation between SOLS 2040 and Industry 4.0 is an important step toward developing a comprehensive framework for the Oman logistics industry that will benefit all stakeholders.

Keywords: *analytic induction*, *industry 4.0*, *logistics business*, *logistics sustainability*, *SOLS 2040*, *supply chain operations*

1. INTRODUCTION

The evolving development of the logistics sector plays a crucial role in facilitating global trade (Soledispa-Canarte *et al.* 2023). Over the years, the logistics industry has undergone significant transformations, becoming a vital facilitator of international commerce and trade integration. With the increasing interconnectivity of economies and the growth of global supply chains, logistics has emerged as a fundamental element in ensuring the smooth flow of goods, services, and information across borders (Ben-Daya *et al.* 2022).

The logistics sector encompasses a complex network of transportation, warehousing, inventory management, and information systems, all of which contribute to the timely and efficient delivery of goods worldwide. Efficient logistics operations are essential for reducing costs, minimizing lead times, and enhancing overall customer satisfaction. By optimizing supply chain processes and transportation routes, logistics significantly enhances the competitiveness of businesses in both developed and developing countries.

A key factor in the effectiveness of the global logistics network is the presence of robust infrastructure (Soledispa-Canarte *et al.,* 2023). Well-established transportation infrastructure, such as ports, airports, roads, and railways, serves as the backbone of logistics operations, enabling the seamless movement of goods across different modes of transportation. Investment in infrastructure development and maintenance is crucial to meeting the demands of international trade and accommodating growing cargo volumes.

Furthermore, the logistics sector plays a vital role in attracting investors from regional and international markets. Countries with efficient and reliable logistics platforms become attractive investment destinations as businesses seek

to expand operations and capitalize on global market opportunities. A well-functioning logistics sector provides a competitive advantage and stimulates economic growth, job creation, and technology transfer.

Logistics platforms have also played a critical role in promoting trade integration by harmonizing diverse modes of transportation. As goods often traverse multiple modes like sea, air, road, and rail, an integrated logistics framework ensures seamless connectivity and coordination among these modes. Collaborative efforts between stakeholders, including shipping lines, airlines, trucking companies, and railway operators, optimize resource utilization, improve transit times, and enhance overall trade efficiency.

The logistics sector has been compelled to adapt and embrace technological advancements due to recent global market trends. The emergence of Industry 4.0, combining digital technologies, automation, and artificial intelligence, has revolutionized cargo handling and supply chain management practices (Purnama *et al.* 2023). To remain competitive and meet customer expectations, logistics firms worldwide are investing in advanced technologies and digitalization initiatives. These innovations enable real-time tracking, predictive analytics, autonomous vehicles, and smart warehousing, resulting in improved visibility, operational efficiency, and data-driven decision-making.

Oman's logistics market is undergoing a similar transformation to align with international best practices. Recognizing the significance of a robust logistics sector for economic diversification and sustainable growth, the Oman Global Logistics Group has proposed the Sultanate of Oman Logistics Strategy 2040 (SOLS 2040) (Arnold, 2009). This long-term strategy aims to position Oman as a global logistics hub and enhance its competitiveness in the region. SOLS 2040 involves a comprehensive approach, including infrastructure development, policy reforms, talent development, and technology adoption. By embracing digitalization, automation, and aligning with global trends, Oman seeks to enhance its logistics capabilities and attract investments from international players.

This scenario raises an important question regarding the implementation of two distinct visions, Industry 4.0 and SOLS 2040, in Oman's logistics sector. The integration of these visions requires a comprehensive and coordinated framework that accommodates all logistics players in the industry and policymakers. Investigating and reviewing the correlation between Industry 4.0 and SOLS 2040 becomes essential to developing a dynamic strategic framework for Oman's logistics sector.

2. LITERATURE REVIEW

2.1 Sultanate of Oman Logistics Strategy (SOLS) 2040

The logistics and supply chain field has played a major role in national development, it creates economic, industrial, and job opportunities. Over the last decade, many countries, for instance, Hong Kong, Singapore, Netherlands, and the regional hub Dubai have seized their investment in the logistics market. The unsustainable oil and energy sector is still the main contributor to Oman's economy. Even with the geographical location advantage, Oman is located at the Gulf gate which makes it a superior trading center for the Indian region and African markets. Oman's developed its infrastructures such as roads and ports, unfortunately, the desired development has not been fulfilled. This can be justified by the lack of integration of the logistics systems since the components within the transport and distribution systems are independently developed. That extends to a deficiency in the soft systems like customs/border, legal and documentary procedures. Therefore, a clear and integrated strategy is urgently required for trade facilitation in Oman. Thus, Oman can achieve its aims to be the regional logistics hub by 2040 (Ithraa, 2016; Abdul Rahman *et al.* 2021).

Table 1 The Seven Working Groups

#	Group	Scope, Tasks, and Duties
1	Segmentation	Categorize Oman industrial and economic opportunity and proposed development strategies to elevate logistics.
2	Infrastructure	Oman established its infrastructures like; ports, airports, and roads those are matching with (competition or competitive) standards and how can they be improved.
3	Systems, knowledge, and technology	The success of the supply chain is associated with technological advancement that allows leapfrog competitors. Since modern logistics requires seamless coordinated IT systems between different logistics players, the private sector held a responsibility to upgrade to the latest technology.
4	Legislation and Customs	Revision and reform of current regulation to award more transportation efficiency, clearance optimization, and goods movement around Oman.
5	Capacity and Capability	Conduct a study to state the required number of workers and their associated skills.
6	Education	Specify the skills and training institutions that will prepare the workforce for the logistic development.
7	Marketing Oman as a hub	Initiating Oman marketing strategy and branding Oman as a logistic hub.

The Sultanate of Oman Logistics Strategy (SOLS) 2040 is a strategy introduced by the Supreme Council of Planning (SCP) in 2013, under the lead of the Minister of Transport and Communications (MOTC) (Oman Logistics Center, 2015). Seven contributory working groups were formed with representatives of the private sector, government bodies, and academic establishments, to evaluate the existing Omani logistics, benchmark to other competitors' systems, and introduce a recommended short- and long-term plans. **Table 1** summaries the seven working groups, and their scope tasks and duties.

Oman logistics strategy 2040 is targeting four final ambitions, sit based on the seven working groups' findings and summarized in **Table 2**.

Table 2 SOLS 2040 Ambitions

#	Ambitions		Targets				
			2014	2020		2030	2040
			Actual Data	Forecast Data	Actual Data	Forecast Data	Forecast Data
1	Economic Indicators	Logistics contribution to GDP in real terms (OMR billion)	1.5	3	6.4	8	14
2	Employment	Number of logistics jobs	30,000	80,000	79,000	200,000	300,000
3	World bank	Logistics index ranking	Top 59	Top 30	Top 43	Top 20	Top 10
	World Economic	Competitiveness index ranking	Top 46	Top 30	Top 59	Top 20	Top 10
	Forum indices	Trade enabling index ranking	Top 31	Top 20	Top 46	Top 10	Top 5
4	International Perceptions	Regional logistics hub		by 2020	by 2020		
		Global logistics hub				by 2030	

Result of the seven groups findings (**Table 1**), four core implementation groups were created to set the recommendations and guidelines to execute and implement the SOLS 2040 project (Oman Logistics Center, 2015). These would be:

a. Markets: Combine "Segmentation" and "Marketing Oman as a Hub". Its role is to identify and analyses the industrial and business opportunity in respect to logistics for Oman, which are dependent on logistics facilitation. Therefore, understand the required technologies to maintain the trade flow that will eventually help in the process of promoting Oman as a logistics brand in the region or internationally.
b. Trade facilitation: Represents "Legislations and Customs", it is the link point where import and export cargo meet the governments. It covers the clearance, rules and regulations, approval, and handling of cargoes. To accomplish the targeted ambitions, this group specifically involves the improvement in the speed and reliability of operations that rule the transport, check, and fees transaction all through the supply chain. In addition to facilitating the registration and licensing of companies and logistics operations in Oman.
c. Technology: Combines "Technology and information technology (IT)" and "Infrastructure". It mainly deals with how to utilize technological advancement in optimizing the logistics sector. With a significant augmentation in the care, speed, and handling efficiency of Oman's imported and exported cargo. And to seize the opportunity presented by rapid technological development in order to outperform competitors who have been in the lead using the most recent generation of technology. From a position of necessity, providing the support and incentives for the adoption of the best technology and practices throughout the Oman supply chain (Abdul Rahma *et al.* 2022b).
d. Human capital: Merges "Education" and "Capacity and Capability". This is categorized by three conditions, most of the employment going to be at the base of the transport management pyramid (skilled, semi-skilled) (Abdul Rahman *et al.* 2022a). Logistics tends to be practical and realistic instead of only a theoretical Industry. It also tends toward more complicated as the shift from manual systems to modern electronic systems. Unfortunately, there are obstacles in the way of logistics growth in Oman, such as the lack of trained/skilled nationals that fit the logistics market. That is a result of the deficiency in the training/education systems which is directly relevant to the lack of awareness of the value and potentials of logistics and transport as a worthy career. Taking care of those issues is the role of the Oman Training Logistics Board (OTLB) of the Vocational Training Council (VTC), **Table 3** shows the total forecast number of employees for Omani by skills requirement until 2040. Abdul Rahman *et al.* (2022a) studied about a new human capital development framework in logistics and supply chain incorporating Industry 4.0. The outcomes of such a study proposed that synergy of Industry 4.0 and human development skills in logistics which divided into three levels namely, operational, supervisor, and manager levels.

Table 3 The number of jobs required by skills requirement and occupational profile

Logistics job Function	Qualification Level	2014	2020	2030	2040
CEO, Top Level Management	MSc	242	554	1,572	2,561
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Managers (e.g., Customer Manager, Operation Manager, Terminal Manager) Engineers, Accountants, Communications, Marketing.	BSc	1,440	3,294	9,354	15,237
Supervisory Level, IT Instrument Technician, Freight Scheduler, Import / Export Officer.	Diploma	3,734	8,542	24,256	39,510

Logistics job Function	Qualification Level	2014	2020	2030	2040
CEO, Top Level Management	MSc	242	554	1,572	2,561
Crane Driver, Equipment Operators, IT technicians, Customs Broker	Skilled	5,230	11,965	33,974	55,339
Driver, order pickers, PRO, Office Assistants, Security Supervisors.	Semi-Skilled	11,348	25,961	73,716	120,075
Cleaners, Packers, Lashers, Porters.	Unskilled	7,840	17,936	50,928	82,956
	Total	29,834	68,253	193,799	315,678

2.2 Fourth Industry Revolution (Industry 4.0)

As the "steam engine" was the first industrial revolution, "electricity" was the second, and the third were "computers", the term Industry 4.0 was first introduced in Germany back in 2011. It stands for the fourth industrial revolution (Rojko, 2017). It represents a new stage in the industrial value chain's organization and control, which involves the digitization and automation of work based on its four-corner stone's Cyber-Physical Systems (CPS), Internet of Things (IoT), Big Data, and Smart Factories. Computation and networking are the legs CPS stands on (Benayoune *et al.* 2022); it enables the control of the physical systems of any industrial operation. With the aid of actuators, sensors, and communication tools, a control processing unit will be able to fully optimate any systematic operation. While, IoT is bound to connect any element in the process to the internet, and each other (Barreto *et al.* 2017). It works through cloud computing and many sensors that continually collect data and feed it to the binding system. The massive amount of data that exponentially grow over time and is collected from a variety of sources in different forms which is represented by Big Data. Typically, it can be classified into structured, semi-structured, and unstructured. If those elements have been integrated to work in harmony for a manufacturing process that covers the full spectrum originated at the planning stage to the actuators in the field. Autonomously uses of Artificial Intelligence and Robotics, will form a Smart Factory which in turn ensure the people jobs are safer and more reasonable (Gaspar *et al.* 2018).

By implementing Industry 4.0 in the logistics sector, it will enable real-time tracking of the cargo and goods, enhance transport handling and result in accurate risk management (Benayoune *et al.* 2022). According to Hofmann & Rüsch (2017), industrial revolution can be implemented in logistics in two dimensions, physical supply chain, and digital supply chain. Automation of transportation (autonomous trucks), transitional/cargo handling (robots), and order processing (smart contracts on the blockchain technology) represent the physical supply chain. The structured data which is collected by the physical systems, formed the inputs for the three main divisions of the Digital Data Value Chain (Umachandran *et al.* 2019). First is "Availability", which involves making sure that the service or the products are available at the consumers' fingertips around the clock relaying on autonomous delivery. The second is "Digital Integration", which deals with transparency and traceability of the cargos along the supply chain. The third is "Digital Servitization", which uses the added values of using digital services beyond the product distribution and physical services.

The logistics field represents a perfect environment to implement Industry 4.0. While the technological solutions are continuedly developing, **Table 4** presents some of the logistics technology. Emerging those techniques in the logistics operation and utilizing the power of seamless communication among all its parties, will play the foundation role towards optimized cargo handling, safety, optimizing resources that the logistics field is all about.

According to Hirschi *et al.* (2018) and Benayoune *et al.* (2022), this will result in an impact on human capital employment. Vass *et al.* (2020) published a narrative on the importance of the Internet of things IOT in supply chain management, it was concluded that IOT implementation has the potential to enhance the logistic operations at the retailer, the supplier, and the customers. These add to the findings of Dev *et al.* (2013) as they stated that the UpToDate demand information has a significance on the supply chain performance. According to Taboadaa and Sheeb (2020), the 5G technology is the future of supply chain management, in fact, it's the enabler of Supply Chain 4.0.

2.3 Research Gap

Considering the technological advancement during the connection era, Industry 4.0 has become the leading strategy worldwide in different fields. While the logistics sector is no exception, the industry player and companies are trying to adopt and implement the latest technology to promote their services. On the other hand, the steering committee of each country has developed its vision and strategies that are more oriented to fit the local market. The local strategies are more focused to gain the economic renaissance associated with attracting more logistics players into the domestic market and its impact on the country's development overall. This leaves the industry players with the challenge of implementing two different strategies as controversial as it develops in terms of similarity and discrepancy.

This study aims to investigate a correlation between the national strategy's SOLS 2040 and the international strategy's Industry 4.0. As a result, it introduces the question of how to incorporate Industry 4.0 and SOLS 2040 in comprehensive and dynamic ways that paved the way for the logistics companies in Oman to doubt.

Table 4 Technology Implementation in Logistics

#	Technologies	Implementation on Logistics	Sources
1	Cyber-Physical Systems (CPS)	Implemented automation and robotics in the intermodal terminals and transportation.	Benayoune *et al.* (2022)
2	Internet of things (IoT) and Industrial internet of things (IIOT)	Uses Internet, Smart device connection, and 5G, to tracing shipments reliably with real-time monitoring.	Barreto *et al.* (2017); Taboadaa and Sheeb (2020); Ben-Daya *et al.* (2022).
3	Big Data	Processing a lot of data allow detecting patterns that help in dissection making and automating the process.	Wang *et al.* (2017)
4	Blockchain	Securing data and information flow by encryption.	Sultan *et al.* (2018)
5	Cloud Computing	A technology that allows access to the servers regardless of the hardware device used to access the domain.	Barreto *et al.* (2017)
6	Artificial Intelligence	Machine learning, and systems that perceive its environment and take actions that maximize its chance of successfully achieving its goals and optimizing its process.	Gaspar *et al.* (2018)
7	Augmented Reality	Usually, it is used for warehouse management to improve selection, quality control, and packaging processes.	Delgado *et al.* (2020); Palmarini, (2018)
8	Smart Factory	It uses to predict demand to optimize inventories and product distribution.	Gaspar *et al.* (2018)
9	Enterprise Resource Planning (ERP) Software's	It manages inventory and the supply chain for business activity.	Abdul Rahman *et al.* (2023)
10	Customer Relationship Management (CRM) Software's	It optimizes customer interaction.	Abudaqa *et al.* (2020)

3. METHODOLOGY

SOLS 2040 and Industry 4.0 are two different strategies when in fact they should be two faces of the same coin to achieve optimized logistical practices. That is why finding the correlation between them is an important step in the way to create the dynamic framework for the Oman logistics sector (**Figure 1**). Therefore, an analytic induction method which is a properly established two-variable correlation is essential to highlight the similarities and the deviation.

3.1 Analytic Induction

It is a research technique commonly used in health and social science research and evaluation developed by Florian Znaniecki back in 1934 (Tacq, 2007). It is used for systematically constructing causal explanations for various phenomena. This research is intended to find the correlation between two qualitative variables, the international strategy of Industry 4.0 and the SOLS 2040. It starts by looking at a small number of cases to see if any correlations may indicate common factors. Following the creation of a hypothetical hypothesis, additional cases are investigated. If all of these do not suit the hypothesis, the hypothesis is reformulated to fit the characteristics of all the cases examined (Katz, 2001).

Analytical induction uses more commonly in the sociology field. Donald Cressey implemented the analytical method in an investigation of financial trust violations (Cressey, 1953). While other researchers rely on it in different studies related to addiction (Mitcheson, 1969) and Becker (1953; 1955). That said, the application of the Analytic Induction method is not limited to one field. The inductive approach provides a simple, straightforward approach for deriving findings linked to focused evaluation questions which makes it suitable for logistics strategy correlation (Thomas, 2006).

Following the analytical induction method, this paper systematically aims to find the correlation between Industry 4.0 and SOLS 2040. Starting with a rough definition of the research question, what is the correlation between Industry 4.0 and SOLS 2040? The hypothesis explanation of the research question came in the form that Industry 4.0 and SOLS 2040 share similar aims that revolve around facilitating logistics using technological advancement and the hype of connection. From this point, more specific examination cases were proposed to find if there is deviation or conflict with the proposed hypothetical explanation, or whether there is no deviation at all, and this concludes the hypothesis is correct. As an example, **Figure 2** shows a case of automation, which is the main pillar of the Industry 4.0 strategy. SOLS 2040 aims to create more jobs, while on contrary it also recommended utilizing automation for cargo transitions, like Industry 4.0. As a result, if automation eliminates jobs, the hypothesis must be revised. However, if the hypothesis can be explained, it simply indicates that the

hypothesis is correct and, in this case, the similarity between both strategies Industry 4.0 and SOLS 2040 is discovered.

The analytical induction method has been proposed to be used in this research due to the highly adoptable characteristic. It has to fit the scoop of the study, as it allows for creating different hypotheses, and then deals with each individually to highlight the similarity and the variation. This makes it a suitable for the correlation purpose of this study. As SOLS 2040 and Industry 4.0 are distinct strategies, the analytical induction method helps to resolve the misconception of being able to adopt either one of the strategies and help to achieve the study aims in correlating both strategies. And produced a well-defined correlation that enables the adoption of the booth strategies.

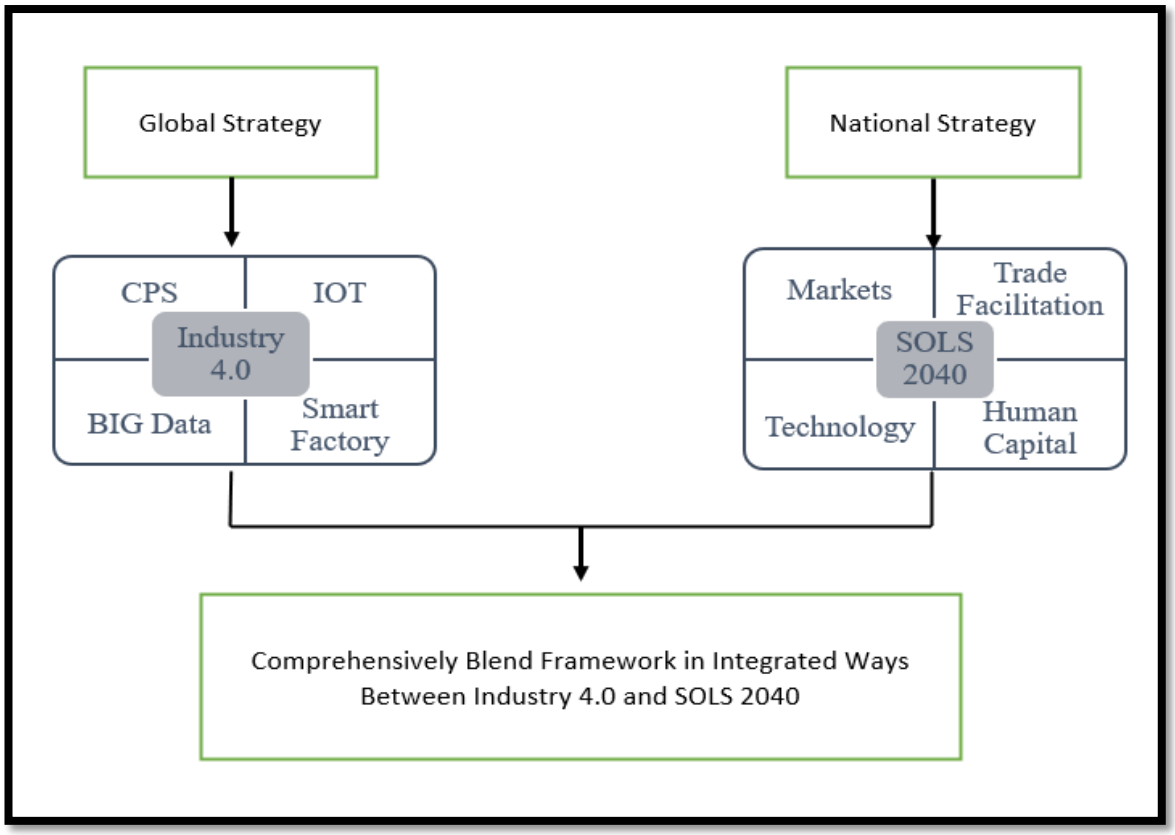

Figure 1 Conceptual framework

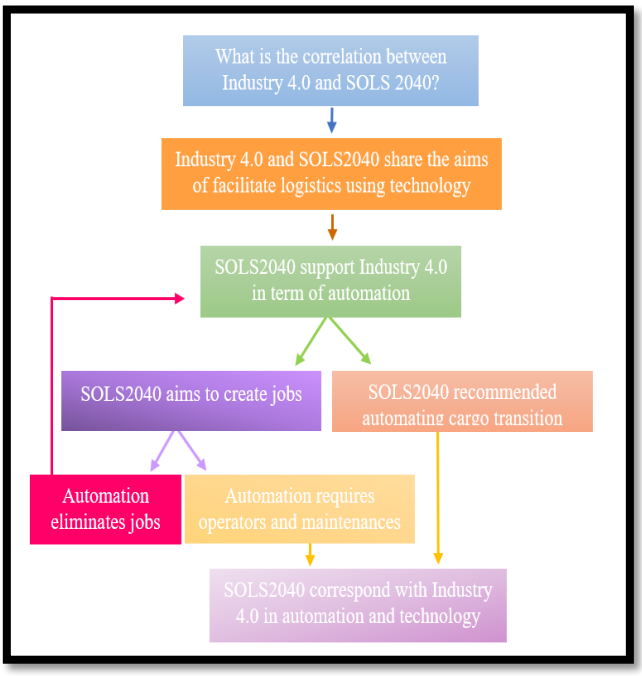

Figure 2 Example of using analytical induction in this research

4. CORRELATION BETWEEN SOLS 2040 AND INDUSTRY 4.0

Since Industry 4.0 is more a broad term, that has more ramification and branches in comparison to SOLS 2040, which tends to be more specific, because it discusses the case of Oman in a more structured format. This research will follow the SOLS 2040 structure, which makes it clearer to identify interest points that relate to Industry 4.0 and came out with a structured correlation. Originated as the core element of change, who proposed specific tasks to be implemented, those specific tasks are the examination cases through the analytical induction to find the correlation.

Proposition 1*: Industry 4.0 shares SOLS 2040 ambition of trade facilitation*

Trade facilitation is the ultimate goal of the logistics sectors, at the same time, it is either the spine that supports it or the stick in the wheel that cripples it from moving forward. It is the key to unlock logistics potentials in any economy. SOLS 2040 has aimed to establish seamless integration across the government and industrial departments involved

in cargo clearance, approval, and handling throughout the supply chain. online systems accelerate cargo approval and clearance by different authorities, for instance: Customs and Health, a significant improvement in customs and border clearance performance is required. As a result, it will enhance the flow speed and reliability of transactions. Here came the role of Industry 4.0, by establishing a combining system "The Single Window". From a logistics standpoint, the ideal goal is to have one integrated portal that approves and clears cargo by various regulatory authorities, manages cargo transportation and clearance, and connects all government entities via a single platform (Cloud Computing). Implementing the single hub will play a major role in straightforward cargo handling procedures, transactions, inspection, and finance. Having a single system that utilizes Cloud Computing will eliminate unnecessary process duplication, which delays or restrict cargo movement across and within Oman borders. Additionally, registering and licensing, and operating logistics in Oman free zones into a single system it will allow for better monitoring and transparency, along with data collection (Big Data), with the aid of artificial intelligence (AI), the system will be able to analyze and utilize the collected data to improve and develop its service and capabilities.

To answer the 1st proposition, Industry 4.0 is found to support SOLS 2040 aims of trade facilitation. While reducing the complexity of import/export and transit legalization and documentation is a key for trade facilitation. In addition, SOLS 2040 supports the digitalization of all logistics processes throughout the supply chain, which is only possible by relying on Industry 4.0 technology. Therefore, Industry 4.0 found supported the SOLS 2040 aims to facilitate trade and it is more of a requirement.

Proposition 2: *SOLS 2040 support the adoption of Industry 4.0 technology*

Technology is a tool for trade facilitation. It forms the infrastructure for modern and developed logistics. The technology team of SOLS 2040 is concentrating on the advantage of the rapid technological change to leapfrog other competitors and to make Oman a significant global logistics hub. Therefore, urges the shift to the latest and advanced transport and logistics technologies all over the supply chain of Oman. Starting with the governmental entities, additionally, to ensure rapid adoption, it even emphasizes the necessity of incentives programs to encourage the private companies and Industry logistics service providers to adopt and upgrade their systems, tools, and techniques (Abdul Rahman *et al.* 2022b). **Table 5** discusses the similarity between SOLS 2040 and Industry 4.0 in terms of technology and techniques.

Table 5 Technological similarity between sols 2040 and industry 4.0

SOLS 2040	Industry 4.0
Automating the process of cargo transport within Oman borders, and between transport modes.	As a part of the Cyber-Physical Systems (CPS), Automation can be subdivided into: -Transportation (autonomous trucks) -Turnover handling (robots)
Tracking the cargo movement around the clock.	As a part of the digital data value chain: Digital integration enables transparency and traceability of goods along the supply chain using Internet of things (IoT), Vehicle monitoring (VM), and Global Positioning System (GPS).
Provide analytical tools to monitor, measure, improve logistics operations.	Digital Servitization: utilizing the values added by the digital services beyond the distribution of products and physical services (Blockchain).
Improve accountability and task responsibility.	-Enterprise Resource Planning (ERP) -Customer Relationship Management (CRM)

SOLS 2040 strategy is to leverage Industry 4.0 technology to improve the logistics sector in Oman and is willing to introduce advanced technology including cold-chain transport and storage with a real-time monitoring system for temperature-controlled cargoes. Also further extends to different logistics specialization, for instance, warehouse management and handling operations, vehicles and track management systems, and safety systems for perishable goods including gas retardation. That said, the 2nd proposition is completely correlated, SOLS 2040 do support the adoption of Industry 4.0 technology.

Proposition 3*: Industry 4.0 (automation) conflicts with SOLS 2040 Human capital targets*

Human capitals are the workforce and the bottleneck of logistic development. While the main concern of the SOLS 2040 strategy is to match the forecasted ambition of 300,000 employments by 2040 (see **Table 2**), this number of jobs is a real challenge in the presence of automation, which cannibalizes existing jobs and future employment opportunities. Such target cannot be achieved without conjunction with the industry and the private sectors, who are more concerned in optimizing their business decision

ether to invest in automation and all its benefits or rely on human workers. A system is responsible to collect and monitor the number and skill of employment on regular basis and measuring the automation efficacy versus workers productivity of will help to make this decision. This system is a part of Industry 4.0 technologies that well extend to human resources management (ERP software). The human capital should have a set of skill that matches the technological advancement of Industry 4.0, therefore, training programs that match the international standards in the different logistics sectors, such as, warehousing, retailing, customs clearance, road, ports, aviation, and so on are needed.

The 3rd proposition is partially corrected to some extent. While there is competition between human workers and the automation machines, Industry 4.0 does not eliminate human jobs. While some basic repetitive tasks are more optimized using automation, a new set of jobs is introduced to operate and maintain those machines. Therefore, the choice is left to the industry player to decide.

Proposition 4: *Industry 4.0 will help to achieve the SOLS 2040 goal of promoting Oman as a global logistic hub*

Unlike the other three SOLS 2040 core elements of change, "Markets" have no direct correlation with Industry 4.0 strategy. However, Industry 4.0 indirectly still a keystone to promote Oman as a global logistic hub. Even with Oman's geographical position advantages, Industry 4.0 technology is essential to encourage foreign investors to join the local market, which will enable the vision of making logistics a core part of the Oman economy. In other words, adopting the international strategy (Industry 4.0) will help to achieve the national strategy of Oman (SOLS 2040) which leads to be more market competitiveness compared to other Gulf countries (Abdul Rahman *et al.* 2022b), hence the 4th proposition is true.

To sum it up, technology is a key for trade facilitation, and it cannot be implemented without the role of human capital, when the tripods are well established it can support the marketing sign of Oman as a global logistics hub. **Figure 3** recap the research findings of the industry 4.0 and SOLS 2040 correlation in graphic form.

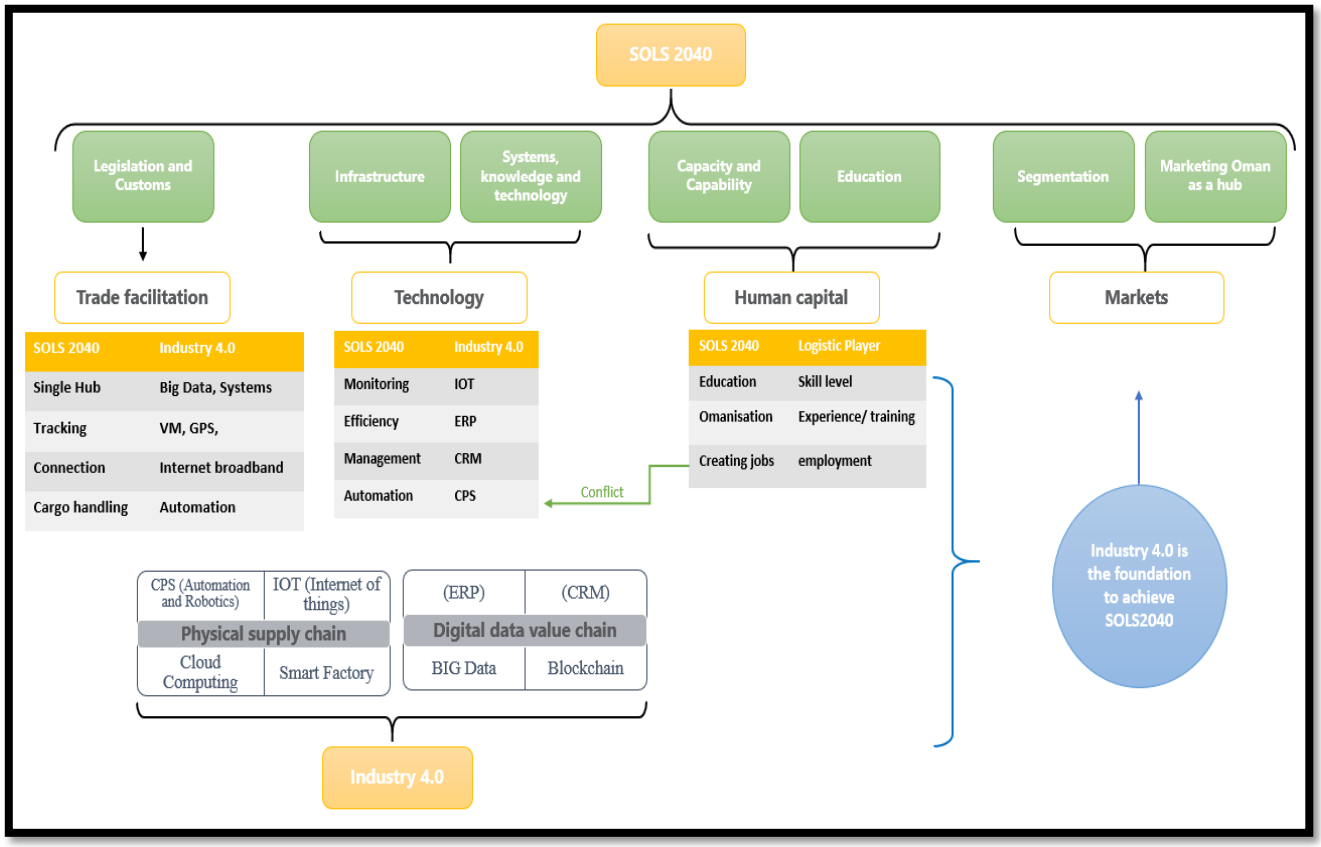

Figure 3 The correlation between industry 4.0 and sols 2040

5. DISCUSSION

The research aims to examine the correlation between Industry 4.0 and SOLS 2040. The investigation covered four propositions analyzed using the analytical induction method. The analysis highlighted the necessity of adopting the Industry 4.0 strategy to achieve SOLS 2040 ambitions. Industry 4.0 strategy can be described as a subdivision of the SOLS 2040 strategy.

In addition, Industry 4.0 represents the "Technology" section of SOLS 2040, but its effect is not limited to it, since technology is the engine that enables "Trade Facilitation" (Ithraa, 2016; Abdul Rahman *et al.* 2021). While Oman has invested in digitization systems and developed individual local systems specific to each entity by itself. The SOLS 2040 proposed adoption of cloud-based systems and the importance of the single hub to link the different government entities and private sectors and logistic players throughout the supply chain to facilitate cargo movement, clearance, and

fees, and financial transactions (Oman Logistics Center, 2015). It is important to point the responsibility of the private sector to update their process and provide their workers with the required training and internet connection to be able to log into the single hub and operate the process online. These are all parts of Industry 4.0.

In brief, Industry 4.0 is one of the major components of SOLS 2040 as the technology and completely supporting the trade facilitation aims (Abdul Rahma *et al.* 2022b). However, the correction does not go in line with Industry 4.0 technologies' direct effect on "Human Capital" development. Which raises the question of whether automation and artificial intelligence are replacing human workers? Or it simply the beginning of a new era where the need for advanced human qualification and skills are evolving.

For further discussion, human capital must be discussed from two perspectives: workers' skill level and education, and employment or job creation. The human factor is critical to the success of the logistics industry (Abdul Rahman *et al.* 2022a). However, in contrast to the SOLS 2040 ambition of creating 30,000 logistic jobs, Industry 4.0 is more focused on reducing the number of human laborers by automating repetitive tasks and replacing human workers with machines and artificial intelligence (Oman Logistics Center, 2015). This contradiction leaves the industry players with a challenging discussion, either to invest in Industry 4.0 systems or to rely on human workers and offer additional employments. Since, it will not be economical to do both as SOLS 2040 suggested, this issue must be addressed in future research. While the SOLS 2040 has predicted the highest job availability for all levels respectively, we notice the importance of technical training and different skills workshops that enable the workers to do their specific tasks efficiently. In contrast, according to the SOLS 2040, the higher education graduates are expected to have less portion of the total employment, still, SOLS 2040 is expecting an overall ten times growth, which requires the introduction of an additional vocational institution that teaches logistics academic program with an up-to-date curriculum that matches Industry 4.0 technology requirements.

Until now, the best way to describe the correlation between Industry 4.0 and SOLS 2040 has been to say that Industry 4.0 is one of the major components of SOLS 2040, which covers the "Technology" and "Trade Facilitation" pillars. However, it will not be a cohesive strategy until the conflict over the role of "Human Capital" in the presence of Industry 4.0 technology is resolved. Once the human capital issue is resolved, it is reliable to reveal that Industry 4.0 is fully compatible with the SOLS 2040 strategy.

6. CONCLUSION

The Oman logistics strategy, SOLS 2040 represents a thoughtful study conducted by a representative from both private and public sectors and it covers the challenges that the country is facing in the logistics sector. Thus, what are the recommended actions that must be implemented to observe the anticipated changes? Oman, with its geographical advantages and ongoing investment in transportation infrastructure, has the potential to become a global logistics center without a doubt. As a result, the logistics industry has the potential to contribute significantly to Oman's economy. Increasing gross domestic product (GDP) and creating additional business opportunities, offer more jobs to the local people, and pave the road for future growth.

SOLS 2040 represents a national strategy, on the other hand, Industry 4.0 is a global trend which includes but is not limited to the logistics sector. It is all about automation, digitalization, and connection. It pushes the next generation technology into transportation, warehouse, ports, aviation, etc. throughout the supply chain both in terms of physical supply chain and digital data value chain. Furthermore, automation of cargo transport and handling, along with systems that collect, and analyze data related to the cargo and proceed the process of clearance, customs, utilizing the single window that connects all the involved authorities related to the cargo movement within and across the country. Along with the shipment tracking and monitoring systems, this extends to the ERP and CRM software that improve efficiency and ensure accountability directly.

To study the correlation between Industry 4.0 and SOLS 2040 using the analytical induction method, the research outcomes stated that Industry 4.0 technologies are the backbones that support the SOLS 2040 strategy. Adopting the Industry 4.0 vision is essential to achieve the SOLS 2040 ambitions. The government and the industry players shared the responsibility to implement both strategies. It raises the critical need for a combining framework that integrates Industry 4.0 and SOLS 2040. This study resolves the issue of having multiple logistics strategies. It clarifies the misunderstanding that SOLS 2040 and Industry 4.0 are two distinct logistics strategies, while it was found that they are two sides of the same coin. This unites the strategy for the industry player and encourages the adoption process.

The limitation of this study is about the missing practical studies and statistical reviews. consider the impact of implementing Industry 4.0 strategies on the viability of SOLS 2040 ambitions. Also, when Industry 4.0 technology such as automation is implemented, human capital development in terms of job elimination will occur. Furthermore, the addition of job-related to the implementation of this technology, such as monitoring and maintenance, etc. Another point to consider is that Industry 4.0 is not a well-defined or structured strategy; this reflects a problem with the continued development of technology, which may change other facts about Industry 4.0. Hence, change its effect on the SOLS 2040 plans and ambitions, eventually the logistic market.

There are multiple areas of this research to be addressed in future studies, for instance few of them, but not limited to: study the effect of adopting Industry 4.0 technology on other aspects of SOLS 2040 like human capital development and introducing new jobs. The readiness of the private logistic sector to adopt advanced technology in their process. Furthermore, in the legislation changes and trade facilitation changes, each change must be developed based on a clear vision delivered by the industry player who is the major affected party. To conclude, the logistic sector is not a young field, but still, many further studies are needed to be improved and optimized.

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