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by A B

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1. Introduction

Background of the market

A supply chain is the kind of network where an individual connects with the organisation's resources, activities and technology involved in the creation as well as the sale of a product or service. Supply chain management is part of the practice of coordination of various kinds of activities which are required for producing and delivering products and services to consumers or clients. The activities are respected with designing, manufacturing, packaging, transportation and many more aspects. Investigation of the supply chain market in the UK has obtained 0.96 billion USD by the start of 2023. The revenue is expected to show an annual growth rate of 6.42% within 2023-2028, which results in an increase in the volume of the market by 1.32 billion USD at the end of 2028. The section of supply chain management in the UK market has engaged the delivery integrated through the application of application programming interference (APIs) and robotic process automation (RPA), which is a part of the machine learning process. It provides briefing towards the retailers and the business struggling to sustainable integrated into the developing complex supply chain. With respect to identification the supply chain operates in various changes and information is handled with cost-effectiveness and time-consuming process (Banat, 2020). The Global supply chain is the part where the supply chain market is largest, for operating with a Global supply chain the system has to move to just in time (JIT) supply chain procedure where Global skills are delivered with providing benefits for reduction of cost on holding stocks and raw materials, reduces the wastage and avoiding the discarded products and materials due to rise of change in fashion.

Introduction supply chain and its key players, stakeholders and processes

The supply chain can be explained as a logistics system which consists of facilities in terms of converting raw materials into finished products which a later distributed to the end customers. Inspecting the demand for supply chains in the UK has gained a growth of 31% in the upcoming years and it makes the UK one of the leading countries to offer better job opportunities with respect to the enhancement of supply chain management. In the UK, 2017 became a challenging year for the automotive supply chain industry due to the effects of Brexit and the post-Brexit also create a huge challenge towards key investment decisions (Bailey *et al*., 2023). However, the government has announced to invest almost 1.1 billion GBP towards the supply chain manufacturing industry which provides a fast opportunity to the supply chain industry to engage automation and AI systems in the various functional

activities of supply chain management. The supply chain management market has enlarged its scope through comprises revenue growth as a key performance indicator. Only through engaging the revenue, it is easier to generate primary vendors with the manufacturing price level that can be distributed in various channels excluding value-added tax through which it is easier to implement the sales channels in B2B and B2C approaches.

There are four kinds of key players in the supply chain which provide performance in terms of activation of supply chain work and provide a reason for its existence. The key players are distributors and wholesalers, producers, retailers and customers. The stakeholders in the supply chain a distributed into internal stakeholders and external stakeholders. The internal stakeholders provide an equitable interest to the organisation which consists, of employees, investors and managers. The external stakeholders, show interest in indirect processes in the company such as suppliers, customers and the government. Additionally, the process in the supply chain a divided into 5 stages which consist of planning, obtaining products, producing, delivering and returning. The process mainly engages with the monitory inventory through the help of advanced administrative software in connection with the automation and AI process.

Identification of issues associated with the performance of the supply chain

The supply chain in the UK is converted into automation and incorporates an AI system which is helpful in the reduction of employee cost, inventory, overheated cost, and many more aspect which helps in providing strategy decision-making and financial help which can be excesses in other manufacturing and operating system of an organisation. However, automation of the supply chain has involved issues in the performance and competitiveness process. The issues are:

- Systematic issues which uncovers various deployment in the data engine for a company for instance mismatched lead time and due purchase order that prevented indication for future demands from reaching the suppliers creates issues. This kind of systematical issue fails to provide demand for any kind of product with direct effects reaching the consumer on time. it also affects almost 30% of productivity.
- Unauthorised software is one of the common issues in the digitalisation of the supply chain. studies have engaged the report that almost 29% of the IT team monitors the digital supply chain failed due to unauthorised software engagement in the organisation which directly creates a massive amount of software waste. it also

affects the financial cost where new and authorised software requires lots of money which is a huge degradation for the automation of the supply chain.

2. Technology-driven improvements in the supply chain management

2.1Automation and AI in the supply chain environment

In today's highly digitalised and globalised world, maximising speed and productivity is the major criterion for acquiring a competitive edge. Artificial intelligence is the modern-day tool that helps to achieve an effective and innovative supply chain. The following are the major benefits of implementing Ai in the supply chain -

Accurate inventory management

Inventory management is an integral part of the supply chain because it ensures the accurate and precise flow of products in or out of the warehouse. It has been argued by Chebet and Kitheka (2019) that effective inventory management can remove hindrances like inadequate stocking, overstocking and unpredicted stock-outs. However, inventory management is complex and time-consuming, here comes the role of AI in inventory management. AI has the ability to handle mass data and with this ability, AI drives the supply chain and can increase the effectiveness of inventory management. Moreover, advanced AI technologies can accurately predict customer demand and thus help organisations to make their stock.

Enhanced safety

AI tools are capable of analysing workplace safety; moreover, AI can immediately inform manufacturers about any potential risks. Thus, AI can support workplace safety and mitigate any risk associated with technical glitches or so on. AI is further helpful to record stocking parameters, in addition, it can feedback loops and ensure proactive maintenance. Thus, the implementation of AI in the supply chain is essential because it helps organisations to take quick decisions on the security and safety of warehouses.

Warehouse efficiency

An automated supply chain based on AI can improve the process of retrieving an item from the warehouse and the ultimate delivery to the customers. It has been argued by Klumpp and Loske (2021) that AI is capable of solving complex issues of warehouses and reduces human effort and time. Moreover, it has been found that AI can reduce the required number of warehouse staff and thus increases the cost-effectiveness of warehouse management.

On-time delivery

AI-driven supply chains reduce manual efforts and automatism the supply chain, thus, AI ensures the entire supply chain is quick, fast and responsive. According to the perspective of

Helo and Hao (2022), AI can accelerate traditional procedures and remove several bottlenecks in the supply chain, ensuring on-time delivery.

Reduced operation cost

An automated supply chain is less prone to make errors, moreover, AI reduces the risk of warehouse incidents and the need for manual efforts. All these characteristics of AI result in a significant reduction in operational costs.

2.2 Automation applications: workflows, inventory, routing, packing and, robotics

Workflow automation refers to the execution, design and automation of different processes, which are based on the rules of workflow. Automation of the workflows, primarily in those areas where manual efforts are essential, significantly increased productivity and work efficiency. Implementation of automaton applications in inventory management enables this organisation to manage its inventory in real-time. Automated applications simplify workflow processes and optimise the entire procedure of inventory management. Moreover, automation prevents miscalculations of stock and increased accuracy.

Route planning is integral to the entire value chain, and the company has implemented automation applications to increase the efficiency of delivery routes. Automation applications help to find out the most effective routes for delivery, which in turn helps to reduce the time of delivery. Thus, it enhances customer satisfaction as well because customers get their products delivered on time.

Packaging automation is the process of packaging products without the requirement of manual labour. Previously, automation in packaging was possible in only a few steps, however, in recent years it has been possible to fully automate the packaging process. The organisation has implemented automation in packing and thus now the organisation is able to package more products in less time. This has significantly reduced manual efforts in packaging and increased cost-effectiveness.

Robotics in the supply chain helps to reduce the overall spending of the organisation, and at the same time, it ensures stability and increases the productivity of the organisation. Robotics further helps the organisation to avoid errors and mistakes. In addition, robotics enables greater workforce adaptability and improves the safety of the workers. Furthermore, robotics in the supply chain reduces human-made errors and improves delivery, which eventually leads to higher customer satisfaction.

2.3 AI Applications: traceability and Predictions

Traceability in the supply chain refers to the processes of identifying and tracking all the movements of a product at any stage, from the sourcing of the raw material to its delivery. According to the comments of Hassoun *et al*. (2023), AI applications help to trace the movements of raw materials, manufacturing processes, inventory and finally delivery to the customers from the retail stores. Traccilibily is an integral part of the business model because it promotes growth and sustainable development. AI applications have changed the traditional operations of traceability and AI-driven traceability is highly effective and produces accurate information for organisations. Thus, the organisation is able to trace the movements of products accurately and ensure enhanced customer experience.

AI algorithms are capable of analysing data to predict the demand for products. It has been observed by Pallathadka *et al*. (2021) that AI is not only capable of predicting the quantity, but it is also capable of predicting the demand for the types of products. AI has enabled this organisation to predict product demand accurately. Demand projection is essential for accurate inventory and stock management (Jauhar *et al*. 2023). Thus, with the help of AI-driven predictions of product demand, this company is able to successfully eliminate over-stocking and ensure proper inventory management.

2.4 Management of transport options

AI is the most useful automation tool for an organisation to manage its transport options. It has been used by Bhargava *et al*. (2022) that the incorporation of AI transportation management has been widespread and it has become essential to get a competitive edge. AI makes the process of route optimisation easier and more effective by utilising real-time and historical data. By applying statistical modelling and analysing historical data, AI is capable of forecasting - freight volume, weather, truck delivery capacity, inventory, warehouse space and so on. Based on this forecast, the organisation is able to decide on transport options. Selection of the most accurate transport option helps the organisation to transport goods faster and easier.

Moreover, the AI tool helps to find out the best possible routes by utilising real-time data. This enables the organisation to deliver products on time and ensure customer satisfaction. In addition, it has been found that some routes save fuel and thus fuel expenses get reduced. Furthermore, AI-powered software is capable of minimising drive time by recalculating routes with changing route conditions. Thus, AI-driven software increases the efficiency of the supply chain in terms of transport options as well.

2.5 Machine Learning

Machine learning is a specialised brand of Artificial intelligence, the role of ML is to use algorithms to analyse data and improve accuracy over time (Baryannis *et al*. 2019). The supply chain of an organisation is heavily dependent on data, therefore ML is one of the best tools that helps supply chain managers to maintain the supply chain more effectively. The following are the major benefits of ML in the supply chain of the organisation -

- The organisation is now able to use the benefits of predictive analytics. Predictive analytics is an essential tool for demand forecasting; ML identifies the hidden patterns of historical data and provides more accurate demand forecasts. Moreover, ML is capable of detecting underlying issues and alerting the organisation beforehand. Thus, the business of the organisation can mitigate the risks that could be caused by those underlying issues.
- ML is able to detect technical glitches in different equipment and thus helps to mitigate risks associated with dysfunctional machines. Thus, ML contributes to employee safety and uninterrupted production.
- ML uses combined analytics like IoT and real-time monitoring to increase the visibility of the supply chain. Thus, the company is able to transform the customer experience and achieve its target delivery dates.
- Moreover, ML algorithms help the company prevent fraud by automating inspections. In addition, ML audit processes are followed by real-time data analysis to detect any anomaly and deviation from normal patterns.

2.6 E-platforms

E-platforms help to transform the market of the organisation and it has automated a major portion of trade and functions of customer service. The traditional marketplace is no longer as effective as before because customers have the tendency to buy products from online stores, therefore, companies have to increase their presence in e-platforms to sell their products in e-marketplace (Wei *et al*. 2021). E-platform is helping this organisation showcase its products in the digital space. In addition, it is helpful for the organisation in case of maintaining logistics, financial processes and marketing. With the help of e-platforms, the organisation is able to communicate effectively with the customers. Moreover, data collected from the e-platforms is used for demand forecasting. Furthermore, e-platforms are helpful for the organisation to analyse market needs and market trades. Thus, e-platform also contributes to new product development and modification of existing products. Moreover, marketing

through e-platforms increases the sales and revenue growth of the organisation and ensures sustainable business development.

3. Development of a model of Supply Chain 4.0

Supply chain 4.0 is a part of the predictive analysis which is made from the integration of new technology. It helps in engaging automation in the process and the use of artificial intelligence which provides the organisation to avail streamline the various functions, and operations in the supply chain and it also helps in cost reduction. Supply chain 4.0 is considered a part of the application adjusted with the industry 4.0 concept. The phenomenon has provided digitalisation and automation in the supply chain industry leading to various new ethical challenges in relation to ethical policies which can be integrated to satisfy ethical as well as financial goals (Liu and Chiu, 2021). The rise of various issues In the UK which is derived at the time of Brexit and the Covid-19 pandemic start huge disturbance among the suppliers which represent the Government of the UK to adopt automation and artificial intelligence in supply chain management which helps in reducing the various distractions in the Business expansion and also helps to get connected with the globe. Technology provides a huge Force for transforming society and studies in significant ways where industrialisation is necessary to introduce key technology which can gain a huge positive impact on economic growth as well as productivity. Technology provides flexibility in the innovation and manufacturing system which comes under computer-integrated manufacturing which provides a proper shape towards practice and skill engagement in terms of manufacturing a product (Tschang and Almirall, 2021). These are the few ways where automation and AI are necessary to engage in supply chain management for establishing sustainability in the business expansion.

The contribution of automation and AI in the supply chain has delivered a powerful optimisation which is fulfilled with capabilities that are necessary for engaging accurate planning, an improvement on forecasting of demands, engaging productivity, reducing the cost of various operations of the supply chain, gathering huge output and various safe working conditions. The AI-based system provides an ongoing monitoring process which optimises the supply chain and provides an output which helps to reduce the risk and challenges involved with the operations and manufacturing (Unhelkar *et al.*, 2022).

Figure 1: Graphical representation of the supply chain after engaging in Artificial Intelligent 2022-2029

(Source: www.databridgemarketresearch.com, 2023)

The in-depth relationship with the IT industries in the UK it is easier to expand throughout the world and artificial intelligent issues increment the demand of the supply chain by 8.60%. With respect to big data analytic input in the supply chain has gained the position of 40%, whereas digitalisation in the supply chain has gained the position of 35%, including cloud computing and artificial cognitive computing has the position of 29%. This percentage is the analyse report where the impact of the supply chain in the UK by 2025 is going to increase.

The traditional supply chain model provides a huge change in the flow where the materials are engaged with the physical distribution channels such as suppliers, warehouses, distribution warehouses and final customers. The traditional supply chain model helps in privatizing the production of goods rather than focusing on other aspects. The model creates a focus on the manufacturing of large volumes and working to deliver to its customer; it optimises the straightforward pathway and not allowed flexibility in the process. However, is necessary to develop a model of supply chain 4.0, which is enclosed with digitalisation, automation and especially embedded with artificial intelligence towards operations.

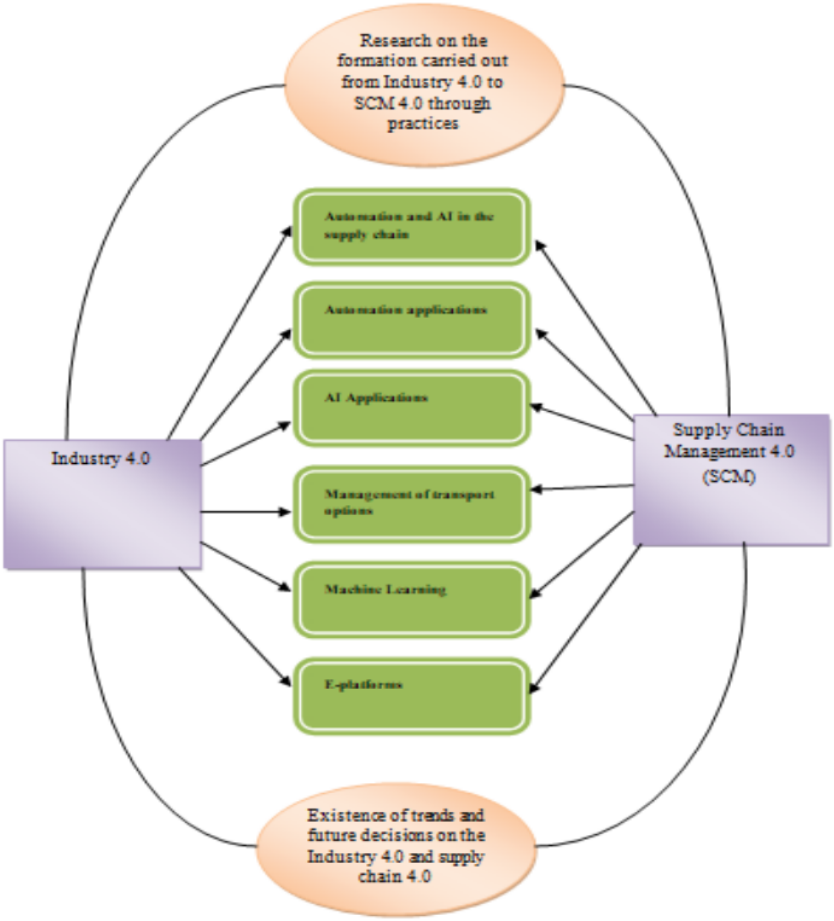

Figure 2: Model for Supply Chain 4.0

(Source: Self-created)

The developed model for supply chain 4.0 is accessing with industry 4.0, which is one of the major parts of conversion towards the implementation of automation in the supply chain. The role of Industry 4.0 is representing a favourable tool which analyse the supply chain to work and operated with automation and adjusted with artificial intelligence which provides revolution to the supply chain industry. The functions of the supply chain ensure integration operations from consumers to suppliers. Industry 4.0 create a disruption towards the requirement of the companies and it provides disruption innovation toward the supply chain management to reaching and approaches with a proper design which is the engagement of several technology and images which changes the path from traditional ways of working to the digital way of working. Involving industry 4.0 embedding technology in supply chain

management is considered a promising strategy which helps in providing resolution to integrate the challenges where the technology has developed to accept the revolutionised supply chain management and it helps to bring an advanced level of connectivity and comprehensive integration (Fatorachian and Kazemi, 2021). The approach model diagram shows the connectivity of Industry 4.0 and supply chain 4.0, which goes through various research modulation and approaches of the practice in the operations of the supply chain through which adaptation of Artificial Intelligence and automation can enhance. it also derived the existence of the trains and future decision-making process between Industry 4.0 and supply chain 4.0. However, it explains the connections of automation and AI in the supply chain with both Industry 4.0 and Supply Chain 4.0; it helps in providing automation towards the management and managing the inventory under real times scenarios. Connection with the AI application provides an extension to trace the movement of the raw material, manufacturing process and delivery to the customer and it provides AI automation which prevents prediction towards the product demand and also stocking of the inventory management. The connection with the management of transport options, machine learning and e-platform is also embedded with supply chain 4.0 and industry 4.0.

3. Illustration of the ethical and regulatory framework for the deployment of the proposed transformation project

Ethical issues associated with Supply Chain 4.0

The ethical issues are associated and raised by the deployment of Industry 4.0 which is directly connected with supply chain 4.0. Hence, the application of proper ethical principles which is undertaken by the ethical theories helps in utilising the analysis process and provides a resolution for the challenges which create a huge impact towards the supply chain 4.0. Understanding the ethical issues associated with the supply chain 4.0 modulation represents the technological challenges which are been rest due to the engagement of industry 4.0, which is a collection of the security issues and the architecture relevant to implementation. complexity and also represent legal issues as well where countering *cybercrime* create a huge disturbance to the organisation with respect to providing protection to the data and largest the data security of the supply chain partners linked with the industry (Luthra and Mangla, 2018). There are representations of various technology incorporation such as e-platform, AI applications, automation software, transportation technology and many more associated in the study which represent that automation helps to engage in the supply chain 4.0. However, challenges arise due to a lack of understanding of the implementation of automation. Due to a

lack of skills, operating with AI systems and automation creates a huge disturbance among the employees and adaptation to a manufacturing automation environment and hard for the employee which directly impacts the performance of the organisation. Engagement of *poor research and development on the supply chain 4.0* adaptation influences the manager to engage in more practices to implement automation. the problem issues with an effective adaptation of supply chain 4.0 create a lack of decision-making strategies at the time of business transformation (Manavalan and Jayakrishna, 2019).

Implementation of the respective compliance procedures

Compliance procedure explains the details of the law, industry regulations and rules and connectivity with the government legislation for managing the business, employees and customers. the compliance process includes human resources policy, data security policy and many more. However, according to the study of the implementation of automation in the supply chain, 4.0 is necessary to engage data security policy through which the ethical complaints can reduce and proper justification can process for engaging automation in the supply chain. Highlighting the ethical issues related to data security which is adjusted with the supply chain 4.0 includes the storage of high-sensitivity data under the technology and for attitude security and privacy (Wang and Siau, 2019). However, discussing the data privacy trade between creating smart devices and maintaining privacy and link, however, it is necessary to understand the malware attack such as cyberbullying which is carried out anonymously. Hence, the organisation is necessary to provide proper policies and laws for protecting the data under clear ethical and moral guidelines which are necessary to retailers to the data of any kind of third parties. protection of the data is one of the necessary aspects for the organisation in terms of maintaining proper ethics through which resolution towards the cybercrime can reduce.

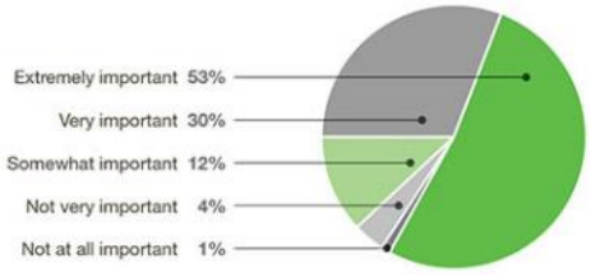

Figure 3: Necessary to enduring ethical principles in the supply chain for managing technological hazards

(Source: www.scmr.com, 2023)

Necessary reports have established that under the professional sectors supply chain, retail and manufacturing which come under the organisation of economic cooperation and development has going to convert on estimating automation with the percentage of 45% until 2023 hence it is necessary to engage proper ethical principles through which the hazards in respect to the technological engagement can reduce down through focusing on the work respectively. However, education with respect to research and development is necessary through which exposure of the risk towards automation can be reduced and implementation and acknowledgement of disruptive technology towards the supply chain 4.0 can change the ordinary ways of working and provide more flexibility towards the work. The development of an essential ethical framework helps in increasing big data towards research and development which is working under the supply chain 4.0. the Framework necessary to provide open-to-big data, Real world scenarios to generate evidence regarding supply chain interventions, AI assistants towards decision-making over the product and services and cross-sectional data (Xafis *et al*., 2019).

Procedure to engage in the SCM strategy

The procedure of training and involving the protection of the data are helpful for supply chain management operations. The goal of the supply chain training helps to provide proficiency in supply chain management to execute with automation and AI support while working. each face of the supply chain is evolved with the sourcing of raw materials to deliver the product to the customers, hence it is one of the crucial parts where personal involvement and necessary for comprehensive training through which implementation of automation and AI can be easier while working. The UK has a law for data protection which is known as the Data Protection Act 2018 which influences the implementation of general data protection which is necessary to project in an organisation which takes responsibility for personal data and follows strict rules and ethical regulations regarding data protection principles under law and transference (www.gov.uk, 2023). It helps to reduce the cybercrime accessed with the technological enrichment in the supply chain operations.

4 Illustration of the advantages and disadvantages which engage challenges associated with the proposed Supply Chain 4.0 transformation

Advantages of adaptation of the proposed Supply Chain 4.0 transformation

Adaptation of the proposed supply chain 4.0 transformation connects with the sensor devices, machinery and other applications which access responsibility for the people in terms of monetary the process for the production of goods and efficiency through wireless networking

technology and enhancement of internet of Technology capabilities. Adaptation of automation in the supply chain helps to create open operation measures which are the extensive knowledge that is necessary to get for taking appropriate decision-making approaches (Javaid *et al*., 2022). The role of supply chain 4.0 provides the vision where the device is interconnected with the manufacturing unit and it also cultivates data that can be accessed through several propaganda, huge volume of data from sensors and equipment provide important and well organised which is necessary for the AI Applications for creating traces and prediction measures. The data helps to identify the expectation of the consumer and deliver a report where changes and various research on necessary to engage for innovative products through which it is easier to get the attention of the consumer and elaborate the business. Machine learning in the supply chain helps provide accurate inventory management in terms of the prediction of demand for raw materials.

Challenges associated with adaptation of the proposed Supply Chain 4.0 transformation

Identification of the supply chain 4.0 challenges include incorporation of new technology as well as the process in the organisation which includes mainly the real-time scenario challenges of data security as well as various crimes in the largest such as cybercrime towards the customer data. The high amount of data breaches is analysed at the time of providing engaging various personal data from the customer for transferring the product and delivery of the product toward the customer. Data protection and data breaching cost is rising higher for the organisation in terms of the application of AI and various data security implementation.

Figure 4: The cost of the protection measures for data breaching and data protection given by the organisation

(Source: www.ekransystem.com, 2023)

From the graphical representation, It is easier to analyse a high amount of data being taken by the cyber attacker where at the end of October 2021 reported 1291 data breaches than that last year's calculations of 1108 beaches. Hence, challenges rises with providing proper data protection to the consumers through the application of automation in supply chain management. The high challenges with machine learning engagement in the supply chain 4.0, include poor quality of data, lack of training sessions regarding the protection of data, irrelevant features and many more.

5. Conclusion

Supply chain analytics refers to the organisation procedure which is essential for extracting exact amounts gained from the larger amounts in terms of data prosecution, distribution and processes for the products. Supply chain analytics is an important tool and part of supply chain management, and the paper cultivates regarding the supply chain performances in the UK. Additionally, the assignment discusses the six themes where supply chain management automation is engaged which include automation and AI in the supply chain environment, automation applications, AI applications, management of transport options, machine learning and e-platform. Discussion elongated with ethical practices and respective elaboration of model for supply chain 4.0.

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