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A THEORETICAL ANALOGY ON ARTIFICIAL INTELLIGENCE ENABLED SUPPLY CHAIN SERVICES

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ABSTRACT:

Artificial intelligence (AI) was introduced to develop and create "thinking machines" that are capable of imitating, learning, and replacing human intelligence. AI has shown great promise in enlightening human decision-making processes and the subsequent productivity in various business endeavours due to its ability to identify business patterns, study business phenomena, seek information, and analyse data intelligently. Despite its widespread acceptance as a decision-aid tool, AI has seen limited application in supply chain management (SCM). To fully exploit the potential benefits of AI for SCM, this paper explores various sub-fields of AI that are most suitable for solving practical problems relevant to SCM. In so doing, this paper reviews the awareness level as well as the reasons that make AI preferable to SCM and identifies the most fruitful areas of SCM in which to apply AI and the major challenges that stood in way of AI implementation.

KEYWORDS:

ARTIFICIAL INTELLIGENCE, SUPPLY CHAIN MANAGEMENT, KEY AREAS.

1. INTRODUCTION

In an era of greater demand uncertainty, higher supply risk, and increasing competitive intensity, supply chain (SC) excellence often hinges on the organisation's ability to integrate and orchestrate the entire spectrum of end-to-end processes of acquiring materials or components, converting them into finished goods, and delivering them to customers. Since such ability can be enhanced by increased visibility across the end-to-end SC processes, many leading-edge organisations have attempted to enrich their information sources and share real-time information with SC partners. Thus, SC management (SCM) is becoming more information intensive and its focus has been directed toward the substitution of assets (e.g., inventory, warehouses, transportation equipment) with information.

Recognising the increasing significance of information to SC success, SC professionals have explored various ways to better manage information and leverage it to make better business decisions. One of those ways may include artificial intelligence (AI) that has been in existence for decades, but has not been fully utilised in the area of SCM. In general, AI is referred to as the use of computers for reasoning, recognising patterns, learning or understanding certain behaviours from experience, acquiring and retaining knowledge, and developing various forms of inference to solve problems in decision-making situations where optimal or exact solutions are either too expensive or difficult to produce.

One area of AI's potential application that has not yet been fully explored is the emerging management philosophy of SCM, which requires the comprehension of complex, interrelated decision-making processes and the creation of intelligent knowledge bases crucial for joint problem-solving. For example, Eastman Kodak once structured the thinking processes of experienced order pickers and then developed a rule-based expert system to select the optimal order-picking path in a warehouse. Also, in an effort to synchronise a series of interrelated but different stages of joint demand planning and forecasting processes in the SC proposed an agent-based forecasting system that has the capability to predict end customer demand through information exchange among multiple SC partners and learn from the past forecasting experience. As illustrated by these examples, some sub-fields of AI such as expert systems and agent-based systems can be useful for dealing with various aspects (e.g., warehousing, joint demand planning, inventory control) of the SC

2. OBJECTIVES OF THE STUDY

- To determine the benefits of replacing manual system with Artificial Intelligence.
- To analyse the current status of Artificial Intelligence adoption in supply chain management.
- To ascertain the major drivers for the implementation of Artificial intelligence in organization.
- To identify the areas where Artificial intelligence can be applied in supply chain management.
- To recognise the challenges for acquiring Artificial intelligence in supply chain management.

2.1 SCOPE OF THE STUDY

The study provides a clear understanding about the awareness level about this technology and the view about the beneficiary in adopting artificial intelligence. The primary reason that strongly recommends AI implementation as well as the key areas were artificial intelligence adoption can be adopted were identified. The major challenges in acquiring of this technology revealed, that opens a huge area of exploitation of this technology in supply chain management

The problem scope is categorised with respect to the three-level decision-making hierarchy: (1) strategic decisions that deal with long-term, executive-level issues such as strategic alliances, facility location, and capital investment; (2) tactical decisions that deal with intermediate term, mid-manager-level issues such as joint demand planning, supplier selection, and inventory planning and(3)operational decisions that deal with short term, routine issues such as vehicle routing, order picking, and cycle counting.

2.3 LIMITATIONS OF THE STUDY

The main limitations of the study are,

It is limited to the field of supply chain alone.

The accuracy level of the secondary data is not known.

Little knowledge and awareness about this emerging technology

3. THEORETICAL BACKGROUND OF THE STUDY3.1 OBJECTIVES OF AI

The main objectives of AI are to understand the phenomenon of human intelligence and to design computer systems that can mimic human behavioural patterns and create knowledge relevant to problem-solving. Thus, AI should have the ability to learn and comprehend new concepts, learn from experience ("on-their-own"), perform reasoning, draw conclusions, impute meaning, and interpret symbols in context. Due to such ability, AI has been successfully applied in areas such as game playing, semantic modelling, human performance modelling, robotics, machine learning, data mining, neural networks, genetic algorithms (GAs), and expert systems.

3.2 IMPLEMENTATION STATUS

Since SC managers may be interested in determining the applicability of the proposed AI technique, we included the third dimension of the taxonomy indicating whether the proposed AI technique has been applied to the real-world decision environment using actual data, and whether the AI technique was successfully implemented in the SC setting.

3.3 THE KEY AREAS OF AI APPLICATIONS IN SCM

Despite the long history of AI, the potential of AI as a means of solving complex problems and searching for information in the SCM area has not been fully exploited in the past. However, some pioneering efforts have been made to initiate AI applications in the SCM area. In particular, certain sub-disciplines of AI such as expert systems and GAs have been increasingly utilised to address SCM issues involving inventory management, purchasing, location planning, freight consolidation, and routing/scheduling problems.

3.3.1. INVENTORY CONTROL AND PLANNING

Inventory represents idle resources that are required to maintain high levels of customer service but which incur substantial costs. Thus, the firm's success in a competitive market often hinges on its ability to control and plan inventory at minimum cost, while making inventory constantly available for customers when needed. Such an ability can be enhanced by the presence of accurate, real-time information about expected customer demands, the size and type of inventory at hand and the amount of order cycle time to fulfill the customer order. However, since this kind of information is often difficult to estimate, predict and obtain, traditional decision rules based on mathematical models such as economic order quantity cannot reflect the very essence of inventory management. That is to say, a tool such as an expert system, which can replace the sound judgment and intellect of experienced inventory managers and deal with the unexpected, is better suited to handling inventory control and planning decisions.

3.3.2. TRANSPORTATION NETWORK DESIGN

So far one of the most popular applications of AI techniques to a particular SC area has been to a class of the transportation network design problems that are intrinsically combinatorial and for which global optimal solutions are thus difficult to find. This class of problems include: the TSP, the vehicle routing and scheduling problem, the minimum spanning tree problem, the freight consolidation problem, and the intermodal connection problem. Other related problems include: road network design, gas distribution pipeline network design, parking space utilisation, traffic assignment, and ramp metering in freeway networks. In particular, due to the combinatorial nature of these problems, GA turns out to be one of the most popular forms of AI techniques employed to handle these various aspects of transportation network design problems

3.3.3. PURCHASING AND SUPPLY MANAGEMENT

A make-or-buy decision is primarily concerned with weighing the options of producing goods or services internally or purchasing those from the external sources of supply to better utilise the firm's given resources (e.g., capacity and personnel) and focus on its core competency. Due to the complexity and dynamics of the above scenarios, the make-or-buy decision calls for systematic decision-aid tools. Such tools include an expert system. To handle a broader spectrum of purchasing decisions, an agent-based purchasing system to automate the on-line ordering process involved can aid the purchasing manager in a series of strategic and tactical purchasing decisions, while traditional OR techniques such as analytic hierarchy process and multiple attribute theory can handle only one

aspect of purchasing decisions (e.g., supplier selection).

3.3.4. DEMAND PLANNING AND FORECASTING

Information about future demand is a basis for the firm's capacity planning, workforce scheduling, inventory control, new product development, and promotional campaigns. However, its usefulness often depends on its accuracy that, in turn, rests with the firm's ability to reduce the uncertainty and variability inherent in future demand. AI techniques have recently been introduced as viable alternatives for demand forecasting and planning. AI techniques such as agent-based systems and GAs can be useful for predicting future demand for new products or innovative products/services that have not yet been introduced in the market and thus have no historical demand data.

3.3.5. ORDER-PICKING PROBLEMS

Put simply, order picking involves selecting the items that have been placed on order. Due to its labor-intensive operations, order picking typically accounts for the largest portion of warehousing operating expenditure. Thus, it affects warehousing productivity significantly. Considering its significant role in warehousing operations, warehousing managers have attempted to devise ways to improve order-picking efficiency. Such ways include the computerization and subsequent automation of sequencing and filling the orders. As part of the automation process, the use of AI techniques such as an intelligent agent-based system may better handle the added complexity caused by the increasing adoption of value-added services and e-fulfillments due to their inherent learning capability.

3.3.6. CUSTOMER RELATIONSHIP MANAGEMENT

To retain customers, the firm should make its customers trust its manufacturing and service capabilities and make customers believe it can deliver exactly what they want. Such trust cannot be instilled without constantly communicating and building a long-term relationship with customers. Thus, CRM is an important prerequisite to demand creation that drives SC activities. it would be necessary for the firm to assess the costs of sustaining CRM and weigh its benefits against costs, an agent-based model that simulated interaction between members of customer populations and business environments in which they were contained. Their agent-based model considered the communication of customer experiences between members of a social network and then incorporated the powerful influence of word-of-mouth reputation on the purchase of products and services. By doing so, it aided the firm in assessing the extent of its return on investment in CRM and enhancing its customer acquisition efforts.

3.4 CHALLENGES FOR AI APPLICATIONS

Challenges for AI applications to SCM include:

- AI does not have free will and thus relies heavily on the computer software, which may lead to wrong decisions, if it is programmed incorrectly;
- AI solutions may not be easy to implement because they are so esoteric and difficult for ordinary decision-makers to comprehend.
- High implementation cost for AI holds another challenge in adoption
- Lack of proper technology needed for implementation is the another barrier in the way of AI

4. CONCLUSION

Since SCM requires the comprehension of complex, interrelated decision-making processes and the creation of intelligent knowledge bases essential for joint problem-solving, SCM has evolved into knowledge management. In other words, it is increasingly important for SC partners to learn from the increased knowledge bases and automate the SC decision-making processes. Thus, AI has been put forward as a useful decision-aid tool that helps the firm connect its customers, suppliers, and SC partners by facilitating information exchange among various business entities across the SC, while replacing assets (e.g., inventory, facilities, transportation equipment) with information. AI has not been fully exploited to solve SC problems whose solutions are either too expensive or difficult to produce due to their inherent complexity and ill-structured nature.

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