

A STUDY ON IMPACT OF ARTIFICIAL INTELLIGENCE ON SUPPLY CHAIN MANAGEMENT

Submitted in partial fulfilment of the requirements for the award of

MASTER OF BUSINESS ADMINISTRATION

by

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**DEPARTMENT OF BUSINESS ADMINISTRATION
SCHOOL OF MANAGEMENT STUDIES**

SATHYABAMA

**INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)**

**Accredited with Grade "A++" by NAAC I 12B Status by UGC I
CATEGORY - 1 UNIVERSITY BY UGC I Approved by AICTE
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BONAFIDE CERTIFICATE

*This is to certify that this Project Report is the bonafide work of **HELVIN R 42410158** who carried out the Project Training “A Study on Impact of artificial intelligence on supply chain management” under my supervision from October 2023 to december 2023.*

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ABSTRACT

This is an exploratory study and analyze the impact of artificial intelligence (AI) on supply chain management (SCM) and the requirements for Human-AI collaboration. New trends of AI technologies in the supply chain brought new challenges. So, there will be an analysis of sub-fields of AI which are more suitable to SCM. Human-AI collaboration requires new roles, high educated and skilled workers. With growing AI technologies, there are limited numbers of high-skilled employees in most regions of the world. AI is increasing the competition among the companies, increasing the need for new job qualifications. Therefore, workers must improve and develop both technical and non-technical capabilities. Innovative humans and AI technology should work together as partners rather than competitors to strengthen one another. This human-AI collaboration establishes super minds that are cleverer than any person or group in our world. This study employs quantitative and qualitative analyses to demonstrate the importance of education/training and skills requirements in human AI collaboration. The study result indicates that firms generally use artificial intelligence in their SCM. The research determined that the companies should have lifelong training programs for employees to get a competitive advantage. There should be mutual readiness of employees and employers to accept the change.

Keywords: Artificial intelligence, Supply chain, Human-AI collaboration, Technological trends, Competition, Job qualifications

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CHAPTER I

INTRODUCTION

The impact of AI technologies on supply chain is investigated in this graduate thesis. In general, small and medium-sized enterprises are unable to leverage artificial intelligence in supply chain management due to their small size. The study's goal is to identify applications, solutions, and needs for human-artificial intelligence collaboration.

1.1 Background

Artificial Intelligence is performing a significant role in SCM. AI aimed to build and develop a kind of machine which can think like human beings. That will have the ability to learn, act and take the place of human intelligence.

In supply chain management, AI had a significant impact in four essential areas: first, in network design and demand forecasting, AI increases efficiencies, enabling traders to be more proactive. Second, AI can modify the connection between clients and logistics suppliers with the help of CRM (Customer Relationship Management) programs. Third, With the help of AI smart warehouses, all operations cost in these warehouses are reduced. And the fourth significant impact of AI on the supply chain is the use of genetic algorithms, which are improving distribution times and decreasing expenses (Min, 2010, p. 20). Rapid changes are happening globally, and AI allows us to understand the future by collaborating and working with it (Blanco, 2018). Human- AI collaboration involves sharing information, responsibilities, and resources to organize, carry out, and assess the actions necessary to complete individual and joint objectives.

1.2 The Purpose, Goals, Research Questions and Hypothesis

For the productivity of employees and the success of companies, education and training in the workplace are essential. Traditionally, supply chain systems operated on a sequential education and training approach: first, when new technology was to be used, needs were determined. Second, if human resources and relevant competencies are needed, only then they are derived and trained (Christopher, Peck, & Towill, 2006, p. 278). There is a debate here on the need for education in logistics, but this

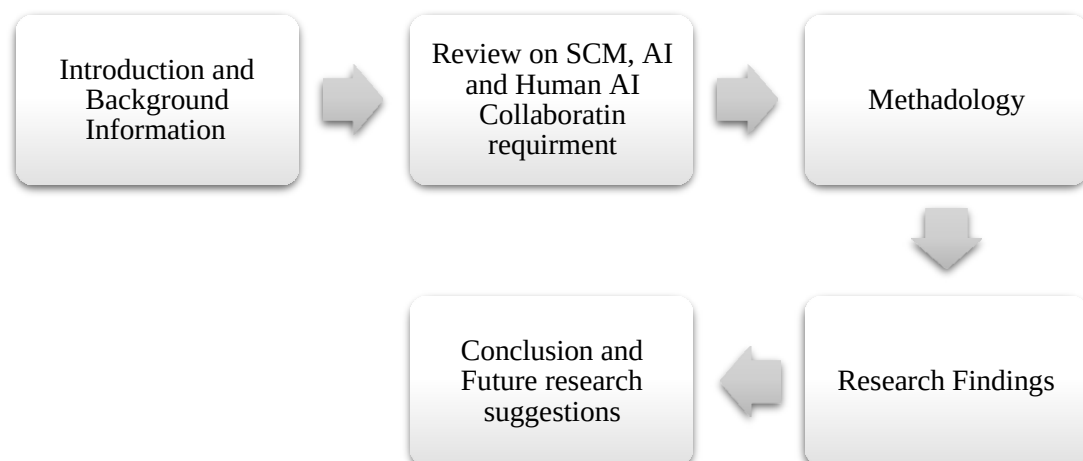
approach will be rejected in the future. The need for supply chain management education and skills is increasing. New technologies have been launched in this area with the assistance of AI, increasing competition for education and skill. Also, how can employees engage with these emerging AI technology trends? (Craighead, 2007).

1.3 Limitations

- The respondents were selected based on their knowledge in the SCM and AI. The sample size of the respondents was insufficient for a detailed statistical analysis. All 35 surveys provided a valuable exploratory finding, however, did not provide usable data for a statistical analysis. Limited number of surveys conducted was due to a shortage of AI professionals in the supply chain industry.
- AI technology and its complexities, it develops rapidly. Therefore, an in-depth assessment of AI is difficult to do. This study focuses only on AI technologies connected to SCM processes.
- Advanced programming is required for AI applications; this study is only explored from a theoretical standpoint.
- It's inductive research. It does not investigate all possible answers to the study issues but instead makes a broad generalization.

1.4 Thesis Structure

Figure I.1: Thesis Structure



1.5. Artificial Intelligence

In the modern world, we face many difficulties in our daily life where human thinking or the mind is unclear and can't solve the problem. Still, with the help of new technological devices and systems, we can solve many of those problems very quickly. The digital and industrial revolutions have influenced numerous aspects of our daily life and work. It changed the structure of significant firms, our entertainment habits, and our shopping patterns, and not only that, but it also affected our work patterns. Artificial intelligence is one of the greatest inventions of the digital and industrial revolutions. AI is developing very fast now and is achieving considerable achievements in economics, supply chain, marketing, banking, healthcare, etc. Airbnb, the biggest housing provider in the world, offers cloud-enabled housing services and hosts millions of guests every day. Airbnb analyzes users' consumption trends, preference criteria, personal expectations and constantly updates their infrastructure according to the results obtained with the help of artificial intelligence algorithms. (Grewal, 2017).

E-commerce companies like Amazon, Alibaba, eBay don't have their stocks. These companies only play the mediation role and provide the necessary technological, reliability, refereeing, and payment facilities (Demirkan, Spohrer, & Welse, 2016, p. 15).

1.5.1. Definitions of Artificial Intelligence

Artificial intelligence is changing our way of life from our personal life to business life. The study field of AI is vast, and it's developing rapidly; therefore, there is no single definition of AI; it differs in different sectors.

1.5.2. Artificial Intelligence History and Development

Before the 1950s, there may have been some studies on intellectual ability and its uses, but none could endorse the potential of computational intelligence. Alan Turing, one of the most prominent figures in the field of artificial intelligence, reported a vital study titled "Computing Machinery and Intelligence" in 1950, questioning the possibility of programming an embedded device to act smartly by asking the question, "Can machines

think?" Thus, after this, Alan Turing created the "Turing test" it will be challenging to describe the entire history of Artificial intelligence from the 1950s till the current time. A timeline from the 1990s till the 203? 's of the AI revolution is below in the table.

Table 1.1: Revolution of Artificial Intelligence

1990	Invention of Neural net devices to reads the handwritten digits
1993	Creation of Robot Polly by MIT AI Laboratory, which navigates by using vision
1997	World Chess Champion defeated by Deep Blue
1998	Furby a computerized toy
2005	Invented, ASIMO
2009	Autonomous vehicle invented by Google
2011	Jeopardy's contestants beaten by Watson computer
2016	Go Champions defeated by AlphaGo
Extensive use of Artificial Intelligence	
2020's	Self-Driving cars and computer translations
202?	DNL "Deep Neural learning"
203?	Artificial consciousness achieved by robots.

Source: (Makridakis, 2017, p. 47).

Table 1.1 explains the evolution of Artificial intelligence; it's started with neural net devices (system learning). In 1990 first time in history, a system learning neural net device was invented that reads and understands the handwritten datasets (initially used to verify the written amount on bank invoices. After this, in 1993 in the form of a robotic toy called Polly senses and navigation was invented and started serving the public. After this, AI's new inventions became masters at chess and mathematical games; robotic toy Furby invented which learns how to speak, and ASIMO robot started to serve restaurant customers.

1.5.3.AI Development from 2000's to Present-Day

Artificial intelligence applications started to entrench our lives at the beginning of the 2000s.

Interesting successes have been achieved by today's giant internet companies such as Google, Facebook, Amazon, Twitter. They financially support their research on this AI and find the rational solution they need in data analysis in artificial intelligence and artificial systems.

In 2015 Google introduced TensorFlow, Google's deep learning platform. It gave all of us the opportunity to create our own models.to-end computational framework. It comprises a customizable toolsets, modules, and public resources that allow academics to explore the frontiers of deep learning and programmers to easily develop and deploy AI-powered systems. (Davies, 2015).

In 2016, Google DeepMind's AlphaGo defeated world champion Lee Sedol in Go fourtimes out of five. Sophia is a sociable humanoid robot built by Hanson Robotics. Sophia can simulate human gestures and responding to questions and carrying on rudimentary discussions on predefined themes. (Riccio, 2021).

1.6.Future of Artificial Intelligence

In the near future, the development of artificial intelligence seems not to be stopping. Artificial Intelligence will stay, and we can't escape from it. Therefore, we must prepare for the contest with it. We have the example of AI self-driving automobiles; we can imagine that these self-driving cars will soon be ordinary in markets worldwide. The present study shows us that AI will be there in every business sector; the use of predicted analysis, virtual reality, and 3D printers in mass production is increasing rapidly. The rise of the Internet of Things will continue to gain momentum in importance.

The Dynamic Analysis and Replanning Tool DART were utilized by US forces during the 1991 Persian Gulf conflict to automate transportation logistics planning and scheduling. (Stuart J. Russell, 1995, p. 29).

1.6.1.The Usage Areas of Virtual Reality will Increase

In the future, the design will become more critical than today. VR (Virtual Reality) is a highly developed human-machine interaction that generates a real - world environment. The virtual environment enables users to move inside the virtual world spontaneously.

Existing deep learning and machine learning studies have led to especially image processing and sound detection tools. Today, Face Recognition technology has made it possible for individuals to give commands to their mobile devices by using artificial intelligence-supported algorithms (Sherman & Craig, 2003, p. 433).

1.6.2.The Increase of Dominance of Internet of Things will Continue

Over the past ten years, many end-consumer products have been "intelligent." Many products, including automobiles, running shoes, watches, homes, bicycles, vases, and water flasks, have become intelligent devices. The trend that drives the future is that products known as intelligent devices will evolve to the level of Connected Devices. It is expected that the spread of artificial intelligence applications at the end consumer level will reduce the number of intermediaries. The Internet of Things is developing day by day, ushering in a new age where everything from automobiles to toothbrushes can be recognized and linked. Things can communicate and make decisions for themselves. There will be the use of Human-human, human-thing, and thing-thing communication modes. The primary traffic generators will be things. Internet of Things can improve the lives of people (Lu Tan, 2010).

1.6.3.The Share of 3D Printers in Mass Production will Increase

The annual turnover of 3D printers, which was initially considered an expensive technology, is likely to grow to more than \$20 billion in the future. Especially in the manufacturing industry, 3D printing technologies will provide advantages in diversifying customer demand and providing a competitive advantage.

1.6.3.1.Sub Fields of Artificial Intelligence

Artificial intelligence is changing our way of life from our personal life to business life. The following are some subfields of artificial intelligence:

- a) Artificial neural networks (ANN), which think like humans.
- b) Machine learning, which acts like humans.
- c) Fuzzy logic, which acts rationally

d) Agent-based systems, which behave like humans (Min, 2010, p. 15).

1.6.3.2.Artificial Neural Networks (ANN)

Artificial neural networks (ANN) theory is established on how the brain cells of a live organism, known as neurons, work. Artificial neural networks may learn from previous experiences, recognize shapes, distinguishing characteristics, assemble items, and conceptual information using a linked computer memory network. The process of placing the links and setting the values of the weights is known as learning. Artificial neural networks may be trained to take action to different data shapes under human preferences or to understand hidden data interrelationships. After establishing the network, An ANN may be trained either supervised or unsupervised via inductive learning. (Russell & Norvig, 1995).

1.6.3.3.Machine Learning

Machine learning (ML) is a rapidly expanding area of computer algorithms that, by learning from their environment, attempt to emulate human intelligence. Machine learning approaches have benefitted a wide range of applications, including computer vision, pattern classification, aerospace engineering, economics, supply chain management, media, and biomedical engineering.

1.6.3.4.Supervised Learning

Supervised learning is a ML subcategory and requires external assistance. In order to train algorithms that correctly classify data or compute results, labeled datasets are available for use. There are algorithms in supervised learning in input (x) and output (y) variables, and to learn the tasks from the input to the output variables. The input datasets have train and testing datasets. There is an output variable in the training dataset that needs to be forecast. All algorithms understand designs from the training dataset and use them to the test dataset for forecast. The practice of algorithm learning from a training dataset can be seen as a teacher supervising the process of learning. The teacher corrects the algorithm's projections based on the training data. Learning process is

complete when the algorithm achieves a sufficient level of performance (Nasteski, 2017, p. 55).

1.6.3.5.Unsupervised Learning

It is a type of learning where there is no human operator available to give instructions. Patterns are recognized and grouped by the learning algorithm itself. Perform the analysis after segmenting the data into groups. Unsupervised learning can be defined in two ways:

a) *Clustering:* In exploratory data, cluster analysis identifies previously unknown shapes. It is useful for grouping data based on shared qualities. Customer segmentation on their monthly income can be an example of unlabeled data, mainly on the time it is used.

Clustering can be done in different ways: hierarchical and K-mean clustering (Ghahramani, 2003).

b) *Dimension Reduction:* The term "dimensionality reduction" refers to the process of decreasing the number of variables or characteristics. Dimension reduction is used when too many characteristics in the data to show the training set adequately. The variables with a strong correlation are removed because they are identical (Ghahramani, 2003).

1.7.An Overview of Supply Chain Management

The term "supply chain management" initially originated in the late 1980s and swiftly became popular during the 1990s. Previously, companies used terms such as "logistics" and "operations management" (Mentzer, et al., 2001).

Supply chain management (SCM) is the management of all those tasks connected with the supply chain. It starts from managing all flows circulating in the company or between the environment and the company. These flows can be financial transactions, information, supply, delivery, storage, etc. (Bachiri, 2019, p. 1).

1.7.1.Variou Levels Decision-Making Processes in SCM

Numerous decisions about the movement of products, information, and finances are necessary for the successful supply chain management. Each

decision should be made with the intent of increasing supply chain surplus. These decisions are split into three levels: strategic decisions, Planning or tactical decisions, and operational decisions (Attadjei, Madhwal, & Panfilov, 2018, p. 158).

1.7.1.1.Strategic Level Decisions

During this time frame, a business decides how to structure its supply chain for the following few years. It determines the chain's setup, resource allocation, and the processes that each step will perform.

1.7.1.2.Planning or Tactical Level Decisions

The period considered for decisions taken during this phase is a quarter to a year. Excess supply chain capacities may be created by identifying and assessing restrictions during the strategy phase. Companies begin the planning phase with a year-ahead prediction. Everything is covered in this phase, from predicting market demand to identifying which markets will be serviced with completed products to selecting which facility will be constructed (Attadjei, Madhwal, & Panfilov, 2018, p. 159).

1.7.1.3.Operational Level Decisions

In this case, the time span is either weekly or daily. During this time frame, businesses make decisions on individual customer orders. The SC design is often defined at the operational level, and planning methods have already been established. The goal of supply chain operations is to handle incoming customer orders as quickly and effectively as possible. During this phase, businesses organize production or inventory to customer orders, establish a deadline for submitting an order, create pick lists at a warehouse, allocate an order to a certain shipping method and shipment, plan truck deliveries, and make orders for items (Jerbi, et al., 2012, p. 1742). A supply chain's Strategic, Planning, and operation have a significant influence on total profitability.

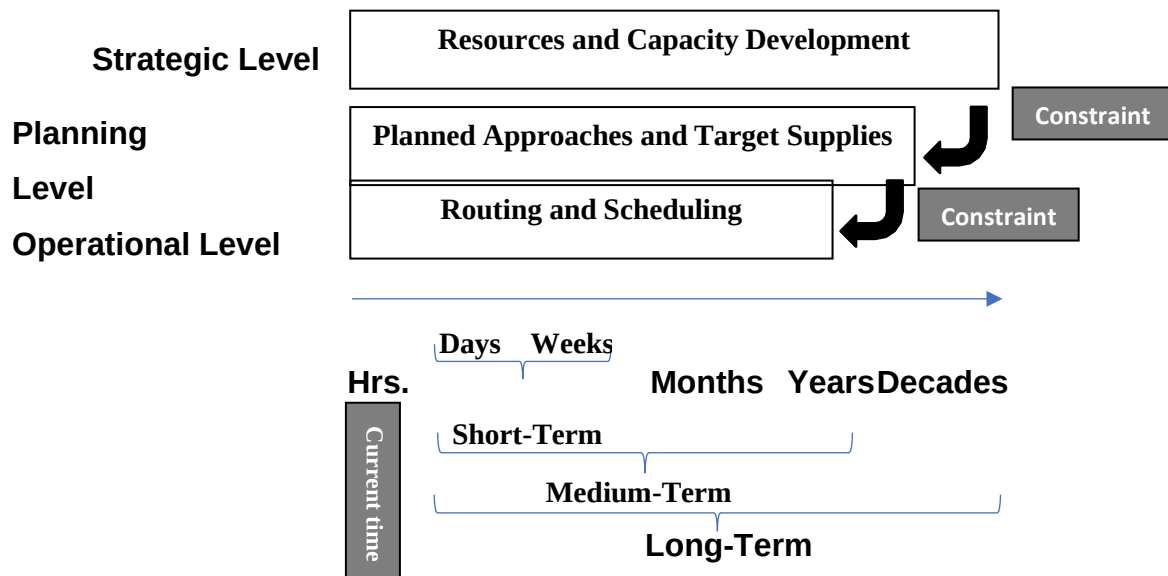


Figure 1.2 : The Time Frame of Three SCM Decision Levels

Source: (Jerbi, et al., 2012, p. 1743).

1.7.2.AI Applications in Supply Chain Management

a) In the field of supply chain management, artificial intelligence (AI) plays an important role; AI aims to build and develop a machine that can think like humans. That will have the ability to learn, act and take the place of human intelligence (Joost N. Kok, 2009). These are some uses of AI where it's putting an impact on supply chain management. Rapid changes are happening; AI allows us to understand the future by collaborating and working with it (Hellingrath & Lechtenberg, 2019).

b) Providing a better customer experience.

In order to achieve a competitive advantage, these four aspects of value creation must be addressed (Dash, McMurtrey, Rebman, & Kar, 2019).

AI has an impact in different areas of SCM; for example, Neural Networks, a developing method in artificial intelligence, has a strong demand for a broad range of uses in SCM in network planning and predictive demand. AI is increasing efficiencies, which allow traders to become more proactive (Leung, 1995).

1.7.2.1.Inventory Management

Most businesses that deal with inventory management have to make judgments for thousands of products, and the characteristics of these products vary, including pricing, demand pattern, supplier lead times and number of stocking locations within the organization. Because at ordinary inventory control, the decision-maker may lack the required theoretical knowledge to arrive at the best option. In inventory management and planning, an expert system is more appropriate as it can replace the insight and intellect of professional managers (Sinha, Ghiaseddin, & Matta, 1989).

1.7.2.2.Logistic System Designing

Finding the network plan that may provide the lowest cost of physical supply flow of products is a fundamental problem in the logistics structure. GAs have been used to solve logistics system design and optimization problems, logistic process optimization, freight transportation planning and automobile transshipment scheduling in port terminals. An optimization approach based on spanning tree GA was employed to discover the ideal production and distribution arrangement (JAUHAR & PANT, 2016).

1.7.2.3.Purchasing and Supply Management

SCM contains the management of supply and demand inside and between organizations. In terms of proportion, procurement is the smallest (about 5.5 percent depending on industry), but it is the most important. The primary goal of procurement is to reduce purchasing costs; though, other priorities include optimizing total procurement costs, securing supplies, internal process optimization, meeting quality guidelines, cost transparency visibility, minimizing warehouse costs, product development with suppliers, and outsourcing of strategic procurement processes. The issue for procurement

organizations is determining which suppliers they should be considered, who are the leading suppliers in the region, and what could happen in the future that could affect future buying choices, such as market consolidation and mergers and acquisitions. AI can find and collect appropriate data from hundreds of digital formats. It can use relevant training on procurement market intelligence to efficiently analyze and categorize data in many groups and subjects throughout the procurement. Procurement and supply chain businesses are looking towards AI and Big Data to realize their potential (Chopra A. , 2019).

1.7.2.4.Optimization and Forecasting Demand

AI has proven to be highly beneficial in forecasting. Businesses are continuously attempting to achieve a balance between supply and demand. As a consequence, more precise forecasting of supply chain and manufacturing is necessary. Since AI is capable of processing, analyzing, and most significantly, predicting data; it is capable of providing dependable and accurate demand forecasts.

1.7.2.5.Production

There are numerous applications of AI which are being used in production. There is a significant role of AI in production because:

- ☐ Improved asset and process optimization.
- ☐ Creating best teams (Human and Robots).
- ☐ Increase in quality and dependability (error-free).
- ☐ Avoidance of downtime for maintenance.

1.7.3.AI in Supply Chain Management: Challenges and Opportunities

Despite artificial intelligence's presence for more than half a century and its recent development in the SCM area, it has yet to be properly used to solving supply chain problems. Because of their complexity and inadequate framework, solutions are either prohibitively costly or impossible to produce. AI applications in SCM face several problems, which include:

- ☐ AI lacks free will; it is highly dependent on computer software; if mis-designed, it may make wrong decisions.
- ☐ AI solutions are so sophisticated and complicated for regular decision-makers to understand, they may be challenging to apply.

- Because of its knowledge acquisition constraints, AI works much better for specialized, narrowly focused SC issues. However, AI may not perform well for addressing uncertainty (Min, 2010, p. 34).

1.8.Human AI Collaboration

When innovative humans and machines collaborate as partners rather than rivals, they strengthen one another. Humans are free to use enhanced socio-emotional intelligence with technological assistance to acquire a deeper grasp of client demands and create whole new customer experiences. Human conscience and self-discipline will also assist businesses in using AI in an ethical and human-centric manner (Accenture, 2018).

1.8.1.An Overview of Collaboration

Human civilization needs collaboration daily. It allows for the substantial enhancement of systems for them to survive and evolve. Any natural or artificial system may be improved by collaboration from human societies to sensor networks, computers, robots, and factories. To achieve individual and collective objectives, distributed agents cooperate by sharing data, responsibilities, and resources in order to plan, execute, and evaluate the activities that are required to achieve those goals.

- For distant communication and knowledge exchange, humans employ several online apps.

- An organization's functional groupings generate knowledge and products supply networks through the use of Internet-based technologies.

The following are comprehensive descriptions of coordination, cooperation, and collaboration, as well as their differences and interconnections. (Nof S. Y., 2003).

Coordination: entails using information and communication sharing to achieve mutual advantages among organizations by assisting in a supportive manner.

Cooperation: Besides all features of coordination, it also includes a resource-sharing component to achieve goals.

Collaboration: includes the exchange of data, responsibilities, and resources between organizations in order to plan, execute, and evaluate the activities required to achieve individual and common objectives. It encompasses both coordination and cooperative functions (Nof S. Y., 2003).

1.8.2.Four Phases of AI-Human Collaboration

1st Phase: On the first phase, we can suppose that human employees either compete with AI robots or operate entirely independently of them (Feldman, 2017).

2nd Phase: On the second phase, humans and artificial intelligence are starting to support one another. The system concentrates on things it specializes in, such as processing large quantities of data. Humans, on the other hand, focus on things in which they specialize, such as complex decision-making, emotional and social ability, or agility (Pittman, 2016).

3rd Phase: Humans and AI become reliant on one another. This might be represented by situations in which AI requires human direction since there is insufficient data for Artificial intelligent systems to make accurate projections and judgments.

4th Phase: Finally, there is the hybridized technique, in which artificial intelligence (AI) serves as an extension of the human mind, where Humans and AI collaborate thoroughly (Kruse, Dmitriyev, & Gómez, 2017).

1.8.3.Human-Machine Collaborations Requirements

Machine partners appear to have the ability to improve team collaboration significantly. But teams are often not practical, which raises the question of what characteristics human-machine teams could require to be efficient.

1.8.3.1.Human-Machine Decision Making

With the growth of AI technology, robots are increasingly influencing, and in some cases, making choices wholly by themselves. Artificial intelligence has the potential to completely replace, augment, and complement human decision-making.

1.8.3.2.Human-Machine Capabilities

According to Johnson & Vera, (2019), teaming is not a single, stand-alone feature that must be implemented as an add-on to a system. Instead, it should be seen as a strategy for defining what artificial intelligence capabilities should be created in order to allow intelligent systems to effectively collaborate.

CHAPTER II

REVIEW OF LITERATURE

1. McDermott (2017)(Madni & Madni, 2018).

--Human-machine decision-making is shared, which eliminates human supervision errors and reduces human mistakes.

--To collaboratively understand the problem area, human-machine partners can draw on various perspectives, expertise, and solutions.

2. (Madni & Madni, 2018).

--Understanding of machine learning model mistakes and biases, as well as the capacity to remedy them.

3. (Smith, 2019)

--In the valid usage situations, the AI solution offers the functionality necessary to suit the expectations of consumers.

4. (Smith, 2019)

--The AI system delivers easy-to-understand security measures that are also resilient, legitimate, and dependable.

5. (Madni & Madni, 2018).

--Capability of integrating the human-machine team into larger systems.

6. McDermott (2017) (Smith, 2019)

--Human-machine teams are capable of recognizing and responding to unexpected events.

-- The AI technologies have the ability to develop itself on a regular basis in order to fulfill human requirements and technological standards.

7. (Smith, 2019) (Madni & Madni, 2018) McDermott (2017) Urlings and Jain (2002)

--Humans with the capacity to redistribute resources, reallocate tasks, change process settings, and rearrange task sequences and priorities.

-- Allow humans to participate at the appropriate level in current AI technology

activities to effectively handle conditions that fall beyond the stated performance range of the human-AI system.

- Humans should be able to operate the system and delegate authority to machines based on circumstances.

8. (Smith, 2019) McDermott (2017) Urlings and Jain (2002)

- The ability of a computer to foresee changes in the situation in order to assist the operator in projecting future situations.

- Clear and understandable data is transmitted in a manner that encourages understanding.

Give info about the system's statuses or properties, as well as its surroundings.

- Individuals should be able to easily verify what the Artificial intelligence system is doing and why.

CHAPTER III

RESEARCH METHODOLOGY

This chapter examines the strategies for gathering and analyzing empirical data. The empirical data, which acts as the basis for this study's introductory statements and derivations, are presented in this section. In this chapter, several areas cover topics such as quantitative, qualitative, and mixed methods are defined. After that, the research process and design have been formed.

3.1 Quantitative and Qualitative Approaches

This part describes the quantitative and qualitative approaches that were used in this research. A quantitative methodology used in an online survey was sent to different people from various SCM and AI fields and backgrounds

3.1.1 Quantitative Methodology

Quantitative research usually comprises the specific empirical analysis of events through the use of mathematics and statistics and the management of numerical data.

3.1.2 Qualitative Methodology

Research methodologies that deal with phenomena by investigating actions, experiences, and connections, rather than employing numerical data analysis, are referred to as qualitative research approaches. The qualitative methodology, also known as a word-based research strategy, often provides answers to research questions such as (a) what, (b) how, (c) when, and (d) where. Qualitative research methods are more natural since the researcher is forced to interpret the information and conclude based on his observations. A qualitative researcher observes, interviews, summarizes, characterizes, analyses, and interprets things in their accurate dimension. One fundamental advantage of qualitative research is that it allows in-depth investigation (Basias & Pollalis, 2018, p. 94).

3.1.3 Mixed Methods

Mixed methods research combines quantitative and qualitative methodologies. It integrates several methods, ranging from a simple structure

to a complicated system. Qualitative research differs from quantitative research. First, quantitative data, then qualitative data, this approach may be divided into subareas, supporting each other. Otherwise, the investigation might uncover fascinating facts that can be examined more closely with qualitative approaches (Brannen, 2017). This study used the first quantitative approach. Following the quantitative portion, the research explores qualitative methodology to boost the accuracy of mixed-method studies.

3.2 Research Process and Research Design

This section focuses on describing the research method and its design. Qualitative and quantitative methodologies are used in the research. Both techniques have their own set of processes and designs.

Figure 3.1: Research Procedure

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Figure 3.1 shows the process of this study. The identification of study goals and research questions is the initial step in the research process. Here, the researcher assesses what the study wants to achieve and what the study's ultimate purpose is. As previously stated, the study questions are "What is the impact of new artificial intelligence technologies on supply chain management?" and "What relationship exists between worker's education/training and Skills and competitive advantage of the companies in Human-artificial intelligence collaboration?". Examining and reviewing literature include researching and reading articles, news, and books on the subject; during this chapter, material obtained while spending a few months to gain a complete overview of the existing AI and SCM knowledge. The quantitative research procedure is made up of a questionnaire and a cover letter.

In the qualitative research process, based on the questionnaire results, interview questions were created to acquire a deeper understanding of the definitions provided in the questionnaire. After participants respond to the questions, they are asked whether they want to be interviewed about the study's subject. Individuals who choose to participate in the interview, contacted after the collection of survey data.

The research questionnaire format, interview questions and answers given by respondents, and a cover letter are included as an appendix.

3.3 Collection of Data

This research adopts a sequential data collection strategy for explanatory purposes, with a quantitative approach followed by a qualitative approach. Mixed methods research may be seen as active and continuous in the research process.

3.3.1 Quantitative Data Collection

There are three benefits of using an online questionnaire as means of obtaining additional information. First and foremost, the questionnaire method may gather helpful info from experts on the applicability of artificial intelligence in supply chain management. Second, considering the specialized nature of the study topic, it is critical to comprehend managers' viewpoints on the significance of worker education/training and skills in human-AI collaboration. Third, the online questionnaire approach was selected for its simplicity, adaptability, and cheap cost. In addition, the online questionnaire was distributed to the senior executives by e-mail and other electronic means.

3.3.2 Qualitative Data Collection

The primary data source for this research was short interviews, based on the questionnaire results, interview questions were created to acquire a deeper understanding of the definitions provided in the survey. Short phone interviews, in- person meetings, and e-mail interviews were conducted with industry-renowned specialists in the domains of SCM, logistics, e-commerce, digital transformation consultants and the answers received from the specialist are included as an appendix 8.

3.4 Data Analysis

This study can divide the data into two categories: Basic information process and information about Human AI Collaboration. In addition, the research establishes the data regarding the impact of AI applications in the supply chain and the requirements for workers' education and skills in human-AI collaboration.

3.4.1 Survey Questions Development

The quantitative part of this study is a survey in the form of online questionnaire published in English and Turkish. The survey was distributed to different people from various SCM and AI fields and backgrounds. The proposal letter both in English and Turkish for participation in survey was sent.

Fundamental Information

- ☐ Name / Surname
- ☐ Country
- ☐ Company Name

Management Area

- ☐ Job Title
- ☐ Years of Experience

Information means

- ☐ Is your organization using artificial intelligence to control the SC?
- ☐ How likely is it that AI will be used in your SC operations in upcoming five years?
- ☐ There should be a specific task for both humans and machines in which they are most suitable.
- ☐ To integrate with AI technologies, human decision-makers must keep their AI knowledge up to date and need to develop analytical skills.
- ☐ Workers must improve and develop both technical and non-technical capabilities.
- ☐ Do you agree that your company will have a competitive advantage over others by giving your employees longer education and training about the latest AI technologies?
- ☐ Do you think new AI technologies will increase the need for new job qualifications? Explain in a few sentences.

CHAPTER IV

DATA ANALYSIS AND INTERPRETATION

This chapter includes study findings in both qualitative and quantitative formats. In the end, the study findings are summarized into concepts. At the start of the results sections, respondents' backgrounds are specified, including their professional status, sector type, and years of experience.

4.1 Q&A: Quantitative Findings

The proposal for online questionnaire participation was successfully submitted to many firms in various supply chain sectors such as transportation, logistics, e-commerce, digital transformation consultants and received responses from various companies located in different countries. In the following, respondents' origin, background information and responses to the questions are presented.

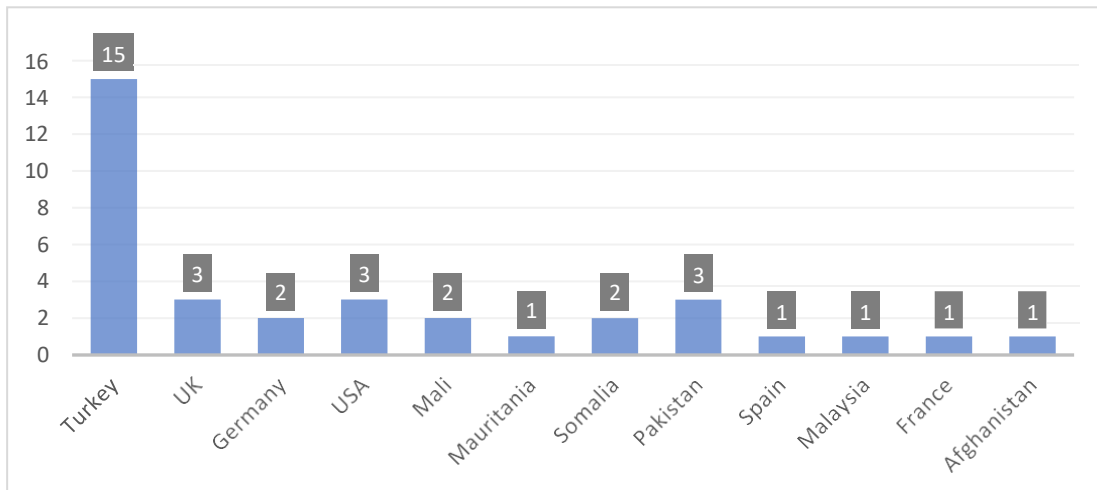


Figure 4.1: Respondents Origin

Table 4.1: Respondents Background Info

Respondent	Country	Experience
AI Specialist	Turkey	5 Years
Autonomy Scientist	UK	10 Years

Chief Technology Officer	Turkey	5.5 Years
Logistic Supervisor	Turkey	8 Years
Logistic Manager	Turkey	6 Years
Supervisor IT support	Germany	3 Years
Digital Marketing Manager	USA	9 Years
Procurement Manager	Afghanist an	4 Years
PhD Student	Turkey	3 Years
IT Executive	France	5 Years
General Manager	Mali	5 Years
Education CONSULTANT	Turkey	5 Years
Social media manager	Malaysia	2 Years
Marketing Executive	Turkey	4 Years
Manager	Somalia	4 Years
CEO	Turkey	3 Years
Teacher	Spain	2 Years
Identity Manager	Germany	2 Years
Social Media	UK	2 Years
Tax Analyst	USA	3 Years
Not Given	Not Given	5 Years
Logistic Manager	Pakistan	4 Years
Business Development	Turkey	3 Years
Digital Marketing Manager	Pakistan	4 Years
CEO/Owner	Turkey	4 Years
Manager/owner	Mauritania	3 Years

Digital Media Manager	Turkey	7 Years
HR	Turkey	1 Years
Export Sales Representative	Turkey	3.5 Years
Owner And Sales Manager	Afghanistan	7 Years
Development Manager	Turkey	4 Years
Oceangoing Watchkeeping Engineer	Turkey	2 Years
Application editor	Turkey	2 Years
Manager	USA	7 Years
Operation Manager	UK	5 Years

Table 4.2: Average and Median of Job Experience

Calculation	Years of Job Experience
Average	4.3
Median	4

The values of five-points Likert scale and the range are given in the table 4.3.

Table 4.3: 5 Points Code and Range for the Mean

Response classifications	Value	Range
Strongly Disagree	1	1,00-1,80
Disagree	2	1,81-2,60
Neutral	3	2,61-3,40
Agree	4	3,41-4,20
Strongly Agree	5	4,21-5,00

Table 4.4: Mean (Average), SD and Interpretation

	Mean	SD	Interpretation
Q3	4,20	0,83	Agree
Q4	3,23	1,19	Neutral
Q5	3,34	1,00	Neutral
Q6	3,66	1,08	Agree
Q7	3,91	1,04	Agree
Q8	4,00	0,97	Agree
Q9	4,03	0,82	Agree
Q10	4,09	0,89	Agree
Q11	3,94	0,84	Agree
Q12	3,54	0,78	Agree
Q13	4,06	0,59	Agree
Q14	4,11	0,63	Agree
Total	3,84	0,89	Agree

Figure 4.2: Developing AI in near future.

1) AI will add value to managing the supply chain operations

This question was a personal view question that tried to discover how professionals feel artificial intelligence adds value to supply chain management (SCM). The question format varied from 1 (Strongly Disagree) to 5 (Strongly Agree). Out of 35 respondents 18 (51%) 'Agree' that AI will add value to managing the supply chain operations, 13 (37%) respondents think 'Strongly Agree,' 3 (9%) respondents answered 'Neutral,' only (3%) out of 35 respondents answered, 'Strongly Disagree' while none of the respondents selected 'Disagree'.

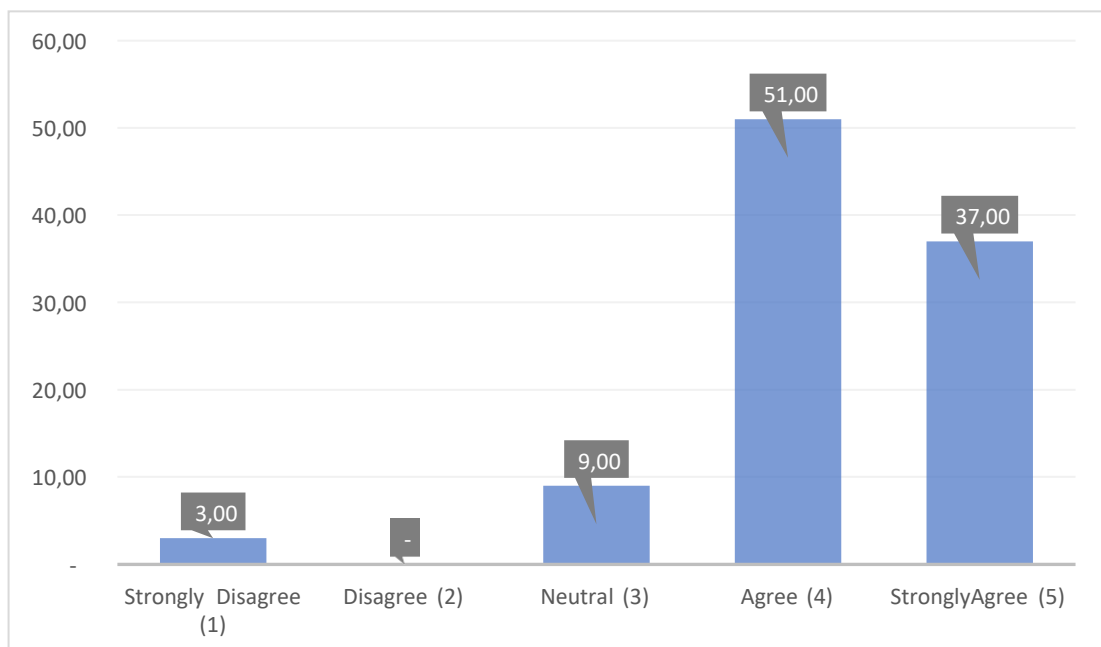


Figure 4.3: Value Creation of AI for SCM

2) Technological development will cause job losses

The fourth question was about the threat of AI applications in SCM. Here, we can see that 26% of respondents answered they 'Agree,' 26% answered 'Disagree,' 26% replied 'neutral,' 17% of respondents think they 'Strongly Agree' while only 6% answered Strongly Disagree.'

According to the result shown in table 4.4, the mean score of question 4 is 3,23 and the standard deviation is 1,19. The interpretation is "Neutral". We can see that the mean is between the range 2,70-3,40 as given in 'table 4.3.' which means answer for this question is 'Neutral' and SD also indicates that the data are more spread out from the mean.

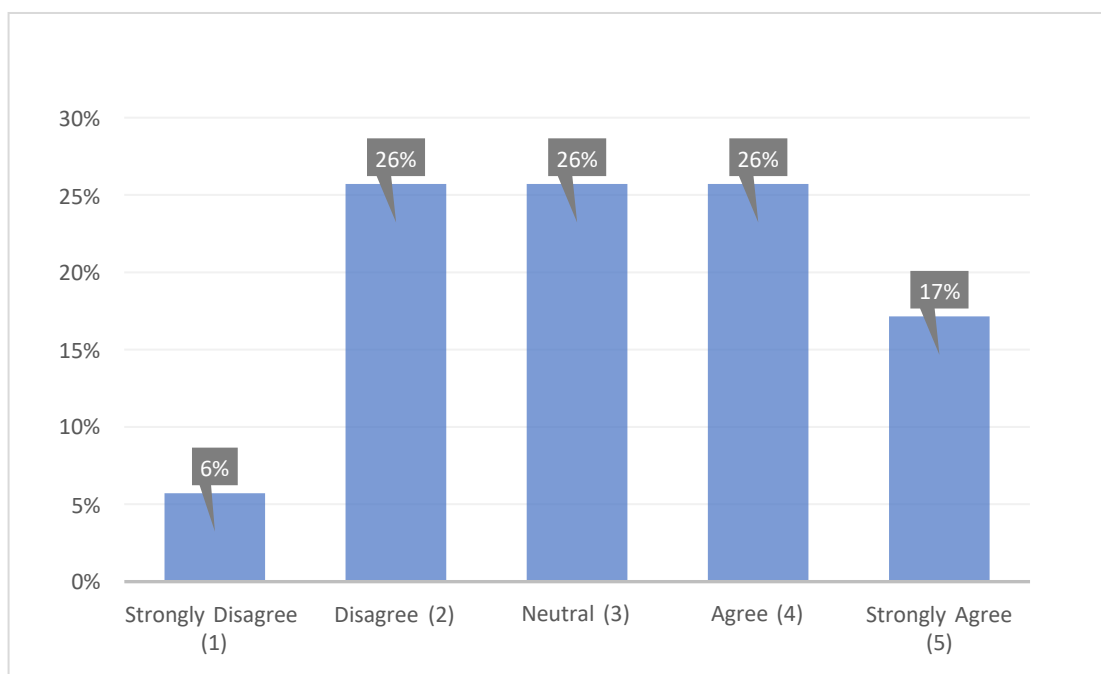
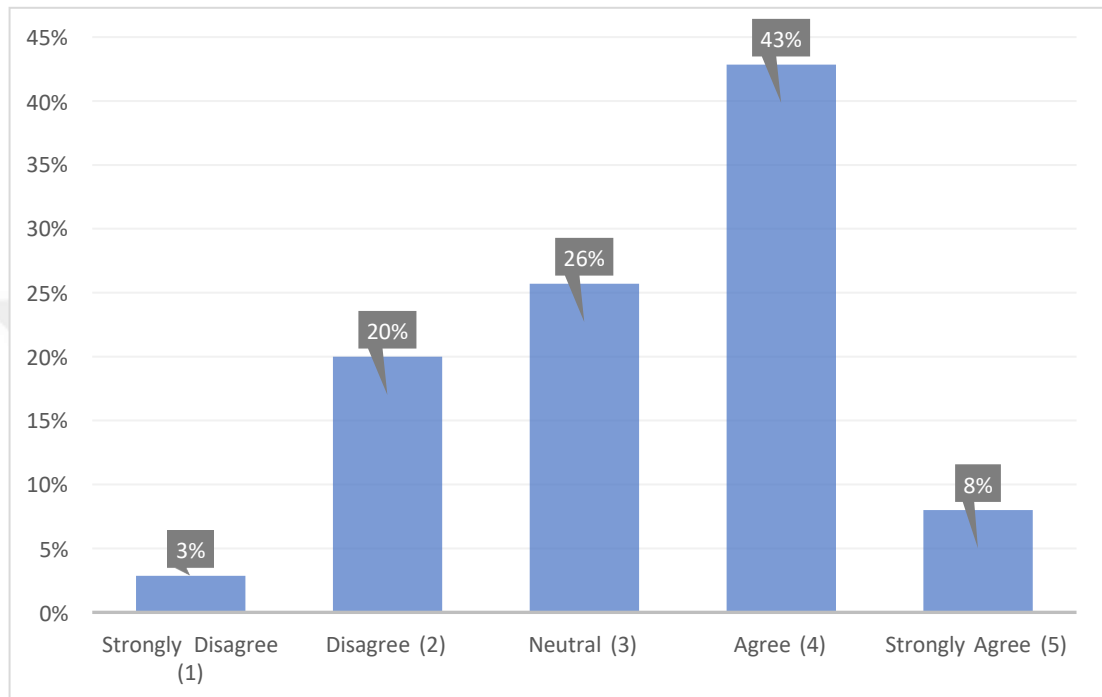


Figure 4.4: AI will cause Job Losses

3) Technological development will increase job opportunities

The fifth question was concentrated on finding out if AI will increase job



opportunities in SCM. 43% of respondents 'Agree' that AI will increase job opportunities in SCM. 26% answered 'Neutral,' 20% 'Disagree,' 8% respondents answered, 'Strongly Agree,' and only 3% replied they 'Strongly Disagree.' As table 4.4 shows that the mean score for this question is 3,34 and the standard deviation is 1,00 and the interpretation is 'Neutra

Figure 4.5: AI Job opportunities

New AI technologies increasing the need of new job qualifications

Respondents were asked about the new job qualifications requirement with the new AI technologies in SCM. Almost half, 46% of them 'Agree' that there will be a need for new job qualifications. 20% of respondents answered, 'Strongly Agree,' 20% answered 'Neutral,' 8% answered 'Disagree' and only 6% of respondents replied with 'Strongly Disagree.'

The mean score of this question is 3,66 standard deviation is 1,08 and the interpretation for the question is 'Agree'. We can see that the mean lies in between the range 3,50- 4,20 as given in table 4.3. which shows that the majority of respondents 'Agree' that AI can cause new job implementation in SCM. the SD also shows that the data are not spread away from the mean.

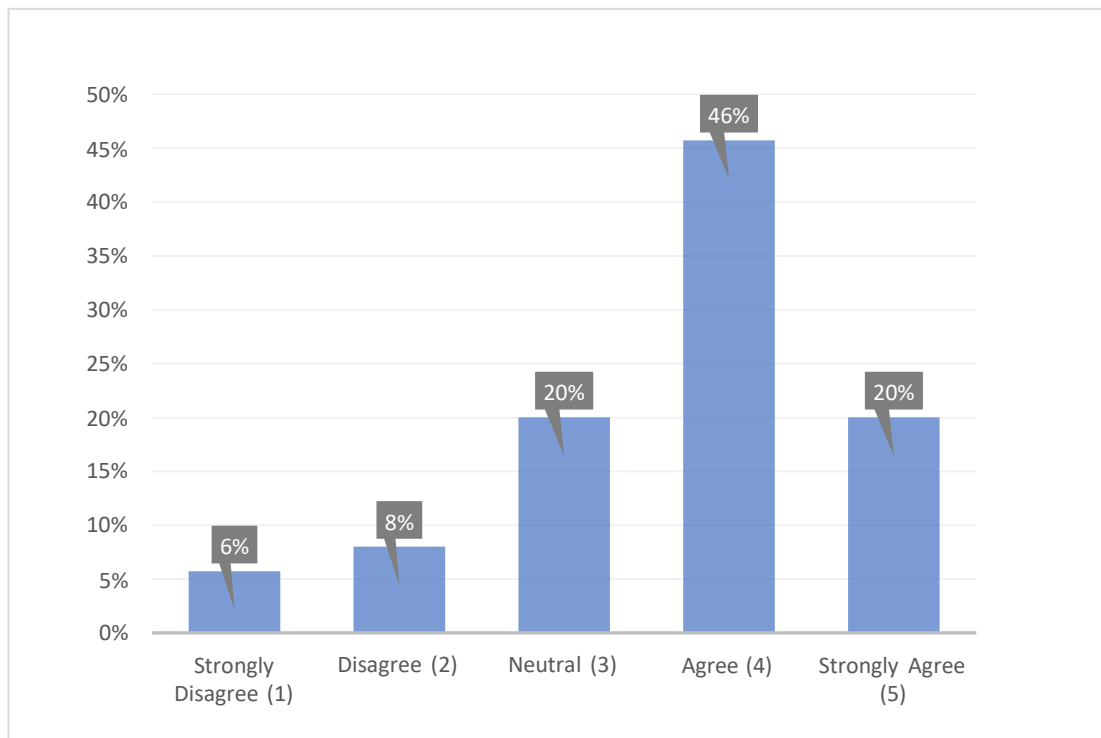


Figure 4.6: AI will Cause new job Qualifications in SCM

4) Workers must improve and develop both technical and non-technical capabilities.

As AI is integrating with every field of SCM, respondents were asked if workers should improve and develop their technical and non-technical capabilities or skills. 43% answered 'Agree' to the question, 31% answered 'Strong Agree,' 14% replied 'Neutral,' 9% 'Disagree,' and only 3% answered 'Strongly Disagree.'

The mean score is 3,91 and the standard deviation is 1,04. And interpretation is 'Agree' as given in table 4.4. The mean '3,91' lies in between the range 3,50-4,20 which shows that the majority of the respondents agree that workers must improve and develop both technical and non-technical capabilities.

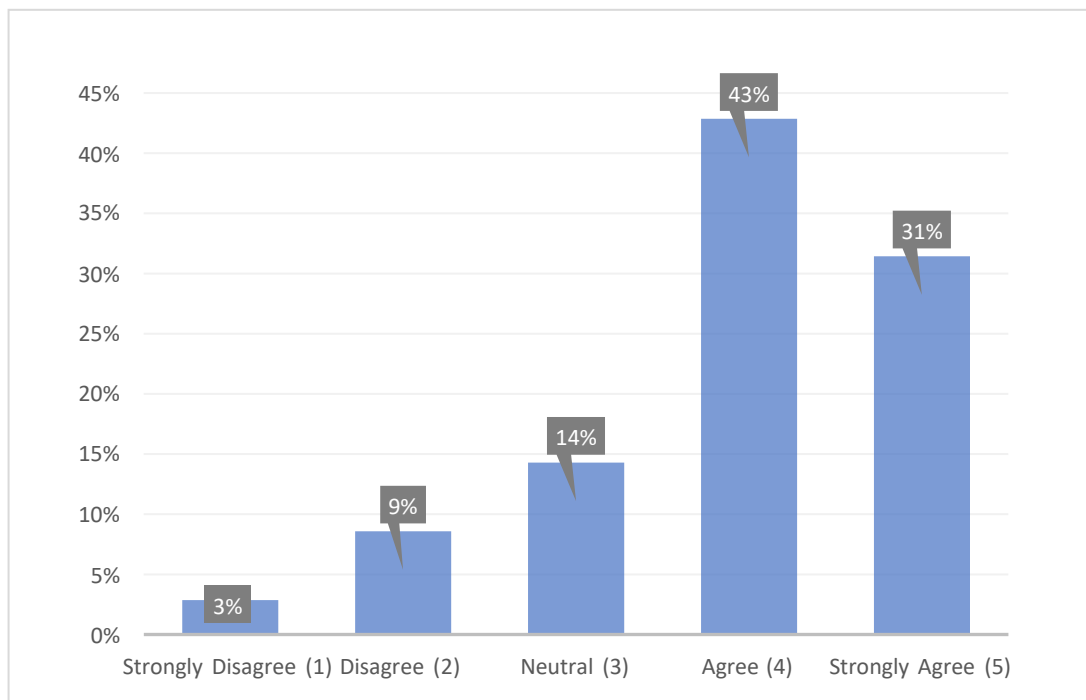


Figure 4.7: Workers technical and Non-Technical Capabilities

5) Human-AI collaboration require new roles and talent

This question was asked to the respondents to learn about the requirement of new roles and talents in Human-AI collaboration. The majority of respondents, 49%, answered that they 'Agree,' 31% replied that they 'Strongly Agree,' 11% answered 'Neutral,' 6% replied they 'Disagree' and only 3% answered that they 'Strongly Disagree.'

The mean score is 4,00 and the standard deviation is 0,97, SD also shows that the data are closely spread to the mean. The interpretation for this question is 'Agree' as shown in figure 4.4.

The mean 4,00 lies between the range 3,50-4,20 as given in table 4.3, which shows that the majority of respondent agree that the Human-AI collaboration requires new roles and talents.

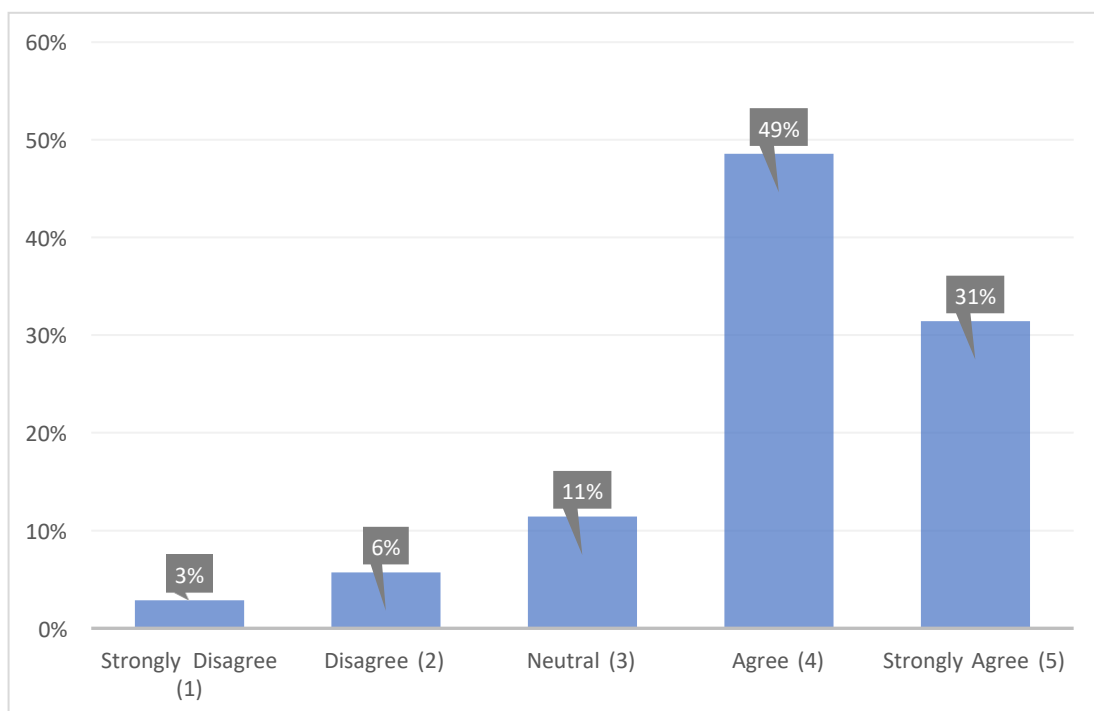


Figure 4.8: New Roles and talents in Human- AI Collaboration
Do you agree that Human and AI collaboration will boost up the productivity and competition level of your company?

Question 9 was concentrated on knowing if Human-AI will collaborate; it will increase the productivity and competition level of the company. The majority of respondents, 43%, answered they 'Agree,' and 31% answered 'Strongly Agree' that Human-AI will increase productivity and competitive level of their company. 23% answered 'Neutral,' 3% of respondents answered 'Disagree,' while none responded, 'Strongly Disagree.'

The score and standard deviation is 4,03 and 0,82 respectively and interpretation is 'Agree' as shown in the table 4.4.

The mean 4,03 lies between the range 3,50-4,20 as given in table 4.3, which shows that the majority of respondent agree that Human and AI collaboration will boost up the productivity and competition level of their company.

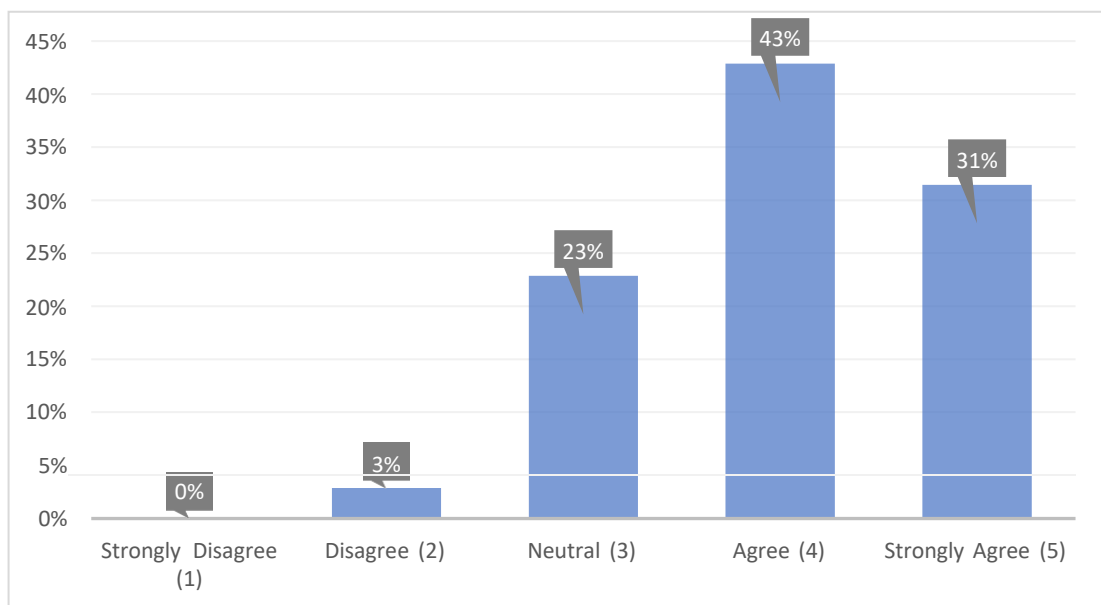
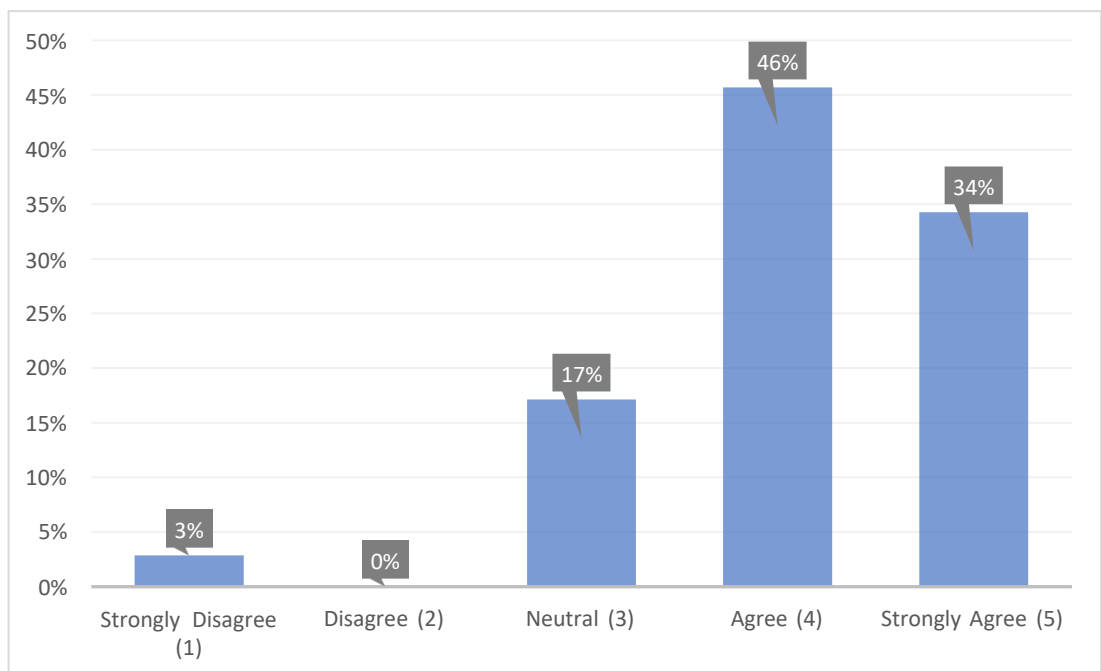


Figure 4.9: Productivity and Competitive level of Companies in Human-AICollaboration

6) Do you agree that the employee's education and training is important to collaborate with AI technologies?



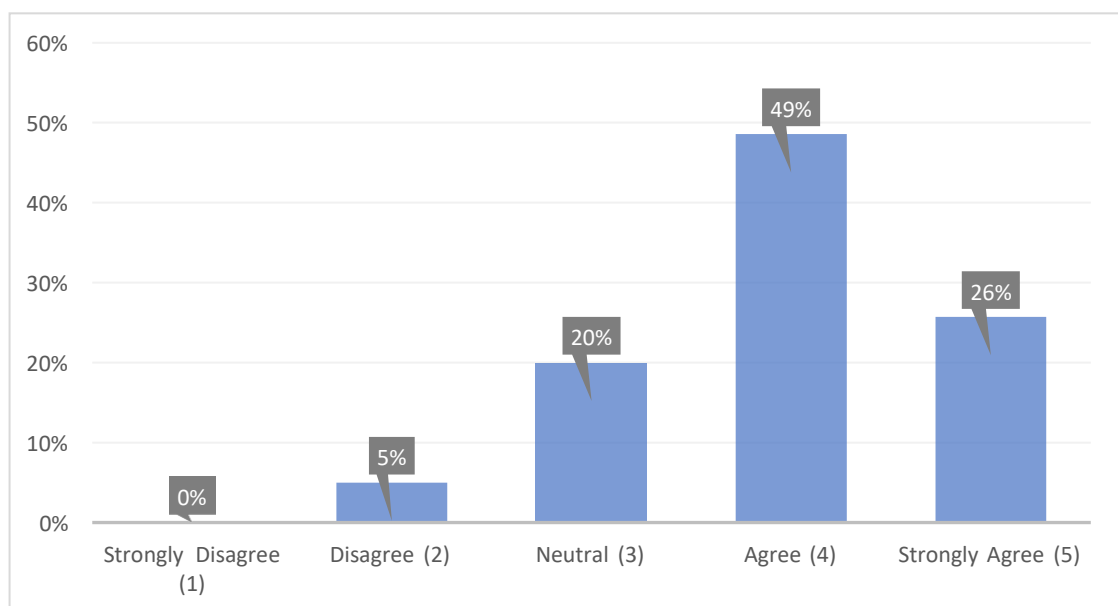
The main goal of this question was to find out if workers' education and training are vital for companies when they work with AI technologies. The majority of respondents answered both 'Agree' and 'Strongly Agree,' 45% replied 'Agree' while 34,3% replied with 'Strongly Agree.' 17,1% of respondents replied with 'Neutral,' and only 2,9% answered 'Strongly Disagree.'

Figure 4.10: Employee's Education and Training in Human-AI Collaboration

7) Do you agree that longer education and training programs about latest Ai technologies for your employees, will give competitive advantage to your company?

This question asked to get the info about the importance of more comprehensive education and training programs of workers in companies if more comprehensive education and training programs will give a competitive advantage to companies or not? Almost half of the respondents 49% answered they 'Agree' that more comprehensive education and training programs will bring competitive advantage to the companies, 26% answered 'Strongly Agree,' 20% answered 'Neutral,' and only 5,7% respondents answered 'Disagree,' while none of the respondents selected 'Strongly Disagree.'

The means score is 3,94 and the standard deviation is 0,84 as given in table 4.4. the standard deviation is low which shows that data are spread nearly around the mean.



The mean 3,94 lies between the range 3,50-4,20 as given in table 4.3, which shows that the majority of respondent agree that the longer education and training programs about latest AI technologies for your employees, will give competitive advantage to their company.

Figure 4.11: Human-AI collaboration & Longer Education and Training Programs

8) Do you agree that usage of new AI will strengthen and harmonize the skills of your employees?

This question was asked to know if AI is helping workers to strengthen and harmonize their skills; the majority and more than half of our respondents, 54%, replied that they 'Agree.' 6% answered 'Strongly Agree', 29% answered 'Neutral', and 11% answered that they 'Disagree'.

The mean score is 3,54 and the standard deviation is 0,78 as given in table 4.4. the standard deviation is low which shows that data are spread nearly around the mean.

The mean 3,54 lies between the range 3,50-4,20 as given in table 4.3, which shows that the majority of respondent agree that the usage of new AI will strengthen and harmonize the skills of your employees.

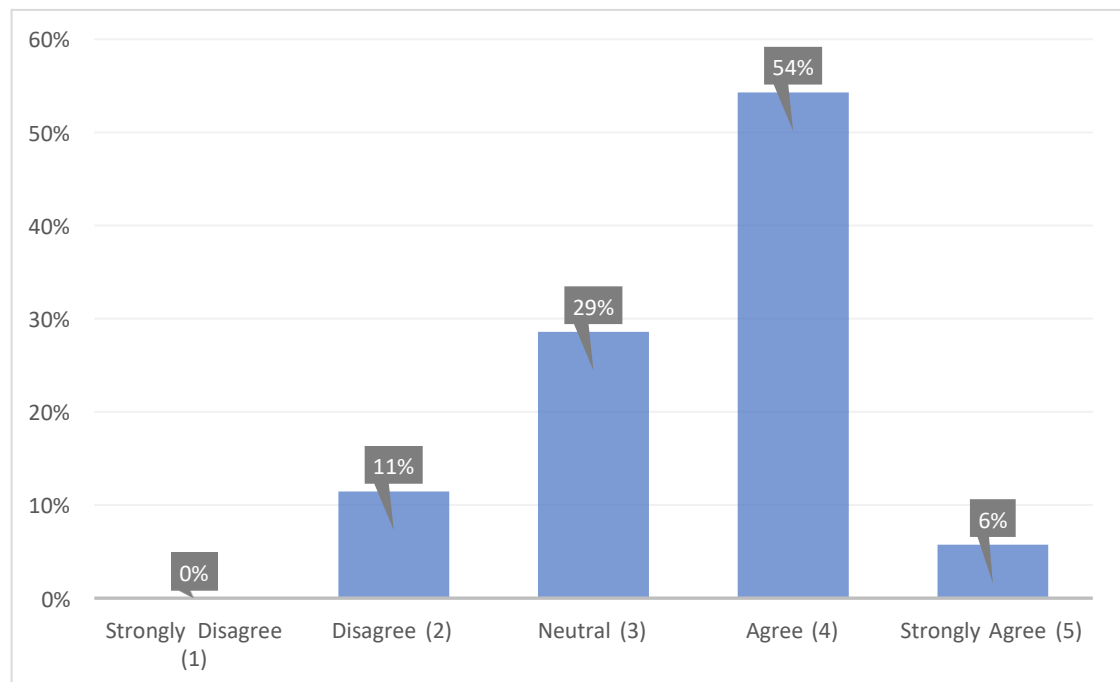


Figure 4.12: AI will strengthen and harmonize workers skills

9) To integrate with AI technologies, human decision makers must have to keep their AI knowledge up to date and need to develop analytical skills.

This question is about the development of the analytical skills of decision-makers in a company. More than half of those who answered the survey, 66%, responded that they 'Agree,' 20% responded that they 'Strongly Agree,' and

14% of respondents answered 'Neutral,'. In contrast, none of the participants answered as 'Disagree' and 'Strongly Disagree.'

The means score is 4,06 and the standard deviation is 0,59 as given in table 4.4. the standard deviation is low which shows that data are spread nearly around the mean.

The mean 4,06 lies between the range 3,50-4,20 as given in table 4.3, which shows that the majority of respondent agree that, to integrate with AI technologies, human decision makers must have to keep their AI knowledge up to date and need to develop analytical skills.

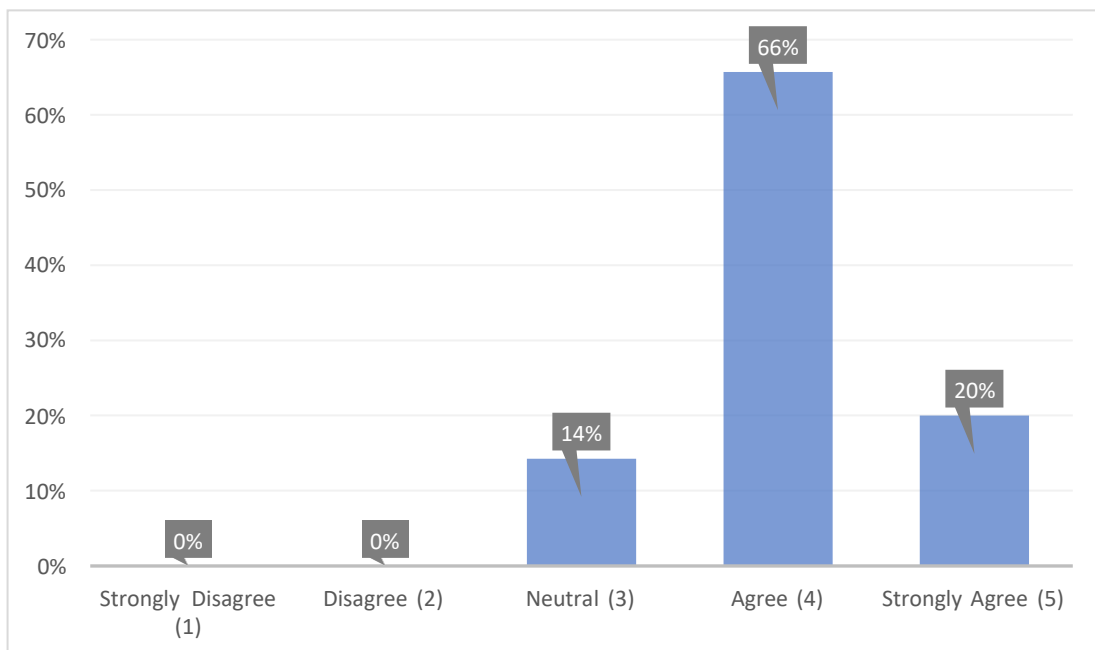


Figure 4.13: Development of analytical skills of Decision Makers

10) There should be specific task for both humans and machines in which they are most suitable.

This question is asked to our experts that if there should be specific task for both human and machine in human-AI collaboration; the majority of them, 60%, answered that they 'Agree,' 25% answered. 'Strongly Agree,' and 14 % answered 'Neutral.'

The means score is 4,11 and the standard deviation is 0,63 as given in table 4.4. the standard deviation is low which shows that data are spread nearly around the mean.

The mean 4,11 lies between the range 3,50-4,20 as given in table 4.3, which shows that the majority of respondent agree that there should be specific task

for both humans and machines in which they are most suitable.

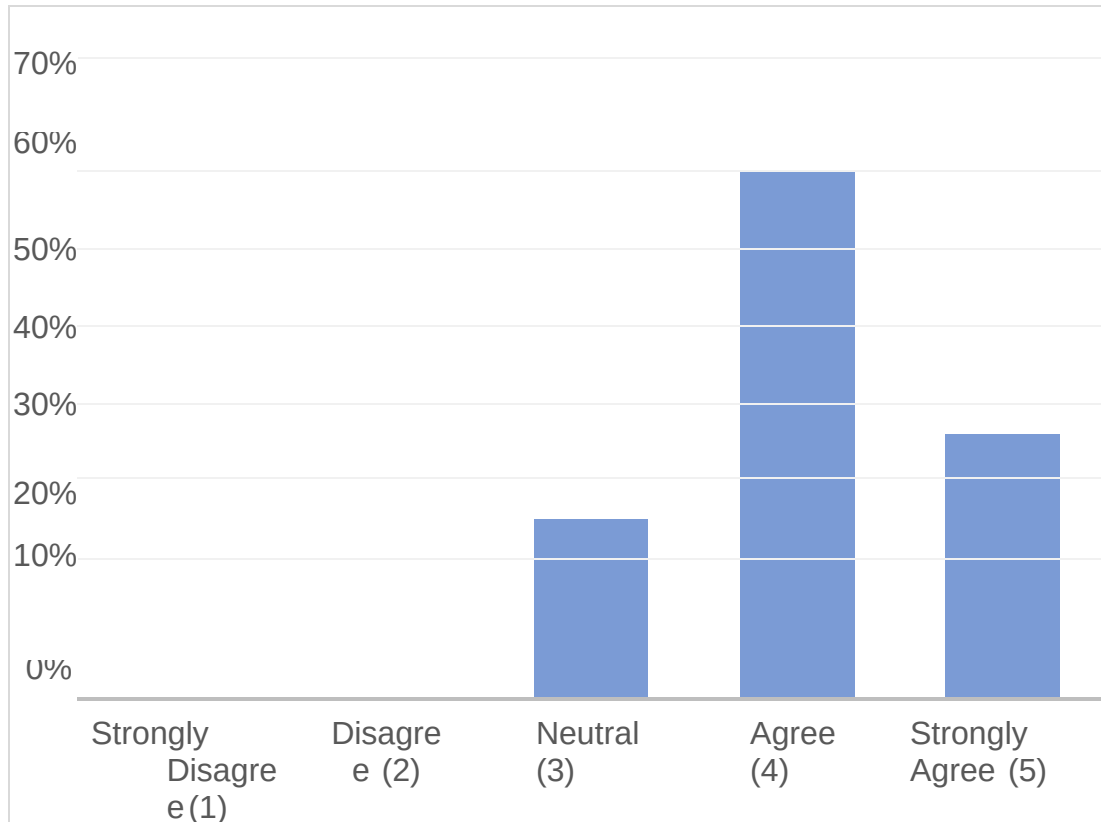


Figure 4.14: Specific Tasks for human and machine

4.2.HYPOTHESIS - 1 :

H0 : There is no significant difference between the age of the people

H1 : There is a significant difference between the age of the people

4.2.1.Anova

ANOVA					
AGE					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	2.439	3	.610	.626	.295
Within Groups	94.2	97	.649		
Total	96.64	150			

INTERPRETATION

The p value is 0.295 which is greater than the significance value (0.05) hence null hypothesis (H0) is accepted. And H1 is rejected

INFERENCE:

Therefore, there is a no significant difference between the age

4.2.2.CORRELATIONS

		AGE
AGE	Pearson Correlation	1
	Sig. (2-tailed)	
	N	100
Do you see a path for people	Pearson Correlation	-.041
Digital transformation	Sig. (2-tailed)	.301
	N	100

INTERPRETATION

The p value is -0.62 which is less than the significance value (0.05) hence alternate hypothesis (H1) is accepted. Therefore, there is a significant difference between the age

CHAPTER V

FINDING, SUGGESTIONS AND CONCLUSIONS

5.1 FINDINGS

- Majority if respondents are male
- Majority 51% of respondents strongly agreed that AI will add value to managing the supply chain operations
- 26% of respondents agreed technological developments will cause job losses
- Majority 43% of respondents agree that AI will increase job opportunities in SCM
- 46% of respondents agree that there will be a need for new job qualifications
- Majority 43% of respondents agree that workers must improve and develop both technical and non-technical capabilities
- Majority 31% of respondents strongly agree that Human-AI collaboration require new roles and talent
- Majority 43% of respondents agree that Human-AI collaboration will boost up the productivity and competition level of the company
- Majority 45% of respondents strongly agree that the employee's education and training is important to collaborate with AI technologies
- Majority 54% of respondents agree that usage of new AI will strengthen and harmonize the skills of the employees.

5.2 SUGGESTIONS

Discussion About the Topic

The result's generalizability is restricted due to a paucity of responders. Even though the results demonstrate that most organizations do not employ advanced AI in their operations, they have high hopes for the technology's development shortly despite their lack of technical expertise. Businesses in highly competitive market sectors must

decide whether to employ the same technologies as their competitors or

introduce something new.

If organizations are more open-minded and prepared to change, AI can

generate various answers to SC challenges. Availability of the financial resources is generally an issue for these implementations, and firms prefer to thoroughly evaluate the AI and wait until someone else implements those technologies first. Human-AI collaboration can help establish a more progressive future. Tasks, not jobs, will be replaced by artificial intelligence. Humans continue to struggle with things that are nearly impossible to do. Implementing AI in businesses, in particular, provides extra employment to manage its system. The world can build a better environment for civilization with the aid of people's great minds and the capabilities of Artificial Intelligence.

Recommendations For Future Research

Additional research on the uses of artificial intelligence is necessary.; It will be essential to investigate further artificial intelligence applications for supply chain management structures. Similarly, other corporate disciplines, such as strategic management, manufacturing, and information technology, should establish a complete plan for implementing artificial intelligence (AI) technologies into their current infrastructure.

It will also be feasible to conduct more in-depth research on the economic and strategic opportunities artificial intelligence (AI) may provide enterprises. However, the number of participants in future interviews should be expanded to boost the usefulness of the results.

5.3 CONCLUSIONS

This chapter will wrap up the study by reviewing the actual research findings concerning the research goals and questions and their value and contribution. Additionally, it will provide suggestions for additional study.

This thesis study aims to ascertain and evaluate the impact of AI applications in SC. and investigate education/training and skill requirements in Human-AI collaboration in SCM. The study attempts to address the questions, "What is the impact of new artificial intelligence technologies on supply chain

management?", "What are the requirements for human – AI collaboration? and "What relationship exists between workers' education/training and Skills

and competitive advantage of the companies in Human-artificial intelligence collaboration?".

The findings reveal that enterprises usually incorporate AI technologies into their supply chain management processes, and they see AI as a beneficial and major component of their operations. AI will help in solving critical problems, fast operations, forecasting, improving the performance of employees, decreasing operation costs, increasing accuracy, ease of decision making, and will find new trading opportunities. Businesses are incorporating artificial intelligence technology such as genetic algorithms, deep learning, and external applications. Most companies intend to create SCM processes using AI during the next five years, increasing competition among companies. Companies first research their competitors and existing know-how to use AI technology to get efficient results and gain a competitive advantage. Research results also show that the amount invested in AI technologies is also essential for a competitive advantage. Large companies invest more on AI, and for medium or small size businesses it's impossible to compete with them. Most of small and medium-sized businesses have a fundamental understanding of artificial intelligence (AI); they are not proficient. Large companies are well advanced in AI; they are proficient and experienced.

The research discovered that increased technology integration is resulting in the emergence of new business models, the culture is changing, and new jobs qualifications are required. There will be a severe scarcity of highly educated and competent workers in some parts of the world. Thus, there will be not only competition

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ANNEXURE - QUESTIONNAIRE

A STUDY ON IMPACT OF ARTIFICIAL INTELLIGENCE ON SUPPLY CHAIN MANAGEMENT

Appendix Survey form (English)

Fundamental Information

1.Name /

Surname

Answer

.....

2.Country

Answer

.....

3.Company

NameAnswer

.....

Management Area

4.Job

Title

Answer

.....

5.Years of

Experience

Answer

.....

Information means

6.Is your organization using artificial intelligence to control

the SC?o Yes

o No

o N/A

o Other:

7.How likely is it that AI will be used in your SC operations in upcoming five

years?

- ☐ Extremely unlikely
- ☐ Unlikely
- ☐ Neutral
- ☐ Likely
- ☐ Extremely likely

8. There should be a specific task for both humans and machines in which they are most suitable.

- ☐ Strongly disagree
- ☐ Disagree
- ☐ Neutral
- ☐ Agree
- ☐ Strongly agree

9. To integrate with AI technologies, human decision-makers must keep their AI knowledge up to date and need to develop analytical skills.

- ☐ Strongly disagree
- ☐ Disagree
- ☐ Neutral
- ☐ Agree
- ☐ Strongly agree

10. Workers must improve and develop both technical and non-technical capabilities.

- ☐ Strongly disagree
- ☐ Disagree
- ☐ Neutral
- ☐ Agree
- ☐ Strongly agree

Additional information (Human AI Collaboration)

11. AI will add value to managing the supply chain operations?

- ☐ Strongly disagree
- ☐ Disagree
- ☐ Neutral
- ☐ Agree
- ☐ Strongly agree

12. Human-AI collaboration requires new roles and talent?

- ☐ Strongly disagree
- ☐ Disagree
- ☐ Neutral
- ☐ Agree
- ☐ Strongly agree

13. Do you agree that Human and AI collaboration will boost your company's productivity and competition level?

- ☐ Strongly disagree
- ☐ Disagree
- ☐ Neutral
- ☐ Agree
- ☐ Strongly agree

14. Do you agree that the employee's education and training are essential to collaborating with AI technologies?

- ☐ Strongly disagree
- ☐ Disagree
- ☐ Neutral
- ☐ Agree
- ☐ Strongly agree

15. Do you agree that the usage of new AI will strengthen and harmonize the skills of your employees?

- ☐ Strongly disagree
- ☐ Disagree
- ☐ Neutral
- ☐ Agree
- ☐ Strongly agree

16. New AI technologies are increasing the need for new job qualifications.

- ☐ Strongly disagree
- ☐ Disagree
- ☐ Neutral
- ☐ Agree
- ☐ Strongly agree

17. Technological development will cause job losses.

- ☐ Strongly disagree
- ☐ Disagree
- ☐ Neutral
- ☐ Agree
- ☐ Strongly agree

18. Technological development will increase job opportunities.

- ☐ Strongly disagree
- ☐ Disagree
- ☐ Neutral
- ☐ Agree
- ☐ Strongly agree

19. Do you agree that more comprehensive education and training programs about the latest AI technologies for your employees will give a competitive advantage to your company?

- ☐ Strongly disagree
- ☐ Disagree
- ☐ Neutral
- ☐ Agree
- ☐ Strongly agree

