**ISTANBUL SABAHATTIN ZAIM UNIVERSITY**
**GRADUATE EDUCATION INSTITUTE**
**DEPARTMENT OF BUSINESS ADMINISTRATION**

# IMPACT OF ARTIFICIAL INTELLIGENCE ON SUPPLY CHAIN MANAGEMENT: REQUIREMENTS FOR HUMAN-ARTIFICIAL INTELLIGENCE COLLABORATION

**MA THESIS**

**Abdul Hayee MAHMOOD**

**Istanbul**
**January-2022**

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**January-2022**

This study has been approved in partial fulfillment of the requirements for MA Degree in Business Administration

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## DECLARATION OF ETHICS AND ORIGINALITY

This is to confirm that this MBA thesis, "Impact of Artificial Intelligence on Supply Chain Management: Requirements for Human-Artificial Intelligence Collaboration," is entirely my own work and throughout the process of developing it, I adhered to scientific ethics and academic regulations. In accordance with scientific ethics and Sabahattin Zaim University's thesis writing rules, I have gathered and utilized all of the material and data that I have gathered. All direct and indirect quotes, as well as all sources I have utilized in this work have been properly mentioned, both in the text and in the bibliography.

**Abdul Hayee MAHMOOD**

Istanbul, January 2022

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**Abdul Hayee MAHMOOD**

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# ABSTRACT

## IMPACT OF ARTIFICIAL INTELLIGENCE ON SUPPLY CHAIN MANAGEMENT: REQUIREMENTS FOR HUMAN-ARTIFICIAL INTELLIGENCE COLLABORATION

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Master, Business Management

Thesis Advisor: Asst. Prof. Canser BİLİR

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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

# ÖZET

# YAPAY ZEKANIN TEDARİK ZİNCİRİ YÖNETİMİ ÜZERİNDEKİ ETKİSİ: İNSAN- YAPAY ZEKA İŞBİRLİĞİ İÇİN GEREKLİLİKLER

Abdul Hayee MAHMOOD

Yüksek Lisans, İşletme Yönetimi

Tez Danışmanı: Dr. Öğr. Üyesi Canser BİLİR

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Bu bir keşif çalışmasıdır ve yapay zekanın tedarik zinciri yönetimi üzerindeki etkisini ve İnsan-yapay zekâ iş birliği gereksinimlerini araştırmaktadır. Yapay zekâ teknolojilerinin tedarik zincirindeki yeni trendleri yeni zorlukları da beraberinde getirdi. Böylece, tedarik zinciri yönetimine daha uygun olan yapay zekânın alt alanlarının bir analizi yapılacaktır. İnsan- yapay zekâ iş birliği, yeni roller, yüksek eğitimli ve nitelikli işçiler gerektirir. Artan yapay zekâ teknolojileri ile dünyanın çoğu bölgesinde sınırlı sayıda yüksek nitelikli çalışan var. Bu nedenle, işçiler hem teknik hem de teknik olmayan yetenekleri geliştirmelidir. Yenilikçi insanlar ve yapay zekâ teknolojisi, birbirlerini güçlendirmek için rakip değil ortak olarak çalışmalıdır. Bu insan-yapay zekâ iş birliği, dünyamızdaki herhangi bir kişi veya gruptan daha zeki süper zihinler oluşturur. Bu çalışma, insan ve yapay zekâ iş birliğinde eğitim/öğretimin ve beceri gereksinimlerinin önemini göstermek için nicel ve nitel analizler kullanmaktadır. Araştırma sonucu, firmaların tedarik zinciri Yönetim'lerinde genellikle yapay zekâ kullandıklarını gösteriyor ve rekabet avantajı elde etmeleri için şirketlerin yaşam boyu eğitim programlarına sahip olmaları gerektiğini belirledi. Çalışanların ve işverenlerin değişikliği kabul etmeye karşılıklı hazırlığı olmalıdır.

**Anahtar Kelimeler:** Tedarik Zinciri Yönetimi, Yapay zekâ, Teknoloji, rekabet avantajı

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| | |
|---|---|
| **SC** | : Supply Chain |
| **SCM** | : Supply Chain Management |
| **GAN** | : Generative Adversarial Nets |
| **ANN** | : Artificial Neural Networks |
| **DL** | : Deep learning |
| **GA** | : Genetic Algorithms |
| **IoT** | : Internet of Things |
| **AI** | : Artificial Intelligence |
| **CRM** | : Customer Relationship Management |
| **HMT** | : Human-Machine Teaming |
| **AV** | : Automated Vehicles |
| **DT** | : Decision Trees |
| **VR** | : Virtual Reality |
| **ML** | : Machine learning |
| **H2M** | : Human-to-Machine |
| **M2M** | : Machine-to-Machine |
| **SD** | : Standard Deviation |
| **TSVM** | : Transductive Support Vector Machines |

# 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. This research advances our knowledge of the impact of artificial intelligence on supply chain management and the requirements for human-AI collaboration, particularly education and training measures for employees to engage with emerging AI technologies.

To attain the purpose, this study employs both quantitative and qualitative methods.

## 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. (Joost N. Kok, 2009, p. 271).

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. In Human-AI collaboration, employees' education/training and skills measures have a massive impact on the competition level of businesses.

There should be an open exchange of knowledge between people and machines in human-AI collaboration. For both humans and machines, there should be a specialized

job for which they are best suited. When people work alongside technology, they will have to adapt and adjust (Dominik Dellermann, 2019). It is the responsibility of companies to provide their staff with the necessary training to help them develop the necessary collaboration skills for working with artificial intelligence. Every company's performance is tied to the quality of its employees' education and training. As a result, it improves the productivity of employees and teams, leading to tremendous success for the organization (Daugherty & Wilson, 2018, p. 11).

### 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).

Numerous studies have looked at how to manage skills development programs in the workplace. However, these studies have historically concentrated on relatively slow-moving sectors where critical skills and knowledge remain constant. This set of theories poses a challenge for companies dealing with a fast-shifting skills environment. For example, the impact of AI application in SC and Human-AI collaboration is developing rapidly, and the current applications of AI are updating daily. The present research is insufficient for sectors where vital knowledge and skills are continuously and quickly changing because it believes that information and skills are constantly and rapidly growing.

There is limited research on corporate education/training and skills development in fast-moving companies. This study aims to provide an exploratory study analyzing and assessing the significance of workers' education/training and skills development programs in business. Such as, in AI human collaboration, to explore if longer education and training programs will give a competitive advantage, such as daily long

duration classes, seminars, etc., or instead of having extended duration programs, should there be more flexible, short, and friendly programs.

Thus, this research helps to understand the importance of education and training to have a competitive advantage and describes companies' current approaches to education and training.

The goal of this study is to identify which artificial intelligence technologies are now being used by businesses, how AI applications have affected the supply chain, and how education and training programs should be implemented in companies while collaborating with AI, and what the benefits toward competitiveness would be.

The research seeks to analyze the impact of AI applications on the supply chain and the present state of the field. Human-AI collaboration requirements and the significance of employees' education/training and talents will be assessed and evaluated using the most recent analytical theories.

**The research's objectives are as follows:**

1. To find and analyze potential uses of AI technologies in the supply chain management.

2. Determine the requirements for human-AI collaboration.

3. Conduct research on the significance of worker education/training and skills development programs where AI is currently applied.

**The following questions are intended to be addressed by the research:**

1. What is the impact of new artificial intelligence technologies on supply chain management?

2. What are the requirements for human – AI collaboration?

3. What relationship exists between workers' education/training and Skills and the competitive advantage of the companies in Human-artificial intelligence collaboration?

**Hypothesis Development**

According to the questions of the thesis, the hypothesis is:

**H1:** In human-AI collaboration, companies who have longer education and training programs for their workers will have higher competitive advantage than who do not or have less education and training programs.

### 1.3 Limitations

The present research raises several concerns due to its limitations. The limitations are as follows:

- 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

In *Chapter 1,* the thesis's context, purpose, goals, and research questions are all defined. Additionally, the definitions and limits of the thesis's core concepts are highlighted. This chapter summarizes Artificial intelligence applications in supply chain management, human- artificial intelligence cooperation, and the critical role of worker education and training.

In *Chapter 2* undertook an analysis of existing literature on AI and human-AI collaboration. Particularly AI history and development, Subfields of AI, the evaluation of the existing literature on supply chain management and its key components, AI

applications in the supply chain, and the literature review of Human AI collaborations and the importance of workers' education and training.

*Chapter 3* presents a theoretical paradigm for artificial intelligence in supply chain management and human-AI collaboration in order to discover the most appropriate artificial intelligence methodologies and strategies to improve SCM operations. This chapter also defines the appropriate approach for human-AI collaboration and worker education and training.

The thesis' approach, research procedure, and layout are all shown in *Chapter 4.*

The findings of the study are presented and discussed in detail in *Chapter 5*. Both quantitative and qualitative results.

*Chapter 6* represent the conclusion of the research result and discussion about the thesis topic. Additionally, in this chapter, the recommendations for further study have been established.

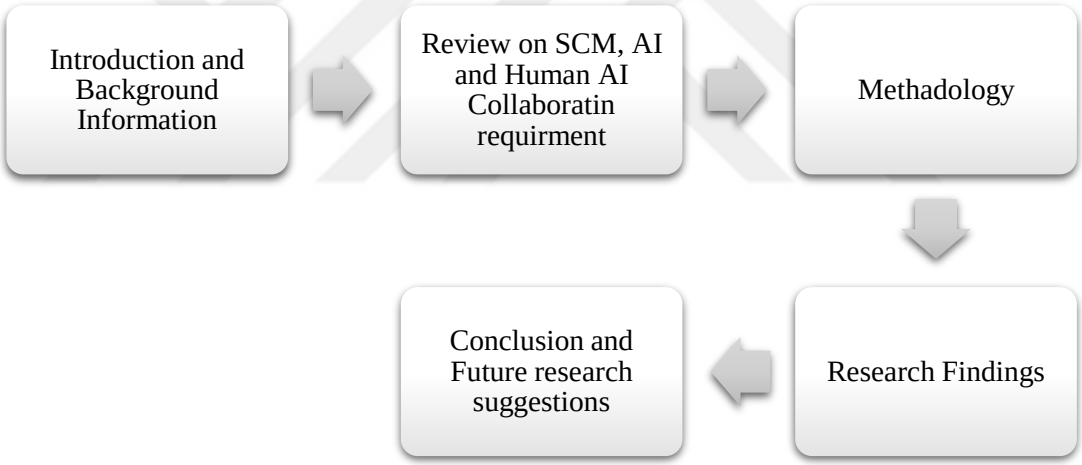


**Figure I.1: Thesis Structure**

# CHAPTER II
# ARTIFICIAL INTELLIGENCE: ADOPTION, APPLICATIONS, HISTORY

## 2.1 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. The idea of artificial intelligence was founded in the early 1950s, but the subcategories of artificial intelligence functions to enter into our daily lives took a long time (Makridakis, 2017). AI is developing very fast now and is achieving considerable achievements in economics, supply chain, marketing, banking, healthcare, etc. AI technologies are being introduced in different fields by different significant companies all around the world. Many multinational companies have already taken their top places. Microsoft introduced advanced image identification technologies and real-time translation robots (Microsoft Translator Speech API, 2017). In addition, the world's most popular media organizations, Google, Facebook, and Twitter, have their own unique artificial intelligence algorithms and use cloud-enabled social networking services. These companies do not create content themselves. Content is created by people who are members of these platforms. Apple and Samsung established face recognition in their smartphones, same as that, based on AI, Facebook introduced facial recognition technology which is named "Deep Face" (Taigman, 2014).

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).

In short, the role of artificial intelligence applications, artificial systems, robotics, and specialized environmental units is increasing and rooting day by day in human beings' cultural, socio-economic perceptions and habits, scientific, political, and statistical life.

### 2.1.1 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.

According to Joost et al. Artificial intelligence is concerned with the development of machines capable of performing rational processes similar to those of humans, such as, thinking, and self-correction (Joost N. Kok, 2009, p. 271).

### 2.1.2 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" to determine if a computer might be recognized intelligently. (Plant, 1994, p. 294). Alan Turing attracted professional attention when he resolved Enigma, the encryption device used in Nazi Germany, and produced the Turing Intelligence Test. In 1995 Alan Turing test and paper published, shortly after, the term "Artificial Intelligence" was coined at "The Dartmouth Conference" and became the name of the field (Perez, Deligianni, & Ravi, 2018, p. 19).

In 1969 the first "International Joint Conference on Computer Science" was arranged in Washington, and the phrase "Artificial Intelligence" was formally announced into the system (Alla A. Kornienko, 2015, p. 589).

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 2.1:** 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 2.1 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.

First time, Google introduced the autonomous car in 2009. Computer developed by Watson beat Jeopardy's contestants. AI is developing rapidly, and it's hard to calculate how far it can go because there are no limits. Today, we can see self-driving cars and unmanned aerial vehicles (UAV) invented by different multinational companies.

### 2.1.3 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 2004 DARPA held its first robot competition in Mojave Desert (USA), organized by the US government to promote research and advancement in autonomous driving. In this competition, though none of the participating vehicles completed the course, Carnegie Mellon University's robotic car had achieved great success by 12 kilometers. Although in 2004, no vehicle covered more than 5% of the track, in 2005 there was a great success, and five vehicles finished the course, and among these five, four vehicles finished within the allotted time. This contest was a significant incentive for the awareness of artificial intelligence (Michael Montemerlo, 2006).

The artificial intelligence program NEIL (Never Ending Image Learner) was developed by Carnegie Mellon University (the world's top institute for internet and artificial intelligence studies) in 2013. NEIL was unique in that it analyzed the connection among various pictures and designs (T. Mitchell, 2018).

In 2014 there were numerous AI inventions, such as, GAN Invention, Ian Goodfellow built a strong AI tool by putting neural networks against one another. GAN (Generative Adversarial Nets) gives robots the ability to imagine and create (Ian J. Goodfellow, 2018).

Alexa is Amazon's virtual assistant technology, first used in several amazon products: Echo dot, Amazon Echo smart speaker, Amazon Tap speakers, and Echo Studio. Alexa can also function as an intelligent home system, managing a range of intelligent devices (Hoy, 2018).

We're halfway through the decade, and AI is starting to have a significant influence, with big companies spending substantially in the sector.

In 2015 Google introduced TensorFlow, Google's deep learning platform. It gave all of us the opportunity to create our own models. TensorFlow is an open and free end-

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 four times 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).

Google has also announced its virtual assistant in 2016. (Amrita S. Tulshan, 2018).

In 2017 AlphaGo was updated into Alpha Zero, a generic and more powerful form, following its surprising victory against the most incredible human Go player in 2016. (David Silver, 2018).

In 2018, Deepfakes were invented; deepfakes are automated techniques that use the most recent advances in AI and machine learning to produce fake material that is becoming increasingly difficult to detect by humans (JanKietzmann, 2020, p. 135).

In 2019, Artificial intelligence lung cancer detection was created (Sandoiu, 2019).

Google, Apple, Amazon, and the Zigbee Alliance have formed a new working group to create and encourage the implementation of a new, royalty-free connection standard to improve smart home devices interoperability. They have given a name to this working group which is Connected Home over IP. By establishing a new, open standard for Smart Home Device Connectivity, this working group hopes to make development easier for device makers (Vint Cerf, 2019).

### 2.1.4 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.

#### 2.1.4.1 The Use of Predictive Analysis will Become a Base

Predictive Analysis will be at the top of the leading manufacturing trends of the coming years. It will dominate basic business activities such as procurement, planning, production, sales and financing, supported by artificial intelligence applications. It is a planned process. In institutions that have established a predictive analysis process, there will be an increase in efficiency, productivity, profitability, customer satisfaction rates, and a decrease in error, waste, and time loss rates.

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).

#### 2.1.4.2 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.

Virtual reality is mainly used in computer games and entertainment products. It is expected to be used more frequently and effectively in museums, education, the manufacturing industry, medicine, and architecture. The concept of virtual reality will use augmented reality platforms called Augmented Reality and artificial intelligence applications in technology-heavy branches such as the defense industry, organ, and tissue production, space, and aviation industry.

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).

#### 2.1.4.3 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).

#### 2.1.4.4 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. And also, it is expected that 3D printing technologies, which will reduce the time and costs of prototyping, will increase the product variety in the manufacturing industry. In industries like automotive, aerospace, medicine, etc., almost every business area relies on the AM opportunity to bring new ideas (Attaran, 2017).

### 2.1.5 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).

#### 2.1.5.1 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. In further detail, Nodes in an ANN are like neurons in the human body. Each of these nodes is connected to the rest. Each link or connection is given a numerical weight. Links and their weights are the fundamental building blocks of longer record storage. The network converts data such that one neuron's output becomes another's input connected to it. The weights

determine whether the data transmitted via the link is strengthened or weakened. 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).

#### 2.1.5.2 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.

Machine learning can define as the field that studies how AI machine can learn without being clearly designed. ML is a method of training computers how to manage information better. The goal of machine learning is to extract knowledge from data (Samuel, 1959).

To tackle data problems, ML utilizes a range of processes. Theoretically, data scientists believe that there is no such thing as a single algorithm that can be used to solve every issue. The sort of algorithm that is utilized is decided by the kind of problem that you are attempting to solve. (Mahesh, 2018, p. 381).

The following are the most often used ML algorithms.

#### 2.1.5.3 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).

There are several algorithms for supervised learning, which have been discussed in the following. There is no one optimal learning algorithm for all supervised learning tasks.

***a) Decision Tree (DT)***

Decision Tree (DT) Induction is presently an important supervised learning technique in the ML field. In a decision tree-based technique, C4.5 and C5.0 are the most popular and effective methods. The C4.5 algorithm constructs a tree model by utilizing just one attribute's values at a time. The decision tree induction method, originally developed to solve classification issues, has now been expanded to handle single and multi-dimensional regression. The main advantages of decision trees are i) simple to comprehend, ii) generating overall results, and iii) maintaining a well-organized information structure. DT algorithms are categorization trees that place instances depending on the values of their features. Nodes indicate features of the instance to be classified, while branches represent possible values for nodes. Beginning with the root node, instances are classified and grouped based on the values of their feature attributes. DT are widely applied to categorize data in a variety of computational fields. The flexibility of Decision trees to apply in a broad range of problems are the main reason for its general use in many fields of machine learning. The tree pathways or rules are mutually unique and comprehensive. An intriguing and significant characteristic of a decision tree and its associated collection of rules. Which shows that a single rule applies to every data instance/example record/case/vector (Muhammad & Yan, 2015, p. 947).

Lim (2006) used the C5.0 algorithm to resolve forecasting issues in Supply Chain Management sustainable collaboration. Managers of SCM can evaluate which controls are most suited to organizational contexts.

***b) Navie Bayes***

Another type of supervised learning approach is Bayesian classification. Classification tasks are frequently performed using Bayesian classification. Its primary goal is to solve predictive problems, integrate observed data, and give practical learning algorithms (Nasteski, 2017, p. 58).

The supply chain of producing, processing, and distributing resources is generally a vast, complicated network, and its operation management demands advanced network optimization. Different ML algorithms are being used in SCM; with the help of Naive Bayes algorithms, some of the essential data will be used as features to optimize product availability and warehouse storage in a real-time process (Rothman, 2018).

***c) Support Vector Machine (SVM)***

Support vector machine a new artificial intelligence tool that employs statistical learning theory, effectively applied to various fields. Vapnik and colleagues (1995) presented this algorithm, and it was initially used to solve pattern recognition (classification) problems. SVMs function within the regularization theory framework to minimize an empirical risk in a consistent and well-posed way. SVM is a type of kernel method, a new type of learning algorithm. To achieve maximum generality, flexibility, and performance, use data, optimization, and practical evaluation techniques. In the supply chain, SVR is adequate for anticipating demand. (Sarhani & El Afia, 2014, p. 79).

### 2.1.5.4 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).

#### 2.1.5.5 Semi-Supervised Learning

Semi-supervised learning techniques integrate the benefits of supervised learning methods with the benefits of unsupervised learning approaches. It is the study of how computers and natural systems, like we are human, learn in both labeled and unlabeled input. Semi-supervised learning is popular in data mining and ML because it can enhance supervised learning tasks with easily accessible unlabeled data when labeled data are rare or expensive (Zhu & Goldberg, 2009, p. 9).

The following are examples of semi-supervised learning algorithms:

***a) Transductive SVM***

Transductive support vector machines (TSVM) have frequently addressed partly labeled data. It is used to label the unlabeled data in order to ensure that the margin between labeled and unlabeled data is the maximum (Zhu & Goldberg, 2009, p. 12).

***b) Self-Training***

In self-training, a classifier is trained on a specific subset of labeled data. Unlabeled data is then provided to the classifier. In the training set, the unlabeled points are added to the estimated labels. This procedure is then done many times. The term "self-training" refers to the classifier's ability to learn on its own (Zhu & Goldberg, 2009, p. 15).

#### 2.1.5.6 Reinforcement Learning

The reinforcement learning approach seeks to adopt behaviors that maximize incentive or reduce risk based on observations obtained through interactions with the environment.

Reinforcement learning goes through the following phases to generate intelligent programs (also known as agents):

a) The agent monitors the input state.
b) The decision-making function is utilized to direct the agent's actions.
c) The agent is rewarded or reinforced by the environment after completing the activity.
d) The reward's state-action pair information is saved.

Policy for a particular state in terms of action may be fine-tuned using the stored knowledge, assisting our agent in making the best possible decisions.

Robotics and industrial automation may both benefit from Reinforcement learning. And also, it is being employed in data processing and ML in fields (Mohammed, Khan, & Mohammed Bashier , 2016, p. 11).

#### 2.1.5.7 Deep Learning (DL)

The term "deep learning" refers to a kind of machine learning that utilize artificial neural networks (ANN). It supports computational models made of various type of layers to comprehend several levels of concept for data representations. (DP) utilizes the backpropagation method to show how a computer should change its inner settings to derive each layer's representation from the previous layer's representation, showing precise structure in large data sets.

Some deep learning (DP) algorithms like convolutional neural networks and generative adversarial networks have radically transformed our understanding of data processing. (LeCun, Bengio, & Hinton, 2015).

#### 2.1.5.8 Rough Set Theory

The need for information analysis tools is rising with the growing volume of data and everyone wish to automatically obtain the possible knowledge from the available data. Knowledge discovery (machine learning, data mining, rule extraction etc.) has gotten a great deal of attention in the field of AI in the last 30 years. As a result, several types of information finding strategies arose.

Pawlak suggested a rough set theory in 1982 to synthesize thoughts from data that had been gathered, using a data table that has one or more classification characteristics. These characteristics include indistinguishability relations, equivalence classes, and set approximation. These categorization characteristics are required to develop methods comparable to those used by human beings to classify and recognize objects (Pawlak, 1997, p. 48).

Because of its innovative thought, distinctive approach, and simplicity of use, rough set theory has emerged as a critical data processing tool in intelligent information processing. Additionally, it's often used for tasks such as machine learning, knowledge

extraction, data gathering, and decision support and analysis (Zhang, Xie, & Wang, 2016).

#### 2.1.5.9 Expert System

Expert systems are AI systems that can mimic human intellectual skills including decision making, visual observation, language comprehension, and reasoning about a topic that requires a high degree of human knowledge. (Hadden & Feinstein, 1989).

Expert systems are comprised of the following four components:

**a)** ***Knowledge base:*** is a collection of rules, facts, and information gathered from human experts.

**b)** ***Inference engine:*** is a collection of resolving problem algorithms; we can say that it serves as the expert system's central nervous system that manages to reason, seeking, and conclusion, based on the knowledge base's guidelines.

**c)** ***Justifier/scheduler:*** Explains the reasoning behind an expert's findings, whereas the scheduler is in charge of coordinating and controlling the sequencing rules.

**d)** ***User interface:*** The user interface allows the computer and its operator to communicate and engage with one another by asking a series of queries to the system (Min, 2010, p. 16).

Expert system is recognized for increasing logistic productivity. Allen (1986) used more than 400 rules and algorithms established by various experts to handle various echelon inventory management challenges.

#### 2.1.5.10 Genetic Algorithms

Genetic Algorithms (GA) is the most common and widespread direct search approach for dealing with complicated real-world issues. GA has emerged as a critical optimization technique in past few decades. In the mid-1960s, J. Holland and his associates came up with the concept for GAs. Scientists and academics were attracted by the notion of using natural genetics as a possible problem-solving tool, and GAs quickly became recognized for their resilience in tackling challenging issues that were otherwise difficult to tackle using standard approaches (Jauhar & Pant, 2015).

A genetic algorithm (GA) is a type of evolution program that mimics natural evolution and draws rules from natural selection methods to generate organisms best suited to

their surroundings. Genetic algorithms are frequently used to address combinatorial optimization issues. It is possible to design a function that foresees the efficiency of a sample in relation to a given environment. Genetic algorithm uses mathematical strings known as chromosomes to determine alternative solutions to the problem. Genetic algorithms (GAs) provide solutions that are not absolutely optimal but are very satisfactory in terms of suitability to the optimization problem by continually altering the genetic operators to a population of chromosomes that are suitable for the optimization problem. GAs have been used to solve several complex supply chain network challenges. These challenges are delivery and pickup, minimum spanning tree, vehicle routing, scheduling, etc. GA is also being used to deal with well-known logistics and buying problems: inventory control, pallet loading, facility planning, container loading, material handling, express courier services, supplier selection, etc. (Min, 2010, p. 17).

#### 2.1.5.11 Agent-Based Systems

In a distributed problem-solving approach, Essentially, an agent-based system breaks down a decision issue into specific sub problems and handles those smaller sub-problems with the help of autonomous beings known as agents. To complete tasks, each agent might employ a distinct technique, expertise, and resources. As an independent entity, an agent is capable of doing particular activities to accomplish a collection of goals, as well as competing and cooperating with other agents to achieve those goals.

An agent-based system has frequently been used to solve different supply chain challenges, including shop floor control, logistics planning, aggregate demand planning, forecasting, etc. (Min, 2010, p. 19).

#### 2.1.5.12 Fuzzy logic

The basic definition of fuzzy logic is that it uses expert opinions as an input to characterize "good" and "poor" parts of each variable by comparing them. It compares the input variable to the expert opinion to estimate the likelihood of "goodness" and "badness" levels. Fuzzy logic is often made up of five fundamental elements: (a) linguistic values, (b) linguistic variables, (c) membership functions, (d) fuzzy sets, and (e) fuzzy IF-THEN rules. Objects with uncertainty, imprecision, and inaccuracy can be handled via fuzzy logic. For example, without setting a clear-cut boundary, fuzzy

logic can assist us in determining how hot it is, how much heavy something is, and so on (Min, 2010, p. 18).

### 2.1.6 The Historical Impacts of Technological Development on Employment

Historically, technological advancements have had varying effects on the labor economy. Productivity and career opportunities have increased as a result of technological advances.

The nineteenth century was marked by technological development, which increased the productivity of lower-skilled employees while decreasing the relative productivity of some higher-skilled employees. This type of innovation is known as unskilled-biased technological change. The emergence of mass manufacturing methods that utilized assembly lines with replaceable components and lesser trained employees endangered the jobs of highly skilled artisans who supervised and executed whole manufacturing processes (Autor, Levy, & Murnane, 2003).

Throughout the late twentieth century, technical advancement has tended to take a distinct path. The advent of internet and technology enhanced the relative productivity of higher-skilled workers, indicating that technological development is skill-biased. Routine-intensive jobs based on predictable, readily programmed activities, for instance telephone exchange operators, office assistants, tour agents have been very prone to automation. Some jobs were virtually abolished, while others saw decreased demand (Autor, Levy, & Murnane, 2003).

### 2.1.7 AI Impact on Employment

The impact of technological advancement, particularly digitalization, on labor markets is significant. Evaluating its impact will be critical in formulating policies that promote a competitive labor market for the benefit of workers, organizations, and society.

Technological developments may have a significant impact on employment in two different ways:

**a) *Displacement Effect:*** by directly replacing employees from previously performed jobs.

**b) *Productivity Effect:*** expanding the demand for labor in businesses or creating or growing jobs due to technological advancement (Petropoulos, 2018, p. 119).

The number of high-skilled occupations (managers, engineers, and health professionals) is increasing, whereas machine operators, assembly line workers, and clerks are all losing their middle-skilled jobs. There has been an increase in the number of low-education service employment, such as shop workers, they are difficult to replace with automation. The quality of human capital is equally critical. Individuals' capacity to utilize technology developments for the benefit of their job, requires the development of particular digital competences through well-designed regulations. This underlines the need to employ suitable tools to guarantee that workers are correctly ready to embrace the transformative powers of digital technologies (Petropoulos, 2018, p. 120).

### 2.2 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).

Hokey Min describes the evolution of supply chain management and how it changes focus, philosophy, and performance metrics. During the early 1980s, supply chain philosophy was Product-driven, and in the late 1980s, it was volume-driven. In the early 1990s, supply chain philosophy was market-driven, and in the late 1990s, it was customer-driven, and the critical driver was lead time. When it comes to the early twenty-first century, this philosophy became knowledge driven. This philosophy is customer-driven in the present and future, and here the critical driver is technology (AI, Blockchain, Internet of Things) (Min, 2015). In a nutshell, 1980 was the creation era, the 1990s was integration, and the 2000s was the globalization era ( Movahedi , Lavassani, & Kumar, 2009). In the future and now, this is the time of technology, i.e., AI, IoT, and blockchain (CENTRE, 2018).

Logistics activities and Conventional buying have developed into a more prominent strategic method to materials and distribution management. The supply chain and the businesses that make up it is viewed as a single unit by supply chain management. It

takes practices to manage the various actions required to organize the movement of goods and services to provide the finest possible service to the end consumer (ChoonTan, 2001).

### 2.2.1 Various 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).

#### 2.2.1.1 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. The senior management oversees all strategic choices. Production of products, factory site (which should be simple for carriers to load material and deliver at their specific place), warehouse location, and many other considerations are among them. Strategic supply chain choices are often made for the long term and are extremely expensive to modify on short notice unless necessary (Attadjei, Madhwal, & Panfilov, 2018, p. 159).

#### 2.2.1.2 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).

#### 2.2.1.3 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.

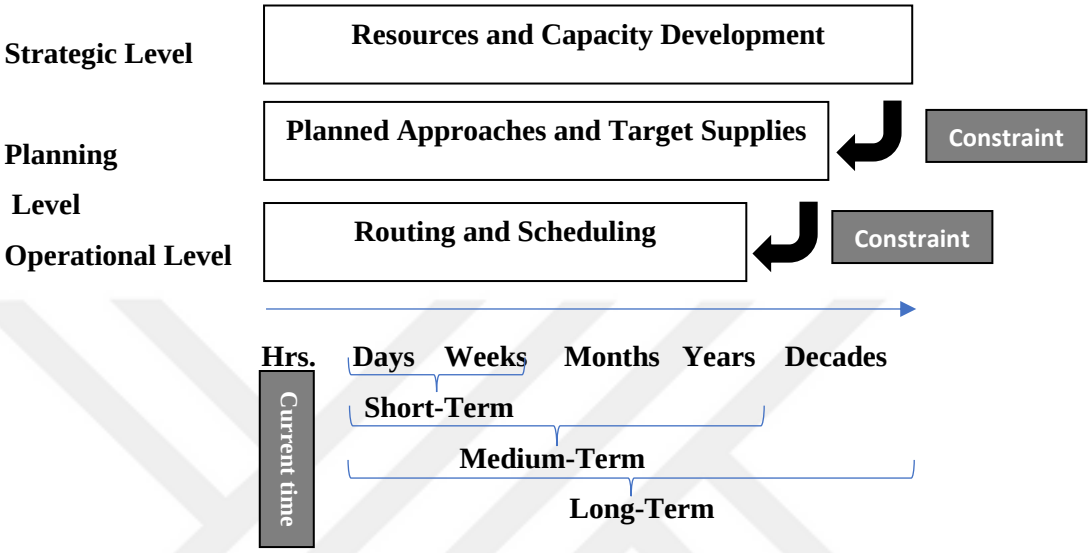


**Figure 2.1:** The Time Frame of Three SCM Decision Levels
**Source:** (Jerbi, et al., 2012, p. 1743).

### 2.2.2 AI Applications in Supply Chain Management

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). There are four critical areas where AI is assisting companies, which are,

**a)** Gain ideal forecasting accuracy, including client demand and projections.

**b)** Maximize productivity while lowering costs and improving quality.

**c)** Providing assistance with marketing activities such as evaluating pricing, demographics, identifying potential consumers, and developing the proper message, among other things.

**d)** 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). AI can modify the connection between clients and logistics suppliers with the help of CRM programs. With the help of AI, intelligent warehouses operations become more cost-effective. The use of genetic algorithms which are developing delivery times and decreasing costs (Min, 2010). Deloitte insight explained how the linear supply chain changed into a more interconnected network with the help of AI. As opposed to the typical linear supply chain, a more dynamic network is being established (Mussomeli, Gish, & Laaper, 2016).

Nearly half of the world's companies will have implemented AI-related technology and re-engineered their supply chains by 2023. The advanced analytics of AI and the Internet of Things (IoT) are regarded as being of significant value. Companies must use these technologies to be competitive in the future (Panetta, 2018).

This section contains a discussion of artificial intelligence applications in a number of supply chain management sectors.

#### 2.2.2.1 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. These variables have a considerable impact on inventory management policies. The analysis and formulation of effective policies necessitate the use of accurate mathematical formulae. 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).

The expert system increased IBM's product production by 35% while saving the company more than $10 million in capital expenditures in the process. (Sullivan & Fordyce, 1990). The expert system's application potential in the supply chain area is infinite by its successful use in geographical mapping, vehicle repair, and maintenance of airline profitability. Furthermore, in terms of computing speed, forecasting accuracy, cost efficiency, and user understanding, at each stage of the supply chain, an expert system might be more advantageous. (Min, 2010, p. 20).

#### 2.2.2.2 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).

#### 2.2.2.3 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).

For collaboration and coordination, the demand for rapid information sharing has grown across faraway locations. An agent-based purchasing system has been proposed by Kim (2002) to automate the online purchase procedure for shoe materials from a worldwide supplier base.

#### 2.2.2.4 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. They enable businesses to streamline their purchasing and product delivery processes, cutting expenses related with transportation, supply chain management, and warehousing. Businesses utilize AI technologies in various ways, including stocking just the exact amounts of specific items sold and eliminating waste. Similarly, they may place additional orders for items that are about to become popular based on accurate sales trends. They do not lose sales due to product unavailability since these demand estimates are precise (Dash, McMurtrey, Rebman, & Kar, 2019).

With a machine learning algorithm, Otto, a German online retailer, cut their inventory by 90%. As the AI projections are accurate, Otto builds inventory in advance of requests, depending entirely on AI without human interaction (Burgess, 2018).

#### 2.2.2.5 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.

Artificial intelligence is used by utility companies to manage their massive systems. Machine learning systems make use of data to assist grid operators in maintaining asset health. Similarly, AI is the optimal solution for enterprises with a high asset base that

need sophisticated systems to operate with little downtime. (Bughin, et al., 2017, p. 26).

#### 2.2.2.6 Order-picking

Order picking includes selecting the products that have been ordered. Order picking, a labor-intensive activity, often accounts for many warehouses operating expenditures since it is the most time-consuming. Considering the critical role that order-picking plays in warehouse operations, warehousing professionals have attempted to create techniques to improve order-picking productivity. Examples of such approaches include the digitalization and subsequent automation of order scheduling and completion. (Frazelle., 2016).

#### 2.2.2.7 Customer Relationship Management (CRM)

It is impossible to build customer loyalty and trust without frequent and consistent engagement and a long-term relationship. Customer relationship management (CRM) is a key necessity for demand creation, which manages SC operations. CRM is described as the process of anticipating customer behavior and determining actions to affect that behavior in a way that benefits the organization, generally via the use of database-related techniques and information technology. Customers are at the core of CRM. It provides the company organization system with a fresh lease on life and improves the business operations. Companies can sell relevant things to the appropriate groups at the appropriate time via suitable distribution channels if they anticipate customer needs in advance. Customer happiness may also be increased with better marketing. Customer categorization and prediction, in which a firm divides its customers into preset categories with identical behavior patterns, is one of the essential aspects of CRM (Hua, 2011).

### 2.2.3 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).

AI is still in its infancy, and it confronts several challenges. The four critical components of AI challenges are implementation of AI technology, Legislation and Regulation Regarding Artificial Intelligence, AI ethic and AI society. (Wirtz, Weyerer , & Geyer, 2018).

In SCM, AI has a bright future. Various artificial intelligence systems will be used to continuously evaluate the efficacy of SC by evaluating billions of bytes of data produced by various objects. These algorithms will predict and recognize risks and take proactive steps to avoid them before becoming a problem. With robust, detailed simulation technologies, the SC will be able to estimate the future with only minor inaccuracies and take disciplinary action if performance does not meet expectations (Calatayud, 2017).

There are already instances of AI decisions being made at various stages in the SCM, such as transportation, in which autonomous cars employing navigation systems determine the most efficient route while interacting with their environment. Apart from transportation, AI technologies will contribute to industrial automation systems that can adapt quickly to real-time demand data and automated logistics systems that can change suppliers based on real-time supply shortages or interruptions (Calatayud, Mangan, & Christopher, 2018).

To better understand the causes of rising demand patterns, businesses may employ artificial intelligence (AI) to take over basic scheduling, decision-making, and management in SC. When adapting to unexpected demand patterns, demand planning is generally inefficient. Deep learning identifies patterns in external signals autonomously and can discriminate between irrelevant and relevant signals. It is capable of fine-tuning demand forecasts via the use of signals. AI developments include weather forecasting, identifying market capacity, identifying important demand driver factors, product quality feedback, and gathering data from manufacturing equipment to improve planning. Batches linked to SC planning and

decision-making processes can be identified using genetic algorithms. These orders are rerouted to avoid supply shortages soon. Using genetic algorithms to identify batches helps identify in-house costs and automate the purchase of alternative capabilities (Monahan & Hu, 2018).

Deep learning research continues to unravel the riddle of the massive amounts of data collected across many sectors. Deep learning was used in picture identification projects for the healthcare industry, and Facebook faces recognition features arrived at this result. In addition, deep learning AI technology is helping the automotive, banking, and data mining industries enhance their operations. Furthermore, the ability to recognize patterns in data to make valuable predictions for the future will drive the worth of deep learning to $10.2 billion by 2025 (Abduljabbar, Dia, Liyanage, & Bagloee, 2019).

In short, In Accenture-insights Thruman, described that Implementing AI technologies in the supply chain are not an easy task. Businesses face a number of obstacles when using artificial intelligence in supply chain operations. These challenges are lack of good useable data, understanding which is an artificial intelligence solution and which is not. The most important is the lack of education and skills essential for humans collaborating with AI technologies (Thurman, 2017).

### 2.3 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).

#### 2.3.1 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. The

term "internetworked e-Work" refers to a collection of collaborative activities that use information technology (Zhong, Levalle, Moghaddam, & Nof, 2015). The following are examples of collaborative efforts.

- 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.

- Businesses are gradually evolving into highly distributed enterprises, which share technology, tasks, and duties to survive and grow (Nof, Morel, Monostori, Molina, & Filip, 2006).

Humans collaborate with machines, and e-Business parties collaborate to develop advantages that would be hard to obtain individually. Certain operations demand collaboration among the entities, whereas others do not require collaboration but might benefit from a collection of collaborative activities that use information technology (Zhong, Levalle, Moghaddam, & Nof, 2015).

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).

Collaboration is standard in business since research shows that encouraging employees to work in groups increases motivation, productivity, and job happiness. When employees work with others, they tend to produce better outcomes and feel more naturally motivated. This proclivity may bring people together to achieve mutual goals and tackle common difficulties (Carr & Walton, 2014). There are no defined measures that describe what practical collaboration looks like or allow for an analysis of a

company's current situation. Worker collaboration surveys are one of the most commonly used strategies (Olguin & Pentland, 2007). Increasing productivity implies achieving more with the same or fewer resources, which directly leads to growth. The productivity of employees is a primary indicator of their value to the firm. (Chew, 1988).

### 2.3.2 Four Phases of AI-Human Collaboration

There are four different phases of interaction between artificial intelligence and humans.

**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 (Norvig, 2017).

**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).

The question here is how each degree of collaboration affects the outcomes produced by the two parties, such as greater productivity and satisfaction.

There are several examples of people working together with technology in the workplace. Robotics is one famous example of such tight collaboration. Collaborative robots are being developed in order to engage with humans in a shared environment. They are primarily used in industrial and manufacturing jobs to help employees achieve their professional objectives. The purpose of Human-machine Collaboration is to enable safe, frictionless, and successful cooperation between people and robots (Sowa, Przegalinska, & Ciechanowski, 2021).

In the physical and intellectual activities of human groups, AI is playing a huge role. According to Malone here, humans and AI should work together. The main impact of AI will be strengthening and harmonizing the skills of a human. This human-AI collaboration establishes super minds that are cleverer than any person or group in our world (Malone, 2018).

Human-AI teaming is the collaboration of people and machines into a team structure that maximizes their individual strengths while compensating for each other's limitations (Madni & Madni, 2018). Effective human teams have accomplished tremendous things in the past, for example, the Apollo moon mission. Some experts, on the other hand, believe that, as artificial intelligence progresses, true organizational change can only be realized via human-machine partnership (Daugherty & Wilson, 2018).

### 2.3.3 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.

#### 2.3.3.1 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. The best way to make a decision is to combine the rationality of machines with people's intuition. Thus, to integrate with AI technologies, human decision-makers must keep their AI knowledge up to date and develop analytical skills (Jarrahi, 2018).

However, this raises the issue of how humans and machines should collaborate in making decisions. Furthermore, it should be studied which choices may be assigned to the computer and made by humans.

According to dr. Saenz and colleagues (2020), before any artificial intelligence system is built, it is necessary to thoroughly investigate the decision-making environment in which AI technology will be used. Two primary characteristics can support this evaluation:

a) Define the limits and sources of variability to determine if the AI system is "closed" or "open." The term "closed system" refers to an AI algorithm that already has a well-defined decision parameter structure. In artificial intelligence, the phrase "open system" refers to a system that is responsible for identifying the internal mechanism of collected data without the need of pre-defined or labeled parameters.

b) The level of risk associated with the AI system's decision-making. Risks might include poor actions that result in bodily harm to people, damage to firm facilities, reputational damage, or financial loss.

In many decision-making and AI design domains, humans and machines can play distinct roles.

#### 2.3.3.2 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.

McDermott (2017) explains that machines must win human confidence as autonomous technology advances and requires continual human supervision. For human-AI teaming to be successful, machine transparency, constant human-AI contact is required in order to identify changes in the surrounding environment. At different levels of technological activity, humans must intervene to change the objectives of the system. Human- AI collaborations will be at their finest and most effective when people can put their confidence in AI technology to support as predicted, in a safe, secure, and easily understandable manner. (Smith, 2019).

According to the suggested design, Human-AI Teaming should be adaptable, which focuses on the AI systems' interaction skills. When designing adaptive human-AI collaboration, it is critical to address factors such as joint performance, work allocation, knowledge exchange, accessibility, consultation, and sustaining human- AI technology teaming activities (Madni & Madni, 2018).

**Table 2.2:** Literature Review Summary of Human-Machine Teaming

| Capabilities | Writers | Concepts |
|---|---|---|
| **Shared Decision Making** | 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. |
| **Transparency** | (Madni & Madni, 2018). | --Understanding of machine learning model mistakes and biases, as well as the capacity to remedy them. |
| **Useful, Functional** | (Smith, 2019) | --In the valid usage situations, the AI solution offers the functionality necessary to suit the expectations of consumers. |
| **Security** | (Smith, 2019) | --The AI system delivers easy-to-understand security measures that are also resilient, legitimate, and dependable. |
| **Interoperability** | (Madni & Madni, 2018). | --Capability of integrating the human-machine team into larger systems. |
| **Learning** | McDermott (2017) (Smith, 2019) | --Human-machine teams are capable of recognizing and responding to unexpected events. -- The AI technologies has the ability to develop itself on a regular basis in order to fulfill human requirements and technological standards. |
| **Controllability, Accountability, Directability,** | (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. |
| **Predictability, Directing Attention, Observability.** | (Smith, 2019)<br>McDermott (2017)<br>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.<br>-- Clear and understandable data is transmitted in a manner that encourages understanding.<br>Give info about the system's statuses or properties, as well as its surroundings.<br>-- Individuals should be able to easily verify what the Artificial intelligence system is doing and why. |

#### 2.3.3.3 Human-Machine Mutual Learning

Both humans and machines assist each other in several ways. There are three crucial roles for humans: training machines, explaining the results, and sustaining the machines to ensure they are working correctly. Machines also assist humans in building up our intellectual strengths; to free us from top-level duties, machines co-operate with clients and workers, and to broaden our natural abilities, machines embody our skills. Human-AI collaboration requires new roles and talent. Employees must have Fusion skills, which empowers workers to work efficiently at human-AI collaboration. Workers should also know about their unique human skills and combine these skills with AI technologies to achieve better results (Daugherty & Wilson, 2018).

Similarly, Seeber (2020) explains another requirement for this teaming or collaboration. In human-AI collaboration, machines should share their learnings with humans. There should be a specific task for both humans and machines in which they are most suitable. This collaboration of humans with machines will bring a need to adapt and change themselves. In the required collaboration competencies for collaborating with AI, Companies should enable this change by training their employees.

### 2.3.4 Latest Studies on AI in SCM – Education and Training in Human and Al Collaboration

Accenture's (2018) research "Missing middle-skills for Human-AI collaboration." This paper provides a solid foundation for this research work and evaluating employees and employers' collaboration with AI. Three dimensions are explained about the application of crucial human education/training and skills to allow human-AI collaboration and competitive advantage.

And the work done by Henk Zijm & Matthias Klumpp (2016). In "Logistics and Supply Chain Management: Developments and Trends," In this paper, the authors described the importance of workers' education/training and skills and qualifications for different works when there would be the implementation of new AI technology. And also provide three different SC models about the education and skills of employees how they changed over time. Significant adjustments will be required in education/training systems in technology implementation that will need to be reevaluated.

#### 2.3.4.1 Education / Training in Supply Chain How It's Changing with AI

The literature study section determines AI's primary idea with potential applications; however, assessing human education/training when partnering with AI in SCM is more complicated.

Henk Zijm & Matthias Klumpp (2016) described three supply chain education/training models. In the future, in supply chain management education and training will become increasingly exciting and crucial to SCM innovation processes. There was a sequential model "A" (Fig. 3.1) in the traditional SCM system about education and training. First, if there is an implementation of new technology, the requirements are explained and defined. Second only, if necessary, then human abilities and required competencies were trained. However, in today's world, this paradigm is no longer valid because of the following:

**a)** The time available for creation and change becomes more limited, there is a little time for the "luxury" of sequential techniques.

**b)** The amount and complexity of training have expanded dramatically.

The current model "B" takes a parallel approach, with deployment and learning experiences providing vital input to future technical advancement. The training process may even start well before initial execution, of any new equipment or software delivered to the service.

Model "C" suggests a future scenario in which the latest AI robot devices have the potential to completely automate the innovation activities by integrating new production and administrative decision-making ideas without the requirement for extensive human training. (Henk Zijm, 2016).

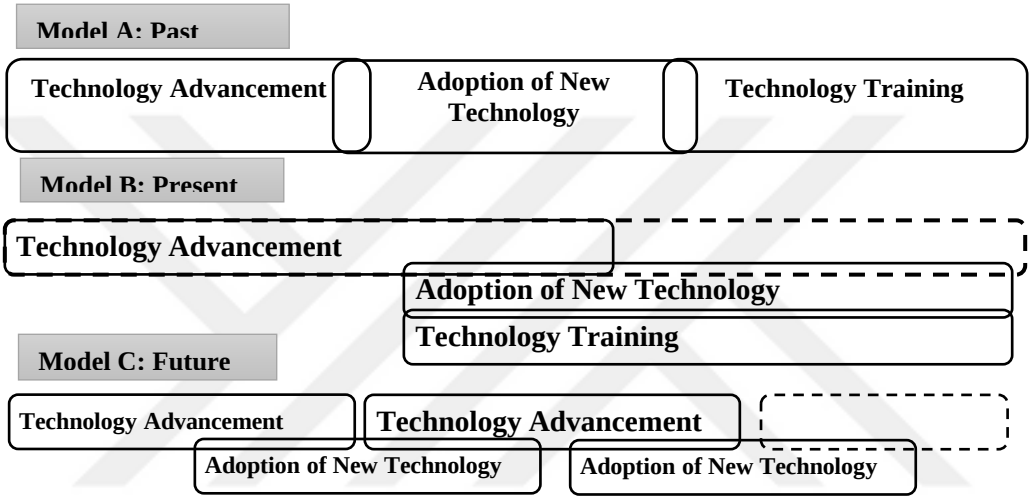


**Figure 2.2: Three Development and Education Regimes**

**Source:** (Henk Zijm, 2016)

Education and training of workers have been discussed in many contexts and defined its importance. But when it comes to its strategic role, the problem was not to explain it. But in the future, these approaches will be rejected because, First, there will be a massive requirement of competence, and there will be a shortage of highly educated and skilled workers in some areas of the world. This will increase the competition of talent in the workforce (Gammelgaard, 2001). Second, the latest trends in AI technologies in SCM are essential, which need high interaction (Manuj, 2011). AI will change most of the jobs in SCM in the future. Thus, the demand for new job qualifications and competition will increase. (Dominik Dellermann, 2019).

### 2.3.4.2 Education / Training and Skills Development for Human AI Collaboration

Businesses are increasingly using artificial intelligence (AI) technologies. According to the Accenture's report (2018), some tasks will be performed solely by people or AI, but most upcoming roles will be performed collaboratively by humans and machines.

Accenture (2018) outlines natural, high-level intelligence vital for growing human/machine collaboration after conducting substantial research on improving human capital. Almost half of the CEOs surveyed by Accenture (2018) recently stated that the widening skills gap is one of the top three factors influencing their employment strategy. Workers and corporate executives have pretty different perspectives on the skills gap. How can businesses and employees establish common ground and work out their differences?

Accenture proposes in its study that workers and employers collaborate in three different ways to accelerate the development and implementation of important human education/training and skills required for human-AI collaboration and to gain a competitive edge.

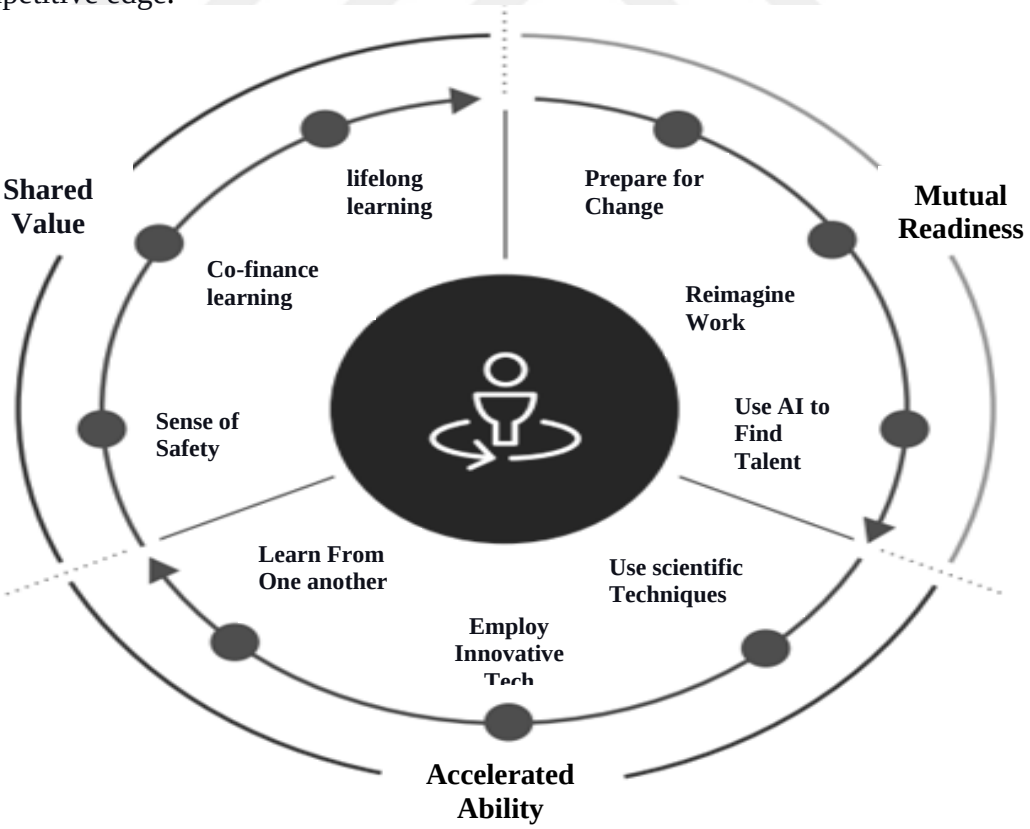


**Figure 2.3: Three Aspects of Developing Skills and Education/Training**

**Source:** (Accenture, 2018, p. 11)

***a) Mutual Readiness***

In which both sides realize they have similar goals for the new employment environment. This readiness may be divided into three phases:

- **Get ready for the possibility of change** - by establishing a long-term plan and speaking with employees openly far in advance.

- **Reimagine work** - Begin by identifying the tasks that will be required, then to solve talent shortages, link existing skills to these before developing new talent.

- **Use AI to find talent**- Artificial intelligence technologies can aid in the identification of latent talents and transferable abilities, allowing you to make the most of your present talent.

Businesses should design long-term investments in worker skill development, while people should begin to adjust their talents for AI. However, this willingness to change is only possible if both the organization and the employee have the opportunity to accomplish their mutual goals in the new workplace (Accenture, 2018, p. 12).

***b) Accelerated Ability***

Make sure that the employees have access to up-to-date materials to help them improve their skills.

- Using scientific approaches to increase learning effectiveness, particularly for experienced professionals.

- Employ innovative technology like virtual reality (VR) to increase immersion, allow individuals to experience real-world scenarios, and cut training costs.

- Employees can learn from one another by encouraging them to build new abilities through mentoring learning (Accenture, 2018, p. 15).

***c) Shared Value***

Establish a culture that places a strong emphasis on education and lifelong learning.

- Recognize individual requirements by allowing time for employees to adjust and prepare for new types of work.

- Co-finance learning to allow individuals to expand their skill development path.

- Drive lifelong learning by measuring performance results, engagement, and integrating skill training with assistance (Accenture, 2018, p. 18).

Existing personnel must be reskilled since there will soon be a severe supply and demand gap. Furthermore, it must be a moral duty to prepare future workers with the broader education system.

# 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. Following the research process and design, data collection has been explained, which contains quantitative and qualitative data collections, and then analysis of these collected data was discussed. In the end, there are survey and interview questions development, and the study validity and reliability of the research are explained.

## 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. The interview with industry-renowned experts in AI and supply chain management, transportation, logistics, e-commerce, digital transformation consultants were conducted using qualitative methodology.

At first, there will be the definition of both quantitative and qualitative methodologies.

### 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. In quantitative research, estimating numbers act as the essential connection between empirical observation and mathematical description of quantitative relationships. Data in quantitative analysis is often selected and analyzed numerically.

Statistics, which are utilized in quantitative research, are an essential subject of mathematics that is commonly employed when:

a) There's no need to evaluate and process vast amounts of quantitative data to validate hypotheses and put theories to the test.

b) There is some ambiguity around the theories under examination.

c) Questionnaires with basic questions and quick answers might be used to conduct research successfully.

d) The gathered data may be quantified and compared (Basias & Pollalis, 2018, p. 92).

### 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; it is based on the researcher's questions. The combination of these two procedures, which several methodologies and concepts have proved, results in greater validity and reliability. (Brannen, 2017).

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.

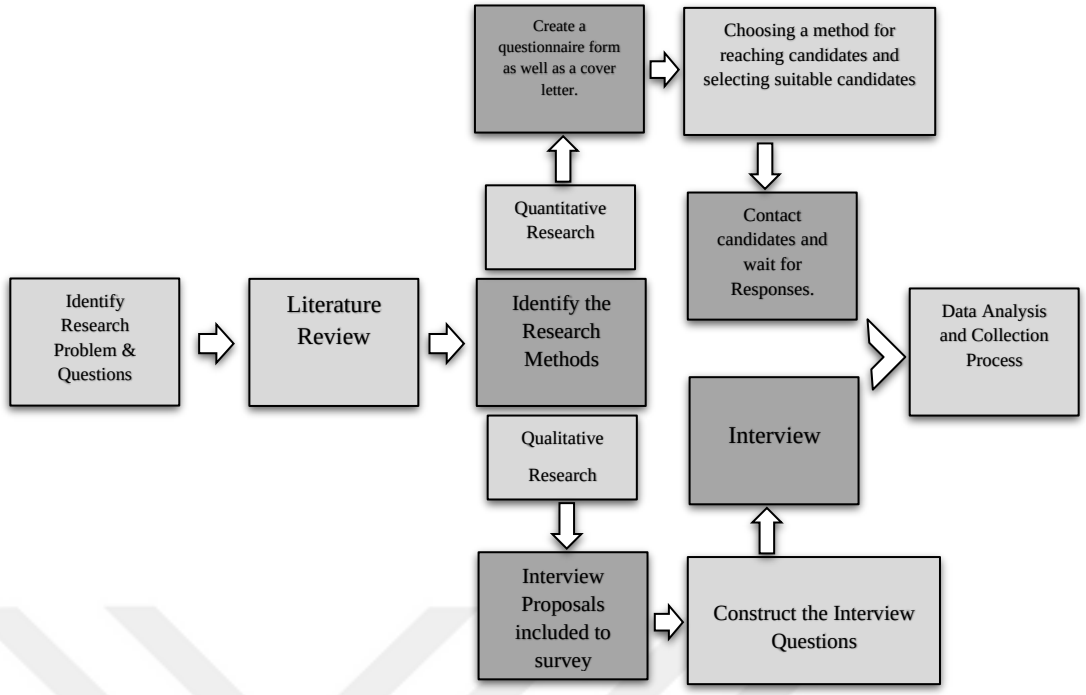


**Figure 3.1: Research Procedure**

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?". The goals may be summarized as follows: discovering and assessing potential artificial intelligence uses in the supply chain and researching the importance of workers' education/training and skills in Human AI collaboration. Particularly in the supply chain field and assisting in understanding how AI technologies change workers' education and skills in organizations and achieve competitive advantage.

The research methodology extracts a quantitative approach to construct a qualitative approach, mixing quantitative and qualitative research procedures. 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.

***Additional information (Human AI Collaboration)***

- AI will add value to managing the supply chain operations?
- Human-AI collaboration requires new roles and talent?
- Do you agree that Human and AI collaboration will boost your company's productivity and competition level?

- Do you agree that the employee's education and training are essential to collaborating with AI technologies?
- Do you agree that the usage of new AI will strengthen and harmonize the skills of your employees?
- New AI technologies are increasing the need for new job qualifications.
- Technological development will cause job losses.
- Technological development will increase job opportunities.
- 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?

The goal of these survey questions is to get an understanding of the present status of artificial intelligence technologies in supply chain management and the importance of education/training and skills in Human AI collaboration.

### 3.4.2 Interview Questions Development

Based on the questionnaire findings, interview questions were developed to understand better the definitions offered in the survey. Short interviews were conducted by phone, face-to-face, or e-mail with industry-renowned experts in supply chain management, Logistics, e-commerce and digital transformation consultants.

***Fundamental Information***

- Name / Surname
- Country
- Company Name
- Years of Experience
- Job Experience

***Information means***

- Do you have any experience with Al?
- What are your thoughts on the impact of AI - powered technologies on the supply chain industry? Share your thoughts

- Have you had any technological projects developed in your company in the recent past?
- What are the most significant developments that will occur in SC in the near future?
- What recommendations would you provide to companies on how to deal with the changes you've mentioned?
- Do your company plans incorporate technical investments? What sort of investments are you considering?
- Where can you see your company at this point in this AI-based automation level?
- Which of the following describes the best your knowledge of artificial intelligence?

AI Novice, AI Ready, AI proficient or AI Advanced

- Can you express the degree of the predisposition of your employees to technological developments as Not Predisposed, Predisposed, very prone?
- What do you think that the technological development will cause job losses or job increase in logistics and transportation sector?

***Additional information (Human AI Collaboration)***

- What are the potential consequences and benefits of the outcome of Human AI Collaboration?
- Do you think that the latest AI technology will boost up your company's productivity and competition level compared to others?
- Do you think that the employee's education and training are essential to collaborating with AI technologies in your company?
- Do you have any education or training program in your company for your employees about New AI technologies used in your company? Would you please explain in a few sentences?
- Do you think expected and required workforce competence levels should increase on average due to increased AI technology development and implementation?
- Do you think that usage of new AI will strengthen and harmonize the skills of your employees?

- 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.
- Do you think that workers must improve and develop both technical and non-technical capabilities?
- Do you think that in human-AI collaboration, human decision-makers must have to keep their AI knowledge up to date and need to develop analytical skills?

### 3.5 Validity and Reliability

#### Validity

Validity comprises the complete experimental idea and determines if the obtained results satisfy all of the standards of the scientific research technique. Internal validity and external validity are the two primary forms. Internal validity regulates the construction of an evidence-based notion and spans all stages of the various scientific study process. On the other hand, external validity is a method for reviewing outcomes and deciding if any more basic connections are possible (Shuttleworth, 2008).

To establish the internal validity of the study, many forms of information channels were used. In addition, respondents' input on the readability and mutual understanding of the questions was acquired. Questionnaires and in-depth interviews were carefully considered. However, the research focuses on obtaining a broad knowledge of AI solutions utilized in SCM, and despite the small data sample, the results successfully answer the research objective.

#### Reliability

Researchers must make judgements on the study's 'accuracy and reliability in terms of the adaptability and applicability of the methodology used, as well as the purity of the derivations, to determine the dependability of study results. Qualitative research is usually chastised for failing to adhere to academic standards due to a lack of explanation for the approach used, failing to give clarity in the analytical operations, and exposing individual beliefs to scholar bias. Accuracy is a challenging characteristic for a new researcher to establish while conducting qualitative research. There is no general agreement on the criteria by which a study should be rated.

To assure the 'reliability' of the research findings, a range of empirical methodologies were applied in this study. To begin, the author's inherent bias was eliminated to achieve precise and persuasive results. The online questionnaire and interviews should have included AI specialists and supply chain professionals, allowing for the evaluation and notation of both parts for improved findings. There were no personal involvements, societal stereotypes, or cultural backgrounds engaged in developing the online questionnaire and interview questions and the analysis of the results. In the questionnaire and brief interview framework, everything was kept detailed and exact. The researcher used the online questionnaire and short interview strategy because he could not apply his implicit prejudice to the responder.

The researcher maintained extensive records of online interviews, including screenshots, voice recordings, and emails received from respondents, and verified that data explanations were consistent and intelligible.

# CHAPTER IV
# FINDINGS FROM THE STUDY

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.

The quantitative data are presented in the form of a clustered column chart and a Likert scale is utilized to quantify attitudes or views. In this scale, the items are listed in increasing order from 'Strongly Disagree" at the far-left end of the scale to 'Strongly Agree' at its opposite end. Participants were then asked to score things on their degree of agreement or likelihood using this scale. The % numbers are displayed in clustered graphs and text. The respondent was asked twenty questions, and the respondent interview answers are shown in appendices.

The interview questions are generated from fundamental data; information means data, and Additional information (Human AI Collaboration). These factors are discussed in the conclusion section, and a clear statement is made.

## 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.

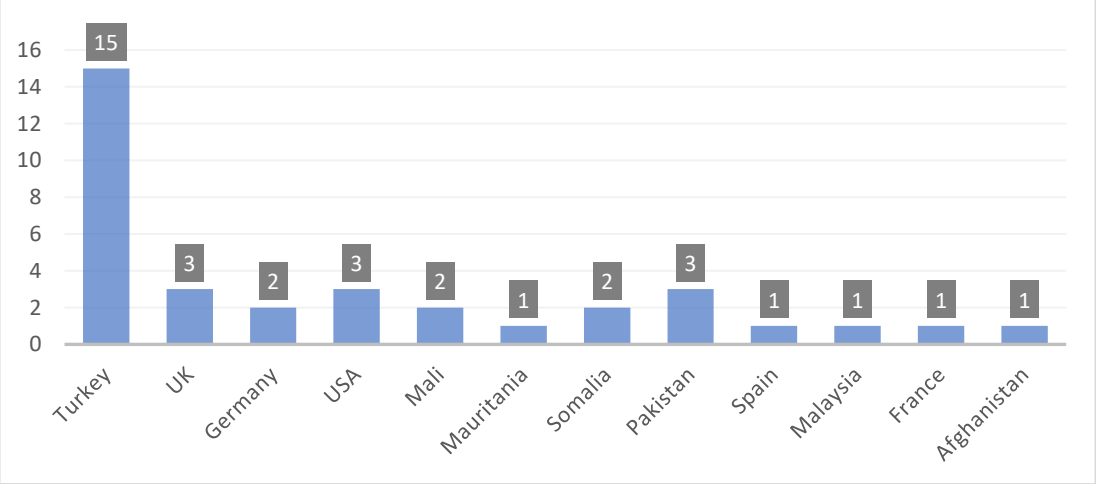


**Figure 4.1:**Respondents Origin

Figure 4.2 shows the origin of the survey participants, majority of the respondents are from Turkey.

**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** | Afghanistan | 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 shows the average and median of the job experience, where average job experience of the participants are 4.3 years, and the median is 4 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 |

(Sozen & Guven, 2019)

**Mean, St deviation and interpretation**

Data collected from respondents from survey question 3 to question 14, included as an appendix 5. The data were examined using mean and standard deviation to determine the level of agreement among AI and SC specialists about AI applications in SC, as well as the importance of education and training in human AI collaboration. Mean, Standard deviation and interpretation are given in table 4.4.

**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** |

**1) Is your organization using artificial intelligence to control the SC?**

The first question attempted to recognize firms that use artificial intelligence technologies in their supply chain management activities. As shown in figure (8), 45.70% of respondents replied "No" they don't use AI in SCM, 42.90% answered

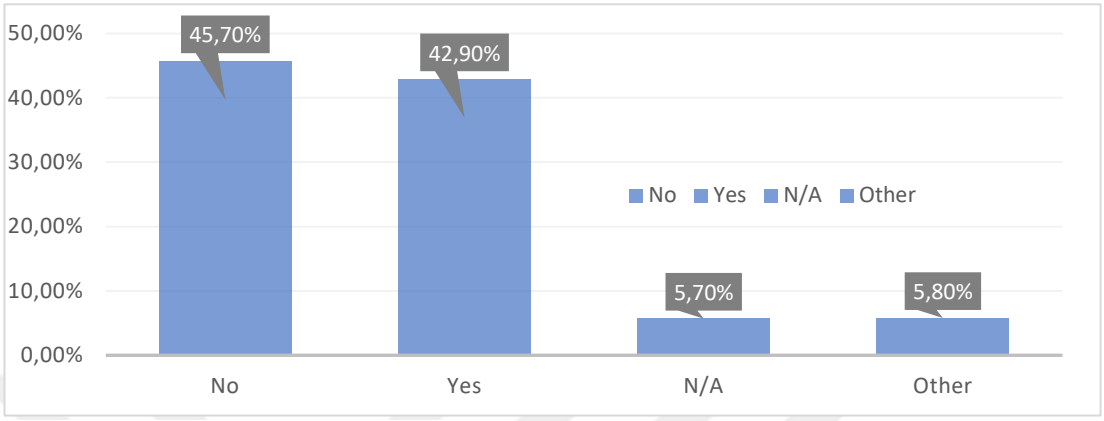


**Figure 4.2: Use of AI in SCM**

"Yes" while 5.7% did not reply, and the remaining 5.80% answered "Others," indicating that AI is used in SCM to some extent.

**2) How likely is it that AI will be used in your SC operations in upcoming five years?**

Question number two, which all respondents were required to answer, seeks to discover firms' desire to create AI solutions over the next five years. We can see that 48,6% answered 'likely,' 14,3% answered 'Extremely Likely,' 22,9% replied in 'Neutral,' those who answered in 'Extremely unlikely' were 8,6%, and the remaining 5,7% of respondents answered 'Unlikely.'

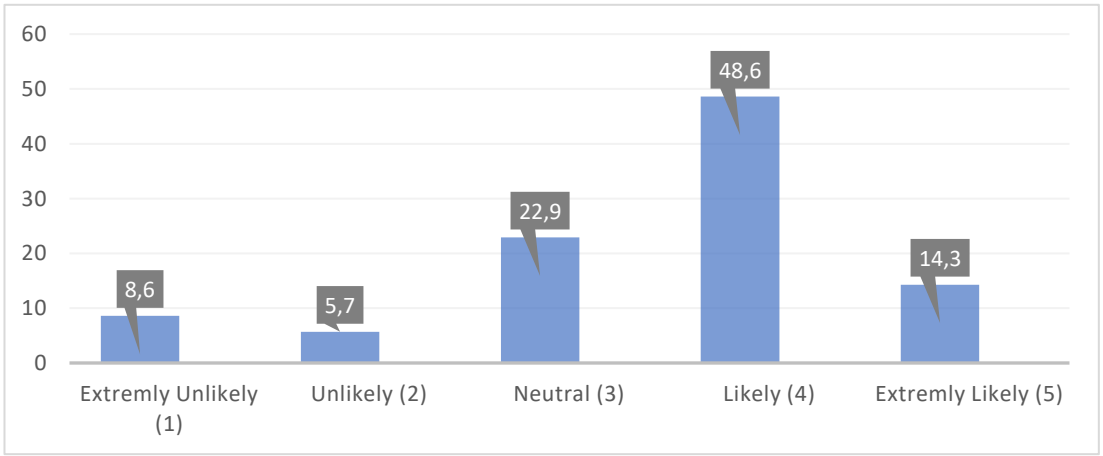


**Figure 4.3: Developing AI in near future.**

### 3) 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'.

The mean is 4.20 and standard deviation is 0.83 as given in table 4.4. The interpretation for this question is ‘Agree’, the SD is less spread out from the mean, thus we accept this question as ‘Agree’.

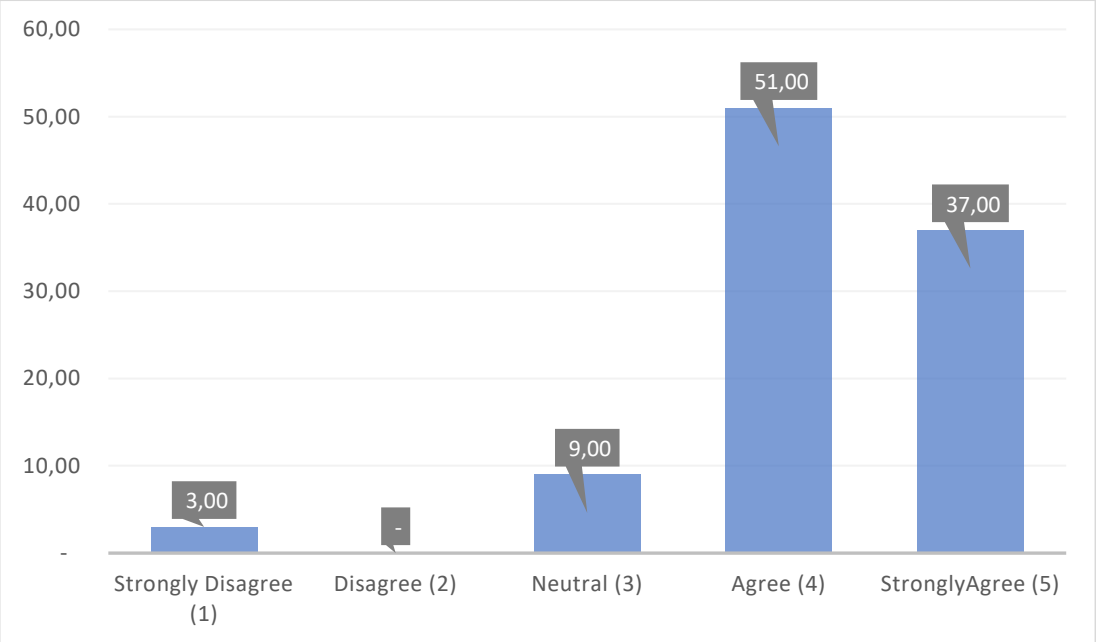


**Figure 4.4: Value Creation of AI for SCM**

**4) 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.

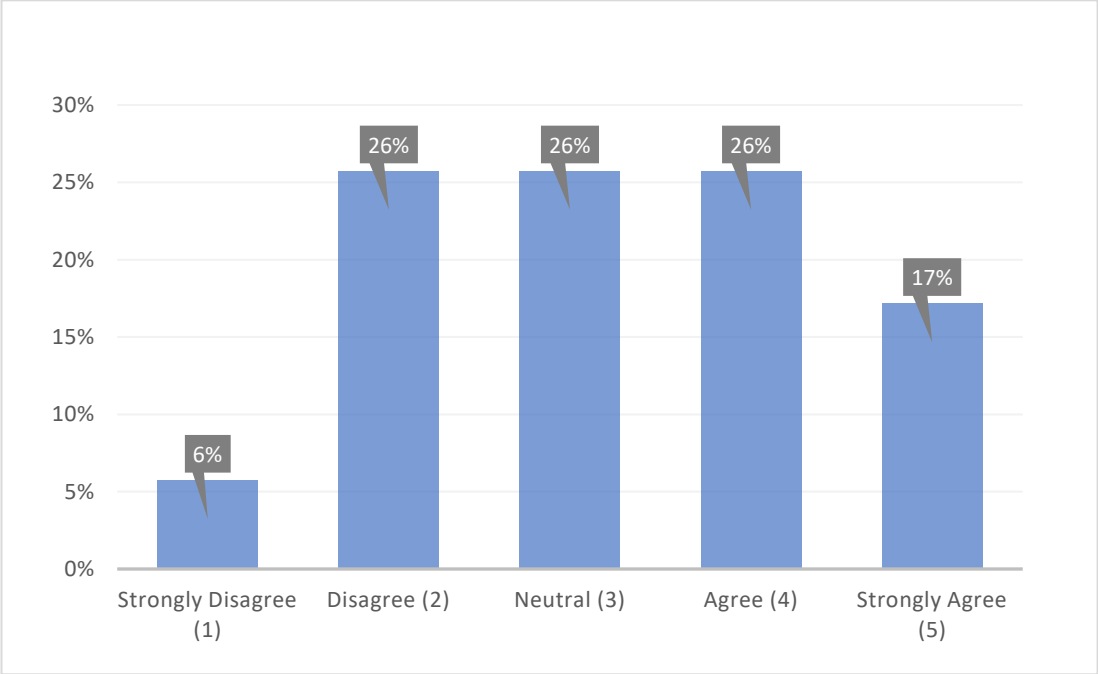


**Figure 4.5: AI will cause Job Losses**

**5) 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 ‘Neutral’. According to the range given in 'table 4.3,' the mean is between 2,70-3,40, indicating that the answer to this question is 'Neutral,' and the SD also suggests that the data are further spread out from the mean.

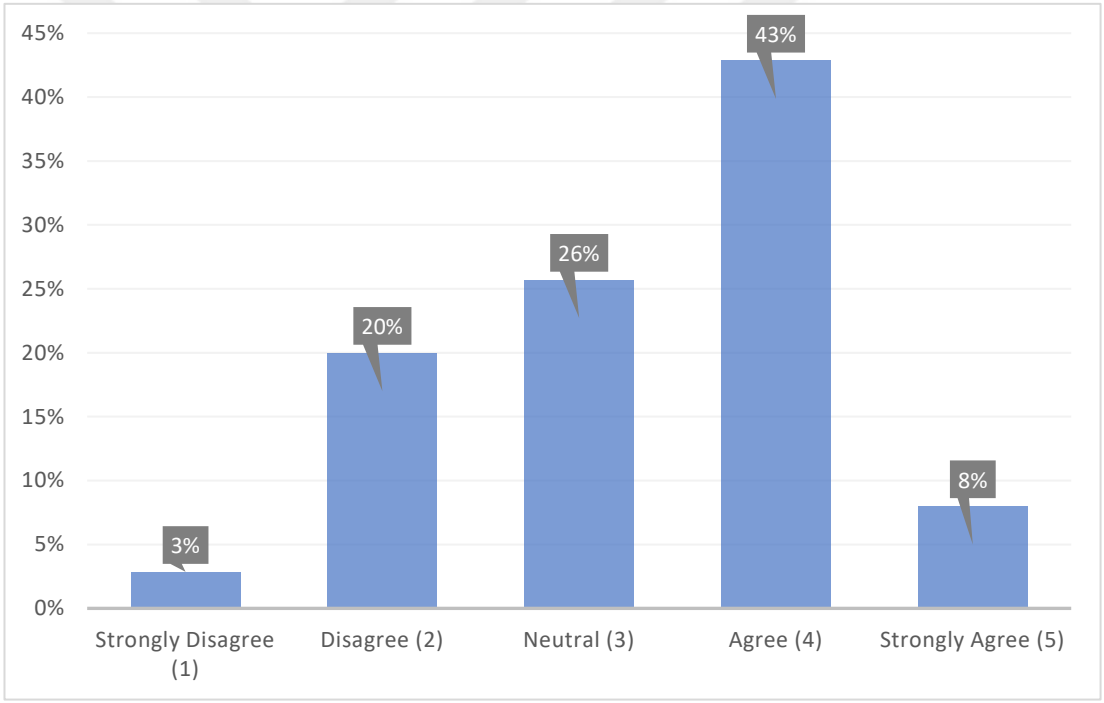


**Figure 4.6: AI Job opportunities**

**6) 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.

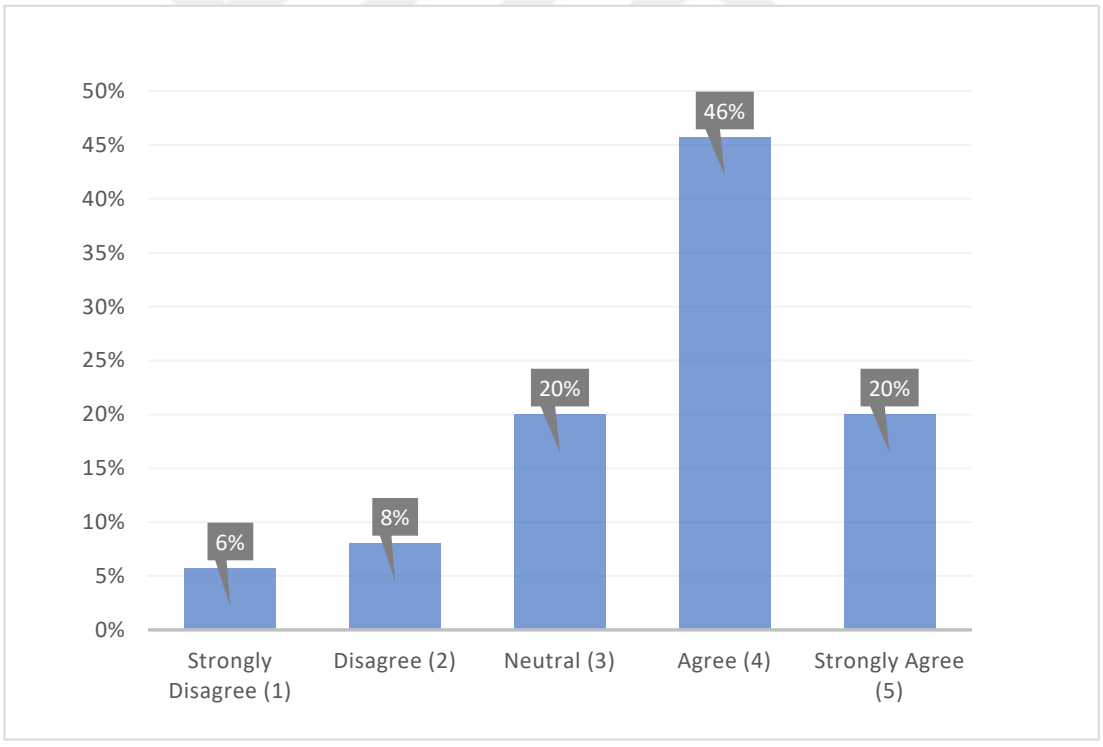


**Figure 4.7: AI will Cause new job Qualifications in SCM**

**7) 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 sore 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.

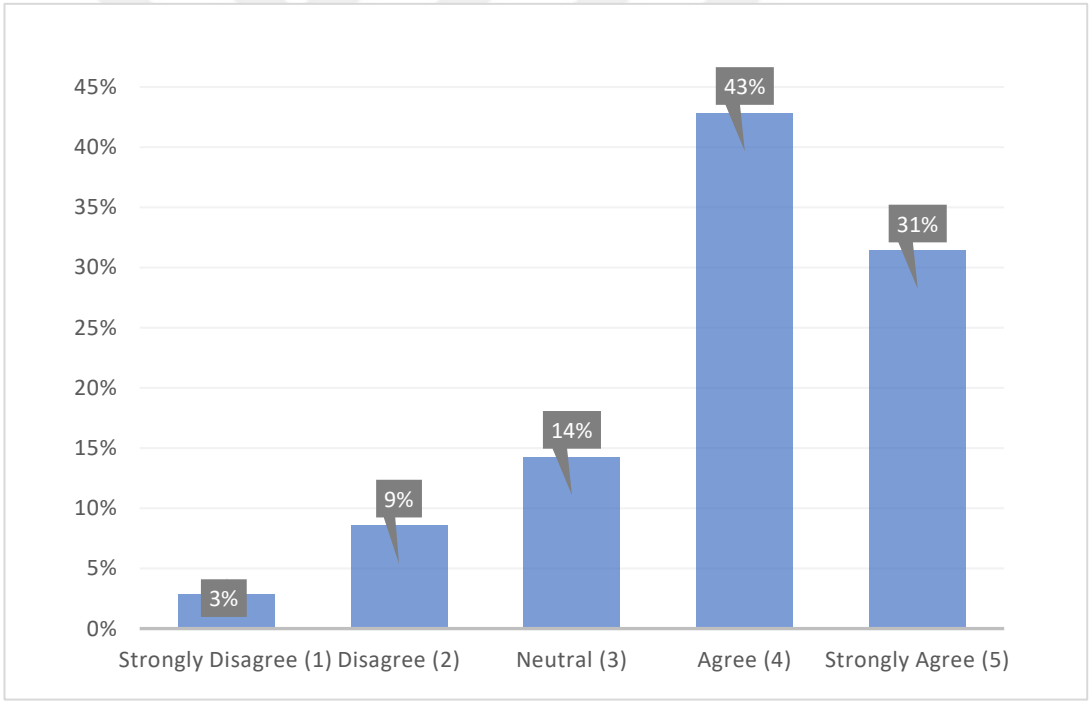


**Figure 4.8: Workers technical and Non-Technical Capabilities**

**8) 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.

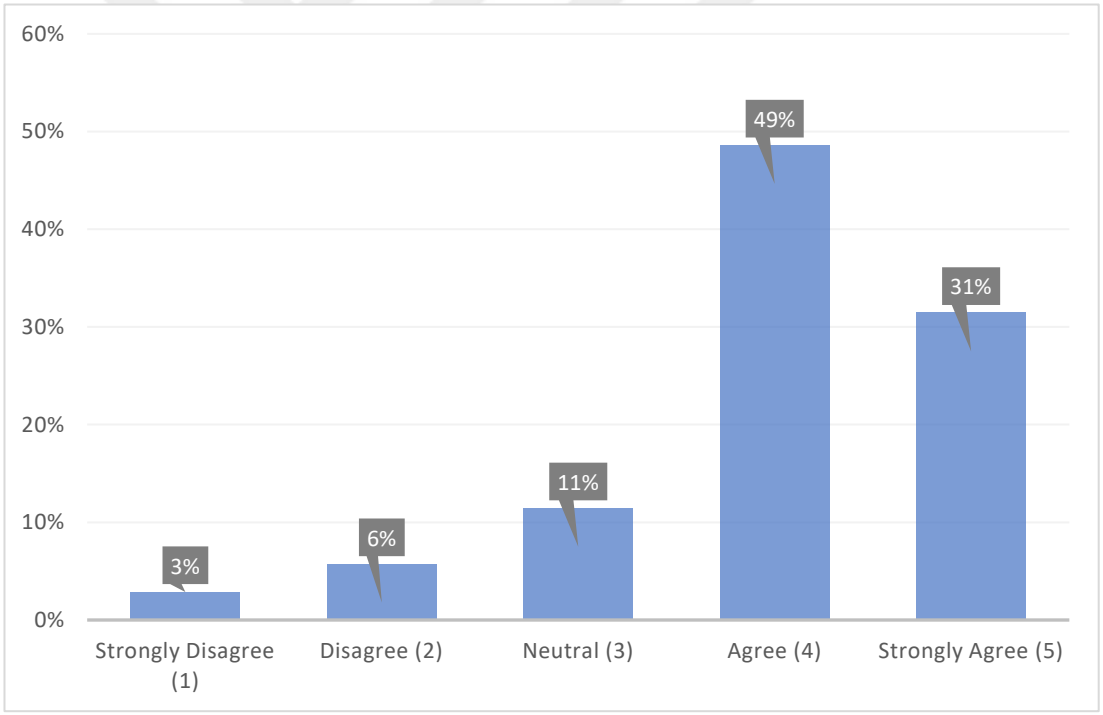


**Figure 4.9: New Roles and talents in Human- AI Collaboration**

**9) 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.

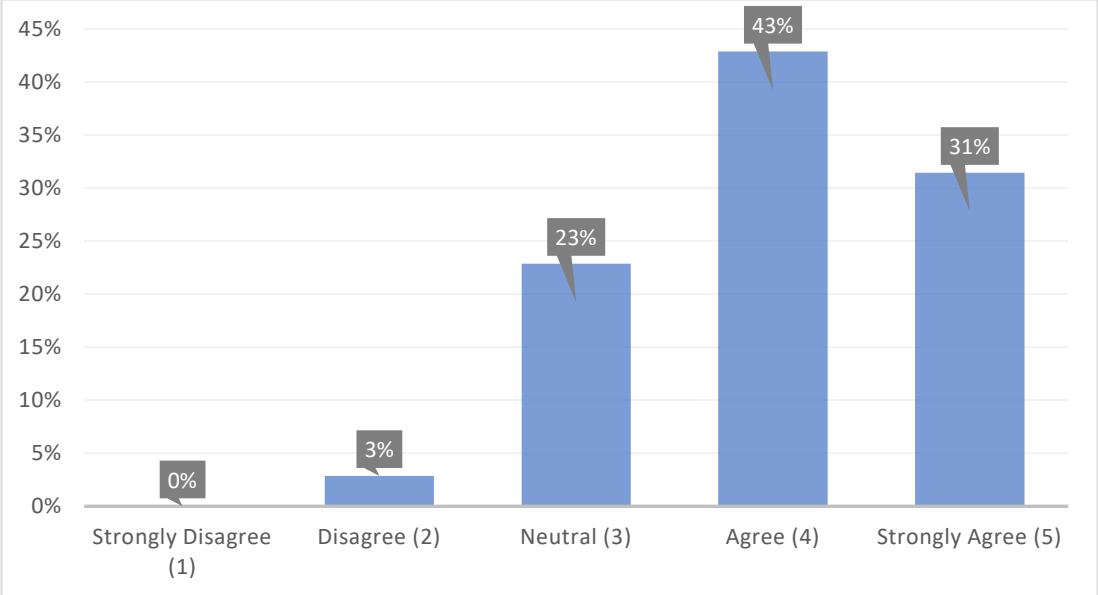


**Figure 4.10: Productivity and Competitive level of Companies in Human-AI Collaboration**

**10) 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.'

The mean score is 4,09 and standard deviation is 0,89 as given in table 4.4. the standard deviation is low which shows that data are spread nearly around the mean.

The mean 4,09 lies between the range 3,50-4,20 as given in table 4.3, which shows that the majority of respondent agree that the employee's education and training is important to collaborate with AI technologies.

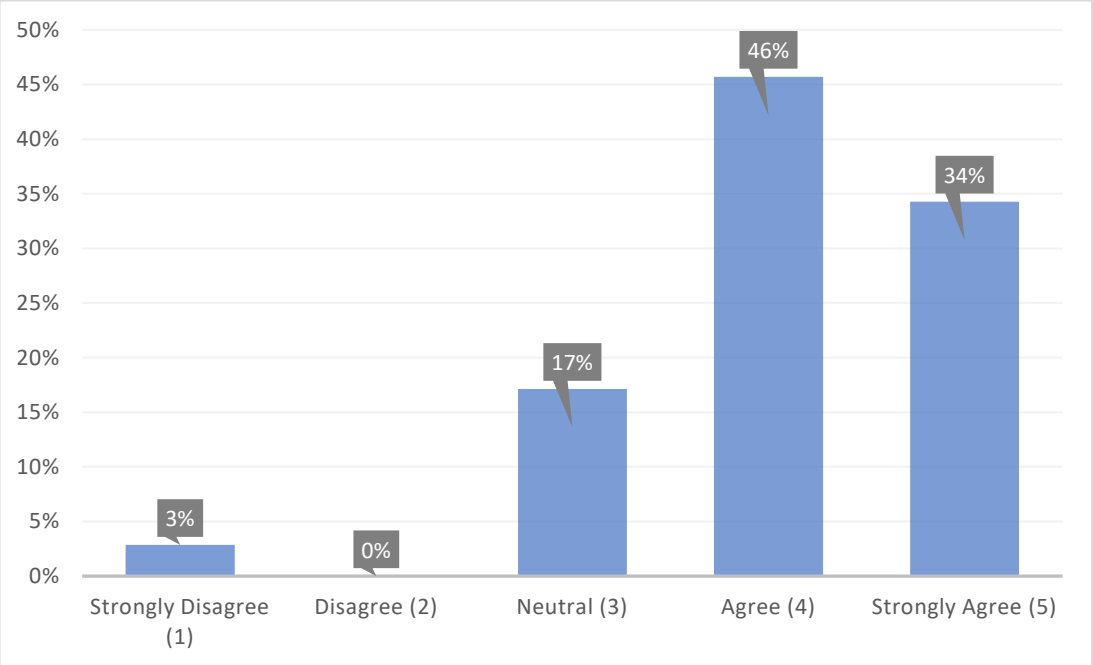


**Figure 4.11: Employee's Education and Training in Human-AI Collaboration**

**11) 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.

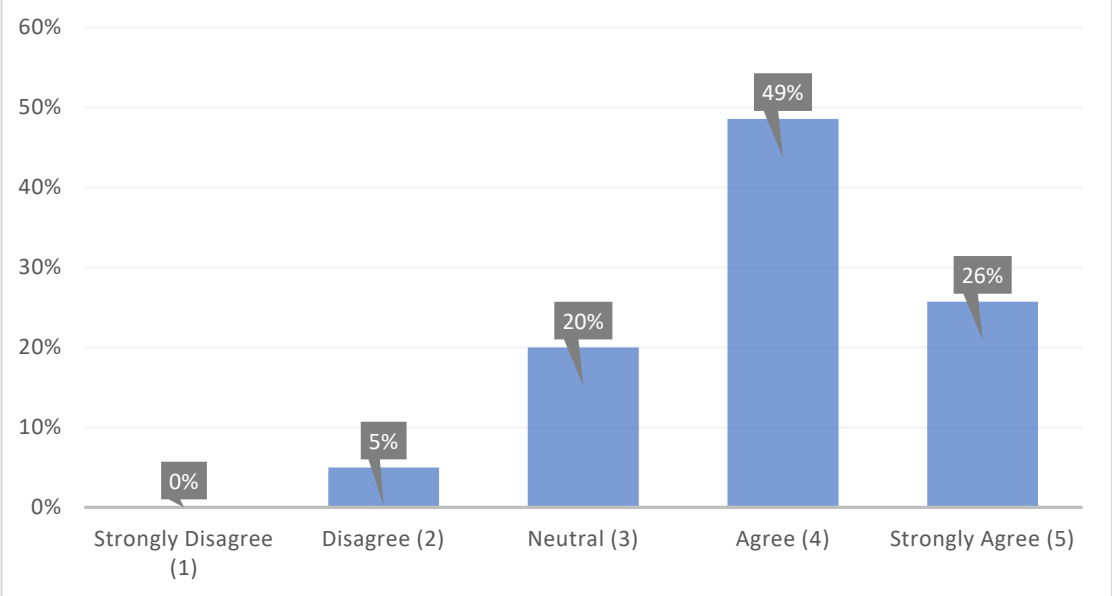


**Figure 4.12: Human-AI collaboration & Longer Education and Training Programs**

**12) 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.

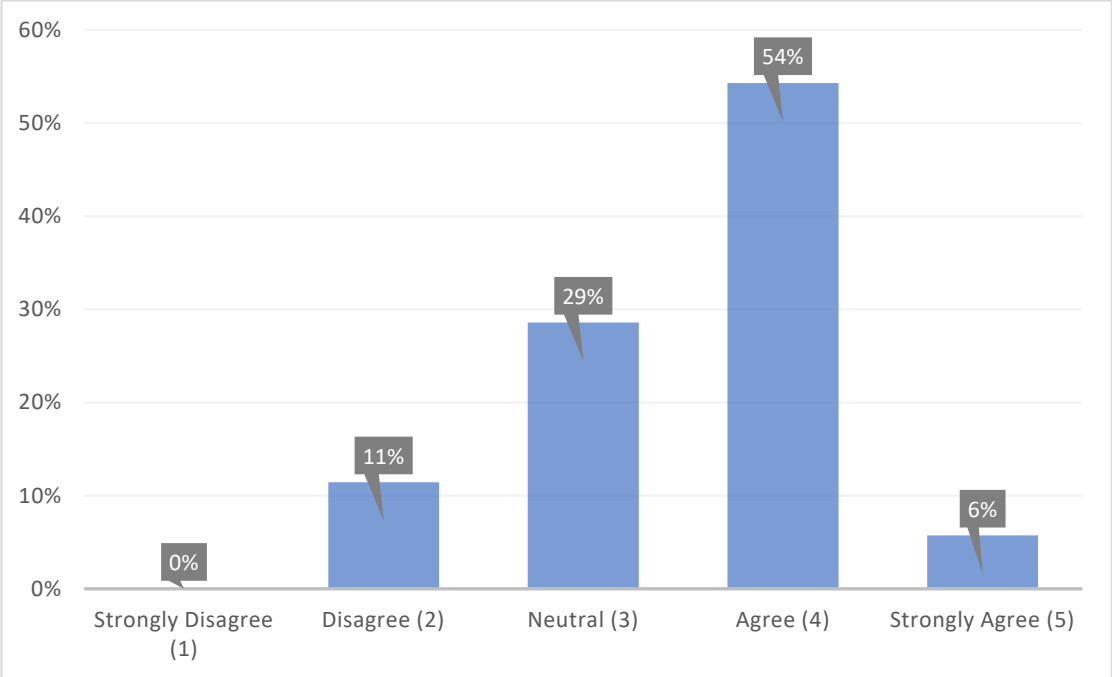


**Figure 4.13: AI will strengthen and harmonize workers skills**

**13) 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.

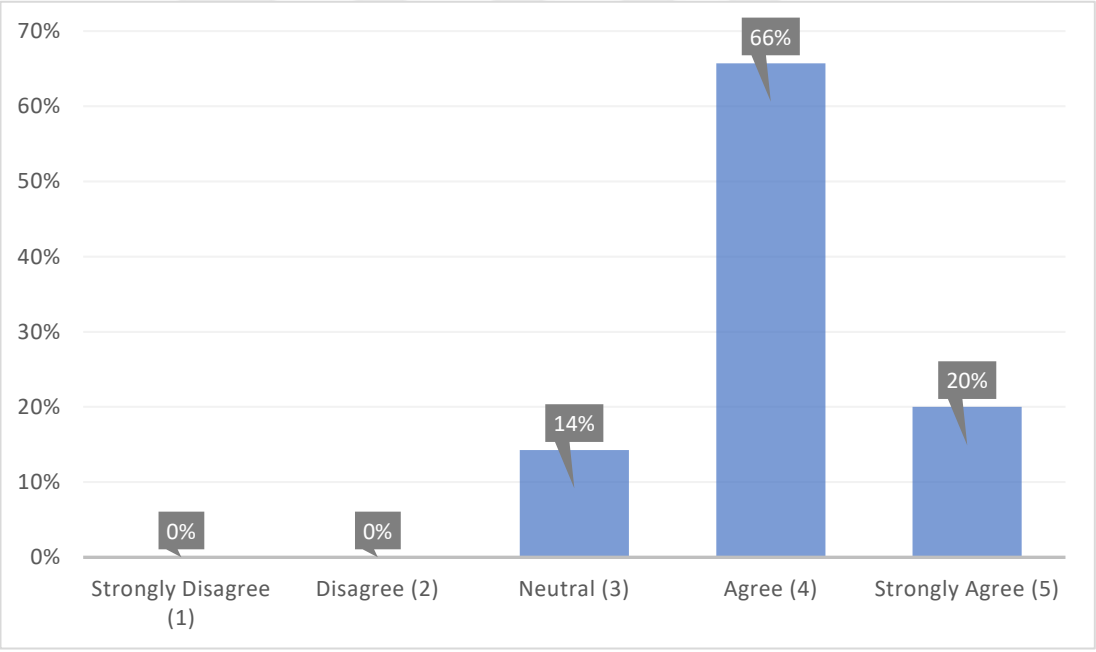


**Figure 4.14: Development of analytical skills of Decision Makers**

**14) 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.

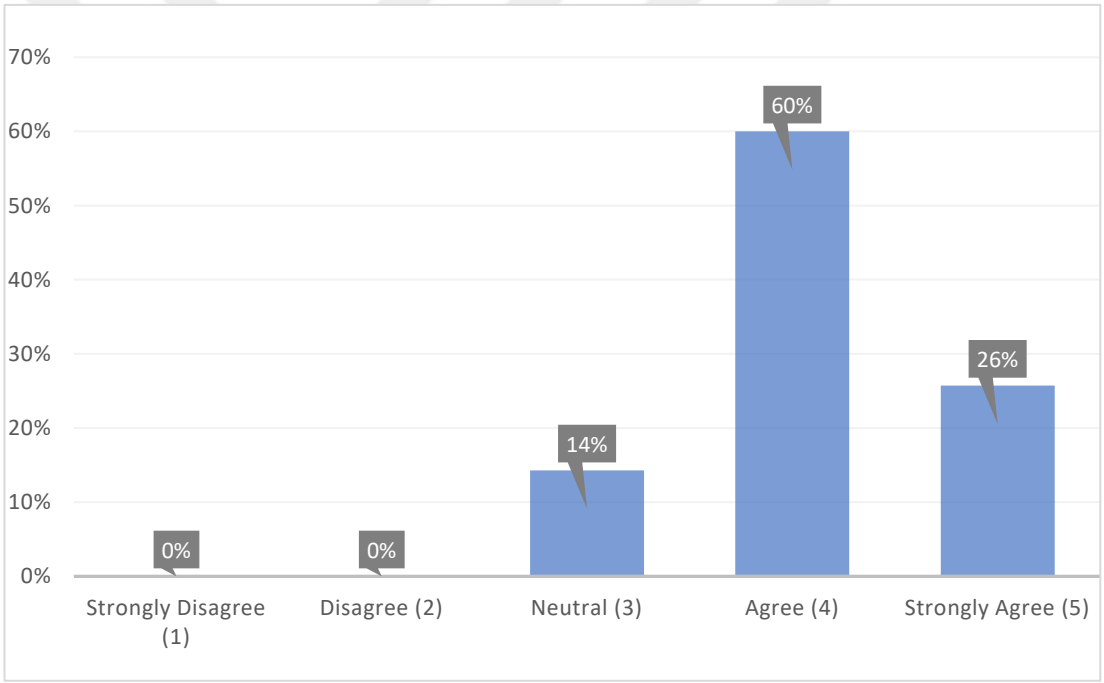


**Figure 4.15: Specific Tasks for human and machine**

### 4.2 Interview Answers: Qualitative Findings

Short phone interviews, in-person meetings, or e-mail interviews were conducted with industry-renowned experts in supply chain management, transportation, logistics, e-commerce, digital transformation consultants. There were 21 questions in total, composed of fundamental information about the participants, their experience, their info about AI applications in supply chain and additional info about human-AI collaboration requirements. The interview form is presented as an appendix 6.

In appendix 7. the background information of the respondents is supplied in order to demonstrate the job description of eight interviewed executives. It was selected to feature a variety of executives from various businesses to understand better the significance of education and training in Human-AI collaboration. Additionally, it was necessary to gain an accurate evaluation of the influence of artificial intelligence technologies in supply chain management. The executives were picked based on their previous work experience.

**Interview questions and answers**

All the questions and answers received from the interviewees are presented as an appendix 8. In this section, there are only evaluations, and the findings are discussed.

**1) What are the most significant developments that will occur in SC in the near future?**

According to the information gathered via short interview about the changes that will occur in the supply chain in the future, most experts believe that the SCM will see tremendous changes in the future. AI, in particular, will have a major impact on SCM. AI is simply a system that never tires or becomes bored. It can operate continuously delivering the same standard of achievement and reliability. This increases company efficiency and makes the industry work more smoothly and successfully. There are also less risks of mistake when an AI machine does the task. There will be increase in customer satisfaction with strengthening optimization because of relative shortening of the time of buying products. The quantity in the workforce will decrease and the quality of services and products will increase at the same time.

**2) What recommendations would you provide to companies on how to deal with the changes you've mentioned?**

It is clear that all managers agree and believe that the advancement of technology is inextricably linked to the future of SCM. It is critical for SC managers to see the value of adopting Artificial intelligence technology into their operations rather than being scared by it. To ensure the long-term viability of the supply chain, digitization is an unavoidable need. Experts think that efficient digitalization may improve the efficiency, mobility, and dynamicity of your whole supply chain.

Because of personalization, segment-based adjustments to SC operations should be implemented to meet the demands of consumers.

**3) Do you have any experience with Al?**

This question aimed to get knowledge about the understanding of the managers about the AI. All of the respondents replied 'Yes' and they have excellent and deep knowledge about AI and its applications in different areas of the supply chain. According to the interviewees, AI is being used to provide computer vision solutions, there are various AI applications in logistics that help businesses optimize best routes. Furthermore, these apps aid in determining the most efficient route for logistics vehicles, there are AI chatbots and CRM programs etc.

**4) What are your thoughts on the impact of AI - powered technologies on the supply chain industry? Share your thoughts?**

This question about *"about the effects of Artificial Intelligence applications on logistics, transportation, and supply chain industry?"* was asked to managers to get knowledge about the impact of Artificial intelligence (AI) in the area of supply chain (SC). Only one manager discussed that there could be adverse effects, but he also stated that AI would significantly impact the supply chain. Thus, according to all respondents, the impact of AI is marvelous; AI applications are decreasing the workload of people in many fields of the supply chain. Numerous difficult operations have been mechanized. There is no requirement for human assistance in carrying out such activities. Artificial intelligence has the capability of collecting massive volumes of data. This is critical for the productivity and success of organizations. Getting data into the right hands takes time and effort, as does successfully implementing it. AI computers are capable of crawling gathered material fast and recognizing patterns that

humans are incapable of recognizing. As a result of this productivity and sales of companies are increasing which increase the profit. Automated transportation is not only decreasing operation costs but also increasing accuracy. AI applications are helping us in cost efficiency; in time efficiency, there will be fewer errors during production and delivery processes, and it's going to create much faster and more rapid delivery times. For example, in transportation. If we had autonomous trucks and trains, there would be fewer crashes. AI assists in forecasting future demand by evaluating consumption patterns on the website and predicting inventory requirements. This improves efficiency lowers expenses and boosts corporate performance.

**5) Have you had any technological projects developed in your company in the recent past?**

This question about the "technological projects developed companies in the recent past?" was targeted to know how likely companies are using AI technologies. The answer showed us that all companies used AI technologies in different business operations, such as forecasting, building relations with customers, collecting massive data, optimization, project management, etc. One thing observed here is that larger companies are investing a tremendous amount of money in AI, and as compared to other small companies, these large companies are using AI technologies all most in every area of their businesses.

6) **Where can you see your company at this point in this AI-based automation level figure? (Figure 5.1 given as an appendix)**

The sixth question was about the *"AI-based automation level, where companies see themselves in figure 5.1."* the majority of respondents selected *"Human led, and machine supported,"* which means in these companies using a set of tools, a human conducts analysis and generates insights. When it comes to a decision-making Human makes decisions based on optimized machine suggestions.

Two of the respondents selected *"Machine led, and Human governed,"* one of these two companies also selected *"Human led, and machine supported,"* this is a multinational company. We can see that in *"Machine led, and Human governed,"* machines make analysis and produce insight without human opinion, and the machine makes decisions with a framework of human governance. It shows us that

huge companies are far ahead of other small ones utilizing AI technologies and spending millions every year.

**7) Which of the following describes the best your knowledge of artificial intelligence?**

**AI Novice, AI Ready, AI proficient or AI Advanced**

Out of eight, six respondents selected "AI-ready," and only two selected "AI advanced" from 'figure B.' which means that these companies which selected "AI-ready" have a fundamental understanding of artificial intelligence, not proficient. And two companies that selected "AI advanced" have expertise and experience in AI. Thus, it shows us the level of AI applications maturity in different businesses.

**8) Do your company plans incorporate technical investments? What sort of investments are you considering?**

All of the respondents answered positively to this question; all of them are willing to invest in technology in the future in different areas of SC, such as employees' education, R&D, digitalization products, optimized procurement, and inventory. Some of these companies arrange annual budgets for technological investments, and they already have ongoing AI projects. Two big companies invest vast amounts of money, and technology is the crucial factor of success in the future and has a competitive advantage.

**9) What are the potential consequences and benefits of the outcome of Human AI Collaboration?**

According to our respondents, Human-AI collaboration will have more benefits than consequences. All managers replied that human-artificial intelligence collaboration would rise the productivity and efficiency in the company; as a result, it will increase sales and profit, there will be smooth operations without human error, reduced time, and most importantly, AI will augment human talents. About the consequences, almost all managers think that there can be some direct job losses in some areas, and AI will make humans lazier.

**10) Do you think that latest AI technology will boost up the productivity and competition level of your company as compared to others?**

Our respondents gave almost similar answers to this question. All of them think that AI will increase the productivity and competitive level of companies. AI applications will decrease the costs, predict the future, accuracy will increase, and workers will work more productively and efficiently; thus, productivity of the company will also increase. But when it comes to the competitive level of the company, according to the experts, companies should only not invest in technologies, but they should know that what are technologies that can increase their productivity and competence level. Companies should research their competitors, what kind of technologies they are using, how much they are spending on technologies, etc., companies should know how they can get full use of any technological development, and education and training of employees are essential.

**11) Can you express the degree of predisposition of your employees to technological developments as Not Predisposed, Predisposed, very prone?**

The major aim of this question was to know about the degree of the predisposition of employees to technological developments; out of eight respondents, five answered "predisposed," two answered that their employees are "very prone," and only one answered that their employees are "not predisposed." This shows that the degree of the predisposition of employees to technological developments is mainly "predisposed." And this degree of predisposition is more significant in large multinational companies**.**

**12) Do you think that the employee's education and training is important to collaborate with AI technologies in your company?**

This was an essential question about the "*importance of education/training and skills of employees when collaborating with AI*," all the respondents answered that education training/training and skills of workers are essential. Employees should learn from each other in their workplace and prepare for the changes. Companies should help employees to get their interested education and training by giving them bonuses etc. It's important for both company and employees to be ready for the new reality, and there should be lifelong learning.

**13) Do you have any education or training program in your company for your employees about new AI technologies used in you company? Please explain in few sentences.**

This question was about "*if there is any ongoing education or training program for employees about new AI technologies,"* Except for one respondent, all others answered that they have ongoing education and training programs for their workers. One manager answered they don't have it because they think they don't need it now. Some managers answered that there is lifelong learning, and they arrange their education and training program so that employees can get the required education and training according to their need of jobs. Employees are always informed in advance which tasks should be done first, and according to that, they should get education and training. Some managers answered that their education and training program is on-spot, where employees can learn from each other. One manager answered that also answered that they use AI tools to educate their workers.

**14) Do you think that expected and required workforce competence level should increase on average due to increased AI technology development and implementation?**

This question was about the "competence level of the workforce if it will increase or decrease with AI developments. Most managers answered that it would increase, and employees need to work hard to increase their competence level by developing their skills. According to one manager, it will not affect the competence level if employees have already theoretical background; they need to keep themselves up to date with the latest AI developments. One manager replied that there would be neither an increase nor decrease in incompetence level, but employees can have a shift incompetence level.

**15) Do you think that usage of new AI will strengthen and harmonize the skills of your employees?**

The question *"if AI will strengthen and harmonize the skills of employees or not"* was asked to managers; all of them answered they agree that new AI technologies will strengthen and harmonize employees' skills. One manager answered that it would also decrease the unproficiency gap among employees, as employees' skills will strengthen

and harmonize. AI developments will have a favorable influence on the efficiency of employees, which will result in a rise in profitability and efficiency for the firm.

**16) What do you think that the technological development will cause job losses or job increase in logistics and transportation sector?**

This question aimed to know about the "job losses or job opportunities with the development of new AI technologies." All of the managers answered almost in the same way; they think there will be both job losses and job opportunities. For example, in the logistic sector, a manual human or physical job like lifting heaving objects was already vanished by AI technologies. Some other jobs like retail salesperson, Receptionists, Couriers, etc. they will also be replaced by AI technologies. On the other side, there will be new job areas that arise by developing AI technologies. AI will affect the characteristics of job in a wide variety of different occupations, enabling people to concentrate on higher-value activities that frequently need human engagement. These newly improved employment will help both firms and people by providing more time for creativity, leadership skills, and entrepreneurship.

**17) Do you agree that your company will have competitive advantage as compared to others by giving your employees longer education and training about latest Ai technologies?**

This question is the central question of this research work; it's about "if workers longer education and training programs about new AI technologies will increase the competitive advantage or not," Interestingly all of our respondents answered that its important, but the most important thing is not the longer duration of education but lifelong education and training programs. Businesses must acknowledge and appreciate education and lifelong learning, which includes allowing employees time to adapt and expand their talents. Employees, for their part, must commit effort and time to understand new methods of working. Employees need to learn different skills and information regularly. Companies must begin by determining the tasks that must be completed. This adaptability is only possible if both the organization and the employee can accomplish their mutual goals in the new workplace. Thus, there should be mutual readiness. These companies must be aware of the markets and what kind of technologies competitors are using, but they must also analyze these things to have a competitive advantage.

**18) Do you think that new AI technologies will increase the need of new job qualifications? Explain in few sentences.**

We asked managers, "if new AI technologies will increase the need for new job opportunities," they all agreed that there would be a need for new job qualifications with the advancement of new Ai technologies. AI developments will produce new job areas which will need new job qualifications. Emerging AI technologies will raise the demand for new employment skills. Through the tools they use or by automating certain regular jobs, artificial intelligence has begun to dramatically impact the way people work and progressively transform employees into 'enhanced employees.' Creative work qualities will emerge in the field of analyzing critical data and creating scenarios.

**19) Do you think that workers must improve and develop both technical and non-technical capabilities?**

Out of eight managers, only one answered that it's not essential for workers to improve and develop both technical and non-technical capabilities. Because there can be different jobs for the technical employee that a non-technical employee cannot do. Seven managers answered that technical and non-technical both are important for workers to improve. In human-AI collaboration, non-technical workers must understand some basic technical tasks such as operating a machine and getting the best outcome.

**20) Do you think that in human AI collaboration, human decision makers must have to keep their AI knowledge up to date and need to develop analytical skills?**

Except one, all other managers agree that human decision-making must keep their AI knowledge up to date and develop their analytical skills. According to one manager, AI developments can be a more social and human role in that collaboration will be only controlling while machines will take all decisions. At the same time, other remaining managers stated that human decision-makers continuously update their AI knowledge to observe the process and make future predictions and direct machines.

**Table 4.5:** Research Findings Comparison Chart

| **Phases** | | **Abdullah,** | **Batuhan** | **Buğra** | **Emirhan** | **Habib** | **Esztr** | **Ayub** | **Abdul** |
|---|---|---|---|---|---|---|---|---|---|
| **Mutual Readiness**<br><br>**Questions: no 8,12,13** | Prepare for change | | x | x | x | x | x | x | |
| | Reimagine work | | x | | x | | x | | |
| | Use AI to tap potential | x | x | | | | x | | |
| **Accelerated Ability**<br><br>**Question: no 13,8,12** | Use scientific methods | | x | | | | x | | |
| | Use smart technologies | | x | x | | | x | | x |
| | Teach each other | x | | | | x | | x | |
| **Shared Value**<br><br>**Question: no 12,13,17** | Sense of wellbeing about change | x | | | x | | x | | |
| | Co-fund learning | | | x | | | | | |
| | Encourage lifelong learning | x | x | | x | x | x | x | x |

# CHAPTER V
# 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

to acquire the latest AI technology, but there will be also competition for well-qualified workers. Supply chain management poses massive challenges because of the specialization and diversification of many products, and consumers are demanding more in the markets. The requirement for workers who can use socio-emotional, creative, and complicated reasoning talents to meet the organization's unique needs is increasing. New types of training are thus desperately needed to assist workers in developing and using higher-level of AI technologies. There should be lifelong training programs in organizations. Human- machines are being partners and have become joint forces. Most upcoming roles will be performed collaboratively by humans and machines. Both technical and non-technical skills are essential to developing. Employees and decision-makers should keep their AI knowledge and analytical skills up to date because machines learn automatically from different factors and environments in which they are working. Every day there are new developments and updates, thus while working with AI technologies and making decisions and forecasts about different organizational operations, the latest knowledge about AI must be up to date, and analytical skills should be developed.

This study also measures workers' education/training and skills requirements in human-AI collaboration by using methods that measure the aspects that determine competitive advantage. Businesses spend a considerable amount of money on their human capital to meet their education/training requirements and improve their skills in general by organizing education and training programs to make their competencies by the need of a changing world, which ultimately contributes to gaining a competitive advantage. The role of companies in workers' education and training programs is crucial to get a competitive advantage over their competitors. Though longer education/training and skills programs will give competitive advantages, the duration of the programs should not be very long. Long and unplanned programs can decrease the interest of workers; they can get bored. To get a competitive advantage, companies should have lifelong training programs. Both company and employees should prepare for the change. New skill development and lifelong learning are desperately needed instead of having longer and boring education and training programs. Education and training programs should be more friendly, exciting, and delivered efficiently to employees in advance and will strengthen and harmonize employees' skills when they work together. Companies must have particular well-planned education/training and

skills programs to improve workers' skills and get maximum from AI. Companies should help employees achieve their interested education and training by giving them bonuses etc. Employees and businesses must interact on three levels to accelerate the learning and deployment of vital human skills needed to succeed in human-AI collaboration and competitive advantage. Businesses' education and training programs must address the notions: mutual readiness, accelerated ability, and shared value. In conclusion, the current research demonstrates that a training-focused approach improves competitive advantage in job satisfaction, reduces absenteeism, and minimizes the urge to suspend.

In table 4.5, there is a comparison of research findings of companies' education and training programs and the dimension of skills development. The result of table 5.1 shows that almost all of the managers mentioned lifelong learning, which shows lifelong learning is essential, not extended duration learning. There should be a well-planned, attractive, and friendly way of learning programs. We can see that the companies following most of these three aspects of skill development have a competitive advantage over others, and these are big companies.

The shift to the future workforce will be effective only if both executives and employees walk this path together. We must all prepare for change by utilizing scientific approaches and intelligent technology and embracing a lifelong learning mentality. Companies must rethink organizational structures and procedures to allow employees to participate in the process, and employees must seize every chance to learn in the long term. Thus, our findings somehow prove the hypothesis; There is a significant and robust relation between workers' training and education and the business's competitive advantage. However, these education and training programs must not be long enough; longer ones can make employees bore and lose their interest in learning.

### 5.1 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.

### 5.2 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.

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# APPENDICES

**Appendix 1. Proposal Letter for Participation in Survey (English)**

Respected respondent,

This online questionnaire is being performed by Abdul Hayee MAHMOOD, an MBA student at Istanbul Sabahattin Zaim University, for the purpose of his master's thesis. The study seeks to determine the impact of artificial intelligence on supply chain as well as the importance of employee education and training programs in the context of human AI collaboration. This survey is totally optional and anonymous. As a result, the data obtained will be kept anonymous and used just for the purpose of completing the thesis.

The survey contains 14 questions, and This survey will take around 4 – 6 minutes of your time to complete. Whenever you have a question about any aspect of the survey, or about the whole research in general, please don't hesitate to get in touch with me at

Kind Regards,

Abdul Hayee MAHMOOD

Istanbul Sabahattin Zaim University

Institute of Social Sciences

Business Management

Graduate Student

**Appendix 2. Survey form (English)**

***Fundamental Information***

Name / Surname

Answer
……

Country

Answer
……

Company Name

Answer
……

***Management Area***

Job Title

Answer
……

Years of Experience

Answer
……

***Information means***

Is your organization using artificial intelligence to control the SC?

o Yes
o No
o N/A
o Other: ……

How likely is it that AI will be used in your SC operations in upcoming five years?

o Extremely unlikely
o Unlikely
o Neutral
o Likely
o Extremely likely

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

o Strongly disagree

- o Disagree
- o Neutral
- o Agree
- o Strongly agree

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

- o Strongly disagree
- o Disagree
- o Neutral
- o Agree
- o Strongly agree

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

- o Strongly disagree
- o Disagree
- o Neutral
- o Agree
- o Strongly agree

***Additional information (Human AI Collaboration)***

AI will add value to managing the supply chain operations?

- o Strongly disagree
- o Disagree
- o Neutral
- o Agree
- o Strongly agree

Human-AI collaboration requires new roles and talent?

- o Strongly disagree
- o Disagree
- o Neutral
- o Agree
- o Strongly agree

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

- o Strongly disagree
- o Disagree
- o Neutral
- o Agree
- o Strongly agree

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

- o Strongly disagree
- o Disagree
- o Neutral
- o Agree
- o Strongly agree

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

- o Strongly disagree
- o Disagree
- o Neutral
- o Agree
- o Strongly agree

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

- o Strongly disagree
- o Disagree
- o Neutral
- o Agree
- o Strongly agree

Technological development will cause job losses.

- o Strongly disagree
- o Disagree

- o Neutral
- o Agree
- o Strongly agree

Technological development will increase job opportunities.

- o Strongly disagree
- o Disagree
- o Neutral
- o Agree
- o Strongly agree

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?

- o Strongly disagree
- o Disagree
- o Neutral
- o Agree
- o Strongly agree

**Appendix 3. Proposal Letter for Participation in Survey (Turkish)**

Sayın katılımcı,

Bu anket İstanbul Sabahattin Zaim Üniversitesi Yüksek Lisans (İşletme) öğrencisi Abdul Hayee MAHMOOD tarafından tez amaçlı yürütülmektedir. Anket, Yapay Zekanın Tedarik Zinciri Yönetimi Üzerindeki Etkisini ve İnsan Yapay Zekâ İşbirliğinde Çalışanların Eğitim ve Öğretim programlarının Önemini ölçmeyi amaçlamaktadır. Tamamen gönüllü ve anonim bir ankettir. Bu nedenle toplanan veriler gizli olacak ve sadece tez yazmak için kullanılacaktır. Bu anket yaklaşık 4-6 dakikanızı alacaktır.

Anketin herhangi bir bölümü veya genel olarak tüm çalışma ile ilgili herhangi bir sorunuz varsa, lütfen Hayesalive@gmail.com veya Abdul.haji@std.izu.edu.tr adresinden benimle iletişime geçmekten çekinmeyin.

Saygılar,

Abdul Hayee MAHMOOD

İstanbul Sabahattin Zaim Üniversitesi

Sosyal Bilimleri Enstitüsü

Yüksek Lisans Öğrencisi

**Appendix 4. Survey form (Turkish)**

***Temel Bilgiler***

Ad / Soyadı

Cevap

……

Ülke

Cevap

……

Şirket Adı

Cevap

……

***Yönetim Alanı***

İş Unvanı

Cevap

……

İş Deneyim

Cevap

……

***Bilgi,***

Şirketiniz tedarik zincirini yönetmek için yapay zekâ kullanıyor mu?

- o Evet
- o Hayır
- o Yok
- o Diğer: ……

Önümüzdeki beş yıl içinde yapay zekâ tarafından tedarik zinciri operasyonları geliştirme olasılığınız nedir?

- o Son derece olası değil
- o Olası değil
- o Cevapsız
- o Muhtemelen
- o Son derece muhtemel

Hem insanlar hem de en uygun oldukları makineler için belirli bir görev olmalıdır.

- Kesinlikle Katılmıyorum
- Katılmıyorum
- Cevapsız
- Katılıyorum
- Kesinlikle katılıyorum

Yapay zekâ teknolojileriyle entegre olmak için, insan karar vericilerin yapay zekâ bilgilerini güncel tutmaları ve analitik beceriler geliştirmeleri gerekir.

- Kesinlikle Katılmıyorum
- Katılmıyorum
- Cevapsız
- Katılıyorum
- Kesinlikle katılıyorum

Çalışanlar hem teknik hem de teknik olmayan yetenekleri geliştirmelidir.

- Kesinlikle Katılmıyorum
- Katılmıyorum
- Cevapsız
- Katılıyorum
- Kesinlikle katılıyorum

***Ek bilgiler (İnsan Yapay Zekâ İş birliği)***

Yapay zekâ tedarik zinciri operasyonlarını yönetmeye değer katacak mı?

- Kesinlikle Katılmıyorum
- Katılmıyorum
- Cevapsız
- Katılıyorum
- Kesinlikle katılıyorum

İnsan-yapay zekâ iş birliği yeni roller ve yetenek mi gerektiriyor?

- Kesinlikle Katılmıyorum
- Katılmıyorum
- Cevapsız
- Katılıyorum
- Kesinlikle katılıyorum

İnsan ve yapay zekâ iş birliğinin şirketinizin üretkenliğini ve rekabet seviyesini artıracağına katılıyor musunuz?

- Kesinlikle Katılmıyorum
- Katılmıyorum
- Cevapsız
- Katılıyorum
- Kesinlikle katılıyorum

Çalışanın eğitim ve öğretiminin yapay zekâ teknolojileriyle iş birliği yapmak için gerekli olduğunu kabul ediyor musunuz?

- Kesinlikle Katılmıyorum
- Katılmıyorum
- Cevapsız
- Katılıyorum
- Kesinlikle katılıyorum

Yeni yapay zekâ kullanımının çalışanlarınızın becerilerini güçlendireceğini ve uyumlu hale getireceğine katılıyor musunuz?

- Kesinlikle Katılmıyorum
- Katılmıyorum
- Cevapsız
- Katılıyorum
- Kesinlikle katılıyorum

Yeni yapay zekâ teknolojileri, yeni iş niteliklerine olan ihtiyacı artırıyor.

- Kesinlikle Katılmıyorum
- Katılmıyorum
- Cevapsız
- Katılıyorum
- Kesinlikle katılıyorum

Teknolojik gelişme iş kayıplarına neden olacaktır.

- Kesinlikle Katılmıyorum
- Katılmıyorum
- Cevapsız

- Katılıyorum
- Kesinlikle katılıyorum

Teknolojik gelişme iş olanaklarını artıracaktır.

- Kesinlikle Katılmıyorum
- Katılmıyorum
- Cevapsız
- Katılıyorum
- Kesinlikle katılıyorum

Çalışanlarınız için en son yapay zekâ teknolojileri hakkında daha kapsamlı eğitim ve öğretim programlarının şirketinize rekabet avantajı sağlayacağını kabul ediyor musunuz?

- Kesinlikle Katılmıyorum
- Katılmıyorum
- Cevapsız
- Katılıyorum
- Kesinlikle katılıyorum

**Appendix 5.** Data Collected from Respondents - Question 3 to Question 14

| Respondents | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 | Q10 | Q11 | Q12 | Q13 | Q14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1** | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 2 | 2 | 3 | 3 |
| **2** | 3 | 1 | 2 | 1 | 2 | 2 | 3 | 3 | 2 | 2 | 3 | 3 |
| **3** | 3 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 2 | 3 | 3 |
| **4** | 3 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 2 | 3 | 3 |
| **5** | 4 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **6** | 4 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 4 | 4 |
| **7** | 4 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 4 | 4 |
| **8** | 4 | 2 | 2 | 3 | 3 | 4 | 3 | 4 | 3 | 3 | 4 | 4 |
| **9** | 4 | 2 | 3 | 3 | 3 | 4 | 3 | 4 | 3 | 3 | 4 | 4 |
| **10** | 4 | 2 | 3 | 3 | 4 | 4 | 4 | 4 | 4 | 3 | 4 | 4 |
| **11** | 4 | 2 | 3 | 3 | 4 | 4 | 4 | 4 | 4 | 3 | 4 | 4 |
| **12** | 4 | 3 | 3 | 3 | 4 | 4 | 4 | 4 | 4 | 3 | 4 | 4 |
| **13** | 4 | 3 | 3 | 4 | 4 | 4 | 4 | 4 | 4 | 3 | 4 | 4 |
| **14** | 4 | 3 | 3 | 4 | 4 | 4 | 4 | 4 | 4 | 3 | 4 | 4 |
| **15** | 4 | 3 | 3 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| **16** | 4 | 3 | 3 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| **17** | 4 | 3 | 3 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| **18** | 4 | 3 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| **19** | 4 | 3 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| **20** | 4 | 3 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| **21** | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| **22** | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| **23** | 5 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| **24** | 5 | 4 | 4 | 4 | 4 | 4 | 4 | 5 | 4 | 4 | 4 | 4 |
| **25** | 5 | 4 | 4 | 4 | 5 | 5 | 5 | 5 | 4 | 4 | 4 | 4 |
| **26** | 5 | 4 | 4 | 4 | 5 | 5 | 5 | 5 | 4 | 4 | 4 | 4 |
| **27** | 5 | 4 | 4 | 4 | 5 | 5 | 5 | 5 | 5 | 4 | 4 | 5 |
| **28** | 5 | 4 | 4 | 4 | 5 | 5 | 5 | 5 | 5 | 4 | 4 | 5 |
| **29** | 5 | 4 | 4 | 5 | 5 | 5 | 5 | 5 | 5 | 4 | 5 | 5 |
| **30** | 5 | 5 | 4 | 5 | 5 | 5 | 5 | 5 | 5 | 4 | 5 | 5 |
| **31** | 5 | 5 | 4 | 5 | 5 | 5 | 5 | 5 | 5 | 4 | 5 | 5 |
| **32** | 5 | 5 | 4 | 5 | 5 | 5 | 5 | 5 | 5 | 4 | 5 | 5 |
| **33** | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 4 | 5 | 5 |
| **34** | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| **35** | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |

**Appendix 6.** The Online Interview Questions for the Top Managers.

***Fundamental Information***

- Name / Surname
- Country
- Company Name
- Years of Experience
- Job Experience

***Information means***

- Do you have any experience with Al?
- What are your thoughts on the impact of AI - powered technologies on the supply chain industry? Share your thoughts
- Have you had any technological projects developed in your company in the recent past?
- What are the most significant developments that will occur in SC in the near future?
- What recommendations would you provide to companies on how to deal with the changes you've mentioned?
- Do your company plans incorporate technical investments? What sort of investments are you considering?
- Where can you see your company at this point in this AI-based automation level?
- Which of the following describes the best your knowledge of artificial intelligence?

AI Novice, AI Ready, AI proficient or AI Advanced

- Can you express the degree of the predisposition of your employees to technological developments as Not Predisposed, Predisposed, very prone?
- What do you think that the technological development will cause job losses or job increase in logistics and transportation sector?

***Additional information (Human AI Collaboration)***

- What are the potential consequences and benefits of the outcome of Human AI Collaboration?
- Do you think that the latest AI technology will boost up your company's productivity and competition level compared to others?
- Do you think that the employee's education and training are essential to collaborating with AI technologies in your company?
- Do you have any education or training program in your company for your employees about New AI technologies used in your company? Would you please explain in a few sentences?
- Do you think expected and required workforce competence levels should increase on average due to increased AI technology development and implementation?
- Do you think that usage of new AI will strengthen and harmonize the skills of your employees?
- 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.
- Do you think that workers must improve and develop both technical and non-technical capabilities?
- Do you think that in human-AI collaboration, human decision-makers must have to keep their AI knowledge up to date and need to develop analytical skills?

**Appendix 7.** Background Information of Interviewees.

| Respondent | Industry Description | Experience | Country |
|---|---|---|---|
| **Abdullah AI Specialist** | Electrical and Computer Engineering program | 5 Years | Turkey |
| **Batuhan Baskurt Autonomy Scientist** | Provide autonomous mobility solutions for the port industry. | 10 Years | UK |
| **Buğra BÖLÜKBAŞ Chief Technology Officer** | Company that provides consultancy services, sales and support services to various sectors through zoho CRM products. | 5.5 Years | Turkey |
| **Emirhan Battal Logistic Supervisor** | Production of different types of metallic pipe components. | 8 Years | Turkey |
| **Habib Mahdum Logistic Manager** | A supply chain logistics organization that organizes, executes, and manages the movement of goods, services, or information. | 6 Years | Turkey |
| **Eszter Toth Supervisor and team leader at IT support** | An international leader in technology and services. It has around 395,000 employees globally. | 3 Years | Germany |
| **Ayub Awaz Digital Marketing Manager** | A rug manufacturer company. Use online platforms for the marketing and sales of their rugs. | 9 Years | USA |
| **Abdul Rehman Procurement Manager** | An international import export company. | 4 Years | Turkey |

**Appendix 8.** Answers Received from Interviewees

1) **What are the most significant developments that will occur in SC in the near future?**

**Abdullah, AI Specialist:** "*There will be significant changes in the future with the advent of AI smart applications, but first, what is this supply chain? The supply chain is a connected network of individuals, organizations, resources, activities, manufacturing, and sales of the product on our services. So, during this process, you know many things can occur, and many problems occur.AI technologies will help companies. So, integrating AI into our supply chain will increase the productivity and sales of the company. Most of the jobs in the field of Supply chain will change, and AI will replace them. The competition will increase among the companies."*

**Batuhan Baskurt, Autonomy Scientist:** *"Supply chain industry might be more user-oriented soon with the fast improvement of drone technologies. Also, it might be completely automated end-to-end from production to customer".*

**Buğra Bölükbaş, Chief Technology Officer:** *"First there will be increasing competition between raw material, semi-finished producers and logistics companies with the increase of technological opportunities. Second, increase in customer satisfaction with strengthening optimization because of relative shortening of the time of buying products. Third, decreasing quantity in the workforce and increasing the quality".*

**Emirhan Battal**, **Logistic Supervisor:** *"The supply chain sector will change as AI technology is proliferating. Most of the things will be autonomous like we have autonomous cars and other means of transportations in different fields of SC. AI applications will increasingly help companies in their decision-making processes, and there will be new AI technologies that will help SC save time and work in an efficient and fast way".*

**Habib Mahdum**, **Logistic Manager:** "*We can see many changes in the field of the supply chain. If I have to talk about logistics, I can say that the first change is the rising complexity and mobility of supply networks necessitates more sophisticated information technology solutions or AI technologies. Secondly, going international or global. Many firms' overall business growth plan currently includes international, mature, and growing markets. And logistic solution suppliers must support this trend.*

*And alternative transportation modes and channels are necessary to support the ongoing trend of outsourcing logistics services to ensure speed to market and decrease the risk of delays".*

**Eszter Toth**, **Supervisor and team leader at IT support:** *"If I were to describe the present and future developments in Bosch's supply chain, I would say that in a globalized world, digital technologies transform markets, and sustainability is becoming a crucial component. For Bosch, this means responding to more customized client desires with greater flexibility, speed, and openness, all while achieving the highest quality standards".*

**Ayub Awaz, Digital Marketing Manager:** *"I can say that the Covid 19 pandemic forced the majority of companies to digitalize their product and services. Thus, the interest in using new AI technologies boosted in different sectors of SC.* AI's usage will rise in the future, *as globalization increased companies should work globally".*

**Abdul Rehman, Procurement Manager:** *"I think that supply chain will change in the upcoming years. We can see that logistics and cargo companies are using drone deliveries. Digitalization of products and services will increase. Most of the manual task will be done by new technologies".*

**2) What recommendations would you provide to companies on how to deal with the changes you've mentioned?**

**Abdullah, AI Specialist:** *"Well, companies can research supply chain and applications of AI being used in the supply chain. They should research similar companies, research their competitors, and see how they've also improved on the supply chain. Then after that, they can develop their strategy about applications of AI. What to do and how to apply those AI technologies? So, this is what I think they should do by conducting some research analysis about the latest AI developments".*

**Batuhan Baskurt, Autonomy Scientist:** *"Companies should keep their internal system and architecture up-to-date regarding the development of the industry."*

**Buğra Bölükbaş, Chief Technology Officer:** *"Raw material, semi-finished products manufacturers and logistics companies should take themselves one step forward in this competition by strengthening their technological infrastructure and workforce*

*with artificial intelligence. Since the most important output of the procurement process is sales and customer satisfaction, companies have to resort to artificial intelligence solutions to fulfill customer requirements under the necessary conditions and at the necessary time without including errors in this sense".*

**Emirhan Battal**, **Logistic Supervisor:** *"My advice for the companies is that they should be open to changes and the innovation of the technologies. Technology is meant for humans because if we use AI technology that we need, it will help our company in different ways".*

**Habib Mahdum**, **Logistic Manager:** *"I think that logistic companies should follow the new AI developments and implement new AI applications that will help them be more productive and efficient in logistic operations. They should go global and always should have alternative ways or channels to continue their operations".*

**Eszter Toth**, **Supervisor and team leader at IT support:** *"Implementing and then using AI applications in the supply chain are critical in a connected world if we have to satisfy our clients' individualized, exact requirements more swiftly. Those that do not adopt AI will be left behind. Small and medium-sized businesses, in particular, still have a lot of room to develop and strengthen their competitive positions by using AI technologies".*

**Ayub Awaz, Digital Marketing Manager:** *"My advice to the companies will be like they must adopt new AI technologies to get better results. With the help of new AI digital technologies, companies can increase their productivity; their sale will increase and make their product and services digitalize and use different online platforms to reach their target customers globally".*

**Abdul Rehman, Procurement Manager:** *"I can say that companies should participate in different technological exhibitions and webinars from where they can get latest AI technological information, and they can evaluate their current situation in the market and which AI application they can adopt in the company. Or they can outsource services".*

**3) Do you have any experience with Al?**

**Abdullah, AI Specialist:** *"Yes, I have; AI refers to a machine's capacity to think and learn. In general, the phrase "artificial intelligence" refers to a software that simulates human intellect."*

**Batuhan Baskurt, Autonomy Scientist:** *"I've been using AI to provide computer vision solutions in the industry for five years."*

**Buğra Bölükbaş, Chief Technology Officer:** *"I studied Supply Chain Management and Meta Intuitive Optimization in my university master's degree. Zoho products, which I am currently consulting on, also have AI-powered services".*

**Emirhan Battal**, **Logistic Supervisor:** *"Yes, sure, I can say that nowadays all of us have a little bit of experience with AI. More basically, now everyone has smartphones. In our smartphones, we have AI assistants there like Apple's Siri, Microsoft Cortana, Google now, etc. except these we have latest AI navigation applications in our phones and cars".*

**Habib Mahdum**, **Logistic Manager:** *"Yes, in logistics, there are some AI applications which assist firms in analyzing existing routing and optimizing routes. And these applications help to determine the most effective route for logistics trucks".*

**Eszter Toth, Supervisor and team leader at IT support:** *"Artificial intelligence is the use of excitable algorithms to enable robots to learn, comprehend, and behave appropriately. Artificial intelligence is increasingly becoming a human collaborator. It has an impact on our lives and jobs".*

**Ayub Awaz, Digital Marketing Manager:** *"Yes, we are using different AI technologies in our company, such as we have AI chatbots and CRM program."*

**Abdul Rehman, Procurement Manager***: "Yes, Artificial intelligence is being used in different trade companies to enhance future trend forecasts, such as changes in customer demand, and to manage risk along the supply chain better."*

**4) What are your thoughts on the impact of AI - powered technologies on the supply chain industry? Share your thoughts**

**Abdullah, AI Specialist:** *"AI applications have a great impact on SCM, logistics, and all other SC areas. We now have automated driverless cars and other autonomous vehicles used in transportation. AI applications are decreasing the workload of people in many fields of the supply chain. As a result of this productivity and sales of companies are increasing which increase the profit. For example, we have Amazon. Amazon introduced its drone cargo. Which save our time".*

**Batuhan Baskurt, Autonomy Scientist:** *"Operations in the logistics, transportation and supply chain industry are quite straightforward to be supported/conducted by AI. Automated transportation is not only decreasing operation costs but also increasing accuracy. I think we will see AI-powered autonomous solutions in these industries more often shortly".*

**Buğra Bölükbaş, Chief Technology Officer:** *"Artificial intelligence is already used in problem-solving, especially in the field of logistics. With artificial intelligence models that include meta-intuitive methods, the shortest path problems and charting problems offer solutions close to the optimum solution. The procurement process will become more predictable and controllable with artificial intelligence applications that help the procurement process adapt to optimum conditions".*

**Emirhan Battal, Logistic Supervisor:** *"Yeah, surely AI will have both positive and negative effects on the artificial supply chain industry. If we look at positive effects, we can see that AI applications are helping us in cost efficiency; in time efficiency, there will be fewer errors during production and delivery processes, and it's going to create much faster and more rapid delivery times. For example, in transportation. If we had autonomous trucks and trains, there would be fewer crashes. As humans have a limit in most things, but machines can work more than human limits, the machine does not get tired".*

**Habib Mahdum, Logistic Manager:** *"AI-powered inventory management technologies can be quite effective. These intelligent algorithms can swiftly evaluate and understand massive datasets, offering immediate forecasting recommendations on supply and demand. AI automated technologies can work error-free for a longer period, minimizing the number of mistakes and workplace mishaps. AI technologies may assist in reducing reliance on manual labor, making the overall process quicker, safer, and smarter".*

**Esther Toth, Supervisor and team leader at IT support:** *"Artificial Intelligence is already changing the face of the supply chain business, exacerbating the split between winners and losers. AI in supply chains assists in the delivery of important optimization skills necessary for more accurate capacity planning, enhanced efficiency, high quality, reduced costs, and increased production, all while encouraging safer working conditions".*

**Ayub Awaz**, **Digital Marketing Manager:** *"AI applications in supply chain management helps organizations to correctly forecast demand surges and alter material flow routes and volumes. There are a lot of other applications of AI in supply chain management, such as CRM programs that help companies track their inventory and collect data from customers and other partners. In the eCommerce sector, AI assists in forecasting future demand by evaluating consumption patterns on the website and predicting inventory requirements. This improved efficiency lowers expenses and boosts corporate performance".*

**Abdul Rehman, Procurement Manager:** *"AI applications in international trade companies evaluate massive amounts of data and execute transactions at best possible price, analysts anticipate markets more accurately, and trading businesses effectively manage risk to give larger profits.*

**5) Have you had any technological projects developed in your company in the recent past?**

**Abdullah, AI Specialist:** "We have some projects in our workplace. We have done things like a smart classroom, smart office, etc. With the help of AI technology and the Internet of Things technology, we are working on these projects to make them more useful, which will help us be more efficient".

**Batuhan Baskurt**, **Autonomy Scientist:** *"Yes, we have several projects, including autonomous driving and crane control."*

**Buğra Bölükbaş, Chief Technology Officer:** *"Yes, we developed CRM (Customer Relationship Management) application."*

**Emirhan Battal, Logistic Supervisor:** *"In our company for last two years, we are using artificial intelligence application which helps us and gives its suggestion in stocking and delivering the products. For example, with the SKU numbers of the products, AI machines predict the demand and trend of the product, giving us suggestions to produce specific products if we get the raw material for them. Around 85% of the suggestions are correct, so it helps us a lot with time-saving and in productivity".*

**Habib Mahdum, Logistic Manager:** *"Yes, we have developed technological projects in our company; for example, we employ artificial intelligence to create supply chain*

*solutions that manage transportation and logistical demands so that clients can move their goods swiftly, safely, and affordably."*

**Eszter Toth, IT support supervisor and team leader:** *"Self-propelled lawnmower, smart home systems."*

**Ayub Awaz, Digital Marketing Manager:** *"Recently we developed a CRM application for our company to store customers' data and reach new potential customers and also control inventory."*

**Abdul Rehman, Procurement Manager:** *"We have some AI optimization tools that help us give accurate results about ordering new products."*

**6) Where can you see your company at this point in this AI-based automation level?**

**Table: 8.1**

| | **Which one provide information** | **Who makes the decision and how** | **Behaves in accordance with decisions** |
|---|---|---|---|
| **Human-directed** | Humans analyze and get information with minimum tech. | Based on past experiences and regulations, humans make decisions. | Human acts. |
| **Human-directed and machine-assisted** | Humans do analysis and generate insights via the use of a variety of instruments. | Appropriate machine recommendations guide human judgments | Human acts. |
| **Machine-directed and human-assisted** | The machine analyzes and generates ideas from human opinion. | Decisions made by Human on computer recommendations that are bound by all considerations. | Human acts supervised by machines. |
| **Machine-directed and human- Ruled** | Without human input, machines analyze and provide findings. | Computers make decisions under human control. | Machine implements or acts with human oversight. |
| **Machine governed** | Machine analyzes and discovers. | Decisions made by computers | Machine acts |

**Source:** (Vesset, 2020)

**Abdullah, AI Specialist:** *"Human Led and machine supported."*

**Batuhan Baskurt, Autonomy Scientist:** *"Machine led and human governed."*

**Buğra Bölükbaş, Chief Technology Officer:** "*Human Led and machine supported*."

**Emirhan Battal**, **Logistic Supervisor:** *"Human Led and machine supported."*

**Habib Mahdum**, **Logistic Manager:** *"Human Led and machine supported."*

**Eszter Toth**, **Supervisor and team leader at IT support:** *"Human Led and machine supported" and some places it's "Machine led and human governed."*

**Ayub Awaz, Digital Marketing Manager:** *"Human Led and machine supported."*

**Abdul Rehman, Procurement Manager:** *"Human Led and machine supported."*

**7) Which of the following describes the best your knowledge of artificial intelligence?**

**AI Novice, AI Ready, AI proficient or AI Advanced**

**Source:** (Ellefsen, Szłapka, Pawłowski, & Toboła, 2019)

**Abdullah, AI Specialist:** *"AI-ready."*

**Batuhan Baskurt, Autonomy Scientist:** *"AI Advanced."*

**Buğra Bölükbaş, Chief Technology Officer:** *"AI ready".*

**Emirhan Battal**, **Logistic Supervisor:** *"AI-ready."*

**Habib Mahdum**, **Logistic Manager:** *"AI ready".*

**Eszter Toth**, **Supervisor and team leader at IT support:** *"AI advanced."*

**Ayub Awaz, Digital Marketing Manager:** *"AI-ready.*

**Abdul Rehman, Procurement Manager:** *"AI-ready."*

**8) Do your company plans incorporate technical investments? What sort of investments are you considering?**

**Abdullah, AI Specialist:** *"Yes, sure, we already have some AI projects in our company, and we are planning to arrange more budget for new AI technology implementation in our company."*

**Batuhan Baskurt, Autonomy Scientist:** *"Yes, we have several projects including autonomous driving and crane control. In the future too, there will be technological investments in our business plan".*

**Buğra Bölükbaş, Chief Technology Officer:** *"In the short term, technological change and labor investment are necessary for us. In the medium and long term, we can develop our products through Zoho CRM".*

**Emirhan Battal**, **Logistic Supervisor:** *"Yes, we are already investing in the different logistics areas. Especially the training of our employees in the logistics and AI fields, how they can collaborate and work more efficiently with new AI technologies. We are examining every department and trying every possibility that we can invest in technologies to create a better flow in the production and other SC area"*

**Habib Mahdum**, **Logistic Manager:** *"Sure, we want to invest in artificial intelligence shortly to successfully optimize procurement, inventory, and distribution strategies that match client demand and our company's revenue targets."*

**Eszter Toth**, **IT support supervisor and team leader:** *"Yes, we are working on several initiatives, including autonomous driving and crane control. As we all know, Bosch is a multinational company that invests millions of dollars each year in innovative technology. The most crucial thing for the organization to do is invest in new technology and employees training to work with that. In 2021, Bosch, which has its North American headquarters in Farmington Hills, intends $360 million in capital investments in North America, $250 million of which will be in the mobility industry".*

**Ayub Awaz, Digital Marketing Manager:** *"Yes, technological investments are included in our business processes. In the eCommerce sector, we have to keep developing all of our digital platforms; thus, in the future, we plan to have more AI-based eCommerce websites, and we arrange separate budgets for the training of our workers about new technologies".*

**Abdul Rehman, Procurement Manager:** *"Currently we are using an AI optimization application as I discussed before* in the future, if the necessity arises *surely, we will include technological investments in our budget plan. But for now, we do not need any further implementation of AI technology because of target importing and exporting countries are Afghanistan and some African countries where most of the things are being done manually".*

**9) What are the potential consequences and benefits of the outcome of Human AI Collaboration?**

**Abdullah, AI Specialist:** *"As the Human-AI collaboration will Increase efficiency and productivity, it will also increase the sales and profit will also increase. We will consume a lot of time by using AI applications. About the consequences, I can say that,*

*as AI technologies are developing rapidly, it will cause some job losses in SCM. Most of the work will be done by machines".*

**Batuhan Baskurt, Autonomy Scientist***: "Cost-efficient and smooth operations without human error."*

**Buğra Bölükbaş, Chief Technology Officer:** *"In general terms and the short term, it can cause some decrease in the workforce and create an unemployment problem. It improves productivity by providing a significant improvement in the minimization of errors caused by human errors. It will provide small and medium-sized enterprises with the opportunity to compete with large companies".*

**Emirhan Battal, Logistic Supervisor:** *"Human AI collaboration can cause both benefits and some negative results. When it comes to the benefits, we can see that AI and human collaboration are increasing the productivity and efficiency of companies, and also, workers are getting more productive on their tasks. On the other hand, AI is causing job losses in some areas of the supply chain".*

**Habib Mahdum, Logistic Manager:** *"In human-AI collaboration, I can say that there are multiple benefits such as reduced time spent on logistical operations and increased resources and capabilities.* However, there may be some drawbacks*, like most workers will lose their manual jobs, machines will take their place. For example, before, workers used to carry heavy stuff physically, but heavy weightlifter machines have replaced them, but there will be new job areas too, it will not be only job losses"*

**Eszter Toth, Supervisor and team leader at IT support:** *"Human-AI collaboration may assist individuals in becoming more efficient. Yes, AI will replace a large number of employments. However, AI will augment human talents in many other areas, such as manufacturing and customer service. Humans and robots have distinct and frequently complementary strengths and weaknesses. B*ecause of this, we don't foresee massive job losses as a consequence of automation for the time being*".*

**Ayub Awaz, Digital Marketing Manager:** *"Ai-Human Collaboration has several advantages. For example, human error will be reduced, and AI Digital Assistance will save time for human employees. Workers' productivity and efficiency will improve. The consequences may include making humans lazier, increasing unemployment in manual labor, etc.".*

**Abdul Rehman, Procurement Manager:** *"In human-AI collaboration, I can say that there will be numerous benefits such as for trading companies it will reduce the costs, increase profit, and accelerate the operations. There will be fewer errors and optimal ways to do different tasks in many fields of SC".*

**10) Do you think that latest AI technology will boost up the productivity and competition level of your company as compared to others?**

**Abdullah, AI Specialist:** *"Yes, I Agree with this; if we apply AI, it will increase productivity, and companies will have a competitive advantage over their competitors."*

**Batuhan Baskurt, Autonomy Scientist:** *"Yes, because we are developing cutting-edge solutions that keep us up-to-date with the latest developments."*

**Buğra Bölükbaş, Chief Technology Officer:** *"Definitely. AI is an excellent tool for predicting the future and taking action by better analyzing existing data. That's the number one rule of competition. In addition, AI can take a step forward in competition by reducing our existing costs".*

**Emirhan Battal, Logistic Supervisor:** *"Yes, for sure, if we implement the right AI technology in our company, it will give our company a competitive advantage over others. But as I discussed before, we should follow new AI technologies and research our competitors and what kind of technologies they are using and how our company can use the latest AI technologies that are much better than our competitors. Thus this will give us a competitive advantage".*

**Habib Mahdum, Logistic Manager:** *"Yes, AI technologies have also enhanced supply chain productivity while reducing costs and mistakes. These advancements assist the whole logistics business, including truck transportation, global transportation, supply chain management, and cargo monitoring. So, I think these AI technologies are giving a competitive advantage to our company. But we need to research our competitors too, what kind of AI technologies are they using and how we can develop our AI technologies in our company to get a competitive advantage".*

**Eszter Toth, Supervisor and team leader at IT support:** *"Yes exactly, new AI technologies will boost up the productivity and competition level of Bosch as compared to others, as I mentioned before that Bosch is spending millions every year on different AI technologies to have a competitive advantage."*

**Ayub Awaz, Digital Marketing Manager:** *"AI applications can boost up the productivity and competition level of our company, but we should exactly know the applications we are using are they updated and latest versions? What are our competitors using, and what is their technological investment budget? So, we should keep all these factors to get a competitive advantage*".

**Abdul Rehman, Procurement Manager:** *"It's all up to our competitors, we have to do our research about the technologies which are being used in our competitors' companies and then we should analyze our company and try to be a step forward than competitors. How much we invest in new AI technologies and how efficiently we are using all these technologies are the key to getting the competitive advantage of our competitors. And this will increase the productivity of the company".*

**11) Can you express the degree of predisposition of your employees to technological developments as Not Predisposed, Predisposed, very prone?**

**Abdullah, AI Specialist:** *"Predisposed."*

**Batuhan Baskurt, Autonomy Scientist:** *"Very prone".*

**Buğra Bölükbaş, Chief Technology Officer:** *"Predisposed".*

**Emirhan Battal, Logistic Supervisor:** *"Predisposed."*

**Habib Mahdum, Logistic Manager:** *"Predisposed."*

**Eszter Toth, Supervisor and team leader at IT support:** *"Very prone."*

**Ayub Awaz, Digital Marketing Manager:** *"Predisposed."*

**Abdul Rehman, Procurement Manager:** *"Not Predisposed."*

12) **Do you think that the employee's education and training are essential to collaborating with AI technologies in your company?**

**Abdullah, AI Specialist:** *"That's crucial employees need to have some basic knowledge of AI; at least know the terms and orders like how that AI application or technology work; they should help and learn from one another. They should know the working principles of how they operate. Whenever companies want to implement a new AI technology, they must need to give education and training programs to their employees about that new AI technology it's essential".*

**Batuhan Baskurt**, **Autonomy Scientist:** *"AI technologies are being improved by the community each passing day, so each employee has to follow the latest development via online resources to advance the quality of the products."*

**Buğra Bölükbaş**, **Chief Technology Officer:** *"Definitely. Mastering software processes, basic information necessary for artificial intelligence (intuitive algorithms, machine learning, artificial neural networks, etc.) are of great importance. Therefore, he must have acquired these skills in his learning life or through courses, and companies should help employees by giving them extra bonuses to acquire their interested education and training".*

**Emirhan Battal, Logistic Supervisor:** *"Well, education and training are important. Either decision-makers or other workers, we all need education and training about new AI developments and new updates. I can say that there should be lifelong education and training programs because every day, we have new updates and developments in AI. So in a nutshell, I can say that education and training are important to get better usage of AI technologies and get perfect results*".

**Habib Mahdum, Logistic Manager:** *"Yes, it's very important, As I discussed before the AI technologies being used in our company. These AI technologies are updating very fast over time. So, to collaborate with AI, there must be continual education and training programs for employees. We should adjust our training strategy based on the various training requirements, and employees should already update about the education and training programs. Employees can learn by doing; on-the-job training is typically more successful".*

**Eszter Toth, Supervisor and team leader at IT support:** *"Yes, it is critical. At Bosch, there are several training and education programs for their staff to interact with AI technology.* Fortunately, employees are willing to embrace the changes they expect*".*

**Ayub Awaz, Digital Marketing Manager:** *"Yes, employee's education and training are important in human-AI collaboration. AI technologies keep developing and updating, for the best result from these technologies the education and training of employees are important".*

**Abdul Rehman, Procurement Manager:** *"When we implement new AI technologies, it brings new responsibilities and operating tasks. To utilize these AI technologies in*

*the best and most efficient way, companies can use different technological simulators that will give real situation experience".*

13) **Do you have any education or training program in your company for your employees about new AI technologies used in you company? Please explain in few sentences**

**Abdullah, AI Specialist:** *"Well, we have seminars, workshops, and conferences about AI technologies."*

**Batuhan Baskurt, Autonomy Scientist:** *"We are regularly attending high-quality webinars to be aware of the latest developments. Also, we have internal webinars that experts in the area transfer their knowledge to others".*

**Buğra Bölükbaş, Chief Technology Officer:** *"yes we have training programs; usually we arrange practical and interactive programs so that employees can learn when it is convenient for them. We use AI tools to educate and train them. Such as there is digital assistance in ZOHO CRM called 'Zia' which helps employees and employers develop their skills".*

**Emirhan Battal**, Logistic Supervisor: *"Yes, we already have logistics and AI education and training programs in our company. There are weekly education and training sessions. We update our employees in advance before implementing any new technology and Begin by determining the tasks that must be completed first with the implementation of new technology".*

**Habib Mahdum, Logistic Manager:** *"We have on-site education and training to improve job-related skills, and also we arrange webinars and video conferences."*

**Eszter Toth, Supervisor and team leader at IT support:** *"As a result of existing competency centers, the "Bosch Center for AI" (BCAI) was founded in 2017 with the goal of applying cutting-edge AI techniques to Bosch goods and services, resulting in "Invented for Life" solutions. Employees may take part in a range of training courses that are tailored to their specific job".*

**Ayub Awaz, Digital Marketing Manager:** *"Recently we implemented new CRM program we have weekly education and training programs and some time on spot training is also given".*

**Abdul Rehman, Procurement Manager:** *"Right now, we don't have any education and training program in our company. But in the future, if there will be need to any education and training program, we can give education and training of new AI technologies to our employees because it's important to utilize new AI technologies".*

**14) Do you think that expected and required workforce competence level should increase on average due to increased AI technology development and implementation?**

**Abdullah, AI Specialist:** *"With latest AI technology developments and implementation. Yes, I think that expected, and required workforce competence level should increase on average".*

**Batuhan Baskurt, Autonomy Scientist:** *"It's not required. Focusing on AI-related subjects and improving the theoretical background in this area would be enough to follow the development".*

**Buğra Bölükbaş, Chief Technology Officer:** *"Of course. In the short term, I do not expect, but in the long run, I think the need for competence will increase logarithmically".*

**Emirhan Battal, Logistic Supervisor:** *"Yes, expected and required workforce competence level will increase with new AI developments. Employee's competence level will also increase thus we need more qualified employees".*

**Habib Mahdum, Logistic Manager:** *"In logistic and supply chain, we know that traditionally there were a lot of manual tasks done by humans, but now those tasks are replaced by AI technologies. AI technologies are developing very fast, and if I have to give an example, I can say that our company is trying to implement AI applications in every possible area of logistics. Thus, we need more qualified employees who can collaborate with these AI technologies. So, I can say that these developments will increase the competence level of the workforce".*

**Eszter Toth, Supervisor and team leader at IT support:** *"Yes. Some capabilities, such as technology and social and emotional skills, will be in more demand, while others, such as physical and manual skills, will be in lower demand. These developments will need workers worldwide to expand their current skill sets or learn new ones".*

**Ayub Awaz, Digital Marketing Manager:** *"I think it can depend on the sector; each sector has its criteria. In eCommerce, I can say that the competence level will increase on average".*

**Abdul Rehman, Procurement Manager:** *"I think there will be no increase or decrease in the competence level of the workforce, but there can be a change like competence level of the workforce. Most importantly, it's all depended on the work sector, and there will be only a shift of competence level of employees with the development of new AI technologies".*

**15) Do you think that usage of new AI will strengthen and harmonize the skills of your employees?**

**Abdullah, AI Specialist:** *"Surely it will strengthen and harmonize employees' skills, particularly if the employees are also educated and trained and understand AI. In this way the employees will be more productive in their tasks, their skills will increase, they will consume more time".*

**Batuhan Baskurt, Autonomy Scientist:** *"Yes, AI can close the gaps in terms of proficiency among the team and minimize the redundancy that causes a waste of time for the team members. So, people can be more productive by focusing on challenging issues".*

**Buğra Bölükbaş, Chief Technology Officer:** *"Of course. AI will make it easier for employees to work daily without getting bored and will be useful in minimizing possible human errors".*

**Emirhan Battal, Logistic Supervisor:** *"I agree that using AI in companies will strengthen and harmonize the employees' skills. New AI technologies will help workers increase their skills".*

**Habib Mahdum, Logistic Manager:** *"Yes, agree with that, Ai will help employees increase their productivity. As AI performs routine activities across a company, it allows employees to focus on innovative solutions, difficult problem solving, and significant works".*

**Esther Toth, *Supervisor and team leader at IT support:*** *"Sure, it will harmonize and strengthen employees' skills, and their productivity in different tasks will increase."*

**Ayub Awaz, Digital Marketing Manager:** *"Usage of new AI will strengthen and harmonize employees' skills."*

**Abdul Rehman, Procurement Manager:** *"With the implementation of new AI technologies, I can say that it will strengthen and harmonize the skills of employees."*

**16) What do you think that the technological development will cause job losses or job increase in logistics and transportation sector?**

**Abdullah, AI Specialist:** *"Well, I can say that this is a true and false question. Both are correct. Some people will lose their jobs, but at the same time, there will be new jobs. Some manual jobs will vanish, but at the same time, there are other new jobs opportunities".*

**Batuhan Baskurt, Autonomy Scientist:** *"Automation in logistics and transportation is going to cause less human support in the process. Therefore, we will have a more productive system with fewer people working on it".*

**Buğra Bölükbaş, Chief Technology Officer:** *"It's hard to predict. Because it will cause losses in some areas, and it will cause gains in other areas.* In my opinion this would be a more appropriate way to describe it *as a transformation in the business structure than as a job loss or job gain".*

**Emirhan Battal, Logistic Supervisor:** *"I can say that it can be in both ways. With new AI developments, there will be new job opportunities and more task areas will open, but at the same time there AI technologies will abolish some basic human jobs from the SC sector".*

**Habib Mahdum, Logistic Manager:** *"The majority of the employment will be in the technology sector. AI technologies will eventually reduce human employment, but at the same time, I can say that this AI sector will also create jobs. There will be some manual jobs such as Retail Salesperson; AI technologies will replace receptionists, Couriers, etc.".*

**Eszter Toth, Supervisor and team leader at IT support:** *"The demand for sophisticated computer skills will grow by 90%, while physical or manual skills will diminish considerably. However, 'human' abilities, particularly those connected to well-being, i.e., soft skills,' will continue to be in demand. To better grasp technology and adapt to complicated contexts, conceptual or interpersonal skills will be required.*

*When hiring, many firms are already focused on basic or complicated social and emotional cognitive abilities".*

**Ayub Awaz, Digital Marketing Manager:** *"AI developments are causing job losses in many sectors of the supply chain. We can see that most of the manual jobs have been replaced by AI technologies. But at the same time, AI will produce new jobs in different sectors of the supply chain. So, we cannot go with any of these options; it will cause the job to lose or create job opportunities".*

**Abdul Rehman, Procurement Manager:** *"Lately it's a very favorite topic as the AI will increase there will be job losses or job opportunities. We can say that if there is any job loss in any sector of SC, there is always another job opportunity in another sector".*

**17) Do you agree that your company will have competitive advantage as compared to others by giving your employees longer education and training about latest Ai technologies?**

**Abdullah, AI Specialist:** *"Yeah, I think so; the education and training of employees are significant and keeping them up to date with the new technology. When a new technology is being added to the existing one, they also need to be updated, but it should be done by keeping the interests of employees. There must be lifelong education and training programs for employees to implement and update new AI technologies".*

**Batuhan Baskurt, Autonomy Scientist:** *"Yeah, I agree, but there should be a long-term plan and convey it effectively to employees well in advance. Using the scientific method will keep the interest of workers, and it will improve their effectiveness in learning new AI developments".*

**Buğra Bölükbaş, Chief Technology Officer:** *"Ultimately, each company invests to increase its competitiveness. With artificial intelligence, we can increase our competitiveness, especially by reducing costs and increasing our awareness of the market."*

**Emirhan Battal, Logistic Supervisor:** *"Yeah, I think it's important, but companies should not only focus on longer education and training programs, but they should also think about how they can educate and efficiently train their employees. Companies should have more efficient education and training programs. There must be lifelong education programs, but at the same time, these programs will arrange in a way that*

*should not waste the time of employees. Companies should be strategical in their education and training programs. There should be friendly and shorter education sessions for employees".*

**Habib Mahdum, Logistic Manager:** *"It's essential, I can say that not the longer period of education and training is important because it will make employees bore and they will not be more interested to learn, but there should be continuous education and training. When a firm enters a new marketplace, it modifies its strategy or adopts a new business model. Nowadays, with the implementation of AI applications, companies are entering into a new way of competition. Thus, here lifelong learning plays a critical role in assisting employees in developing the essential skills and knowledge to collaborate with AI".*

**18) Do you think that new AI technologies will increase the need of new job qualifications? Explain in few sentences.**

**Abdullah, AI Specialist:** *"With the development of new AI technologies. There will be a need for new job Qualifications. AI technologies are being used in warehouses, transportations such as ports, etc., and other supply chain fields. Thus, we need people with those kinds of skills to work in those areas, so I think we will need new job qualifications".*

**Batuhan Baskurt, Autonomy Scientist:** *"Yes, it will increase."*

**Buğra Bölükbaş, Chief Technology Officer:** *"Yes, there will be new job qualifications, Creative work qualities will emerge in the field of analyzing critical data and creating scenarios."*

**Emirhan Battal, Logistic Supervisor:** *"AI developments will surely develop new job qualifications. For example, we have different AI applications in transportation trucks, so to understand these AI applications in trucks, there will be a need for newly qualified drivers to have that job".*

**Habib Mahdum, Logistic Manager:** *"Yes, definitely AI will increase new job qualifications."*

**Eszter Toth, Supervisor and team leader at IT support:** *"Yes, I believe that emerging AI technologies will raise the demand for new employment skills. Through the tools they use or by automating certain regular jobs, artificial intelligence has*

*begun to dramatically impact the way people work and progressively transform employees into 'enhanced employees.' People and their capacity to enhance their talents are critical to a company's development".*

**Ayub Awaz, Digital Marketing Manager:** *"Yes, I think it will increase the new job qualifications."*

**Abdul Rehman, Procurement Manager:** *"With new AI technologies, there will be new job models. There will be new job sectors; thus there can be new job qualifications".*

**19) Do you think that workers must improve and develop both technical and non-technical capabilities?**

**Abdullah, AI Specialist:** *"I don't think so that they should have both. I think there should be some technical team in the company and a non-technical team. The technical team should be skilled in the technical parts of the company. While non-technical don't need to know about the technical stuff like writing different algorithmic codes etc., they should be more focused on administrative tasks. Non-technical employees should have only basic knowledge about the new AI technologies such as operating and understanding the use of new technologies etc.".*

**Batuhan Baskurt, Autonomy Scientist:** *"Non-technical capabilities such as communication with an AI-powered system might be more useful than technical capabilities shortly. So, we can say that both are important".*

**Buğra Bölükbaş, Chief Technology Officer:** "In the short to medium term, such a necessity is necessary. However, in the long term, *AI systems will be able to realize this requirement themselves".*

**Emirhan Battal, Logistic Supervisor:** *"They must improve their technical and non-technical capabilities to compete with others. The basic use and understanding of new AI technologies are important for workers, and they must have these capabilities".*

**Habib Mahdum, Logistic Manager:** *"To collaborate with AI, the workers need to improve and develop both technical and non-technical capabilities. We can see those major multinational companies nowadays hiring those who have both of these capabilities".*

**Eszter Toth, Supervisor and team leader at IT support:** *"Technical abilities are highly valued in the workplace. These work skills assist individuals in navigating and elevating their organizations' systems for the benefit of the business. However, in every job description, you'll discover requirements for non-technical skills such as manners, communications, and leadership capabilities that aren't exclusive to any position but make for a successful employee. Even as technology enters every business, non-technical or "soft" work skills are more crucial than ever."*

**Ayub Awaz, Digital Marketing Manager:** *"It is very crucial, they must have both of these capabilities to understand AI applications better and increase productivity on their tasks."*

**Abdul Rehman**, **Procurement Manager:** *"Absolutely both are important."*

**20) Do you think that in human AI collaboration, human decision makers must have to keep their AI knowledge up to date and need to develop analytical skills?**

**Abdullah, AI Specialist:** *"Yes, it's essential, as, in many AI technologies, there are machine learning programs. These machines learn automatically from different things and keep updating themselves. Thus, human decision-makers must keep their AI knowledge up to date and need to develop analytical skills; if not, there will not be harmony and understanding of new AI technologies".*

**Batuhan Baskurt, Autonomy Scientist:** *"I don't think so. AI-powered systems should be more user-friendly than the existing technology. I think a human's role will be more in control of the process rather than the decision making".*

**Buğra Bölükbaş, Chief Technology Officer:** *"I think it's essential, in human-AI collaborations human decision-makers need to make crucial decisions thus they need to keep their knowledge up to date and try to learn new changes in AI machines to collaborate in the best way."*

**Emirhan Battal, Logistic Supervisor:** *"To work with AI, they must know about the new AI developments. Decision-makers should be more active to keep their knowledge about AI developments. In AI, machines learn by themselves when there is something new, and machines update themselves, so decision-makers must understand these changes and keep their knowledge updated".*

**Habib Mahdum, Logistic Manager:** *"it's important because decision-makers are those who usually collaborate with AI technologies and they analyze everything with the help of these technologies thus to make good decisions with AI they must have to keep their AI knowledge up to date, in this way they can understand the new updates and learnings of AI."*

**Esther Toth, Supervisor and team leader at IT support:** *"It is critical for human decision-makers to maintain their AI knowledge up to date and to improve their analytic skills. Frequent training programs and the acquisition of new information are required to guarantee sustainability and performance.".*

**Ayub Awaz, Digital Marketing Manager:** *"In human-AI collaboration, human decision-makers play an important role. AI technologies are developing and updating day by day, Human decision-makers must keep their AI knowledge up to date, and they must have experience about the AI applications they are using and how they can analyze everything while collaborating with new AI technologies".*

**Abdul Rehman, Procurement Manager:** *"It's essential, decision-makers must keep their AI knowledge up to date and develop their analytical skills too. I think they should keep learning about new developments of AI and how to utilize them in the best way".*

# RESUME

## A. Education

**Graduate:** İstanbul Sabahattin Zaim University

MBA, Business Administration and

Management, (2018 - 2021)

**Undergraduate:** İstanbul Sabahattin Zaim University

Bachelor of Business Administration - BBA

(2013 - 2016)

**Erasmus:** Universidade Nova de Lisboa

Bachelor of Business Administration - BBA, Information

Technology · (2014 - 2014)

**Second Major:** İstanbul Sabahattin Zaim University

International relations and political science · (2013 - 2017)

## B. Experience

**AIDRIVERS LTD**

Operations Executive

July 2019 - Present (2 years 6 months)

**EXTRATIK**

Business Development Officer

February 2019 - July 2019 (6 months)

**Istanbul Sabahattin Zaim University**

Assistant Specialist in student Affairs

September 2016 - August 2017 (1 year)

**Istanbul Sabahattin Zaim University**

Internship, IZU International Office

June 2015 - July 2015 (2 months)

## C. Publications

2020 - Impact of Artificial Intelligence on Supply Chain Management: Requirements for Human-Artificial Intelligence Collaboration, IZU Social Sciences Graduate Student Congress, Supervisor: Asst. Prof. Dr. Canser BİLİR

2017 - Impact of Globalization on Global Inequalities in Terms of Income, Health and Education, Undergraduate Dissertation, Supervisor: Asst. Prof. Dr. Mevludin IBISH