T.C.

ISTANBUL OKAN UNIVERSITY

INSTITUTE OF GRADUATE SCIENCES

THESIS

FOR THE DEGREE OF

MASTER OF BUSINESS ADMINISTRATION

IN BUSINESS ADMINISTRATION

OUMAYMA SARI

ROBOTICS & ARTIFICIAL INTELLIGENCE APPLICATIONS IN DIFFERENT FIRMS

A STUDY ON TUNISIAN COMPANIES

ADVISOR

Asst Prof.Dr HAKAN ÖZCAN

ISTANBUL, March 2022

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ÖZET

FARKLI FİRMALARDA ROBOTİK VE YAPAY AKILLI UYGULAMALAR, TUNUS FİRMALARI ÜZERİNE BİR ARAŞTIRMA

Yapay Zeka (AI) ve Robotik sistemleri ve uygulamalarının günümüzün ileri teknoloji teknolojileri olduğu varsayılmaktadır. Yapay Zeka ve Robotik uygulamaları, lojistik, nakliye, envanter yönetimi, depolama vb. dahil olmak üzere tedarik zinciri yönetimini (SCM) yeniden yapılandırır. Bu araştırma, bu uygulamaların kuruluşların başarısı için ne kadar önemli olduğuna ve bunların tedarik zincirini (SC) ne ölçüde etkilediğine ve kolaylaştırdığına odaklanmaktadır. süreçler. Araştırma ayrıca, hem Tunus'ta hem de dünya çapında farklı iş sektörlerindeki AI uygulamalarını karşılaştırmalı bir şekilde araştırıyor.

Robotik ve AI, hızla genişletilen devrim niteliğinde bir kavramdır, ancak bu konudaki literatür ilerlemiş değildir. Bu nedenle, bu çalışmanın amacı, hem Tunuslu hem de Tunuslu olmayan şirketlerde robotik ve yapay zekanın tedarik zinciri yönetimi üzerindeki etkisini analiz ederek, daha az gelişmiş ülkeyi, kalkınma ülkelerine kıyasla yapay zeka ve robotik kullanımında daha yüksek bir seviyeye ulaşmaya teşvik etmektir.

Bu çalışmanın sonuçları, anket bulgularına ve analizlerine dayanacaktır.

Şirketlerin referanslarını, raporlarını ve en son haberleri analiz ederek yapılan keşifsel bir araştırma. İkincil veriler, birçok farklı şirkete gönderilen 15 sorudan oluşan bir anketten toplanmıştır. Farklı sektörlerde faaliyet gösteren birden fazla şirketin yöneticileriyle yarı yapılandırılmış görüşmelere dayalı nitel.

Robotik ve yapay zeka lojistiği, insan hatalarını azaltarak önemli karlar getirebilir ve ayrıca depo maliyetlerini azaltabilir. Robotik, iş gücünün uyarlanabilirliğine izin verebilir. Robotik lojistik, yüksek raflardan veya depolama alanlarından eşya almak gibi tehlikeli işleri üstlenerek çalışanların güvenliğini artırır.

Anahtar Kelimeler: robotik , Yapay Zeka , lojistik , imalat , performans göstergesi , dijitalleşme , tedarik zinciri yönetim

ABSTRACT

ROBOTICS & ARTIFICIAL INTELLIGENT APPLICATIONS IN DIFFERENT FIRMS , A STUDY ON TUNISIAN COMPANIES

Artificial Intelligence (AI) & Robotics systems and their applications are assumed to be today's high-end technologies. AI& Robotics applications reconfigures the supply chain management (SCM) including logistics, transportation, inventory management, warehousing, etc., This research focuses on how important these applications are to the organizations success and to what degree they affect and facilitates supply chain (SC) processes. The research also investigates the AI applications in different business sectors ,both in Tunisia and worldwide in a comparative way.

Robotic and AI is a revolutionary concept that is being expanded rapidly, but the literature is not advanced in this topic. Therefore, the purpose of this study is to analyze the impact of robotic and AI on the supply chain management in both Tunisian and non Tunisian companies in order to encourage less development country to achieve a high level in using AI and robotic compared to development countries .

The results of this study will be based on questionnaires findings and analysis .

An exploratory research made by analyzing companies' testimonials, reports, and the latest news. The secondary data is collected from a survey with 15 questions sended to many different companies . Qualitative based on semi-structured interviews with managers of multiple companies operating in different industries.

By reducing human errors, robotic and AI logistics can bring in significant profits and can also reduce warehouse costs. Robotics can allow for workforce adaptability. Robotic logistics improve safety for workers by taking over dangerous jobs such as getting items from high racks or storage spaces

Keywords: robotic , Artificial Intelligence , logistic , manufacturing , performance indicator , digitalization , supply chain management

ABBREVIATIONS

AI	Artificial Intelligence
GPS	General Problem Solver
IoT	Internet of Things ML Machine Learning
OMS	Order Management System
WMS	Warehouse Management System
GPS	Geographic Positioning System
RFID	Radio Frequency Identification
JIT	Just in Time
TMS	Transportation Management System
ERP	Enterprise Resource Planning
SRM	Supplier Relationship Management
CRM	Customer Service Management
SCM	Supply Chain Management

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CHAPTER 1 INTRODUCTION

Artificial intelligence (AI) and robotics are very recent technologies and risks for our world. They considerably develop their capacities and shift their origins of development of intentions to other dimensions. When humans see the past stories of AI and robotics, humans can examine and understand their own goals and intentions that make life easier and help humans in different circumstances and situations. However, currently and in the near future, due to the change in attitude of inventors and experts in robotics and artificial intelligence, as well as the nature of artificial intelligence, Their ability to acquire and adapt to new environments may cause them to become predators, putting species at risk. They can also get a creature's entire essence. As a result, either they will construct their own universe or the fate of our planet will be threatened.

Artificial Intelligence (AI) is a normally hired appellation to consult the sphere of technological know-how aimed toward supplying machines with Logic, thinking, planning, learning, and perception are all aspects of acting's potential. Despite the fact that this definition mentions "machines," it will be applied to "any kind of living intellect". Likewise, the that means of intelligence, as it's miles observed in primates and different great animals for instance, it is able to be prolonged to consist of an interleaved set of capacities, which includes creativity, emotional knowledge, and self-awareness. The time period AI changed into intently related to the sphere of "symbolic AI", which changed into famous till the quit of the 1980s. In order to overcome a number of the constraints of symbolic AI, subsymbolic methodologies inclusive of neural networks, fuzzy systems, evolutionary computation and different computational models began out gaining popularity, main to the time period

“computational intelligence” rising as a subfield of AI. Nowadays, the time period AI encompasses the complete conceptualisation of a system this is sensible in phrases of each operational and social consequences. A sensible definition used is one proposed via way of means of Russell and Norvig: “Artificial Intelligence is the look at of human intelligence and moves replicated artificially, such that the consequent bears to its layout an inexpensive degree of rationality” (1).This definition may be in addition refined via way of means of stipulating that the extent of rationality might also additionally even supersede humans, for unique and well-described tasks. Current AI technology are utilized in on-line advertising, driving, aviation, medicine and private help photo popularity. The current achievement of AI has captured the creativeness of each the scientific network and the public. An instance of that is automobiles ready with an automated guidance system, additionally called self reliant cars. Each car is ready with a series of liar sensors and cameras which permit popularity of its three-d surroundings and affords the capacity to make sensible selections on maneuvers in variable, real-site visitors street conditions. Another instance is the Alpha-Go, evolved via way of means of Google Deepmind, to play the board game Go.

Last year, Alpha-Go defeated the Korean grandmaster Lee Sedol, turning into the primary system to overcome an expert participant and currently it went directly to win towards the modern-day global variety one, Ke Jie, in China. The variety of viable video games in Go is envisioned to be 10761 and given the intense complexity of the game, maximum AI researchers believed it might be years earlier than this may happen. This has brought about each the excitement and worry in many who AI will surpass human beings in all of the areas it involved. However, modern-day AI technology are restricted to very particular applications. One problem of AI, for instance, is the shortage of “ordinary sense”; the capacity to choose statistics past its obtained knowledge. A current instance is that the AI robot evolved through Microsoft and designed for making conversations on social platforms. It needed to become unconnected rapidly after its release as it changed into now no longer able to differentiate among high quality and bad human connection. AI is likewise restricted in phrases of emotional intelligence. AI can best discover a fundamental human morale state which includes sadness, anger, worry, pain, strain and neutrality. One of the next horizons of better levels of customisation is emotional intelligence. True and entire AI does now no longer but exist. At this level, AI will be able to imitate human cognition to some extent that it's going to allow the capacity to dream, think, sense feelings and feature very own goals. Although there may be no proof but this form of authentic AI may want to exist earlier than 2050, although

the laptop technological know-how ideas riding AI ahead are unexpectedly advancing and it's far vital to evaluate its impact, now no longer only from a from a technical perspective, however additionally from a social, moral and prison point of view.

There are five chapters in this study. The first chapter is an introduction,which include an introductory on e investigated subjects of the research and a brief description of its contents The second chapter is the theoretical knowledge, SCM element explanations and applications, as well as robotic and AI concepts and an introduction of some of the research's applications and models are all included.The study method, questions, restrictions, and research questionnaire are all demonstrated in the third chapter. The fourth part contains survey which contains 15 questions which has been performed on 12 companies from Tunisia which is a non development country and worldwide companies which are more development , as well as an analysis of the research questionnaire and a comparison is talked about the application of AI and robotic integration in order to encourage less development country (Tunisia) to go further in the term of AI and robotic . Finally, the fifth chapter which represents the obtained results, conclusions, and future research suggestions.

CHAPTER 2 THEORETICAL BACKGROUND

2.1 Supply chain management

2.1.1 Definitions

The supply chain is a relatively new period in time, having been first recognized in 1958. Jay Wright Forrester* had made a mental note of this concept without ever labeling it. You can read all of his writings, but the time period supply chain does not exist in any of them! Nonetheless, he remains a significant theorist in this field. As an alternative, he came up with a fair and current definition of the supply chain. Supply chain, when translated from English, now refers to the supply chain or supply chain management (1).

Essentially, the supply chain denotes the various levels of acquisition, manufacture, and distribution of goods. It's made up of a number of streams. Physical flows, information flows, and financial and administrative flows are all examples of this. As a result, flow management is the key issue. The deliver chain isn't usually the logistics chain, which refers to warehouse control, internal and external transport flows, chemicals, and the final shipment of items to customers.

In a later post, we'll return to this topic. The ultimate goal is to get the right item, at the right place, at the right time, in the right portions, and in the right condition, all at a lower cost. It is a necessary component of the supply chain, but it only relates to one section of the SC. The words are mutually beneficial, and one technique cannot exist without the other. However, they are never interchangeable.

So be careful, whilst the use of those phrases, to apply them successfully with out difficult them.However, past being a time period designating the collection of steps that the products

follows from its introduction to its arrival on the quit customer, it's miles a present day and revolutionary idea that permits a organization to be extra aggressive at the marketplace. the marketplace in opposition to its competitors.

A supply chain is described as a network that links a supplier's supplier to a customer's customer. To put it another way, it's a chain that brings together a group of specialists and tries to get them to collaborate as much as possible. As a result, we include manufacturers, suppliers, producers, transporters, purchasers, and logistics providers among the supply chain's major players.

Example

What exactly is a supply chain? Here's a concrete example for newcomers. As I stated at the outset of this definition of the supply chain, it encompasses all product ranges. From the initial introduction to the final consumer. But what exactly does that imply? Let's walk through the process of making a jar of tomato sauce from beginning to end.

- In his land, a farmer plants tomatoes. He sells them to a distributor. The merchandise is delivered to the wholesaler (provider of the products).
- The tomatoes are delivered to the distributor, who immediately sells them to a company that makes tomato sauce. The tomatoes are delivered from the wholesaler to the garage warehouse, which is located within the factory's pre-manufacturing area.. - The tomatoes go through a metamorphosis process once they get at the manufacturing plant. They turn into tomato sauce.
- They leave the factory once the tomato sauce pots are ready. They are transported to the warehouse, where they are packaged and placed on pallets for shipment to the customer. During this stage, the products are also distributed to numerous clients in accordance with the quantities ordered through them.
- The items then go away the warehouse for vendors to be bought in supermarkets to stop consumers.

2.1.2 Valuable tools

It is a long and complicated procedure, made even more complicated via way of means of the duration of the chain. It is consequently vital to manipulate, manipulate and well alter the flows generated. The organization can anticipate diverse control equipment at its hands:

ERP, CRM, SRM, TMS, GPAO, WMS, PLM, etc.

Too many abbreviations which form all of the software program critical for a organization as a way to higher manipulate its activities. They permit it to be as productive, efficient and profitable as possible, usually maximizing consumer pleasure and being attentive to the environment.

When a consumer locations an order with a organization, there's an entire procedure in region to create the product and supply it to them. Thus the supply chain brings collectively all of the capabilities inner and outside to the organization, which can be chargeable for and actors of this procedure, of this "chain". I used to be talking about the flows that make up the supply chain earlier. Supply Chain Management is the result of a well-managed combination of the three flows (physical, records, and financial). So, here's something to assist you better understand, a more detailed rationalization of each of those flows.

2.1.3 The different flows of the SCM

2.1.3.1 Physical flow

Physical flow is made up of material flows (purchase of raw materials, transformation of raw materials into product, delivery of products.) The optimization of this flow aims to satisfy the customers of the system.

The activities and processes of physical flow (supply, manufacture, distribute, plan).

The physical operations cover mainly the transport, handling, storage and differentiation of products

2.1.3.2 Information flow

As its name indicates, a data flow is a transfer of useful information carried out from point B to point A. The operation is carried out from a conveyor belt where the processing of the elements is sequential and not global. It is important to distinguish clearly between the flow and the batch of data. The latter is a series of automatic commands that result from a process. On the other hand, one flow generates other flows to ensure the transfer. We then speak of

processing chains since these same flows, sometimes assimilated to filters, present similarities in their operation.

Information flow management is involved both in the operation of computer equipment and in the applications it offers. This aspect is constantly put to contribution in the use of a PC. Moving files, starting up software, managing traffic for an IP network, statistical analyzes, web browsing, managing incoming and outgoing information ... Whatever aspect is concerned, data flow is an essential factor in heart of any IT activity.

How does an information flow work?

In order to provide and to transcribe the data in its original form, the management of the transfer of information requires a rigorous protocol. The system integrates a type of continuous requests to ensure an automatic renewal of execution. This ensures the continuity of data which is, in essence, volatile. As for requests, they are considered static.

It is also possible to take into account a reduction in the load in the management of data flows. The principle is based on adaptation mechanisms in order to match the variables of fluctuations and the pace of information. In particular, this prevents a break in the processing chain.

Whatever mode is adopted, the flow of information must remain stable and efficient. This is why there are several system offerings dedicated to data flow management.

ERP, CRM, SRM, PLM, TMS, WMS, GPAO, and other management solutions are available to the organization (2).

2.1.3.2.1 ERP

Accounting, purchasing, mission control, risk control and conformity, and supply chain operations are all examples of regular commercial enterprise tasks that are controlled by enterprise resource planning (ERP) software. A complete ERP package also includes company's business overall performance monitoring, software that allows an organization to plan, budget, forecast, and report on its financial results.

ERP systems connect a slew of business processes and allow data to move freely between them. ERP architectures eliminate data duplication and provide records accuracy with a single point of contact by gathering an organization's common records from a few sources. ERP

systems are now required to manage hundreds of businesses of all sizes and across all industries. To those enterprises , ERP is just as important as the energy that keeps the lights on.

ERP business value :

In today's commercial enterprise world, it's impossible to overlook the impact of ERP. Companies can link different divisions and improve workflows when corporate records and techniques are herded into ERP systems, resulting in substantial lower right savings. The following are some examples of specific commercial enterprise advantages:

• Improved commercial enterprise insight from real-time facts generated with the aid of using reports

• Lower operational prices via streamlined commercial enterprise techniques and first-rate practices

• Enhanced collaboration from customers sharing records in contracts, requisitions, and buy orders.

• Improved performance via a common consumer experience across many commercial enterprise capabilities and well-described commercial enterprise techniques

• A consistent infrastructure from the back office to the front office, with all commercial enterprise sports having the same look and feel.

• Higher customer adoption costs as a result of a standardized user interface and design

• Chances are reduced due to increased record integrity and cost controls.

• Reduced control and operating cost through standardized and integrated structures

2.1.3.2.2 CRM

Relationship Management, or CRM, is a technique for managing a company's interactions and connections with its clients or future customers. A customer relationship management system (CRM) aids businesses in maintaining continual contact with customers, streamlining operations, and profit growth.

CRM generally covers three concepts:

CRM as a software: a platform technical tool that allows teams to record, monitor, and evaluate transactions between the organization and its customers. It's also known as a customer relationship management (CRM) system or solution.

CRM as a strategic approach: a corporate philosophy on how to handle customer and prospects interactions.

CRM as a procedure: a company's method for developing and managing these connections.

What does CRM software do?

Customer interaction info, such as email accounts, phone numbers, and social media accounts, is stored in CRM software. It can also instantly retrieve other data, such as the most recent company news, as well as store information such as client communication styles.

The Crm software organizes this data to give you a complete record of people and companies, allowing you to better understand your interactions through time.

CRM software enhances customer relation management by providing a 360-degree view of customers, documenting their actions with the company, and surfacing the information needed to improve client discussions.

What benefits does a CRM bring to the various functions of the company?

Although CRM has long prevailed as a sales and marketing tool, it also offers major benefits Customer care, HR, supply chain, and company is engaged are just a few examples.

Here are the benefits that a CRM brings to the various functions of the company:

Sales teams can use CRM to gain more control over their sales pipeline.For example, Managers of sales have access to dependable information. information on team members' progress against their goals, or observe the performance of sales teams, products and campaigns.Sales reps are relieved of some paperwork, understand their customers better, and spend more time selling than entering data.The phrase pipeline refers to the progression of a long-term aim through a succession of distinct stages.

CRM can help marketing departments improve prediction performance and simplicity.

They can organize the complete client experience, from the request through the sale, because they have excellent insight into each opportunity or business lead. As a result of this information, they are able to better monitor the sales funnel and make more accurate

estimates. Customer information from social media can also be used, such as what they like, dislike, and how they feel regarding specific products or companies.

Client service representatives can keep track of interactions across many channels in the following ways:

A client can raise an issue on a social media platform like Twitter or Facebook and then resolve it privately via email, phone, or Live Chat.

In the lack of an unified platform devoted to client interactions, they may become drowned in a sea of data, causing consumer unhappiness.

Relationship management is easier with dedicated supply chain, purchasing, and partner management teams.

They may track requests, make valuable notes, set reminders, and predict future steps after meetings with partners and suppliers.

Companies can use monitoring to compare provider productivity and better control the entire supply chain.

CRM can be used by HR to speed up the hiring process and keep records of employee productivity.

CRM can aid HR by accelerating the recruitment, automating candidate management, assessing project resources, detecting talent shortages, and promoting employee loyalty.

The advantages of CRM:

1. Improved management of contacts

2. Collaboration between teams

3. Increased productivity

4. Dynamic management of sales

5.Accurate forecasting of sales

6. Consistent reporting

7. Optimized business indicators

8. Satisfied customers are higher.

9. More profitable marketing financial return on the investment

10. Best services and products (3).

2.1.3.2.3 Warehouse Management Systems (WMS)

A warehouse management system (WMS) is a combination of programs and systems that allow businesses to manage and track warehouse management from the time items or materials enter until they leave.

What is the purpose of a WMS?

Because they store everything from raw resources to finished good, warehouses are at the center of industrial and supply chain activity. A (WMS) is designed to aid in the efficient and cost-effective movement of commodities and products through warehouses. A WMS manages many functions that enable these motions, include inventory tracking, selecting, shipping, and put away.

A WMS also allows a company to see its inventory at any moment and in any location, whether it's in a warehouse or in transit.

WMS's Role in the Supply Chain ?

Only warehouse practices allow the supply chain to operate at the rapidity, reliability, and effectiveness that they do. A warehousing (WMS) is critical to supply chain management since that oversees the product delivery procedure from raw resources collection to delivery of completed goods.

If natural resources are not collected efficiently or components are misplaced in a warehouse, the distribution system may be affected. By survey takes and ensuring that things are appropriately gathered, sorted, transported, and controlled, WMSes are critical to ensuring that these operations work successfully.

Warehouse management systems have certain characteristics:

WMS software products exchange a lot of features .The following are some of them:

• Warehouse design enables businesses to customize workflow and selection logic to guarantee that the warehouse is configured for optimized inventory distribution. To maximize capacity and adapt for seasonal fluctuations, the WMS provides bin slots.

• Inventory detection, which enables enhanced tracking and automatic identifying and data gathering (AIDC) devices like RFID and barcode scanners to ensure that products are quickly found if they need to transit.

• Receiving and put away, which aids warehouse personnel in storing and retrieving merchandise utilizing pick-to-light or pick-to-voice technologies.

• Area selection, phase selection, and group selection picking are all methods of picking and packaging items. Pick-and-pack activities can also be directed in the most effective way by using lot zoning and job interleaving functions.

• Shipping, which enables the WMS to send shipping documents (B/L) in advance of a cargo, generate packing lists and receipts for the cargo, and notify responsive recipients of the cargo in advance.

• Labor management, which assists warehouse managers in evaluating workers' production using performance indicators (KPIs) that show when or not they are working as expected.

• Property and port management is a service that assists truck drivers in finding the optimal loading terminals while entering a warehouse. With a more complex usage of yard and dock management, cross-docking and additional inbound and outgoing responsibilities are feasible.

• Reporting, which aids managers in analyzing warehouse operations and identifying areas for improvement (4).

2.1.3.3 Financial flow

Financial balance is one of the triangular stones of business success. Keep in mind that it is the cessation of payments (i.e. insufficient cash flow to cover debts) that justifies filing for bankruptcy. This financial balance of the company is ensured by the management of its financing and its cash flow: The incoming and outgoing financial flows of the company are materialized by financing and cash flow tables whose evolution over time according to Business needs are anticipated by its manager. Cash investments, short and medium-term bank financing, accounts receivable recovery, capital increase, etc. are all problems that can be developed in this section.

Payments made between the company and its partners constitute financial flows.

They correspond to movements of money or commitment of money.

- entry (employment) Cash flows can be classified into:
- ➢ financial flows as a counterpart to external physical flows
- ➢ financial flows of financing

External flows concern two economic agents. The balance of partners' obligations therefore reveals two external flows. Example:

- seller's obligation: deliver the item sold (physical flow resource)
- the buyer's responsibility: to pay the price of the thing (resource of the financial flow)

Only one economical agent is affected by internal flows. They take place within the company. As a result, there is only one flow. Transferring an equipment from workplace A to workshop B, for example.

2.1.3.4 The synchronization of flows

Three operational excellence tools at your fingertips:

Currently when we speak of "industrial excellence", which corresponds to a triple problem for any company, namely:

- get the best customer service rate,
- control the operational costs (supply, manufacture, distribution) inherent in its supply chain and
- Reduce its level of cash-consuming stock.

To achieve these objectives, it is necessary to implement the following 3 tools in an appropriate manner:

- Good planning
- A fine control system where all the flows must be synchronized
- A LEAN-type continuous improvement methodology

If the knowledge concerning the first and the last point is currently well mastered by a good number of industries on the other hand the synchronization of the flows is in its beginnings.

The Synchronization of Flows certification training aims to fill this knowledge gap by addressing all the topics related to the synchronization of kanban * type flows, synchronous flows and others.

- Putting into practice the principles of flow synchronization brings "automaticity" to the daily management of flows and eliminates a very large part of the Scheduling phases of Production Orders. This simplification of the daily work of the scheduler is carried out thanks to the management of flows directly carried out by the Operator.
- Giving back control of flows to people on the ground with the right management tools, such could be the adage of these methods of synchronizing logistics operations.
  Kanban (Japanese:, signboard or billboard) is a lean strategy for organizing and improving work in human systems. This method tries to manage work by balancing demand with additional capacity and enhance system bottleneck management.
  Management by Synchronization of Flows
  We could define the physical synchronization of flows as being: "the set of flow control techniques consisting in physically coordinating: the supply, production and delivery of parts by focusing on real consumption or real demand"

  The classic MRP2 system generally generates supply or manufacturing programs taking into account forecasts and current or forecast stocks stored in the warehouse.

  - In a synchronous system:

  Forecasts will not be used to generate Production Orders, but will, by using them over a medium or long term horizon, determine the number of resources required (men, machines.)
  Likewise, the supply or manufacture will only be carried out as a function of a certain event, namely a customer order (Pushed Synchronous Flow) or of an actual consumption by the downstream workstation (Pulled Synchronous Flow).
  if there is presence of stock in a synchronous flow, the latter will not intervene in any formula aimed at modifying the Request (5).
  A synchronous flow will always respect the principle:

Production or Supply = Actual Demand

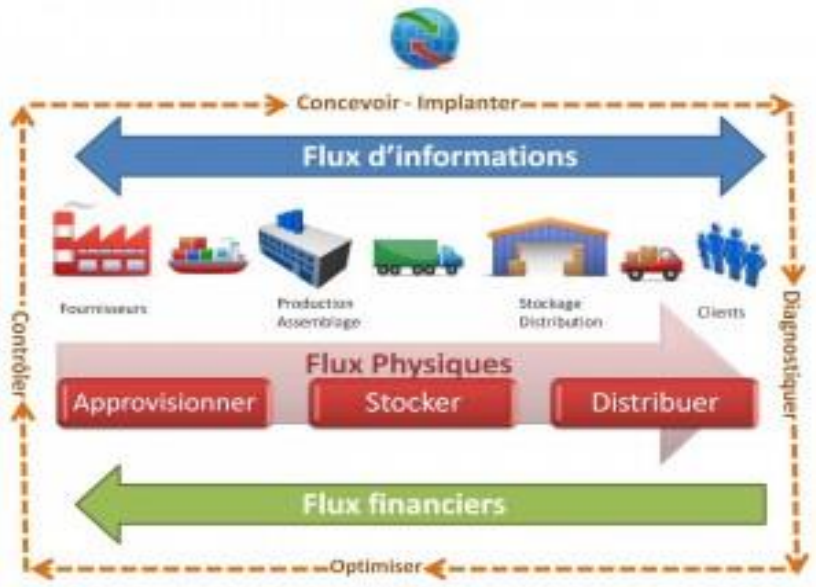

Figure 2.1.3.3: The Synchronization of Flows

2.1.4 Inventory Management

Inventory may be a large asset which could assist a corporation reply to its clients fast via way of means of offering a barrier towards sudden demand changes, first-rate issues, and supply chain disruptions. Stock, on the opposite hand, can be a legal responsibility that makes use of up present company sources via way of means of assisting the expenditure of preserving stock, tying organization employees to stock control, and concealing the supply of logistics/first-rate difficulties. Inventory control is basically a technology that entails figuring out the form and site of saved items.

It is needed to arise earlier than the ordinary and scheduled route of fabric manufacturing and garage at numerous locations inner a facility or throughout more than one deliver chain sites. Inventory control is basically a technology that entails figuring out the form and site of saved items. It is needed to arise earlier than the ordinary and scheduled route of fabric manufacturing and garage at numerous locations inner a facility or throughout more than one supply chain sites

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Inventory control is involved with the excellent strains that exist among replenishment lead times, carrying stock costs, asset control, stock forecasting, stock valuation, stock visibility, destiny product charge forecasting, bodily inventory, available stock space, great control, replenishment, returning defective merchandise, and demand forecasting. Optimal stock degrees are carried out via way of means of balancing those conflicting objectives, that's a dynamic method as commercial enterprise desires alternate and reply to the broader framework. Inventory control necessitates a retailer's attempt to buy and hold an appropriate choice of merchandise even as retaining costs which includes sourcing, shipping, and storage in check.

It additionally includes structures and strategies for outlining stock desires, placing objectives, along with replenishment methods, tracking real and anticipated stock degrees, and dealing with all tracking and cloth control functions.

This will entail monitoring stock because it flows inside and out of stockroom places and resetting stock balances. These also can assist with ABC analysis, batch monitoring, and cycle counting, amongst different things. With the number one purpose of assessing/handling inventory volumes in the bodily distribution network, stock control moves a stability among the call for product availability and the want to lessen inventory retaining and dealing with expenses.

2.1.5 logistics and Transportation Management System

Logistics includes handling the whole thing associated with the shipping and storage of the enterprise's merchandise: cars important for shipping, enterprise suppliers, warehouses, handling, etc., whilst optimizing their visitors to reduce charges and delays. Logistics control is now accomplished via the enterprise's records systems.

For it to be efficient, the enterprise need to preferably use a clear and same codification for every feature of the enterprise, and use the faraway transmission of records The goal of the enterprise's logistics feature is to coordinate merchandise in flow in order that merchandise flow into continuously (to lessen shipping times) and to institution merchandise (to lessen charges).

The enterprise's logistics chain manages flows as effectively as viable to lessen the subsequent major charges: deliver charges, shipping charges, manufacturing charges, storage charges. Logistics control is based on signs to degree the overall performance of the system in area and detect wherein the enterprise desires to improve, such as:

For supplies: availability price and shipping times;

For storage: tracking the cost of the stock, losses in cost and insurance of stocks.

For shipping: Average price consistent with product and filling price of the manner of shipping.

Because transportation is so critical to the supply chain, supply chain professionals will higher prepare, handle, and optimize it. Transport, on the alternative hand, will become extra sophisticated as human civilisation advances. Expanded worldwide reach, numerous mode choices, evolving regulatory/deregulatory laws/policies on transportation, restricted gasoline availability, and more than one stakeholders all make a contribution to transportation's complexity.

To simplify the intricacies of transportation, we should first recognize and verify the important capabilities and settings that surround it. Transportation, for example, lets in the switch of uncooked substances and manufacturing additives/elements to the producers' locations. Similarly, transportation allows producers to supply completed merchandise to their customers' locations.

As a result, transportation provides cost via way of means of moving uncooked substances, additives/elements, and finished items to areas wherein they may be wished or consumed.

Transportation also can set up time-primarily based totally software via the transportation of the vital sources on the identical time on the identical location. Throughout the producing plant, for example, meeting desires a few additives and group of workers on the identical time. Transit enables them to arrive at the same manufacturing location at the same time, preventing manufacturing delays (waste of time).The incremental alters in enterprise situations and idea of control during the last years have eleven appreciably prolonged those simple shipping capabilities. Those alters comprise the following:

• Innovations in technology, inclusive of geographic positioning structures (GPS), satellite tv for pc monitoring structures, and radio frequency identification (RFID) that allow tracking of the placement of shipments throughout movement.

• Involvement via way of means of the authorities in shipping practices with the purpose of regulating the scale of opposition at the market and enhancing shipping safety.

• High gas expenses, requiring the developing utilization of different forms of gas.

• Due to commercial enterprise globalization, operations stretching the complete deliver chain and sooner or later related to intermodal shipping with ordinary modal transfer.

• Just-in-time (JIT) transport structures that require rapid, undisturbed transport inside a restricted time frame.

With rising shipping costs due to uncertain gas prices and high labor costs, there may be an increasing need to upgrade transportation components, anticipate any cost savings, and increase supply chain visibility through effective shipping planning. With this kind of need a shipping control system (TMS) fits the purpose. A software program programmer is commonly used in a transportation control device to manipulate all components of inbound transportation activities such as order practice, loading plan, courier selection, truck pathways, freight accumulation, complaint handling, freight invoicing, and audit. TMS has been extended to include more highlights that can manipulate/control beneficial resource lively as a response to the increasing complexities and globalisation of transportation activities, area control, dealing with sudden activities with cargo following, palletization, documentation wished for import/export, risky fabric delivery, and opposite deliver chain / logistics. A TMS gives numerous organizational benefits if nicely implemented. Those advantages include:

• Reductions in expenses. • Improved purchaser loyalty via best course planning/scheduling, warranty of transport and spark off processing of claims.

• Enhanced visibility of the deliver chain via way of means of stay tracking of cargo and specific delivery notification.

• Decreased administrative burdens via way of means of automation.

2.1.6 Information Technology IT

Information technology (IT) enables businesses to interact with one another at any time and from any location, allowing them to establish a strong commercial company relationship, which in turn promotes information and increases supply chain visibility. E-rapid commerce's growth has completely transformed how people conduct business. Because it allows businesses to get closer to its customers without the involvement of intermediaries, it hastens the process of diminishing the usage of traditional channels such as retailers and wholesalers. However, from another perspective, it increases the pressure on manufacturers' production and distribution requirements, as they may choose to promote and supply products to customers immediately. As a result, logistic may be a significant differentiator for organizations competing in the E-commerce industry. As integrated has become a focal point of supply chain management, an increasing number of organizations have sought to improve their ability to effectively organize, communicate, and interact with their customers and suppliers. These initiatives enable their employer-huge business capabilities and communication business operations to be integrated and coordinated. For such incorporation and harmonizing, many firms have begun to recognize the application of strategic records structures such as customer relationship management (CRM), supplier relationship management (SRM), and enterprise resource planning (ERP).With its ability to maximize traceability, RFID has a lot of potential as a new emerging technology for automating SC procedures. Not most effective does it assist decorate patron pleasure via optimized stock quality, it additionally enables enhance safety of the deliver chain thru the shifting stock's real-time tracking functionality. Another benefit of RFID consists of higher use of warehouse and retail area thru progressed stock place management (6).

2.1.7 Forecasting

It's impossible to forecast with 100 percent accuracy. This is the case while demand and supply are in balance. Forecasting's fundamental goal is to be able to foresee the future over a lengthy period of time. Furthermore, the emphasis is on decreasing anomaly and prediction errors, which could aid in the refinement of the records used. Predictions are commonly generated inside the supply chain utilizing a combination of fundamental statistical models and judgment (7). While making a judgement adjustment to a unique statistics forecast, is a widely employed strategy. Carrying forward with the statistical projections that have been produced, the records can be accumulated with the aid of using the analyst from a couple of

departments withinside the business enterprise, which include the advertising department, consequently the estimate will be changed to make clear the extra details. Many of the most recent projections will thus be treated as the very last estimate inside the supply chain. Such forecasts created within collaborating, it is suggested, are extremely important inside the predicting interest (8). Forecasting accuracy is critical to the success of any supply chain system. Previous initiatives have demonstrated the importance of displaying a larger range of records. Sharing data and making collaborative predictions can help the supply chain value approach while reducing waste and lead time. Similarly, poor records can lead to downward changes in the statistical projection, which can lead to lower changes in the estimations as well (9).For every other case examine made for a business enterprise that manufactures electronics there has been what could be known as purposeful silos, there had been positive barriers that couldn't be included from numerous roles withinside the business. Olivia and Watson looked examined the distribution network as well as the engagement process in great detail (10).

2.1.8 Just in Time

A just-in-time system requires a regular delivery service as well as specific device control. Organizations that use JIT should be extremely flexible and responsive, which is a wonderful approach to recall the unyielding teamwork required in the shipping and distribution business. The JIT method necessitates a complex and methodical approach to sourcing, warehousing locations, and alternative plant life close by.Adjusting the device to the JIT transportation system might also additionally cause or make contributions in lots of adjustments: firstly, with the aid of using decreasing the lead time requirements, faster transportation might result; secondly, with the aid of using shrinking the dimensions of shipments and each day dispatch might also additionally impact transportation expenses being reduced (9). that this may make contributions to a success forecasting (10).

There is inadequate evidence, however, that higher statistics integration or statistical traits of forecasting sports will decorate predicting. To attain an outline at the benefits of amassing extra statistics with the aid of using the usage of statistical analysis, A huge number of elements should be taken into consideration. There are several false linkages between the utilization of various statistic 14 sources and the projected overall performance indicators that are dependent on organizational procedures (9).

2.1.9 Management of risks inside the SCM

The supply chain is a complicated supply system made up of a rising number of interconnected operators. Operational performance and response are no long sufficient to control operational risk in the face of the expansion of these actors. Manufacturers can only ensure the smooth operation of their logistics activities by identifying risks connected with their sales and distribution networks.

Nonetheless, because to its subjective and cyclical nature, the idea of risk is difficult to measure. So, how do you evaluate the potential impact of risks on your company? What can be done to control the effects? Purchasing and Logistics Chain (or Logistics) operations now have a plethora of tools and strategies for identifying and controlling the risks that threaten their supply chains.

2.1.9.1 Identify the risks inside your supply chain management

Risk management is a significant concern for supply chain participants. Consumers are becoming increasingly concerned about the quality and provenance of their items. All of these elements have a role in their purchasing decision. Companies must keep total control of your supply chain in order to achieve these standards and secure the long-term viability of their operations. They must have a broad vision and implement a defined set of responsible practices that are tailored to each category of risk.

Several types of risk confront supply chain teams, each of which can have substantial implications for the supply chain. Both of these factors associated is associated with a set of best practices that should be included into company processes.

Internal risks:

Internal risks are inextricably tied to the nature of your company and the sector in which it operates. As a result, you can exert direct control over them and eradicate the core causes.

Project management: Inadequate project management can have a damage the reputation of your activities as well as your supplier relationships. This is frequently the outcome of a blunder in people or technical resource allocation. To avoid this, ensure that the project manager has a thorough understanding of your SC and its actors.

Human resources: arguably most hardest to forecast, human risk is linked to planning a project. A labor interruption, a lack of knowledge, or a blunder in judgment can all affect output rates.

External risks:

External dangers are different in nature, as we will see below. They are influenced by your workplace, the setting, and the activity of other supply chain actors. While you may not have direct influence over their origins, you can nevertheless learn about them and develop procedures to reduce their effect on the firm.

Financial risks:

Unexpected price increases, whether due to inflation or volatility, make purchasing decisions and, as a result, procurement activities more difficult. This can put a company's market position in jeopardy over time.

Buyers, for example, are interested in forming contract extensions with their suppliers to avoid the effects of inflation. They reduce their investment risk by deciding in front on the necessary tariffs. Companies, on the other hand, lose negotiation room and flexibility as a result of this (11).

2.1.9.2 How to reduce risks

Businesses confront numerous hazards, which is why managing risk should be an integral aspect of any company's strategic planning. Risk management assists you in identifying and addressing the risks that your company faces, increasing the likelihood of meeting your objectives.

A risk management process involves:

- high precision of the risks associated with your firm's operations
- determining the probability of an event

• determining how to respond to these events • establishing systems to live with the consequences

• monitoring the efficiency of your methodologies and controls

As a result, the risk management process:

• promotes judgement, planning, and prioritization

• aids in the effective use of capital and resources

It enables you to foresee potential problems, lessen the amount of fires you'll just had to put out, or, in the worst-case scenario, avoid tragedy or significant financial loss.

• Significantly increases your chances of completing your business strategy on time and within budget.

If your business chooses to try something different, such as releasing a product or expanding into new markets, risk assessment becomes even more critical. In such circumstances, two risks to consider are your adversaries following you into all these marketplaces or technical developments rendering your product obsolete.

2.1.10 The quality factor inside the SCM

If zero risk does not exist, In terms of quality control, several industrial actors have implemented a zero tolerance approach. And rightly so! The slightest quality defect can result in poor equipment maintenance, a slowdown in production or even a stoppage of marketing.

The quality risk is both an external and an internal risk factor.The flaw could be the result of shoddy products or services obtained from vendors, or it could come from the organization's own production line.

Manufacturers, on the other hand, have a number of standard processes and quality assurance labels that allow them to maintain control over their value chain.
The 6 Sigma (or Six Sigma) approach established by Motorola, the telecommunications behe moth, deserves special note.

The Movement Work Hub system enables industry providers and users of their goods to share best practices. OEMs and consumables makers can share their technical material with

Movement Working CMMS (Computer Aided Maintenance And management) users in terms of improving the utilization of their products by making their official catalog available.

2.1.10.1 The six sigma method

Definition:

The Six Sigma process was developed in Motorola plants a few years ago. Six Sigma has developed and expanded into a global approach to management and planning process, having been successfully adopted by significant corporations such as General Motors. Now, the contributions of the 6 Sigma method concern both industrial companies and service companies. The requirements for quality optimization are no different (12).

What is the principle?

The approach offers method and tools to improve process capability while reducing defects.

If we can measure, we can correct

The method owes its name to the statistically acceptable level of variation, ie 3.4 defects per million units produced. Reaching the six sigma profitable level is therefore an objective, and the eponymous process offers tools and methods to reach it.

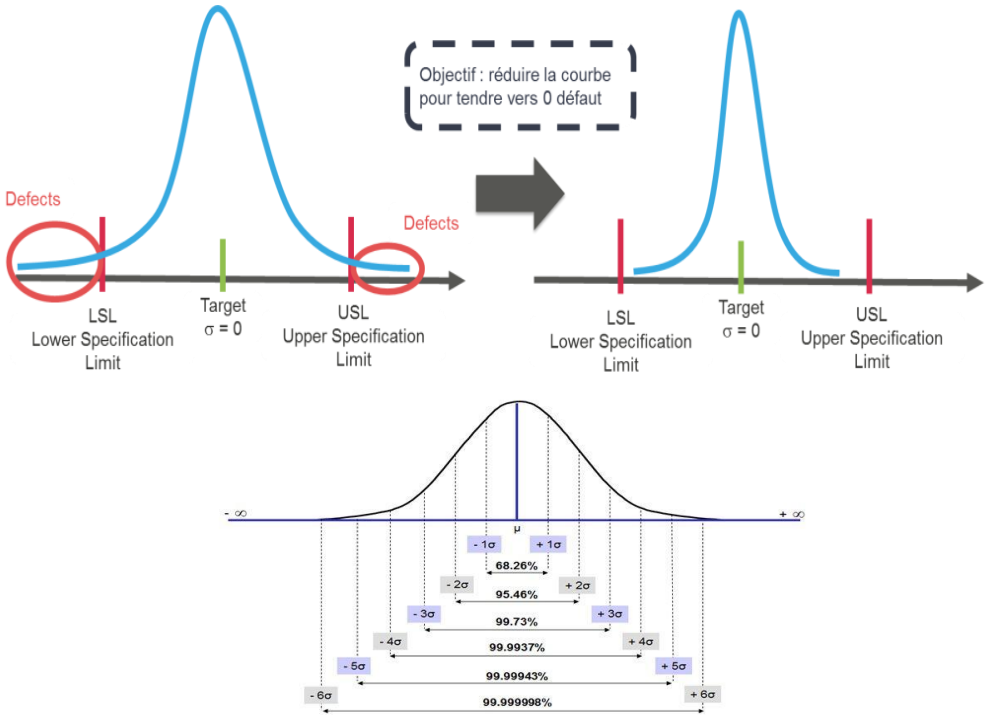

Figure 2.1.10.1: The six sigma method

The 5 steps of the DMAIC method in detail

The Six Sigma strategy is built on a measuring premise that is systematic and targeted. Measuring seems to be the only way to effect change in a specific direction. It is still required to identify the measure's principle, aim, and target. The DMAIC technique clearly and accurately describes the five steps to successfully conduct an improvement project. Each of the letters in the abbreviation D.M.A.I.C. stands for the first letter of the step's considerable effect.

Figure 2.1.10.1: The six sigma method (DMAIC)

The strategy's initial step is to "define." It allows for the definition of the project's scope, expectations, required resources, and timeframes.

"Measure", Gather representative data, assess performance, and find areas for improvement. Assessment of present performance and fluctuation (trend, cycle ...).

"Analyze", To discover the sources of problems, analytic and statistical approaches are used. It is vital to comprehend the challenges at this point in the method's development in order to build solutions that will cross the gap between the current state and the clients' goals.

"Enhance," which includes identifying and implementing ways to prevent the issues mentioned above. This crucial stage can occur in numerous stages in certain circumstances. This allows you to devote more time to testing and validating the best solutions.

"Control," or the monitoring of the implemented solutions. It's critical to avoid going backwards. The results, on either hand, are not usually obvious right away. The work must be

maintained, if not shifted entirely. This is the most sensitive stage, which applies to all improvement activities. Returning is always a possibility. Supporting the effort necessitates the development of a widespread measuring culture (13).

2.1.10.2 PDCA

The PDCA is based on a principle of a virtuous cycle which allows not only to solve the problems identified, but also to initiate the integration of innovations in a controlled context. Invented in the 1950s, this approach is still relevant today. It is thus completely in line with the "agile" trend that is currently crossing the corporate world.

The 4 steps of the PDCA method

STEP 1 - PLANNING - "PLAN"

Unsurprisingly, the first step in the cycle is to analyze the situation in order to:

- Identify and formalize the existing problems to be solved
- Define the quality objectives to be achieved
- Establish the resources to be implemented
- Raise awareness and mobilize the various employees involved in the project
- Write specifications, estimate costs, make a schedule
- Define the key performance indicators that will enable the results obtained to be measured

As one can imagine, this first stage of preparation is absolutely crucial for the rest of the operations.

STEP 2 - THE REALIZATION - "DO"

Once the solution is planned, it is then time to implement it. Deployment can be ensured by:

- The employees concerned
- The manager himself

If he uses delegation, the quality manager must, however, ensure that the action plan developed by him is understood and deployed according to the planned procedures.

STEP 3 - VERIFICATION - "CHECK"

Once the action plan has been deployed, then comes the time to measure the results obtained at the end of the implementation. The results recorded are compared with the previously expected objectives to assess the effectiveness of the solution.

STEP 4 - REACTION AND IMPROVEMENT - "ACT"

This final step allows the manager and the QA teams to ensure that the effectiveness of the actions implemented is sustainable. Concretely, this may involve writing a guide to good practices or updating procedures.

In the event that the actions carried out have not led to the expected results, the manager can then choose to restart a cycle while keeping the objective as well as the procedure, or by adapting them according to the new intervention points identified (14).

2.1.11 The performance of the Supply chain

The performance of the Supply chain conditions the success of the strategy undertaken. Indeed, whether you are looking to conquer new market share, to retain customers, or to improve the profitability of each customer, or all three at the same time, the supply chain does indeed play an essential role. The measurement of the performance of the supply chain therefore deserves particular attention

The conditions for achieving an efficient Supply Chain

- The Supply Chain must be in perfect harmony with the company's strategy

The Supply Chain's efficiency has a direct impact on the viability of much of the techniques implemented. Therefore, it is always a matter of capturing additional share of the market, customer retention, or increasing each customer's profit, or all three at same time (15).

The company's strategy

The process of identifying the strategic and long goals and core objectives, implementing the activities, and assigning the required resources to attain those goals is known as strategy.

2.1.11.1 SWOT analysis

The SWOT matrix (Strengths, Weaknesses, Opportunities, and Threats) is a useful tool for assessing a company's strategic stance and guiding its advancement. When done correctly, this assessment allows you to assess your company's strengths and weaknesses, as well as identify risks and opportunities. We will examine the 7-step approach to perform and pass an specific and applicable SWOT evaluation. We will recognition at the crucial want to undertake a cooperative technique to convey it to completion

The SWOT principle

The SWOT matrix includes a desk with 4 boxes, wherein we rank after identification, the strengths and weaknesses of the company, the threats weighing on it withinside the quick or medium time period in addition to the ability opportunities. This tool fast have become an crucial a part of the strategic technique.

Figure 2.1.11.1 SWOT analysis

How to do? The seven-step method

This 7-step method + a summary is particularly suitable for carrying out SWOT analyzes without wasting time. This is a good way to not spend too long procrastinating before checking out the right solutions.

Let's detail each of the seven steps and the synthesis to conduct a relevant and productive analysis.

1st step:A field survey

Investigation Mobilize widely and invite as many company stakeholders as possible to participate in the study. SWOT analysis, especially in this phase of an active audit, is not reserved for an elite of the company. Quite the contrary.

Any business organization is complex, and information is not centralized. You might as well make the most of the cumulative intelligence to take advantage of the amount of knowledge in the field.

2nd step: Preparation

Preparation each participant in the study is given a pre-model of the SWOT analysis in which known and generally accepted information is listed. Everyone takes the time to comment and reflect on the strengths, weaknesses, threats and opportunities as they perceive them from their vantage point. He compares his ideas with his co-workers.

3rd step: Establish the rules for the confrontation of ideas

The rules as with any effective meeting, from the outset the facilitator specifies the rules. All participants are necessarily aware of the issues. Without necessarily embarking on brainstorming, we will respect the fundamental laws:

- Everyone has the right to express themselves.

- Any idea proposed is in principle a good idea as long as it has not been overtaken by a more federative idea.

- Responsibilities are not yet fixed, so there is no risk of committing and proposing an idea (from experience, this rule is perhaps the most difficult to admit).

4th step: We identify the strengths

Strengths To reconcile and categorize the inputs of each member by similarity, we shall utilize a diagram (KJ Diagram). If necessary, everyone can justify their suggestion.

As a result, it's critical to urge members to focus on the preparatory phase in order to develop a strong battery of arguments. Staff expertise, price structure, field presence, and optimisation are some instances of strengths.

5th step: We identify the weaknesses

Identifying Weaknesses This is a much more delicate procedure. It's never easy to set out value judgments in order to express a more logical viewpoint. This is where the clash of different points of view, represented by actors who have never met before, shows its full meaning.

Looking back on the past year is a good way to identify sticking points that have prevented more significant growth. Some examples of weaknesses: lack of personnel, low qualification, fickle customers, obsolescence of flagship products, archaic processes...

Similarly, a precise representation of the value chain and key processes is quite revealing of the sticking points.

6th step: Identify threats and opportunities

You'll learn how to tell the difference between pessimists and optimists in this chapter. What may seem to be a challenge to the former may present an opportunity to the latter, if the latter does not engage in dreaming due to a lack of pragmatism. In short, it is not that easy, and you must agree to place the suggestions in the appropriate section of the SWOT matrix.

A competitive study using in particular Michael Porter's 5 force model is particularly useful. However, take care to pay full attention to the comments in the practical sheet referenced here.

7th step: We specify the priorities

Step 7 Priorities The results of each of the four headings are ranked by degree of importance and urgency. For each list, we highlight the "Top 3" preferably or the "Top 5" if the study has a large scope. This arbitration is necessarily a team effort. It must be unifying, the fruit of an active consensus (16).

2.1.11.2 PESTEL

The PESTEL analysis is a complimentary method to the SWOT analysis and Michael PORTER's 5 Forces, and one that each effective strategic analyst should have in his toolkit. This instrument, whose name is an abbreviation for Politics, Economical, Sociology, Technical, Ecological, and Legal, aims to provide a clear picture of the company's

environment in all of its dimensions. It's a crucial study since the strategic concept's applicability is inextricably related to the growth of its surroundings.

PESTEL principle

At first, we spoke of PEST analysis and many US consultants in particular limit the study to these four dimensions, disregarding ecology and legislation. This can (in part) be understood since the integration of the environmental or ecological question (the letter "E" of the acronym) deserves to be treated as close as possible to the actors of the company and to counterbalance the quest for financial performance as proposed by the GIMSI method from a perspective of overall company performance.

On the other hand the legislative (the letter "L" of the acronym) can also be considered either as part of the chapter "Politics" or as a 6th force of the model of Michael PORTER, including all the action of the public authorities as Several strategy specialists have suggested it (in contradiction with Michael Porter, but that's another story).

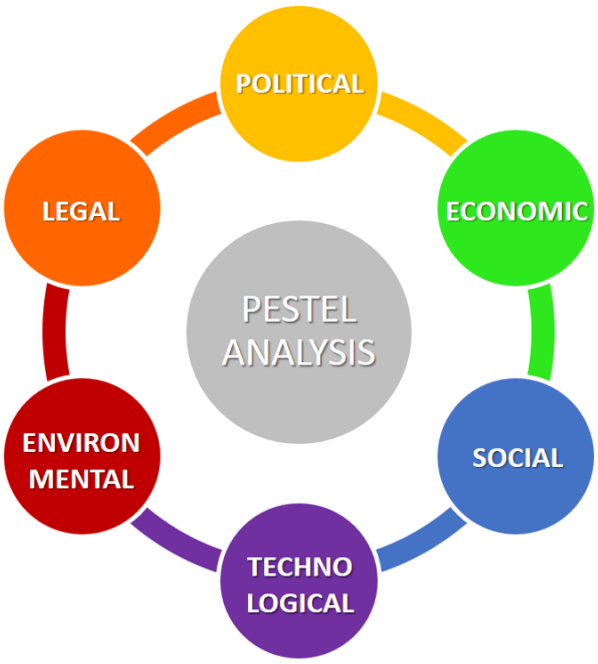

Figure 2.1.11.2: PESTEL

How to do ? The method

Let us review the six steps of the method which correspond to the six axes of the model that must be clearly specified according to the context of the company. It is in this complex environment that the company's strategy will have to be expressed.

Step 1: Political axis

This size performs an crucial position as everyone can imagine. Changes in financial rules, whether or not it's taxation or the company of alternate at a countrywide or worldwide degree, to call simply those elements, may be perceived definitely as negatively withinside the experience of the employer relying on its positioning.

Step 2: Economic axis

Economic elements which include the extent of increase are of direction to be considered whilst growing the strategy. For example, the evolution of alternate prices has an instantaneous have an effect on now no longer most effective on exports however additionally at the crucial purchases of raw substances or extra usually of resources. On the opposite hand, the inflation fee, the interest fee or the intake index immediately impacting the selections to be made.

Step 3: Social axis

The substantial changes in a population, such as the growth of the coming of age, the development of the average level of education, the level of earnings, and more commonly everything related to demography, guide the strategic design toward specific routes while prohibiting others. Similarly, behavioral changes or tastes in a certain community or age group have excellent or terrible effects on groups that are already well-established, depending on the goal pursued.

Step 4: Technological axis

The significance of R&D has been well established. It is unquestionably a matter of always being in sync with future buyers' desires and objectives. In today's world, when changes are quick and radical, this is a critical concern. On the other hand, if the employer wishes to update the goods or services generally provided by using the employer at a lower cost, an increasing era can be significant for the company. This component is linked to the "Threat of Substitutes" in Michael Porter's five forces model.

Step 5: Ecological axis

The significance of the environmental question now no longer wishes to be dismantled today. With weather exalternate the notice of the general public and consequently of clients always have an effect on the selection of strategy. Legislation is evolving and green washing does now no longer resolve the whole lot, no person is fooled. It is certainly closer to sustainable improvement answers of their personal right, respectful of the surroundings that groups will must orient themselves, something their discipline of interest. Resource efficiency, trash recycling, and short circuits are all important considerations.

Step 6: Legislative axis

The development of legislation such as labor law, but also anything health and security, as well as consumer protections, can fundamentally alter a strategic approach.

- The Supply Chain must be aligned with customer needs.

In reality, from the first provider to the final consumer, the entire process must be considered. The concept is that in an ideal system, no break in the overall chain is acceptable, and no weak link is appropriate.

It's much easier than it sounds. This is not always practicable to protect against supplier breakdowns by seeking out alternate suppliers. Certain intricate sub-assemblies necessitate close cooperation with the subcontractor. Changing vendors is not a simple task. In any event, the best answer is to plan ahead as much as possible. Do we begin to anticipate? By exchanging knowledge. This is SCM's most basic guideline.

- When it is well, the supply chain can be a lever for growth and even a point of differentiation from the competitors.

Well enough and, most all, well-managed: it's all about following to the key objectives of budget, quality, and timelines, and giving each of these core parameters the weight that the plan demands.

- Finally, the Supply Chain must be adaptable

Customer demands are shifting, and markets are shifting as well. It's a matter of being responsive at all levels of the chain. There is just one point of view to recognize: the chain's general performance.

- To drive performance, a well-designed dashboard is essential (17).

2.1.12 Supply chain and value creation

To ensure efficient management of the Supply Chain, it is good to keep in sight the notion of value creation. The representation of the global value chain in the sense of Michael Porter facilitates the identification of the process of value creation.

The difficult synergy

Synergy is a term that describes a phenomena in which numerous actors, factors, or influences working together produce an effect that is higher than the total of their individual effects, or produces an effect that none of them could have produced alone. acting on their own.

The term has a positive connotation in popular usage, and it is used to describe a more beneficial outcome when various aspects of a business or network work together. Positive synergy is defined as when the effect of an activity or a component is higher than the total of the components' results. The proverb "one plus one equals three" sums this up nicely.

SCOR model

SCOR version stands for “Supply Chain Operations Reference version”. The Supply Chain Council, an independent organization, defines it as a gold popular for the analysis, assessment and optimization of unique system flows alongside the value chain. A supply chain wishes consistent monitoring, change and development to preserve the go with the drift of products among producer and patron and to make structural improvements. This is why the SCOR version become developed.

First pillar:

process modeling The first pillar of the SCOR version consists of the 5 classes of techniques defined above (planning, procurement, delivery, manufacture, return) and the varieties of techniques, planning, execution, management. SCOR design, that is, price chain modeling, introduces requirements that permit overall performance to be defined. By classifying and characterizing system flows, agencies can recognition on enhancing the first-class and profitability of producing and delivery.

Second pillar:

overall performance measurement The 2d pillar of the SCOR version makes use of a key determine device of over one hundred fifty key figures. The key figures of the SCOR version are prepared hierarchically. Key figures are assigned to every system distinctive withinside the SCOR version and are used for internal assessment of accomplice overall performance and outside deliver chain analysis. In deliver chain management, we differentiate among the angle of the company (internal facing) and the attitude of the customer (client facing)

From a commercial enterprise (internal) factor of view, precise indicators check overall performance characteristics, expenses and capital employed. From the attitude of the (external) customer, on the opposite hand, it's miles important to evaluate the reliability of delivery, responsiveness and adaptability. Key overall performance signs may be used to degree and describe the overall performance of various companions withinside the supply chain in addition to the overall performance and performance of the complete supply chain.

Third pillar:

first-rate practices The aim of the usage of the SCOR version in each commercial enterprise is to satisfy the order as successfully as possible. This approach growing the proper stability among complete delivery, the proper amount of items, punctuality (from the customer's factor of view), reliability and fee performance. In order to evaluate the overall performance of every segment of the supply chain, first-rate exercise values are wished as guiding and benchmarking parameters. These first-rate exercise values can include customer-associated, internal, shareholder-associated and commercial enterprise-to-commercial enterprise overall performance values. The evaluation permits conclusions to be drawn on its very own overall performance and withinside the long, medium and brief term, additionally on performance.

Fourth pillar:

advantageous outcomes at the desired working results After studying the overall performance dimension primarily based totally on real, centered and best key figures and overall performance data, it's miles important to decide the advantageous outcomes (for example, profit, growth in overall performance and decrease expenses) and standardize the strategies that caused a growth in overall performance and include them in tables of values. On the opposite hand, the important thing figures are supposed to put in force fee discounts all

through the supply chain (fabric and employees expenses, warehousing and shipping logistics expenses, go back expenses).

2.2 Artificial Intelligence and Robotic

2.2.1 The robotic

2.2.1.1 Definition

The industrial robot is a machine capable of performing tasks as soon as we manipulate its programming. Three components characterize it: a mechanical part, an electronic part, made up of sensors in the control system, and the latest computer system which allows it to be linked to the user and his environment. They are used for many missions in the industrial sector: assembly, packaging, inspections in sensitive areas, laser cutting, part checks. Depending on their level of technicality, they are more or less multitasking. From the Cartesian robot which circulates only along the three axes X, Y, Z to the robot with several degrees of freedom with joints that allow it to be fluid in space but static, to the SCARA robot which moves on three axes while having an angle of rotation (18).

It's a simple concept to define, but grasping its full meaning can be tough. Robotics is a term that refers to a set of techniques that have been developed and applied to the production of robots. There are unlimited options and a wide, very wide variety of application domains hidden underneath this meaning..

First from start, defining the term "robotic" has been challenging. The term was first used in Karel Capek's drama R.U.R., or Rossum's Universal Robots, in 1921. The word "robot" is derived from the Czech word "pressured labor." These robots, on the other hand, were robots in spirit rather than form. They looked like people, but instead of being made of metal, they were made of chemical batter. The robots were far more environmentally conscious than their human companions, as well as far more murderous—they went on a killing spree.

R.U.R. may have established the stereotype of the Untrustworthy Machine (e.g., Terminator, The Brady Bunch, Blade Runner, etc.) that has persisted to this day—not to mention the fact that popular culture hasn't welcomed kinder robots. Consider the character Rosie from The Jetsons. (Ornery, to be sure, but not homicidal any longer.) Robin Williams as Centennial Man is one of the most family-friendly characters ever.

The real-world concept of "robotic" is just as ambiguous as the literary versions. If you ask ten roboticists, you'll receive ten different answers—for example, how identity does it need to be. They do, however, agree on a few common guidelines: A robot is a machine that is intelligent and physically embodied. To some extent, a robotic can perform tasks independently. A robotic can can sense and govern its surroundings.

2.2.1.2 History

The first robots as we know them were constructed in the early 1950s by George C. Devol, a Louisville, Kentucky-based entrepreneur. He designed and patented the "Unimate," or "Universal Automation," reprogrammable manipulator. For the next decade, he tried unsuccessfully to sell his product within the company. In the late 1960s, businessperson Joseph Engleberger got Devol's robot patent and was able to turn it into a commercial robot and form the Unimation company to sell and market the robots. Engleberger is known within the company as "the Godfather of Robotics" because of his efforts and results.Academy has also made significant progress with the implementation of novel robots. Charles Rosen led a research team at the Stanford Research Institute in 1958 to develop "Shakey," a robotic. Shakey was far superior to the original Unimate, which was intended for specialised, commercial uses. Shakey should roll through the room, glance at the scene with his tv "eyes," flow through strange environments, and, to a degree, respond to his environment. Because of his unsteady and clattering movements, he was given the name (19).

1954 – Unimate

Identifying which invention was "first" is plainly a challenging task. It's impossible to deny, however, that Unimate was the first contemporary industrial robot. The device's function was to carry hot metal components from die casting equipment to a distant location. It made sense to entrust moving manufactured heated metal objects to an emotionless machine because it was a dangerous task for a human.

Although this is a later version of Unimate in operation sometime in the 1980s, the core design originally designed in 1954 is what's important. This design with a versatile arm can still be found in factories and industrial spaces all over the world.

The robot's creator, George Devol, obtained a patent application in 1954, but the prototype wasn't completed until 1959. Unimate would eventually be installed in numerous General Motors companies, but Devol was unable to market them successfully.

Devol tried for a year, although it was Engleberger's efforts and financial savvy in the late 1960s that eventually got the world interested in Unimate and delivered it to industry. Engleberger is widely referred to as "the Father of Robotics" because of this (20).

Figure 2.2.1.2: robot prototype 1956 UNIMATE

1966 – Shakey

Unimate was a technological marvel at the time, but computer scientists realized that robots needed to progress beyond an arm moving warm things from one location to another. Charlie Rosen, the founder of SRI International's Ai Research Center, saw that the next big step forward in robotics would be to develop a device that could solve problems on its own. As a result, Shakey was born. Shakey, as a result of the way it rattled throughout the check area, was given its name, is capable of taking in sensory input from its environment and making plans based on it. Shakey shown to be capable of navigating securely in an experimental region, such as chambers with blocks and ramps, the use of sample credibility algorithms to locate edges and item outlines, and the on-the-fly analysis of complex tasks For example,

after several days of attempting to arrange a field on a level, the robots discovered that he need first bring a ramp into position.

Here lies Shakey in its final resting place, the Computer History Museum. While bulky and unwieldy by today's standards, Shakey completely revolutionized robots.

Furthermore, the robot was capable of following voice instructions. Simple English commands like "go" and "tilt" were transformed into predicate calculus, that Shakey understood and responded to. A complex request, such as "go to room D and move block 9 across toward where door 4 is," necessitated the use of STRIPS, a scheduling system developed by California Institute Of technology.

Shakey couldn't find any practical applications in industry, but that wasn't the point of this gadget. The most significant advances made by Rosen and his team were in visual analysis, item modification, and direction finding. Shakey is remembered among the first artificial intelligence triumphs. Although Shakey and Unimate completely changed the world, they were the best in the start (20).

Figure 2.2.1.2: robot Shakey

2.2.1.3 Revolution of the robotic utility

Until now, factories have operated essentially in a "closed" model: machines repeated the same tasks over and over again, without being connected to each other. From now on, the

robots will communicate and gain experience. They will, for example, know how to "refine" their actions and find the appropriate reaction in the event of an unforeseen situation. They will also be able to work "hand in hand" with the operators, which will increase flexibility. A major development, which some qualify as the "third industrial revolution".

The first took place at the end of the 19th century, with the invention of the steam engine. The second, in the 1930s, had led to massive mechanization of assembly lines. This new wave, of comparable magnitude, could make factories "smart". This is in any case the prognosis of the consulting firm PwC, which, in a recent study, calculated that the European industry intends to invest 140 billion euros per year in "intelligent automation" by 2020, including 40 billion annually only in Germany, one of the main players in this movement, with the United States, China and Japan.

More and more robots in the industry:

The "robotization" is therefore underway. As proof, the number of robots sold in the industrial sector increased by 29% worldwide in 2014, according to the International Federation of Robotics. That is 229,000 devices. This figure could double by 2025, or even triple, according to the most optimistic forecasts.

In this market of the future, there are two types of players. The first, like Siemens, are both equipment manufacturers and integrators, they install their own industrial systems at their customers' sites. Others focus on the manufacture of automata and leave it to their partners to deploy them. This is the case with Mitsubishi Electric. Like Toyota, the inventor of kaizen (continuous improvement process), this manufacturer, which produces robots, but also all kinds of electrical devices, adopted a very Japanese method: it first implemented this "digital revolution" in its own factories before promoting it to others.

“It can recognize the shape and color of an object,” says Kaoru Kawata, chief engineer. “As a result, the camera is able to detect even the smallest defect. It can also test the product during the manufacturing process, which we made it possible to remove control at the end of the circuit and not stop the chain in the event of a problem. " (21).

Bar codes, present on all components, also allow data transmission. They will be dissected and interpreted by engineers, who will use them to improve robot behavior and make the system more fluid. Oddly enough, the pace is much slower than on the "old" channel. Where it only took five seconds to assemble a component, now it takes three. "The robot could go much faster, but the man would not follow," adds Kaoru Kawata (21).

And this one, by the way, what becomes of this new scheme? “Her experience is invaluable,” she adds. "He visually checks parts and can spot problems, even before they happen, because he knows his robots inside out." By drastically reducing untimely shutdowns, this preventive maintenance has generated substantial productivity gains. The output rate of the production line has increased from 60% to 90%, according to Takeshi Tominaga, responsible for the control system. This “smart” design also raised the overall level of quality.

Finally, a better interpretation of the data led to energy savings - up to 20% for a single production island. These are all arguments that Mitsubishi Electric's sales engineers now intend to promote outside. "Our experience is of interest to many industrial groups, particularly in China, and in the automotive sector," he said (21).

2.2.1.4 Description of the different sector of robotic

Robotics has changed the world in a variety of ways. The first phase introduced electric driven devices that could perform repetitive tasks but were otherwise ineffective. Robots like these have been used in the manufacturing of automobiles and on assembly lines for similar products. The second segment has begun to develop commercial robots that do more than just perform routine jobs. They also take in information and respond to new data in order to further enhance. While these robots are currently mostly noticeable within the automobile business, it may not be long before they have an impact on all industries.

2.2.1.4.1 Healthcare Industry

When it comes to implementing the latest developments and technical advancements, the healthcare industry evolves at an unforeseen rate. Robotics has played a significant role in the current progress of this industry. For instance, Advanced Surgical's da Vinci machines are medical robots that may be used by clinicians and are considered standard of care for doing non invasive unnecessary biopsies. They can also help a doctor do hysterectomies, lung operations, and other types of procedures. iRobot's remote presence robotic, which allows outpatient specialists to interact with their patients, is a less intrusive robot development that

has changed the healthcare industry. This robotic allows medical providers to provide a more personalized experience, even from afar.The call for for this type of telemedicine has increased, particularly for the duration of the coronavirus pandemic of 2020.

2.2.1.4.2 Defense and Public Safety Industries

When people think of how robots could revolutionize an industry, they frequently think of security or public safety. The public has seen the security industry alter dramatically, with robots performing surveillance, battlefield assistance, and sentry duty, thanks in large part to the advancement of uncrewed vehicles. Drones were so effective for the army that numerous corporations, including Amazon, wanted to use them for their own purposes. These kind of robots were very beneficial to the public safety industry. Drones can now act as first responders to car accidents and other types of injury. Several groups, for example, may be developing unmanned, remote-controlled flying drones that may provide real-time review and highlight unquestionably dangerous circumstances.

2.2.1.4.3 The Manufacturing Industry

In 1961, the current manufacturing company began using programmable business robots for the first time. Robots used to be automated, performing performing routine tasks that humans found uninteresting or unsafe. Ever since, robotics have progressed to the point where they are currently more environmentally friendly than low skilled workers inside the manufacturing industry. Drake Trailers, for example, reported that it introduced a single welder robotic into their manufacturing line and saw a 60 percent increase in productivity. Robots that are increasing productivity in the manufacturing industry are also becoming more intelligent, occasionally jogging and learning alongside humans to expand the spectrum of tasks that they can do.

2.2.1.4.4 The Mining Industry

Previously dependent on human resource, the mining industry is now mostly based on generation and advanced robotics. These robots conduct investigation and collect vital information about interior. The final human workers will be able to work in a more secure environment as a result of this.

Diamond Creativity, for example, has a sophisticated custom robotic that is mounted on a Segway robot mobility platform (RMP), allowing it to traverse hazardous terrain. Furthermore, in recent years, the digging gadget has become significantly more advanced. Currently, technology drills can conduct drilling deep under the earth as well as offshore,

allowing mining companies to dig a little deeper and in more hazardous conditions than if they had to rely on human operators.

2.2.1.5 The added value of the robotic in the SCM

Traditionally, self-reliant robots were used to do recurring and monotonous tasks, necessitating sophisticated coding for design and execution while also lacking the agility to change operations on the go. As self-contained robots become more advanced, installation times decrease, monitoring requirements decrease, and they're capable of working side by side with their modern companions.

The advantages for the future supply chain are growing as self-reliant robots have the ability to operate around the clock with more consistent levels of exceptional and production, taking on jobs that humans can't, mustn't, or don't need to accomplish. Intelligent machines typically drive supply chain development and cost reduction by cutting direct and indirect operating costs and increasing sales capabilities. Self-reliant robotics, in particular, can help to:

• Improve quality and profitability minimize mistake, waste, and risk rates

• Enhance people protection in high-risk work situations

• Reduce the expense of routine tasks so that individuals can collaborate and focus on more strategic activities that can't be automated.

• boost revenue by improving optimal order completion rates, shipping timeliness, and, ultimately, customer happiness Autonomous robots also have the following secondary capabilities:

• improve worker cost thru awareness on strategic tasks in place of routine responsibilities

• Prioritize on private protection through limiting work in risky regions for personnel

• Increased firm brand awareness by promoting current practices and technology deployment, as well as Expanding research by obtaining and analyzing system data (22).

2.2.2 Artificial Intelligence

2.2.2.1 Definition

Artificial intelligence is such a broad and innovative technology that defining it accurately is challenging. It can be regarded a subset of the computer field, with the goal of developing machines that can accomplish activities that previously required human intelligence.

AI, on the other hand, is a multidisciplinary science with a variety of methodologies. Machine Learning and Deep Learning are two methodologies that are now widely used in businesses across many industries.

Alan Turing's article "Computer science Machine and Intelligence," as well as the "Turing Test" or "Turing Test" that resulted, provided the groundwork for artificial intelligence, its vision, and its ambitions.

Indeed, artificial intelligence aspires to provide a positive response to Alan Turing's query. Its goal is to make machines that can mimic or simulate human intelligence. his is why there is no universally accepted definition of ai technology.

"Intelligent machines" is a vague term that doesn't describe what artificial intelligence is or what makes a machine smart. Stuart Russel and Peter Norvig wrote "A.i.: A Modern Approach" in an attempt to address this issue.

The two experts bring their work on autonomous algorithms in machines together in this book. "AI is the study of agents acquiring environmental perceptions and conducting actions," they write.

Human consciousness, rational thought, human action, and rational action, in their opinion, have traditionally defined the area of artificial intelligence.The first two approaches are concerned with reasoning and thinking processing, whereas the other two are concerned with learning and memory (23).

Professor of artificial intelligence at MIT, Patrick Winston, defines AI as "restriction algorithms, illustrated through representations supporting models integrating thought, perception, and action."

Another recent definition of AI is "machines that react to models in a manner similar to humans, with the ability to contemplate, judge, and intend." These machines are capable of

"making decisions that would typically necessitate human competence." Artificial intelligence is defined by three characteristics: intentionality, intelligence, and adaptability.

These various definitions can appear abstract and complicated. Artificial intelligence, on the other hand, is recognized as a branch of computer science.

Jeremy Achin, CEO of DataRobot, provided his own updated and not without humour definition of AI at the Japan AI Event in 2017.: "A computer system capable of doing activities that normally require human intelligence is known as artificial intelligence... Many of these AI systems are known as machine, some of those on deep learning, and others on fairly mundane things like rules."

2.2.2.2 A Brief History of Artificial Intelligence

The history of artificial intelligence started in 1943, with Warren McCullough and Walter Pitts' article "A Logical Calculus of Concepts Immanent in Nervous Activity." The first mathematical model for generating a neural network is presented in it by scientists.

Snarc, the first neural net computer, was developed by two Harvard undergraduates, Marvin Minsky and Dean Edmonds, in 1950. Alan Turing published the Test ” in the same year, which is still used to evaluate AI today.

Arthur Samuel built software in 1952 that could teach itself how to play chess. Meanwhile, the term "artificial intelligence" would be used for the first time at the "Purpose Of The research Project on Ai - based" conference, which was founded in 1956 by John McCarthy.

Researchers present the mission and aims of AI during this event. Many people consider this symposium to be the genuine beginning of a.i. as we know it today.

While working at IBM in 1959, Arthur Samuel invented the phrase "machine learning." The MIT Artificially Intelligent Project was started by John McCarthy and Marvin Minsky. John McCarthy also founded the Stanford University "AI Lab" in 1963.

The area of AI will be suffocated by skepticism in the coming years. In the backdrop of the Cold War, the American ALPAC study in 1966 noted the lack of progress in automatic translation research is aimed at interpreting the Russian language instantly. Many of the US government's financed initiatives will be canceled.

In 1973, the British government released the "Lighthill" study, which highlighted the failures of AI development. Budget cuts are thwarting scientific programs yet again. This era of uncertainty lasted until 1980, and is now known as "AI's first winter."

The invention of R1 (XCON) by Digital Tech Corporations will bring the winter to a close. This expert trade system was created to set up orders for new systems, and it sparked an investment boom that lasted more than a year.

Japan and the US are both heavily investing in AI development. Expert systems cost over a billion dollars a year, and the business is booming.

Unfortunately, the demand for "Lisp" computers crashed in 1987 when cheaper rivals emerged. This is AI's "second winter." Expert systems are losing favor among businesses. The US and Japanese governments are leaving their research initiatives, wasting billions of dollars. Artificial intelligence can now be revived ten years later, thanks to technical advancements. In 2008, Google made significant advancement in the development of voice recognition and included it in their smartphone applications.

Andrew Ng used 10 million YouTube videos as a training data for a neural network in 2012. This neural network begins to identify a cat without even being told what a cat is thanks to Deep Learning. This is the beginning of a new epoch.

In 2016, Google's DeepMind AlphaGo program defeated Lee Sedol, the Go game champion, in another another success for AI over humans. Artificial intelligence is also gaining traction in video games, with DeepMind AlphaStar in Starcraft and OpenAI Five in Dota 2 being two examples.

Companies across all industries are now using deep learning and machine learning for a wide range of applications. The AI keeps improving and astound us with its abilities. The idea of creating a broad a.i. is becoming a reality.. (24).

2.2.2.3 Machines learn ML

2.2.2.3.1 Definition

Machine learning (ML) is a type of artificial intelligence (AI) that allows computer software to become more accurate at predicting outcomes without having been expressly designed to

do so. Ml algorithms expect new correct output based on historical statistics. Device learning is frequently applied to algorithms. Other well-known applications include fraud prevention, spam detection, virus detection, business process automation (BPA), and proactive maintenance (25).

2.2.2.3.2 The importance of machine learning

Machine learning is critical as it offers businesses a view of traits in patron conduct and enterprise operational patterns, in addition to helps the improvement of latest products. Many of ultra-modern leading companies, which include Facebook, Google and Uber, make machine learning a crucial a part of their operations. Machine learning has end up a massive aggressive differentiator for plenty companies.

2.2.2.3.3 The different types of machine learning

Traditional system learning is defined as the process through which a set of rules learns to become more accurate in its forecasts. Supervised learning, unsupervised learning, semi-supervised learning, and reinforcement learning are the four simple ways. The type of set of criteria that scientists use to anticipate records is determined by the type of records they ought to forecast.

• Supervised learning: In this type of system learning, data scientists provide engines with categorised educational records and establish the variables for which they require a set of rules to analyze for correlations. The set of rules' input and output are both stated.

• Unsupervised learning: Algorithms that educate on unlabeled data are used in this type of system learning.

• Semi-supervised training: This approach of system learning combines the two preceding types of learning. Data analysts can also input an algorithm in most cases classified educational records, but the version is free to find the records on its own and expand its knowledge of the records collection.

• Reinforcement learning: Data scientist use reinforcement learning to teach a machine how to complete a multi-step process with clearly defined rules. Data scientists utilize a system of regulations to complete a project and provide it with excellent or poor cues as it figures out how to do it. However, for the most part, the collection of rules makes its own decisions.

2.2.2.3.4 Who is using machine learning and what is it used for

Machine learning is being used in a wide range of applications. The recommendation engine that drives Facebook's news feed is perhaps one of the most well-known examples of device research in action. Facebook uses device analysis to personalize how each person's news is presented. If a member frequently examines the posts of a particular organization, the recommender system will begin to reveal more of that company's attention in advanced within the feed. Behind the doors, the machine is attempting to boost recognized styles within the on-line activity of members.

CRM systems can utilize machine learning models to evaluate e-mail and alert sales team members to respond to the most important communications first. Superior structures may even suggest responses that are likely to be effective.

• Organizational intelligence. Device examining of their software program is used by BI and analytics organizations to identify potentially significant information factors, styles of information factors, and anomalies.

• Structures for human usable resource statistics. Device studying fashions can be used by HRIS structures to sort among packages and find the best candidates for an available position.
• Autonomous vehicles. Machine learning algorithms may even allow a semi-autonomous vehicle to recognize a partially observed object and inform the driver.

2.2.2.3.5 The benefits and drawbacks of machine learning

System learning has a variety of applications, ranging from forecasting customer behavior to creating the operating machine for self-driving cars. When it comes to benefits, machine learning can help businesses better understand their customers. Machine learning algorithms can assess institutions and assist groups adjust product development and marketing jobs to customer demand by collecting customer statistics and comparing them with actions over time. Machine learning is a major driving force in the business models of several companies.

Uber, Algorithms, for instance, are used to match transporters with customers. Computer science is used by Google to place travel advertisements in searches. However, there are certain drawbacks to using a machine to learn. First and foremost, it has the potential to be costly. Statistics experts, who command high salaries, are frequently used to advance machine learning efforts. These activities also necessitate software program structure, which can be costly. There's also the issue of bias in machine learning. Algorithms trained on statistics units which exclude specific populations or contain errors might result in inaccurate sector

modeling that, at least, fail and, at the very worst, discriminate. When a company's central enterprise approaches are based on skewed assumptions, it risks regulatory and reputational consequences.

2.2.2.3.6 RFID and WSN

As vital functions for net of factors usage, the wi-fi sensor networks and Radio Frequency Identification (RFID) were emphasized. RFID is high-satisfactory expressed thru radio waves or wi-fi verbal exchange as a era which permits the identity of entities. This era can assist to make excellent enhancements because it facilitates to growth productiveness, the growth in productiveness may be visible withinside the control of warehouses and actions. Sensors and the ability to acquire, track, and evaluate data under a variety of environmental circumstances are associated with the smart sensor age (26).

It has also been demonstrated that using this application allows the user to see what is going on in the real world. It demonstrates how the customer can monitor and control the items while also monitoring their performance in real time. The monitors will track prior unmanageable problems through smoother transitions in addition to obtaining data. As a result, the technology aids in improving the quality and timely access to data that the organization need in order to obtain aggressive benefits in the form of production optimization.Walmart, Procter & Gamble, and the Directorate General of Defense are among the companies that have deployed RFID sensors in their supply chain processes. Nevertheless, the RFID's capabilities are far greater. RFID is now used in certain supply chains for monitoring, inventory management, library book tracking, access control, airline luggage monitoring, electronic safe codes, toll payment, fraud avoidance, and health care.

There is a desire for the Active sensor to function, which includes components such as readers and tags. The label has a width of to recognize it and is the Identification number, as well as a memory that stores information such as the company's name, product type, and positive data such as heat. A person which goes the use of wi-fi transmissions is wanted to study the records saved at the tags. Two types of communications exist among readers and tags. Communications may be done both via way of means of inductive coupling, this discuss technique includes antenna systems making an critical characteristic within side the tags in addition to the readers. The different shape is coupling of the propagation, this works via way of means of propagating 25 electromagnetic flags. Tags are connected or putted in items that want to be recognized or controlled in RFID-app.

While the data are being read, a previous past data is formed. The tools allow you to link IDs with products so that the reader can see if they're there (9).Detectors in a sensor network come in a wide range of shapes and sizes, and they can be installed in a variety of locations, including automobiles, floors, and the air. The detector community is used in the areas of mapping, control, safety, and a variety of other applications. Because sensors require a lot of power to reach long-range data sets, wi-fi multi-hop voiceovers is required to get the data to far-flung locations.

RFID channels are superior to Wireless Sensor Networks (WSNs), which are typically used for detecting things in remote areas or identifying environmental concerns. As a result, RFID frameworks frequently deduce the item's existance from its labels. Sensor nodes on faraway WSN sources send data to the base stations, which are started in standard packages. This effectively generates multi-hop networks in which RFID is just one step, together by label and sensor lots. In compared to RFID tags, smart sensor nodes are preferable since their firmware can be reprogrammed quickly, but RFID tags cannot (27). RFID's packages provide a variety of solutions for a variety of circumstances and sectors, particularly for individuals. who use global requirements just same as the automobile sector. WSN will probably collect and do all of the needed facts existing for SCM. RFID will grow productiveness of shipment points in 5 regions: get right of entry to controls, protection of containers, field identity and region, hobby surveillance and regulatory enforcement (9).

2.2.2.3.7 Operation Support

This topic involves equipment that assists employees in their day-to-day operations, such as in the manufacturing or delivery industries. Sharma and al,for example, employ a neural network to evaluate geographical identities on a regular basis. In particular, the growing number of e-trade orders and other similar transactions enables the dissemination of strong messages and programs (28). The specific issues with addresses are that they are stored in several forms and that a method must be used to distinguish critical areas such as the street name. It allows for the creation of a neural networks capable of extracting individual data from a raw text based address and providing a consistent representation (29). Increase in manufacturing also can be involved. Longo and al making a tool equipped with a neural network to understand human speech and determine what the individual is doing at any given time; for example, which portions are being maintained (30).

This system will handle inquiries and provide relevant and correct records for the current scenario and concern in this database. Some structures to assist commercial operations also provide, for example, the automated discovery of false digital additives in order to avoid their setup and the issues associated with it, or the mechanical tracking of materials for re-manufacturing, i.e. the identification of aspects which can and won't be used in the future (29). Tuszynski and colleagues (2013) provide another example of how to support behaviors that occur on a regular basis. They use a deep learning neural connectivity to detect so-called field releases, files that specify the objects that are now in an unit and the similar area. On the basis of containers with unusual densities from their inventory, radiography photographs of the sector are acquired and may be examined (29).As previously said, those are the areas that have been identified as viable industries for AI reputation approaches deployment in the delivery chain. Even though number of learning or samples isn't exhaustive, it does provide an impression of what has evolved in this field and makes suggestions for future usage. In general, full-scale advancements have been made in approaches such as robots, deep learning, and machine learning, and are a must for modern implementations (29).

2.2.2.3.8 The Benefits of AI

EY-Microsoft 2019 recommended a system for visualizing possible AI benefits in their report. According to the research, collaborative firms typically try to profit from all four major areas outlined in Microsoft's Digital Innovation Approach: improving operations, engaging consumers, redesigning product affiliate degreed services, and motivate staff. Each field focuses on fundamental AI capabilities, such as "reasoning" an interpretation and drawing conclusions from conflicting data; 'knowing' of learning represented by writing, voice, and visuals; and classical 'connections' involving employees, customers, and other parties. The application of AI in these situations is frequently groundbreaking for associate degree business, partly because of the dynamic nature of its commercial sense, marketplaces, and eco-systems. examining what that involves in greater depth:

1- Better performance and productivity via effective processes: while electronic modification is frequently used to promote customer engagement, the primary goal of firms using AI is to manage the system. It is influenced by a number of factors, including:

• operational productivity, such as improving forecasting and order to completion within the offer chain or process important volumes of documentation in a fraction of the time;

• strategic productivity, such as improving forecasting and order to completion within the offer chain or process important volumes of documentation in a fraction of the time;

2- Many people are affected by efficiency victimization as a result of human activities. AI: once efficient operations, firms are now attempting to interact with clients as the space where the majority of business edges can be found. Early forms include: methods for conversational agents, such as love bots for private recommendations and transaction-based advice; personal advisors, such as decision-making guidance and lowering change phases; and identity solutions to help customers cut down on the time it takes to fix their problems.

3- Keeping ahead of the competition through expanding services and products: When it comes to where firms will succeed prospective market benefits, growing products and services and enabling people came out at a comparable spot, slightly below the top two areas. In R&D-heavy enterprises, where businesses perceive AI and advanced analytics as instruments to speed development and research, increasing services and goods, consequently results in fresh business models, is most popular. Using multi lingual mental technology, location - based panels, sensitivity analyses, mental robotic consultatory capabilities, customised services, and more, AI creates new services that crossover domains into new degrees of value-added value in Business - to - consumer enterprises.

4- Employees will be more productive and capable as a result of AI: a variety of AI use cases across sectors are aimed at enhancing worker potency or human ability, as well as the competence to complete a task. By analyzing large datasets of consumer behaviour, AI assists B2C employees in extending their business experience, regulating on-line and offline search designs, and driving conversion and revenues. Customization for clients|of consumers|of shoppers is used on a high level, take advantage Of the latest options that outline customer insights in real time, discover the ideal crossselling and upselling opportunities as well as approaches that succeed a 360 ° client experience by assembling customer details into a focused offering plan (31).

2.2.2.3.9 AI Maturity Model

Definition of AI-Maturity and Reasons for Its Importance

Businesses aiming for the benefits of this stage should also make an effort to understand, construct, or own Digital enterprise technology tools. Having an AI-based strategy, on the other hand, is vastly different from having standard regulated computer code or even building a non-AI-based exploitation code solution. Because AI-based systems operate in the sphere of

probability, they must be constantly trained, maintained, or verified for effectiveness. During this phase, AI groups need to protect themselves from degradation, harm, and damage associated with it, as well as AI diverting from its original goal. To ensure that these systems maintain their competitive advantage, Automation productivity, prediction, and accuracy must be maintained. Companies that fail to assess their actual capacity to build, own, and run Intelligence tools may encounter difficulties and risks. Some companies will have a variety of bad outcomes, ranging from antiquated frameworks that will gradually breakdown to patterns that will inadvertently affect structure workers or customers (32).

• The Risks of Ignoring Maturity

Enterprises that commit to implementing Artificial intelligence technology without considering their own maturity level may confront minor or large obstacles. Older established systems and standards functioning at intervals within a regulative context differ significantly from probabilistic systems. Over-reaching difficulties are critical to address in the adoption of AI-based systems that do not take maturity into consideration, even for enterprises who see the promise of Artificial intelligence in traditional techniques. There are a few threats or probable risks that come.

2.2.2.3.10 The AI Maturity Model

Microsoft as main Artificial Intelligence organization is running to expand for useful version to enables corporations decide their personal skills that result in AI era adoption. This AI adulthood version lets in corporations to benefit perception into the middle factors of AI possession with the aid of using the groups and organizations which make a contribution to suitable AI answers being added on the proper time. Furthermore, Microsoft has compiled steerage at the implementation of the AI era for a longtime organization's adulthood and has counseled the way to expand the adulthood to house superior AI ability. You can find bellow a quick review of AI adulthood version that shows the adulthood degrees also different applicable features. The version is an administrative adulthood slope in which levels are grown when the figure is evaluated to the left. What stage of adulthood lies beneath the primary standards that are linked to the middle consciousness areas that progress to maturity. All of the above are essential characteristics to growing adulthood, including the converting cultural understandings of the layout and operation of AI, the moral changes within side the venture to the outcomes of those systems, and a alternate within side the possession, assessment and adjustment Figure 2.2.2.3j.

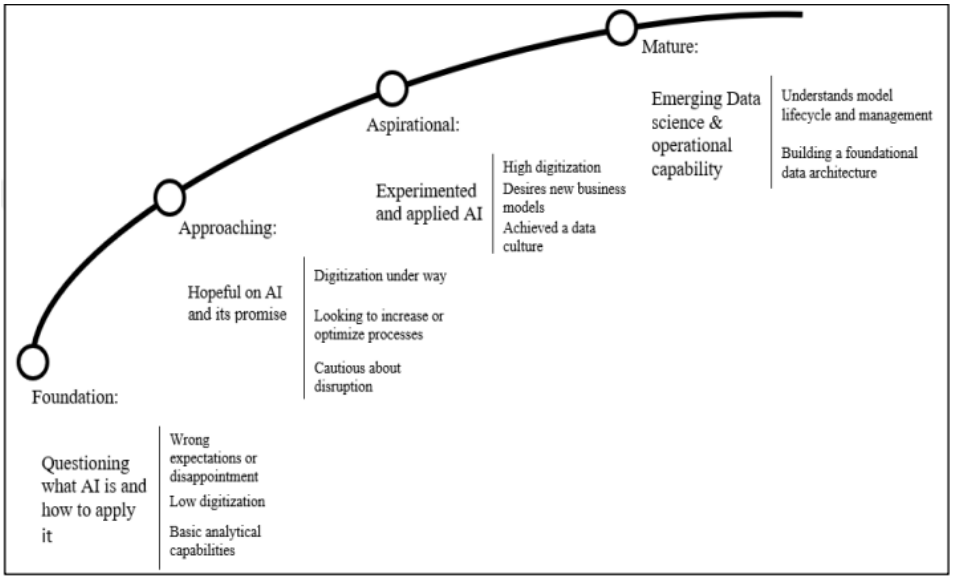

Figure 2.2.2.3.10: The AI Maturity Model

Source (32).

- Foundational

A foundational corporation ought to invest time as an example AI and also the limits and constraints of the assorted connected technologies. Organizations are -at this stage- attempting to know the definition, implementation and situations of AI across a good style of possibilities. Foundational corporations usually ask for to understand how others use AI and the way to use it to their business. Organizations at this maturity stage are seeking to develop systems and processes to assist make selections that are radio-controlled by the data. Usually these organizations rely upon leaders' skills, intuition and experience to create decisions. For specific organizations, existing assessment systems are in situ however can not be accessed in favor of input from a knowledgeable leader. Foundational organizations should invest in quick, unvarying innovation development projects. Investments are created to acknowledge AI, and the way it'll still evolve digitally. A shift to a data-driven culture alongside company members focus productivity and development mindset would be prestigious in implementing AI. AI is enforced by foundational organizations. Corporations at this maturity stage will aim to include AI technologies that

companies like Microsoft are hosting to infuse AI into digital experiences. The adoption of configurable AI can resolve structure ownership and obstacles, and permit businesses to become a digital entity.

- Approaching

Approaching businesses are putting plans in place to bring organizational changes that will make it easier for employees to make informed decisions. These companies specialize in data cultures adoption and continue to utilize primary concern management approach to grow their operations by investing in artificial intelligence to develop new business opportunities and streamline procedures. Caused by medical care of assets and the application of AI to modify activities, such businesses can learn about holding customized AI solutions. Many companies have demonstrated the value of using short reflexive sprints to deploy ideas and price learning from them. Such businesses can afford to try out new ideas quickly. These businesses should invest more resources in understanding how to implement, monitor, and improve AI through time. As AI-based systems are adopted, expenditures in AI visibility standards will increase, analyzing, coordinating, and changing AI over time, and can provide moral views. Companies can develop experience by utilizing AI to digitally rebuild if certain conditions are met.

- Aspirational

Aspiring businesses recognize that artificial intelligence (AI) may help them thrive and grow. Furthermore, these businesses are aware that numerous employ AI and are concerned about various competitors' competitive threats or industry disruptions. Aspirational businesses are also pursuing digital transformation through technique improvement and attempts to use data to help call making. Companies at this maturity level concentrate on changing behavior in order to motivate employees. Worker motivation encourages teamwork, generates ideas for improvement, and aids in the development of new business models.

Those companies are more willing to take risks and are attempting to transition from rigidly structured to more fluid plans. It is necessary to introduce a made-to-order AI system, which is AI managed by software companies such as Microsoft. This diagram illustrates the operational challenge of retaining core AI while allowing AI to infiltrate digital experiences. Furthermore, more delicate AI systems, such as customized AI, are likely to uncover issues with management and structure. Aspirational companies need to

invest in efficient statistical to guide decisions, change their culture to encourage creative thinking, and even research customized AI to provide novel insights.

- Mature

Companies that are more mature have changed their environment to include long process and a training mindset. Progressive and rapid experiments return naturally once a fully supported knowledge environment and strategic goals have been established, and they help to turn ideas into real. Mature firms are likely to successfully individualize AI creative talent and recognize that such instruments will be used for multiple AI efforts at the same time. The company also understands how to develop digital experiences that leave an impact through time.

Mature businesses include moral considerations into the design process of their operations, wondering, "We recognize that AI could do anything, but should we?" Organizations can preserve structure discipline in connection to the control, preparation, and getting ready of AI-based systems if they continue to judge solutions for customized and personalized AI at this stage. Retaining AI expertise, prioritizing new strategic approaches, and continuing agile trials are predicted to be priority areas for mature firms (32) .

2.2.3 Major technological firms AI and robotic

Major technical corporations are investing in speech recognition, language processing, and computer vision applications. Deep learning made a significant improvement in the quality of machine learning techniques by utilizing enhanced equipment and sensor technology to train artificial networks with large volumes of data collected from 'big data' (33) .Current advanced AI allows for the digitization of a variety of operations, and new applications are on the rise that have the potential to change the entire corporate world (Figures2.2.3.1 and 2.2.3.2 and 2.2.3.3).As a result, there is enormous potential for growth in the economy, as evidenced by the fact that among 2014 and 2015, Google, Microsoft, Apple, Amazon, IBM, Yahoo, Facebook, and Twitter acquired a total of twenty-six start-ups and businesses developing Technology for an overall cost of more $5 billion. In 2014, Google acquired provider Deep Mind, a London-based start-up focusing in deep learning, for about $500 million, setting a new record for business investment in AI research for educational purposes.

In fact, since 2012, Deep Mind has published over a hundred forty magazine and conference proceedings, as well as four publications in Nature. One of Deep Mind's accomplishments

was the development of AI technology capable of producing basic computing code agents who change their activities depending mostly on an accumulative reward. This supervised learning approach outperforms humans in various ways, as seen by the loss of the world strategy game champion, marking a watershed moment in AI development. Watson, an IBM mainframe platform, has the abilities to function text analysis and gather advanced insights from vast amounts of unstructured data. In 2011, IBM Watson defeated two high-ranking players on 'Jeopardy!,' a popular quiz show in which contestants must guess queries from specified answers. Although computer systems make data retrieval simple, language comprehension remains a barrier. This achievement has had a huge effect on the performance of online searches as well as AI systems' overall capacity to interact with humans. In 2015, IBM purchased Alchemy API in order to integrate its text and picture analysis capabilities with IBM Watson's psychological feature computing platform (34).

Figure 4. Total estimated equity investments in ai start-ups, by start-up location 2011-17 and

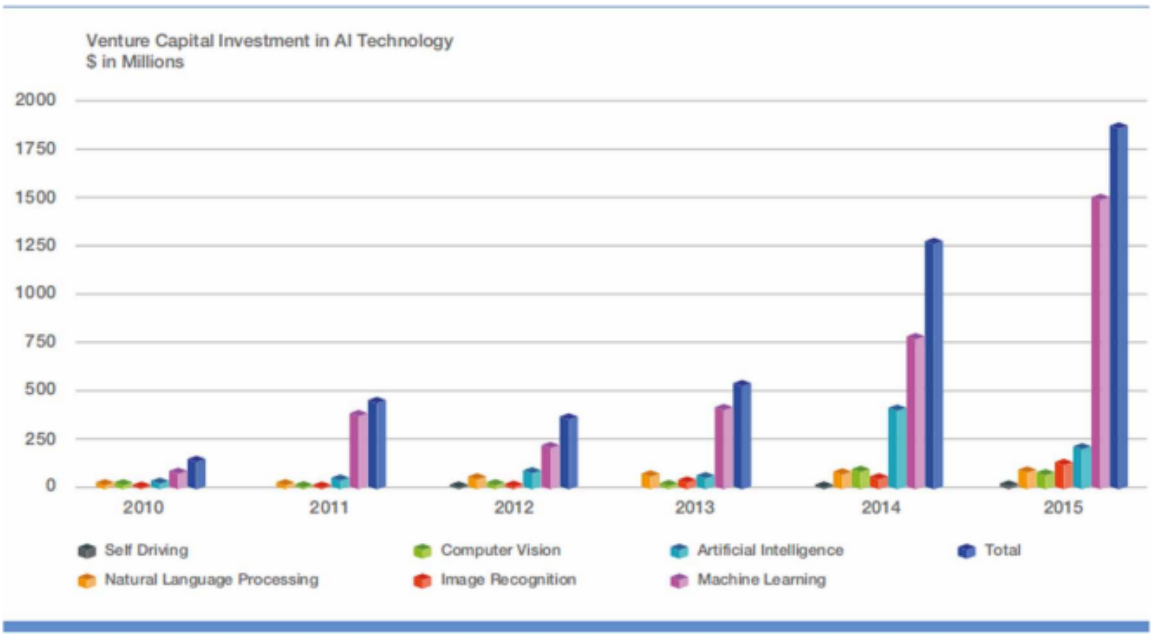

Figure 2.2.3.1. A conservative estimate of venture capital investment in AI technology worldwide according to data presented in (35).

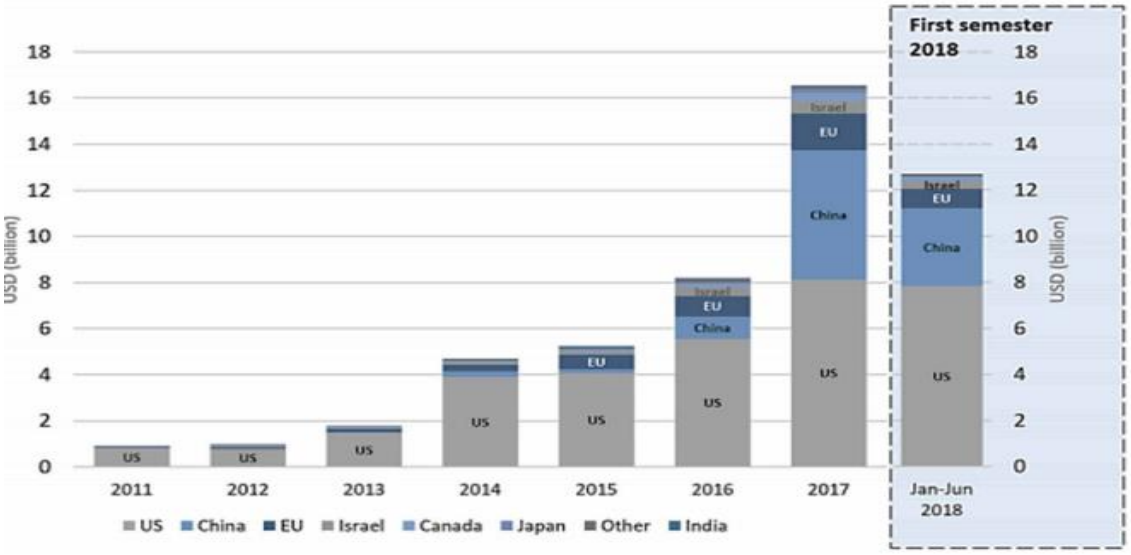

Figure 2.2.3.2 : Total estimated equity investments in ai start-ups, by start-up location 2011-17 and First Semester 2018 (34).

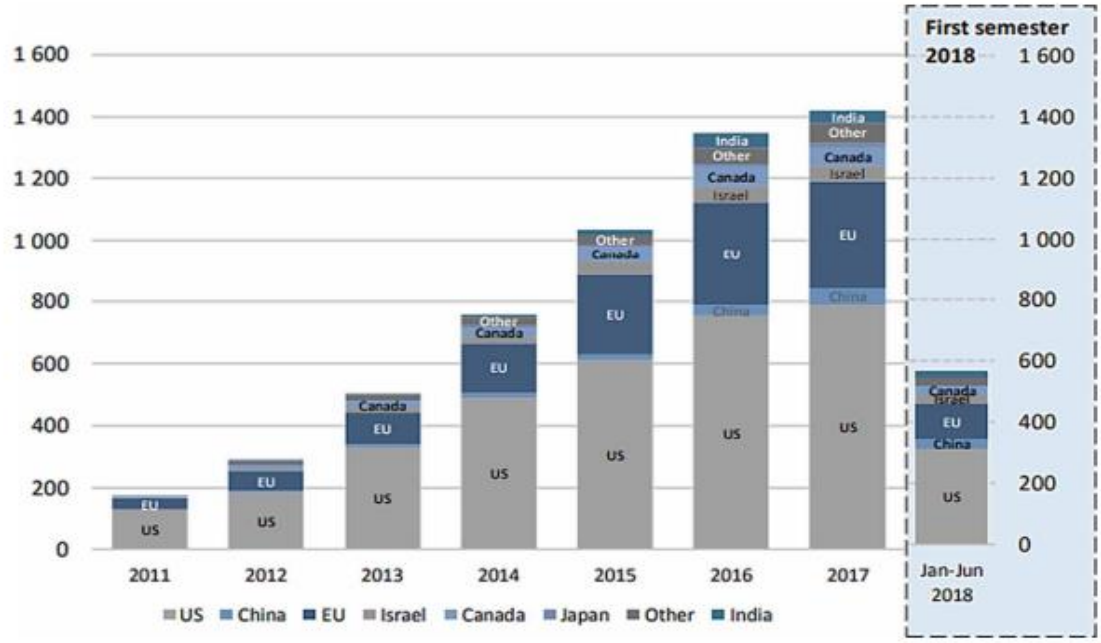

Figure 2.2.3.3: Number of private investment in AI start-ups by start-up location between 2011 and 2017, and the first semester of 2018 (34).

These skills will reshape current health-care and medical-research systems The creation of technologies that are prepared to honestly act with humans is the focus of research in leading AI businesses. Utilizing time period voice recognition and translating skills, interaction takes on more natural forms. Robo-advisory technologies are at the top of the AI market, with an estimated worldwide market value of 255 billion dollars by 2020. There are currently a slew of virtual assistants available from large corporations.

Apple has Siri and Amazon Alexa, Microsoft has Cortana, and Google has the Google Assistant, for example. Apple Inc. bought Emotient Inc. in 2016, a start-up that uses artificial intelligence to analyze people's emotions through facial expressions (36). Wave Net, developed by Deep Mind, could be a modeling approach that simulates human speech. This sounds more realistic than any effective existing Message systems, according to the company's website.

Facebook also sees machine-human communication abilities as a requirement for universal AI. Recently, a deliberate commitment was made to finance OpenAI, a non-profit company, in order to reduce the hazards of monopolizing powerful AI.

To provide increasing performance, OpenAI has developed evolutionary algorithms that can work alongside deep learning models. It's seen as a competitor to Deep Mind because it provides accessible machine learning libraries that are similar to Tensor Flow, a deep learning framework supplied by Google Deep Mind. The major difference between the schoolnology generated at OpenAI and hence the other non-public tech businesses is that the created Innovation is available to everyone. Despite the fact that many business organizations, like as DeepMind and OpenAI, anticipate the answer to the construction of intelligence and hence the supposed robust AI, building computers with unfurled lengthy goals is way beyond existing technology.. Furthermore, there is a heated debate about whether or not we are in the midst of an AI bubble, which contains the paradox that production growth in the United States has slowed over the last decade, despite an increase of technical progress and innovation. It's difficult to tell if this is due to a lack of applied math skills or because current advances aren't sufficiently revolutionary. This loss can also be ascribed to a lack of standardized regulatory frameworks and security standards, which could affect how AI is used in the event of a major incident.

CHAPTER 3 RESEARCH METHODOLOGY & QUESTIONNAIRE DESIGN

The goal of this study is to analyze and quantify the impact of artificial intelligence (AI) in SCM, with an emphasis on the retail sector, and to compare Tunisia's status to that of the rest of the world. It also uses a poll to assess the maturity of enterprises in terms of AI application.

3.1 Research scope

In our study, we looked at how AI is used around the world and in Tunisia, and we used a comparative analysis to show how far the Tunisian version of AI has progressed.

Organizations have progressed in the field of using AI technology to supply chain management (SCM) compared to globally. As a result,6 Tunisian companies and 6 globally have been questioned to analyse and understand more their AI applications.

We looked at applications in various SCM subfields ,Various industries, with a concentration on firms in the retail industry.

As a result, we were able to conduct an investigation into the current situation.

The people who took part in our study were mostly managers or at the top of the hierarchy of the organization. The reason for this is that top leadership people have a full view of the company's financial situation and adequate data to judge or form an opinion on the effect of one or even more newly introduced systems or apps. Since they are intertwined with our research.

3.2 Research Methodology

We conducted our research using a mix of methodologies, including a case study analysis, a questionnaire form, and interviews (however due to COVID-19 precautions, we had to conduct the interviews online despite the ban on face to face meetings), allowing us to:

1- Conduct a comparable case study on publicly available information and documents from Tunisia and around the world.

2- Evaluate a company's ability to apply artificial intelligence.

3- To arrive at a steady and precise conclusion about the use of artificial intelligence in SCM in Tunisia and around the world based on the comparison of the reality in Tunisia and across the world.

4- In Tunisia and other nations, assess the influence of artificial intelligence (AI) on SCM.

3.3 Literature Review

In 2021, a study was conducted in Istanbul by Aicha Ftama Zitouni in her master thesis under the title “the role of artificial intelligence in digital marketing on retail sector” . The goal of this study was to determine the function of Artificial Intelligence (AI) in retail digital marketing. She may study the problems and achievements of Artificial Intelligence (AI) in online marketing in the retail sector .

The first objective was to find the function of Artificial Intelligence (AI) in Digital Marketing in the retail sector, and the second was to highlight the methods and solutions for the effective use of AI in online marketing and in the retail business..

Aicha Zitouni employed the Interview Form as the data collecting method in her thesis approach. In the interview form, the researcher had prepared 15 questions, and because of the epidemic, interviews were conducted online with representatives of digital marketing organizations.

As a conclusion to her results, we can conclude that the reader gained knowledge of the benefits that Artificial Intelligence (AI) is providing to digital marketing in the retail sector as a result of this research. Because of the current availability of a variety technologies, this study also reveals that current Artificial Intelligence (AI) tools can assist marketers in increasing a company's success (37).

A study was conducted in 2021 to anticipate how important it is to obtain information over how robots and AI are working together to help the world grow better. It also tells the backside of the narrative, which is how robots and artificial intelligence are affecting us.

His research was valuable in analyzing the impact of AI and robotics on humans, and it will aid counselors in better understanding and treating people who are influenced by modern technology. This is incredibly beneficial for academics and individuals interested in developing new technologies to understand how many challenges and problems can arise because of AI and robotics; it also aids in the reduction of mental diseases associated to technology. This thesis has five objectives: the first is to explore the relationship between AI and Robotics, the second is to investigate how AI and Robotics affect human human existence, the third is to investigate how humans are affected by AI and Robotics, the fourth is to investigate the impact of AI and Robotics on humans, and the fifth is to investigate how humans perceive AI and Robotics. For the methodology Anis Gilani set two hypothesis that will be neglected or agreed , the first one is *"There is a significant relationship between AI and Robotics"*and the second is *"There is a positive impact of AI and Robotics on human mankind"*

As a result of his findings, the article reveals that AI is a commonly used label to suggest to the discipline of science focused on providing computers with the capability of performing capacities such as reasoning, thinking, arranging, learning, and discerning (38).

Another study conducted in Ankara by Fatih ULAAN found that AI can be useful in certain parts of the Turkish judicial process, such as the Turkish administrative jurisdiction, particularly when the judicial system is oriented to be digitized to some level. To employ AI more effectively, preliminary preparations in government, education, and legal policies are critical, Fatih ULAAN focused on what these policies must be in his thesis.

This research examines the past and present of AI in public services, as well as present applications, in order to better comprehend how far this technology has progressed. The study focuses in particular on preliminary preparations in areas such as education, government policy, and law. Robot law and rights, ethical issues, legislation, control mechanisms, and other topics are examined in order to give a foundation for innovators developing AI applications and humans who may come into contact with them in the future.

We can conclude, based on his findings, that the world's population and the number of disagreements are growing every day in both the woeld and Turkey. The incorporation of AI technologies into the judicial and decision-making process can be a solution for dealing with workloads in cases when the key objectives of the law are realized (39).

Odd Schneider, Gee Hee Hong, and Anh Van Le did another study in Japan in 2018 to see if the artificial intelligence and robotics may help with the increasing drop in the working population: positive or negative news for human work? They conclude at the end of their research that the benefits of robots would spread well beyond Japanese companies, into schools, hospitals, retirement homes, airports, stations, and even temples, allowing people to improve their living conditions and earn more money. They also point out that Japan is a unique instance where, due to the nature of its demography and workforce, the benefits of automation have been large and might be even greater, and these technologies could help to meet the challenge of long-term productivity gains (40).

In a study conducted in Istanbul, İrem Doğan talked about the The application of artificial intelligence in new age of marketing by an analysis on AI mobile banking applications.His thesis' major goal was to investigate and determine whether integrating AI technologies into mobile banking applications has an impact on the usage of mobile banking.

The model was created by combining the TAM and TAM2 models, as well as adding Security and Privacy. To determine the probable level of links between the constructs in the proposed model, nine hypotheses were developed. Finally, we may conclude that by developing a deep learning algorithm-based software, the bank can provide customers the impression of obtaining totally tailored and exceptional service through their smartphones, just as they would if they visited a customer banking consultant at any bank branch (41).

Cemalettdn Öcal fddanboy conducted a study in 2009 to look into current artificial intelligence applications within the CMMI (Capability Maturity Model Integration) process domains. The CMMI Model is the subject of this investigation. Then, utilizing artificial intelligence approaches, recent studies on CMMI process areas were analyzed. The thesis's overall goal is to conduct a survey of artificial intelligence techniques in relation to the

Capability Maturity Model Integration (CMMI) process areas. Finally, future work in artificial intelligence applications was evaluated using the CMMI methodology (42).

In Istanbul in 2021, Begüm AY TÜRE did another study, this time on the methodologies that may be utilized to evaluate the predictive maintenance model, which will help to realize the theory of maintenance more efficiently. Many different learning algorithms and methodologies were tested during the investigation to identify the most convenient method for the entire usable life. When the data is analyzed, it is clear that the Stacking Ensemble Learning approach, which was created utilizing five distinct machine learning methods, exceeds the other models with a 95.72 percent accuracy (43).

Aicha Fatma Zitouni talked about the role of artificial intelligence in digital marketing on retail sector , *Anis Gilani* talek about the perception of artificial intelligence and robotics, *Fatih ULAŞAN* searches about the use of artificial intelligence in the public services especially the case of Turkish administrative jurisdiction, *odd Schneider, Gee Hee Hong et Anh Van Le* mesure if the artificial intelligence and robotics duo could remedy the rapid decline in the workforce: good or bad news for human work? *, İrem Doğan* talked about the The application of artificial intelligence in new age of marketing by an analysis on AI mobile banking applications , *Cemalettdn Öcal fddanboy* did a survey of artificial intelligence techniques for capability maturity model integration , *Begüm Ayture* invented a designe of predictive maintenance model using artificial intelligence methods.

Finally, but certainly not least, The focus of this thesis, which is unique and the only one of its kind, will be on how essential AI applications are to an organization's performance and how they affect and facilitate supply chain (SC) procedures. The study also compares AI applications in other business sectors in Tunisia and throughout the world, and conducts an analysis to show how far Tunisian enterprises have progressed in the field of deploying AI technology in SCM compared to the rest of the world. The second half is about a survey with 15 questions to evaluate organizations' ability to apply AI and conclude to a solid and precise result based on a comparison of the situation in Tunisia and the situation in the world .My indirect objective is to encourage Tunisian companies and less development country to invest and integrate artificial intelligence and robotics in their system , it defently could help to meet the challenge of long-term productivity gains.

3.4 Questionnaire Design

The research questions was based on the Microsoft AI maturity exam for enterprises, however it has been adjusted in addition to extra sections/questions have been included to ensure that the research objectives are met.

The major data source is an online interview that was conducted in a professional and documented manner. The questionnaire is divided into 2 sections with a total of 16 questions. The first five questions examined the participant's name, company's operating country, role, and sector in order to determine categorization. The next 11 questions are intended to assess the company's capability for AI applications as well as the strategic implications of AI.

The two questions 15-16 targeted at determining the direct impact of AI applications on supply chain management.

3.5 The Research's Limitations

The fact that AI knowledge isn't even widely distributed in the various business activities, combined with the spread of the Corona Virus, has made it impossible to identify and conduct such job by restricting movement and engagement with business specialists. This study was conducted in Tunisia using informed people; nevertheless, due to Tunisia's recent implementation of these apps, competence in the relevant subject may be less than that of specialists from western countries, such as the United States.

3.6 Questions

As previously stated, the questions that were asked to the participants were split into 2 parts, each one analyzes and dimensions a specific benefit and scenario. Though may be seen in the research's Appendix.

CHAPTER 4 COMPANIES APPLICATIONS & SURVEY

4.1 A Comparative Analysis of Cases between Worldwide & Tunisia for AI Applications in Various Industries

Cases and applications from several segments of the retail business (logistics and transportation, retail, and E-commerce) are examined and studied in the following section. The analysis investigated a comparision of AI applications and robotic involvement on different Tunisian and worldwide companies and how to adapt with the new technology.

4.1.1 The agricultural field

Agriculture is an important part of the economy. Agriculture technology is a major concern and a rapidly growing topic around the world. The population is rapidly growing, and with it comes an increase in the demand for food and work. Farmers' traditional methods were insufficient to meet these requirements. As a result, new machine-controlled approaches were developed. These innovative methods satisfied the world's food needs while simultaneously providing jobs for billions of people. Agriculture has undergone a revolution as a result of AI.

4.1.1.1 the SEABEX project :

Seabex, innovative solutions for the benefit of sustainable and smart agriculture

SEABEX, a **Tunisian** solution for smart irrigation ,The Seabex project is an agricultural telemonitoring and intelligent irrigation automation system that helps farmers better manage available resources, such as water and energy, in resource and drought-stricken developing countries. Hydraulic limited, in order to produce large quantities of better quality.

Seabex was born in 2015. It is an idea that stems from a recurring problem in the world of High Tech: monitoring and scalable automation. It was highlighted by “Tahar Mestiri” who now chairs Seabex. Seabex was created at a special time for Tunisia, marked by a drought that threatened - and still threatens - agriculture and freshwater dam reserves.

The goal of the start-up team was clear: to achieve optimal use of water resources for efficient, smart and sustainable irrigation.

Thaher mestiri says : “Like all dreams that grow and come true, the history of Seabex has been marked by so many hardships, failures, disappointments, sleepless nights ... but ultimately crowned with tremendous success”.

The start-up has succeeded in implementing smart solutions for precision agriculture, which has led to many positive benefits: improved productivity, a respected environment and natural resources preserved and optimized. In this same context, the farmer is at the center of the Seabex project. By simple SMS, he is accompanied and advised. The process also involves full automation of real-time data acquisition.

With this in mind, a platform collecting data relating to the plots of farmers / operators has been set up. A digitized tool where AI (artificial intelligence) works wonders, through which, for example, calculations of irrigation needs are carried out, which facilitates decision-making. The data collected comes from several sources: satellite images, weather forecasts, etc.

Seabex also deployed the Internet of Things (IoT) to design a solution to facilitate data collection and automate activities related to different cultures. This involves IoTs stations that automate data collection from weather stations and sensors installed on the plots.

The positive effects of these solutions developed by Seabex are numerous, especially for farmers. *“Our platforms provide 80% accuracy for the farmer in terms of information. Our mission is to make agriculture more reasonable and more sustainable. Technology is at the service of agriculture, ”says Amira Cheniour.*

4.1.1.2 The Plantix deep learning application

Plantix, a Berlin-based AI start-up, was founded in 2015 by husband-wife duo Rob Strey and Simone Strey under their startup Progressive Environmental and Agricultural Technologies (PEAT) in efforts to support farm owners use technologies to optimize plant health and identify the correct inputs to produce crops. After trying to analyse the greenery of plants, its methods are able to form a similarity with these ground faults, the existence of insects or illness.

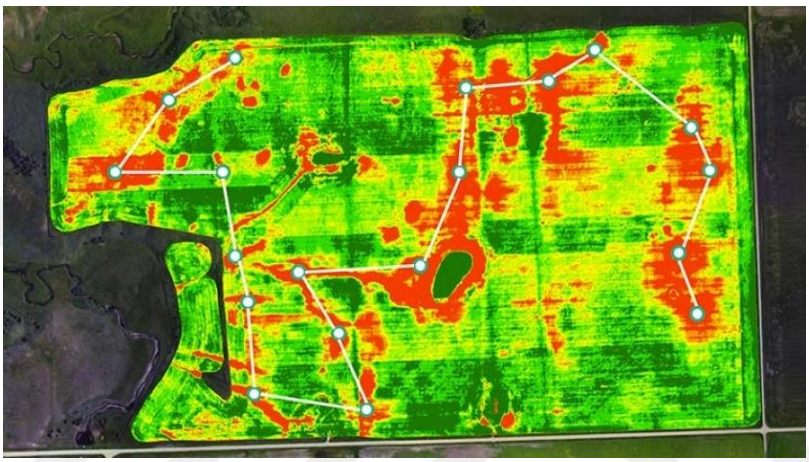

Figure4.1.1.2**:** the Plantix deep learning application

Farmerlabs, on the other hand, uses AI to measure the level of plant health and anticipate risks in terms of yield. The young French company uses computer vision, big data and machine learning to help farmers practice precision and sustainable agriculture.

Indeed, AI can also increase yields (outputs). These are based on parameters like climate, condition of seeds and soils, irrigation levels, disease risk, etc., to allow farmers to know what to plant, where and when, what plants to watch and when to harvest. It's also determine how much water a plant needs. This technology is used in the United States and Mexico by the tomato producer NatureSweet, which It has experienced a 2 percent to 4% increase in harvests and expects to be able to improve its fields by approximately 20% in the near future.

4.1.1.3 Blue River Technology

The exciting new business of John Deere, based in Sunnyvale, California, is Blue River Technology. John Deere is an American firm that mostly manufactures agriculture and construction machines. Since the acquisition in 2017, Blue River has not only developed rapidly, but they've also gained access to world-class equipment manufacturing expertise. Blue River has launched on a mission to produce technology that can help feed the globe more sustainably while maintaining its startup culture.

Blue River focuses on using machine learning, robotics, and computer vision technology to improve agricultural equipment, allowing farmers to make better decisions. See & Spray, their main product, employs computer vision, machine learning, and advanced robotic technology to differentiate between crops and weeds, only spraying the weeds.

Because yes, robots are also making their foray into our fields. Driverless tractors and agricultural machinery are spreading on farms, where they can perform a number of tasks on their own.

Figure 4.4.1: See & Spray robot

Added information :

In the United States, Harvest CROO Robotics has developed a robot to help strawberry growers pick and package their fruit. Faced with labor shortages in agricultural regions such as California and Arizona, Harvest CROO Robotics claims that one of its robots can replace 30 human workers.

"The robotic agriculture market is expected to grow from $ 1 billion in 2014 to $ 14 billion to $ 18 billion by 2020"

According to McKinsey firm estimates, the robotic agriculture market is expected to grow from $ 1 billion in 2014 to $ 14 billion to $ 18 billion by 2020. Guided by artificial intelligence technologies, robots are expected to free farmers from tasks repetitive and painful, while guaranteeing better income. This is also smart, sustainable agriculture.

4.1.1.4 Comparative analysis

The agricultural industry has a number of obstacles, including a lack of appropriate irrigation systems, weeds, crop height-related issues with plant monitoring, and severe storms. However, with the help of technology, performance may be improved, and thus these issues can be resolved. It can be enhanced using a variety of AI-based strategies.

These methods are used in a variety of ways. To begin with, it aids farmers in keeping information about what is going on on their farms. Drones and sensors have been used by the latter for several years, but machine learning allow them to evaluate data more precisely.

Farmers' difficulty was that accuracy gardening techniques were able to minimize the high amount of crops lost during the cleaning procedure. These self-driving robots not only increase productivity, but they also cut the use of unneeded herbicides and pesticides.

It is apparent that both Tunisian and non-Tunisian enterprises agree that AI is currently being used in agricultural field , although Tunisian organizations are still behind in this field compared to global applications.

4.1.2 The logistic and transport field

4.1.2.1 A Comparative Analysis for Retail & E-Commerce (As an Online Retail)

4.1.2.1.1 Jumia Tunisia

Jumia is a global e-commerce corporation with a strong presence in Africa. Jumia, which was established in 2012 by two French entrepreneurs, sells electrical goods, hygiene products, food, and services.

The Jumia platform is an online marketplace that links vendors and buyers by offering a logistics solution that includes parcel shipment and delivery, as well as a payment option1.

More than 80,000 merchants offered a diverse array of goods and services on demand in 2019, including household and technological equipment, fashion, children's toys, as well as services like hotel or plane reservations and food delivery. Jumia has been dubbed the "African Alibaba" or "African Amazon".

A questionnary done with this company and they said that they start using robots and artificial intelligence since 2019 , and they were using robots in warehouse and in purshase service.

“we were working on two work system and we were using 2 different warehouses (the old one and the new one using robots) , we had 300% increase in sales , increase of customers satisfaction from 75% to 97% , before using robots we faced multiple problems considering the unexpected demand of the customers , now in the pandemic we got everything under control.”

*What are the effects of using robotic instead of human : weaknesses , opportunities ,threats strength ?

“Strength : gain of time , stock availability , increase accesibility to our products in the warehouse.

Weaknesses : we need to always adapt our warehouse place with the robot system.

Opportunities : our brand name is getting bigger day by day and we are wroking on starting business in other countries

Threats : we are facing some problems in the purshase system we are working to solve it .

4.1.2.1.2 Carrefour

To Improve Carrefour's Distribution Chain: Carrefour became the first Multinational firm to use AI to improve stock control and reduce spending by using equipment designed with the aid of excellent SAS analytic innovators into their supply chain. Carrefour value chain has chosen the architecture for an AI machine designed by superior analytics innovator SAS, building on the $2 billion yearly financing budget included in the Carrefour2022 business transformation, notably for IT and virtual extension efforts.

The SAS system was used to collect and process data from stores, depots, and e-commerce websites in order to enhance demand estimates and automate provider purchasing once a trial period has ended. Each out share in stores and warehouses will be reduced with better supply

chain management. Within the French retail business, the AI era has been integrated into the supply chain for food and, shortly, – anti food goods. The purpose of this objective is to create a one kind of physical and online environment in which recognized and favored clients may be certain of receiving the best possible deal at all times. The purchasing and planning teams' capabilities could potentially be improved with the help of AI machines.

SAS is a software platform which could manner a number of statistics from the Carrefour's distribution network . It additionally facilitates personnel to end up greater flexible via way of means of incorporating new operating strategies and improving their forecasting procedures continually. Carrefour specialists can also construct their personal custom designed algorithms to satisfy their particular necessities with the SAS open AI solution. SAS claims that they are the usage of their technical and commercial enterprise enjoy to aid Carrefour teams, all through the combination technique of the Big-Data mission which primarily based totally on AI and system learning, with the intention to automate every step withinside the supply chain and enhance consumer pleasure (44).

4.1.2.1.3 Alibaba

China is seen as a fertile land for Ai technologies, and Alibaba continues to grow at a significant rate. Alibaba, the biggest and most popular company, with a revenue of $248 billion, which is far more than Amazon and eBay combined. Alibaba's primary business is sales growth, but the company's influence and operations have grown to making a world leader in the field of technology. Alibaba also invested in a total of 7 research labs, focusing on AI, algorithms, community security, language processing, and other topics.

Many more of their advanced technologies that aided event sales led in $25 billion in profits last year, up from $17.8 billion in profits on the same day in 2016. The AI software that was employed was as follows:

• Tmall Smart Collection: this Intelligence set of criteria allows for the recommendation of goods to customers, as well as contacting stores to increase inventory to keep up with demand.

•Xiaomi, Dian: This Intelligence chatbot understands over 90% of Alibaba purchaser inquiries and supports over 3.5 million consumers every day. A new chatbot model can detect a customer's emotions and prepare and alert a real agent to assist..

•Stocking robotics and drones: In automated warehouses, over 200 robotics can handle one million deliveries every day. When orders are processed, the robots pack and deliver the product, and in some situations, they are able to offer it the same day.. In a few delivery Alibaba additionally makes use of drones.

4.1.2.1.4 Cdiscount French digital company

Cdiscount : French digital company. The site was founded in 1998 by the Charle brothers. Initially specialized in the sale of second-hand CDs and DVDs, the company has since widened its offer and now boasts more than 100 million referenced products offered for sale in the home, high-tech and leisure worlds. , fashion and food.

The company, chaired by Emmanuel Grenier, is based in Bordeaux in Gironde. Since 2000, it has become a subsidiary of the Casino group, which today holds almost all of its capital through the Cnova holding.

Cdiscount uses the Exotec solution for order preparation:

Exotec has designed a robotic system to optimize order picking. Thanks to its fleets of several hundred robots, capable of moving in three dimensions, Exotec not only helps to reorganize warehouses, but also to optimize logistics flows. These robots are able to move on the ground but also in height by climbing on the storage racks, which allowed Cdiscount to multiply its storage capacity by five. The productivity has been costed three to four times that of a manual operation.

Automation of parcel sorting

The flow of parcels, especially with the rise of e-commerce, is intensifying and requires optimized structuring. AI is once again a valuable tool in automating this stage of the supply chain.

How?

Based on a predefined storage system, the robots automatically route the packages to their destination area. Robots move on their own, quickly, taking others into account. The optical reading will allow a rapid scan of labels in order to identify the products as well as their characteristics (weight, dimensions, geographical area of delivery).

What gains?

-Better sorting productivity

-Lower OPEX cost compared to human sorting

-Lower error rate

-Improved operator work

Figure4.1.2.1.4 : Exotec robot

4.1.2.1.5 Comparative analysis

According to Kotler: Retailing includes all the activities involved in selling goods or services to the final consumers for personal, non-business use (45).Retail managers in our research site (Tunisian and non-Tunisian) are evaluating ways to utilize AI for cross-useful coordination and partnerships with clients, according to our research. For those capabilities, more methods that necessitate various gadget integrations are needed. This concentrate is now on the regions that have a lot of distribution network control and in-store actions for AI adoption. Cooperation across some capacities, such as procurement, distribution, and shipping, is part of the supply chain. Previously, all of the techniques linked to those skills were performed manually. AI is considered ideal for this type of operating conditions. With AI-powered systems, info about specific operations may be received, absorbed, and examined without issue. They could then prepare calculations to help outlets make real-time decisions while developing and managing programs, analyzing risks, and making a decision. Manufacturers can also apply robotics to carry out general responsibilities as they do by, coordinate activities, and enforce changes to situations.

Machine learning also could benefit manufacturer activities and in-store offerings greatly. Each town or area is unique, with its own spatially constrained flow of people, places, or

sports that influence customer attitude and request. A university city business requires a significantly larger selection of items than a resort region shop. AI will analyze current information to classify commodities and services that suit the district's needs. This could systematize inventory selection for a specific store based on local region characteristics and accessible ingredients. Companies that are in the planning stages of implementing AI can expect to help their teams perform better than they do now, increasing operational efficiency, enhancing capabilities, and lowering costs.

Artificial Intelligence users have influences which could substantially regulate the manner of making business, increase structural performance, boom selection performance and speed, and improve customer experience. The goal is much less on cost discount and extra on productiveness and long-time period growth. Although the preliminary motivation for engaging with AI programs may be productiveness enhancements and fee savings, a good extra advantages may be accomplished as functionality matures. By enhancing the client experience, stores can launch completely new plans to client interactions and contacts. With the use of AI, they may apprehend the anticipated alternatives with customers on extraordinary instances and use the exact time to advantage huge profits with the proper deals. Manufacturer nowadays had commenced the usage of AI engines to cause e-mail campaigns automatically. That functionality might be plenty extra essential to be delivered to right procedure, in order that customers can easily and freely make all kind of transactions withinside of any assistance. And it’s probably the purpose that lot of Artificial Intelligence programs are client targeted as we've explained withinside the studies.

Consequently, it’s logical that each Tunisian and no-Tunisian firms (in nearly every of the studied sectors) permitted that they formerly within side making use of segment of the Artificial Intelligence in client support region, that's the region maximum of the companies begin with. Regarding demand control, and enhancing stock productiveness and operational agility, it changed into stated that an excessive degree of effect on stock productiveness and operational activities changed into proven in the capabilities of deliver chain control, logistics and management. These are crucial for development and growth. The critical point aim of SC control is to modify demand to supply and items on the exact time, for desire and expectancies satisfaction for clients. Stock plus can bring about mark loose and less stock could result in misplaced orders and benefits. All of those situations had unwanted effect with stock performance and profits.

To boom stock adaptability, outlets could use Artificial intelligence and device mastering programs to enhance making plans of deliver cycle and statistics predictions. Cause of each unexpected and predicted thing, including innovation creation or part time changes, the developed programs can then manipulate the flows to replace and adjust what to do mechanically to cope with markets up and downs. As showen from the following and formerly studies, that Tunisian businesses continues to be both withinside the making plans or piloting stages concerning the utility of AI in demand and stock management, at the same time as the non-Tunisian businesses is extra superior on this area. For example, The Procter & Gamble Corporation, a multi-country wide patron items organization, is running to put into effect a statistics predictions machine of the following technology to decorate its analysis accuracy in general withinside the cloture to term. The point is to enhance productiveness and boost planners to create higher selections in traditionally hard places.

One other problem where Artificial Intelligence can fill in the process in managerial agility.That's the capacity of execution to unexpectedly ,effortlessly and fastly get used to it . That it would be possible to manipulate and tune items flexibility in the duration of the deliver chain, businesses are an increasing number of the usage of IOT and different clever devices. AI and device studying can practice the capacity to display and tune records for studying and reasoning. They can use this records to attract insights and set up guidance for the following high-quality steps for handling probably luxurious barriers and damages (46).

- For the warehouse control structures and manipulate area, as our studies received documented-records the Tunisian businesses are still now no longer into this AI programs yet, at the same time as massive outlets like Amazon, Alibaba, and Carrefour has validated an advanced method concerning the AI programs on this area, which includes clever-robotics and clever imaginative and prescient programs.

4.1.2.2 A Comparative Analysis of Cases between Worldwide & Tunisia for AI Applications in Various Industries: transport and production

4.1.2.2.1 Delice danone industrial comapany specialized in milk and yogurt : TUNISIA

The Délice company is a Tunisian agro - food company that specializes in the dairy sector.

With the aid of the Industrial Promotion and Devolution of power Organization, Hamdi Meddeb launched his first firm, the Tunisian Food Industries Company (STIAL), in 1978. Specialized in yogurt and dairy products, it steadily rises to become Tunisia's dairy sector leader, with 30% market share in 1993.

The group ended its collaboration with Virgin Cola in 2005-2006.

The Délice group was launched on the Tunis Stock Exchange on September 15, 2014, in one of the most significant transactions ever carried out there, with Meddeb holding 81.96 percent of the capital until then. The company made a profit of $1 million at the end of the year.

An interview has done succefully with delice danone company and the survey was accepted to be answered :

" The first time we bought a robot and start using it was in 2011. Now we are using robots in the warehouse and in the production services. The last time we add a new robot was 2 years ago in the production service."

What are the effects of using robotic instead of human : weaknesses , opportunities ,threats ,strength ?

" Strength : more efficiency in work , less defaults , gain of time

Weaknesses : expensive , need time to adapt workers

Opportunities : make the company more closer to 100% digitalization , increase of the company value and brand image in the market

Threats : one mistake in the programation of the robot can lead us to big problems with in the production and with the workers safety ."

We asked them how they adopt with the new technology of robots and what are the results

"we had different worker's training in 2 years before we start to uses robots. after using robots :we had 90% decrease in the numbers of defaults units (from 100 out of 1000 to 10 out of 1000) .

We had 400% increase of the production cycle (from 250 to 1000 daily final products)

we increased the use of robot by multiplying it's functions to cover the shortage of workers force."

4.1.2.2.2 L'Oreal

L'Oréal is a cosmetics manufacturing company based in France. Eugène Schueller founded the company on July 30, 1909, and it has since grown into an international conglomerate and the world's leading cosmetics company.

Example of L'Oreal which has implemented the Hardis Group Eyesee drone system:

A drone, equipped with an on-board camera, passes over the shelves of each department to carry out inventories. Thanks to AI video processing, the drone can read barcodes and recognize empty locations.

Gains:

-Lower error rate

-Cheaper and Faster

-More safety for employees who no longer work at heights

-No need to immobilize the warehouse for days

-Can be done every night or every weekend.

Automation of order preparation

In order to facilitate the work of order pickers or even completely automate it, artificial intelligence enables enormous savings in time and productivity.

From the orders, a swarm of robots move through the racks to collect the goods and route them to the operator. The AI guides the robots and optimizes their movements in the warehouse.

Gains :

-Improved picking productivity

-Improved picking time

-OPEX cost of picking is improved

-Lower error rate

-Improved working conditions for operators.

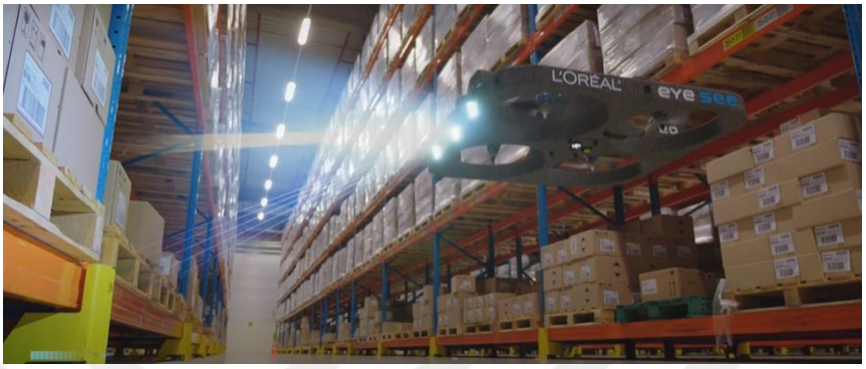

Figure4.1.2.2.2: L’Oreal drone

4.1.2.2.3 STO express

China's and Hong Kong's domestic and international express delivery

As of 2014, there were over 8000 express enterprises in China that have together delivered over 14 billion packages. STO express, the first and largest private express enterprise in China, reached business revenue volume of 2.4 billion in 2014. The number of packages the company delivered has reached 30.5 million

STO Express has equipped itself with robots to sort its parcels:

By scanning the label of the package, STO Express robots are able to route it to the correct area of the sorting center. They can process up to 18,000 packages in an hour.

The use of sorting robots improves efficiency, accuracy and safety during the sorting process and also reduces labor costs by 70%.

Visibility of transport

Tracking the flow of goods is essential for those involved in logistics who are responsible for ensuring that they get to the customer. The latter being more and more demanding, they ask for more transparency on the delivery of their product. This visibility is also valuable for logistics operators who can react to delays and unforeseen events and proactively inform the customer.

Using data on the position of goods around the world as well as transport conditions (weather, congestion, etc.), AI predicts the arrival of goods at their destination by providing complete visibility.

Gains :

-Best estimate of estimated time of arrival

-Greater responsiveness

-Allows you to anticipate rather than suffer delays

Figure4.1.2.2c: STO Express robots

4.1.2.2.4 Clasquin, the world expert in international transport and logistics

With an integrated network of more than 66 offices and 1,000 employees around the world, we are the only French multinational mid-sized company in the Freight Forwarding and Overseas Logistics sector. This unique positioning allows us to offer end-to-end global

solutions like the giants of the sector with the quality of service of an ETI (customer proximity, tailor-made offer, creativity, responsiveness).

This company selected Wakeo best –in-class solution in a pragmatic innovations approach tu putt data at the heart calsquin's transformation

Wakeo is interconnectable with all IT solutions on the market (ERP, TMS, WMS, etc.). This collaborative platform was designed to simplify international transport and improve visibility on the supply chain. To do this, the start-up uses machine learning and large-scale data processing, in order to anticipate delays and thus ensure reliable supplies and customer deliveries. Wakeo integrates both real-time tracking to anticipate delays, email and SMS alerting to notify the various stakeholders, and analytics to accurately measure transport performance.

4.1.2.2.5 DHL company

DHL International GmbH (Dalsey, Hillblom, and Lynn) is a package and transportation firm based in the United States and controlled by German Post With operations in 220 countries and territories, Deutsche Post DHL Group is the world's biggest logistic company. Every year, the firm transports 1.3 billion shipments.

DHL advanced a system-primarily based totally studying device to are expecting air shipment time delays as a way to reap positive improvement. The system studying version will decide whether or not the common each day transit time for a given route is predicted to growth or lower as much as every week earlier throughout fifty eight distinctive inner information parameters. In addition, this method will classify the top elements affecting cargo delays, such as transient elements including day of departure or practical elements including on-time overall performance through airways. It will assist air freight forwarders put together in advance through decreasing subjective guesswork on while or via which airways they may launch their shipments (47).

Intelligent Computer Vision

Since the principal permitting advancements in deep mastering in 2012, intelligent computer vision has been on the rise. Advances have enabled logistics scanner, surveillance, and automated systems to effectively "see," studying and determining content material in a photo or video and operating based on that content material. This has changed the way goods are

sized as well as the way they are inspected. Advancements in computer vision and deep reinforcement mastery have pushed development in self-reliant travel and robot arm choosing precision for robots and self-riding automobiles.

Robotics and automation

Within the logistics industry, the first wave of automation, utilizing smart robotics, has come. Robotics solutions are entering the logistics profession, helping zero-illness procedures and enhancing productivity, thanks to rapid technical innovations and lower costs. Robots, whether mobile or fixed, will play a larger role in the supply chain, assisting employees with storage, transportation, and even last-mile shipment. To increase throughput, cut costs, and satisfy growing customer demand, logistics players ranging from traditional warehousing to new e-commerce startups are moving closer to automated techniques. The robotics industry is most likely to expand if more techniques along the supply chain are paired with robotics solutions.

Logistics robotics are developing and achieving competence levels that are comparable to or better than human capabilities. New technologies feature human-like ability, excellent eyesight, and rapid, fluid movement, thanks to improved hardware and AI advances. With more robotics and more use cases, the logistics sector is forming alliances – teaming old automation businesses with a new generation of startups – to achieve next-degree fee with clever technology. Logistics companies, merchants, and producers are all following suit, founder services and products to improve delivery chain performance profits. Now is the moment for logistics experts to pay close attention to robot capabilities and solutions.

Figure 4.1.2.2.5 : DHL robot

4.1.2.2.6 Decathlon

With over 1647 shops in almost three hundred towns in fifty seven nations and regions (Jan 2020),it's miles the biggest wearing items store withinside the world. The enterprise manages the research, design, production, logistics and distribution of its merchandise in house; partners with worldwide suppliers; and markets their personal manufacturers at once to clients in Decathlon-branded big-field shops. Its achievement has substantially contributed to the decline of impartial outlets in France, even as the spread of its personal manufacturers has brought on exceptional problems for conventional manufacturers. 2008 become a report 12 months for the agency because the logo Decathlon had overwhelmed all its competition on 3 key points: margin, marketplace share, and maximum turnover according to square meter of retail space. It is arguably the 1/3 at a worldwide level.

The survey was answered by this company and they provide us by theses information: they started using exotec solution since April 2021

What are the effects of using robotic and AI instead of human : weaknesses , opportunities ,threats ,strength ?

Strength : Brand Retention , Technology integration

Weaknesses : mature market even we use AI and we have developped very well , sill the US could never accept the brand , competition

Opportunities : Expansion By 2025, the emerging market's yearly consumption will have reached a high level.

Threats :Decathlon's margins may be harmed as a result of this increase in fixed costs.

4.1.2.2.7 AD aeronautical company Tunisia

Created in 2006, the GITAS (Group of Tunisian Aeronautical and Space Industries) is a group of companies, of all types of activities having in common:

- To be established in Tunisia

- To have activities in the aeronautical and space field

The objectives and missions of GITAS are:

- Encourage interactions, collaborations, and synergies among Tunisian firms in the aviation and space sectors. This is to encourage the establishment of a Tunisian aerospace "supply chain," among other things.

- Represent the trade before the Tunisian government.

- Encourage the growth of a suitable environment for the aviation and space enterprises in Tunisia, as well as the foundation of new firms in the field.

The survey was answered succufully with AD company and these are the respond of the CEO of the company were :

“ The first time we used robot was on 2017 and we use many SOFTWARES like CLIPPER

Now we are using robots in production and warehousing.

“ Our new robot was integrated last year in the warehousing service.

“ Strength : We decreased our staff salaries by increasing low specialized workers and decreasing high specialized workers. Weaknesses : it’s take time to integrate especially with old employee Opportunities : facilitate the management of the company and the production cycle Threats : if there is an issue in some machine it will affect the production cycle and by the way it conclude to many loses

Gain and how to adopt :

“We didn’t use any integration techniques we just bought the robot and put it on work. Increase in our business profit buy 250% in 3 years ,Decrease in non-compliant products from 30% to 4% in 3 years (40 unit per 1000) , We had temporary shutdown for all the company production for a period of 1 months. After that we started working using robots in production and a very limited number of worked and it was a succesfull experience.”

4.1.2.2.8 Comparative Analysis for Logistics, Transportation & production Sector

AI has large programs in lots of fields as a various variety of technology that may assist human beings clear up normal issues. AI provides possibilities for healthier,more reliable, powerful and cleanser transport thru the evaluation of visitors situations to prevent vehicle accidents and decorate crusing paths to reduce carbon emissions.There are numerous programs of AI, in each superior economies and growing markets, that show the aids those advancing technology can obtain to markets, as a result demanding situations the technology creates need to be controlled effectively (48).When the direction or climate is poor, structures prepared with smart automation can re-direction delivery automatically, preventing waits and adjusting inventories as needed.

The United Parcel Service (UPS) device studying app, for example, provides an application for locating and removing bottlenecks based on a value/gain analysis. For example, if the program forecasts a storm in the near future, it can successfully route applications away from trouble areas. Businesses become more structured as a result of the use of cutting-edge algorithms in order to meet customer expectations, improve quality pricing, and handle unanticipated situations with agility (46).As an end result of our studies for the transportation and delivery, we discovered that non Tunisian corporations have commenced to use AI in lots of areas, like demand forecasting, clever traffic control systems, and preventive protection,as we mentioned in maritime, railway, and air cargo. Whereas the Tunisian agencies running withinside the equal area have implemented AI withinside the CRM and WMS region only, and want to place greater potentials in such aggressive sectors.

4.1.3 The health and care field

AI to improve diagnosis

With the proliferation of medical tools, doctors have to take more and more data into account. The medical field where AI is most prevalent today is in the interpretation of medical imaging and radiology. Some cancers, such as lung or breast cancer, are very difficult to identify on the images produced by scanners. Programs are able to identify abnormalities undetectable with the naked eye and thus detect early tumors more reliably and better target treatments.

4.1.3.1 MedEspoir hospital medical services company

Medespoir clinic is the number one in cosmetic surgery in Tunisia in terms of price and quality of service.

An interview is done with medespoir and the survey is fully answered they said that they start using robots since 2014 in the reception sector and two years ago they start using robots in medical analysis due to the pandemic of covid 19

What are the effects of using robotic instead of human : weaknesses , opportunities ,threats ,strength ?

" Strength : Optimization in the patient movements in the hospital and decrease in humans interactions.

Weaknesses : no weaknesses

Opportunities : big increase in the yearly numbers of patients and in the hospital profits

Threats : if the machine of reception or medical analyses stop working one day there will be a disaster in the hospital."

Gain and how to adopt :

"we hired a robot's guide besides each robot in work.

increase in hospital net worth by 500% in the last 2 years , increase in numbers of patients satisfaction to reach 98%.

we added 2 more medical analyses robots in the pandemic to make the interaction between patient and doctors falls to 0%."

4.1.3.2 AI Diagnosis Vision, the Tunisian platform that uses AI for e-health

AI Diagnosis Vision is a Tunisian start-up that has a web platform using artificial intelligence to study panoramic radiographs of the jaw of patients. The goal is to provide an accurate

diagnosis with a rate of up to 92% and a treatment plan for the patient. His innovative idea allowed him to be one of the five laureates of the 2021 cycle of the Emerging Mediterranean.

Why did you set up this system?

According to doctor Lynda Sboui, dentist and marketing manager of AI Diagnosis Vision, more than 92% of scanners in Tunisia (40 in total for 12 million inhabitants) are concentrated in the coastal regions of the country. It is therefore to remedy these problems that dentists Saoussen Ayari and Koussal Barhoumi have joined forces with AI doctor Anouar Nechi to set up this platform. It responds to the lack of equipment in dental radiology which leads to false diagnoses and numerous dispensable additional examinations which are often dear to patients (49).

AI Diagnosis Vision provides dentists and public / private hospitals with instant and comprehensive analyzes from any device and anywhere, detailed conclusions report automatically written at 92% accuracy, diagnostic suggestion and a recommendation for further patient management using reverse AI. Thanks to its AI, the platform can also transform itself into a virtual doctor and manage a practice independently.

4.1.3.3 Buoy Health (Boston)

Buoy Healthcare is an AI-based completely symptom and treatment analyzer that uses algorithms to detect and treat sickness. Here's how it works: a chatbot listens to a patient's symptoms and fitness concerns, then directs the patient to the appropriate care purely based on its diagnosis. Harvard Medical School is just one of several hospitals and healthcare providers who use Buoy's AI to help diagnose and treat patients more swiftly.

Buoy Assistant, an AI illness check, asks a series of questions to better understand your current fitness problems. Buoy can become aware of potential reasons for your indications and symptoms based on your responses and guide you to the appropriate care. Buoy Monitor enables you to explore the benefits of your coverage options in order to ensure access to in-community suppliers. Buoy Health has collaborated with Boston Children's Hospital to refine and validate their pediatric product offering, drawing on Boston Children's scientific

knowledge and content. In response to the COVID-19 epidemic, Buoy Health has also developed a corona virus device in partnership with the Health Map team at Boston Children's Hospital. The corona virus device educates patients about their symptoms and provides action actions based entirely on CDC guidelines.

4.1.3.4 Comparative analysis

Artificial intelligence (AI) and related technology are becoming more common in society and business, and are beginning to really be utilized in medicine. These technologies have the potential to transform several aspects of patient care, as well as organizational tactics inside service, insurance, and pharmacy organizations.

There are some previous research indicating that AI can perform as well as or better than humans in significant healthcare obligations such as disease diagnosis. Algorithms are already surpassing radiologists in identifying dangerous tumors and directing researchers in the best method to construct groups for expensive medical studies. However, for a variety of reasons, we believe it will be a few years before AI replaces humans in large clinical procedure domains. In this post, we will discuss each of the capabilities that AI provides for automating aspects of treatment, as well as some of the restrictions to the rapid application of AI in healthcare.

A lack of skills to a belated realization of the opportunity offered by these technologies of the future which include AI, robotics, Internet of Things, blockchain, or even 3D printing. However, that could change quite quickly, as several start-ups across the continent are leading the way in trying to innovate to solve practical problems.

4.1.4 Trade, leisure, tourism field

If these sectors are marked by the importance of human relations and the search for personalization, commerce, leisure and tourism are not immune to the general trend towards robotization and the automation of tasks either. In retail, cashiers are replaced by automatic machines that shift the tasks of passing items and paying to the end customer. Still in commerce, interactive screens are capable of informing customers about the availability of items, their location in a store or even the availability of a particular service in a shopping center.

The leisure sector is also strongly impacted by the emergence of artificial intelligence technologies. In terms of video games, it is possible to compete against opponents who are physically present or connected, but also directly against machines programmed to simulate an opponent. Robots also make it possible to train athletes, such as , a table tennis machine.

In terms of tourism, the Internet has already revolutionized the reservations of hotels, plane tickets or trains. AI is used to adjust prices based on changes in supply and demand. As in commerce or other forms of leisure, AI can also do targeted advertising based on our profile and past destinations.

Finally, robots can replace hospitality tasks in hotels or restaurants.

4.1.4.1 Mouradi Hotels Tunisia

A questioannary is done with Mouradi Hotels and they said that they start using robotic in the reception sector since 2014 , the clients can choose their rooms manually using the machine but now they use robots in the reception sector and and in room service .

What are the effects of using robotic instead of human : weaknesses , opportunities ,threats ,strength ?

Strength : big increase in the hotel market value

Weaknesses : the value of room service robots is too high

Opportunities : big increase in profits and numbers of visitors

Threats : Sometimes we need human help to solve some clients needs that robots can't understand.

Gain and how to adopt :

"we started to use robots in only the VIP sector in a period of 1 year so we could update the robot system with all the clients needs. Of course we hired workers to work on the robots updates and requirements."

" increase in our business profits with 300% in 2 years 95% of clients satisfaction."

"no big changes in the pandamic because we felt capable for keeping our work done using our robots."

4.1.4.2 Lola Application

Lola.com is a sofware as a service (SaaS) company situated entirely in Boston, Massachusetts. It is well-known for expanding firm trip management and cost software application for internet browsers, the App Store, and Google Play. Former Kayak.com directors Paul M. English and Bill O'Donnell founded the firm in 2015. The website functions on a journey company model for inn and flight seek records, as well as reserving services for businesses. It also involves management statistics on employee travel and associated costs. Lola has received about $ eighty million in financing since its inception..

4.1.4.3 Uber

Uber is a journey-hailing carrier that makes use of an app to permit passengers to hail a journey and drivers to fee and get paid. Uber, in particular, is a ridesharing carrier that employs impartial contractors as drivers. It's one in all many offerings that make contributions to the sharing economic system these days through imparting a manner to attach present sources instead of imparting real goods. Travis Kalanick and Garrett Camp released the enterprise in 2009, and it's miles primarily based totally in San Francisco. It is assumed that the business enterprise has one hundred ten million customers worldwide.

Using the Uber app, Uber connects passengers with drivers. The drivers, for the most part, have their own vehicles. Through third-party partners such as Hertz, Get Around, and Fair, the corporation also rents and leases automobiles. Uber Fleet is a driver-management app.

For both drivers and passengers, Uber provides trips with a variable pricing model. Passengers who require transportation can use the app to request a driver and obtain an estimated cost depending on the destination and current demand.

4.1.4.4 A comparative analysis

The travel industry has always been on the cutting edge of technological adoption, particularly when it comes to digital technologies. Travelers have been similarly enthusiastic

about embracing technological advancements that make travel more convenient and enjoyable. This has resulted in massive product and business model innovation, such as Airbnb and Uber. With an online presence soon becoming the major method for reaching clients, the tourism industry welcomed the era of websites with open arms. Then, propelled by the social media craze, it progressed into the mobile era. In order to be everywhere, all of the Time, the enterprise has speedy followed a mobile-first strategy. The future of AI in tourism is open. On the only hand, there may be an constructive view. In this view, society can deal with AI's important challenges. Privacy troubles can be solved, connectivity can be carried out so as for AI structures to be deployed, and employees and AI structures can be capable of paintings hand in hand. From the customer's perspective, AI will permit them to put together their journeys greater speedy, with notably decrease transaction fees and a completely personalised package deal that fits their wishes and interests. They will get hold of predictive gives that in shape their requirements. During the trip, technology will assist vacationers to navigate unknown environments seamlessly, decreasing the tension and worry of the unknown. Language and cultural variations will now no longer be obstacles to tourism, however an extra enchantment instead. Technologies will permit clients to get hold of the pleasant viable carrier even as ensuring privateness as an awful lot as viable.

4.1.5 Financial services

Retail Banking Sector:

According to the European Banking Federation, AI has confirmed security and fraud prevention improvements:

Ai is assisting in the detection of fraud and other suspicious actions that are frequently related with financial crime. Outside crime (such as money-transfer assaults on the bank or its clients, identity fraud, electronic payments, and so on) and internal fraud by personnel have traditionally been kept separate in banks. The Fraud Detection System (FDS) mitigates these risks through artificial intelligence (AI) and adaptive learning, as well as transactional data collecting, analysis, and learning, and interaction with FDS operators.

This could detect suspicious activity and block or prevent it, as well as limit criminal conduct. After creating consumer profiles, fraud protection becomes substantially more effective. .

These artificial intelligence applications are crucial in the battle against money laundering and other financial crimes, as well as in assisting financial institutions in saving money (50).

4.1.5.1 Bank of America

After a pilot duration inside the corporation, Bank of America presented an AI-primarily based totally chatbot named "Erica" to all of its customers in June 2018. The Erica system is stated to have the ability to:

• Give the purchaser an alarm (as much as 7 days in advance) while their spending conduct will push the stability to 0 value, as a prediction. This is maximum probably achieved the use of predictive analytics and is primarily based totally at the purchaser's common month-to-month spending, in addition to his or her month-to-month purchases.

• Inform the client about recurring payments and whether they will be billed over their due dates.

• Adding a note to repeat payments if they are higher than expected. If there is any anomaly, an AI-based technique discovers it immediately.

• Allows the client to lock or unlock his or her card at any time.

According to Bank of America, Erica's daily users have doubled since its launch, and it has made a significant impact to how clients manage their financial difficulties on a timely manner (51).

4.1.5.2 SBI Bank (India)

Indian banks, particularly the state-owned SBI, have begun to use AI to improve performance, detect individual behavior, and lower operational expenses.

The State Bank of India SBI has the most advanced AI technologies to successfully address non-resident Indian client inquiries in the same way that humans do. SBI Intelligent Assistant (SIA) is a sophisticated Chat Assistant based on cutting-edge AI technology. The SBI's gateway has a chat window where you can get quick responses to your banking questions (52).

4.1.5.3 STB Bank Tunisia

The Tunisian Bank Company changed into born after independence. Entered into interest on March 26, 1958, it's miles the primary in particular Tunisian banking established order designed to make contributions correctly to the financial and social improvement of the younger impartial State, in a context of disinvestment, disorganization of the credit score marketplace and a actual hemorrhage of capital toward the strange.

The STB helps you keep your finances close to hand and access your bank accounts with just a few clicks from your smartphone, tablet or smart TV .

Membership in STB Direct gives you access to a set of digital applications tailored to your needs; applications that are both simple and innovative, efficient and secure, personalized and free.

4.1.5.4 Comparative analysis

Banking businesses were the use of artificial intelligence (AI) for plenty years, but it turned into to begin with restricted to three applications. AI generation is increasingly being followed withinside the banking offerings business for a lot of purposes. Banks are making an investment more in AI studies and development, and generation has performed a key element in some of operations, from customer support to higher compliance management. This development may be resulting from elevated get right of entry to to big information units and advanced information processing capacities. The banking quarter is seemed a money-supply or a money-retail entity as a part of our studies, which pursuits to offer extra facts on how AI is advanced and hired in supply chains in diverse sectors. It lays the foundation for a critical dialogue concerning AI's use withinside the banking and economic offerings commercial enterprise, with a focal point on its sensible application.

The case packages are divided into 3 categories, every of which highlights ability possibilities withinside the banking sector:

1- Increasing client engagement and experience, which includes chatbots, voices, and robo-advisors, in addition to enhancing client services, biometric approval and authentication, client segmentation (e.g., via personalised internet site services), and centered client offerings.
2- Enhancement of the first-rate of banking processes, which includes automatic statistics

extraction, record analysis, mortgage rating, monitoring, predictive records generation maintenance, criticism management, and record classification.

3- Improved threat control, law evaluation, anomaly detection, anti-cash laundering, community potential restriction prediction, statistics first-rate guarantee service, fraud prevention, fee transaction tracking, and cyber threat prevention, to name a few.

Another possibility for AI in the banking region is the introduction of recent marketplace possibilities and sales streams, which include private economic management, funding analysis, asset allocation, lead generation (e.g. via consumer demand analysis, transactional analysis, and consumer network analysis), and so on. As a consequence, we determined that Tunisian and non-Tunisian banks are nearly transferring on the identical tempo when it comes to AI in the CSM space. In addition, each corporations have tested development in the use of AI in manner automation/optimization, reporting, criticism handling, and document classification. Tunisian banks are nevertheless withinside the strategy planning stage in terms of anti-cash laundering popularity and monitoring, machine ability restrict prediction, fraud prevention, and cyber hazard prevention, while non-Tunisian banks are withinside the launch phase.

4.2 Interviews & Questionnaire Analysis

In this section,5 Tunisian enterprises are questioned about their AI applications and many researches done for companies from across the world and some of them answered the questionnaire , The survey was sent and answered by 10 different companies 5 companies from Tunisia and 5 international companies .Furthermore, the influence of AI applications in SCM subareas for various sectors has been explored and measured. To meet the research objectives and goals

In addition to case studies from publicly available documents, participating organizations come from a variety of industries, commerce and Manufacturing & Resources lead the way, followed by Financial Services, Infrastructure & Transportation, ICT & Media, .

The importance of AI, as well as its digital counterparts, varies by sector for Tunisian businesses. Retail, Manufacturing & Resources, and Financial Services are the three industries where AI plays a significant role. While non-Tunisian enterprises demonstrate that AI is significant in Manufacturing & Resources, Retail, e –commerce , and Professional

Services, respectively. In comparison to the other industries, the Construction sector ranked AI importance as the lowest.

4.2.1 Analysis of a Maturity Model

To realize the future of AI improvements in Tunisia and different nations, it's miles vital to first realize in which AI discussions are presently taking region due to strategic significance and organizational awareness. According to the findings, AI is in the main pushed via way of means of a mixture of technological push and business pull (with a minor deviation in the direction of business pull)

4.2.1.1 Almost All Participants Work in Senior Level Positions

At make sure that those perspectives and studies are considerable to the executive control level, we surveyed and interviewed senior managers who're chargeable for using the AI time table at their diverse companies. With ninety percentages of contributors in senior control or the executive board, their comments is probably to be notably matched to the organizations' standard strategic path and huge perspective.

4.2.1.2 IT Push and Business Pull in the Right Balance

In the studied firms, a mixture of top-to-bottom and bottom-to-top approaches, in addition to IT push and business pull approaches is maximum desired for AI deployment. This necessitates the formation of cross-useful groups of enterprise humans with necessities and goals, in addition to IT specialists with technical expertise, to collaborate, identify, and install the great AI answer that provides value to the company.

4.2.1.3 The Value of AI Applications in Regards to the Company's Other Digital Priorities

Approximately 60 percentage of each Tunisian and non-Tunisian companies have said that AI is an critical-to-very critical subject matter on the managerial degree and up, impartial in their degree of AI development. Regardless of the participant's position (CEO, CFO, IT Manager, etc.), 30% of Tunisian businesses stated that AI could be very critical to different virtual priorities however nevertheless now no longer superior fee as compared to different worldwide businesses . the primary advantages they anticipate from riding AI via the company are value savings, work efficiencies, and a higher understanding/serving of

customers. This displays the notion that AI can have a large effect at the future and becomes a subject in which competition may be differentiated in all ways .

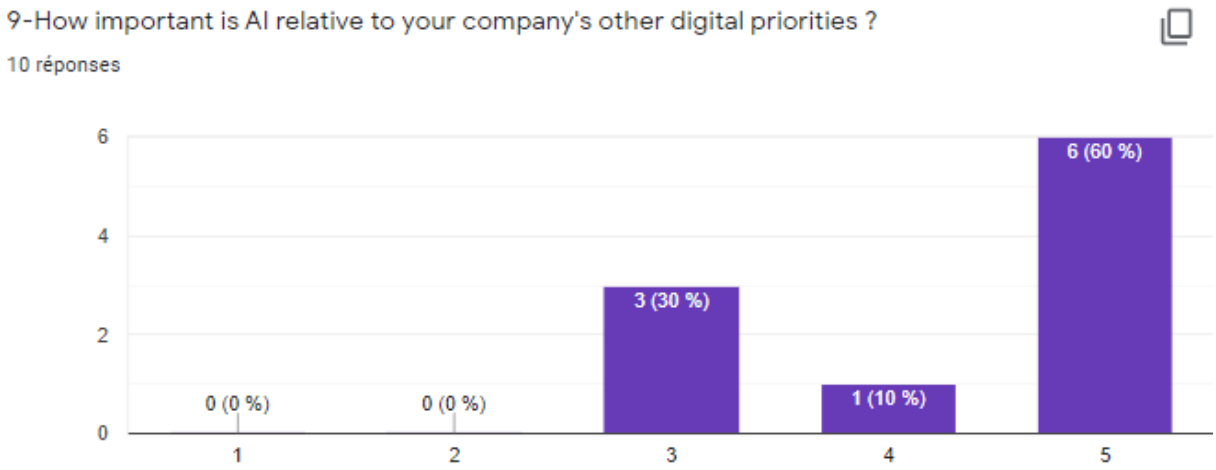

figure 4.2.1.3: The Value of AI Applications in Regards to the Company's Other Digital Priorities

Source :our research

4.2.1.4 At which level(s) in the organization does AI play a significant role

Most of the companies who answered to the survey prove that the AI plays a significant role in different levels in the organization such as the Board of Directors, Executive Management, Managerial Level, and Employee Level (non managerial level) and other levels but still the most reachable level is the executive management level by 40 % , employee level 30 % and managerial level 30% .

Now compared Tunisian local companies with international companies we can conclude that still Tunisian companies doesn’t touch all the level with AI applications

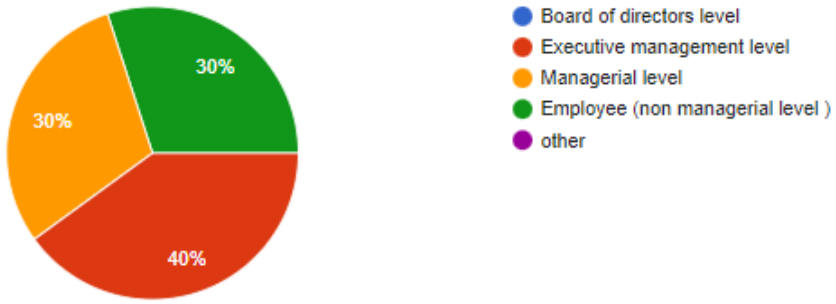

Figure 4.2.1.4: : At what levels of your company's hierarchy is AI a critical topic?

Source :our research

4.2.1.4 IT driven and business driven strategy

Most non-Tunisian companies say their AI operations are guided by a combination of top-down and bottom-up approaches. Business and IT approaches are pretty much the same. Most of the AI projects of Tunisian organizations are focused on business rather than IT, according to their responses. We can explain this factor that Tunisian companies still use the market pull strategy instead of technological push , that means that Tunisian companies follow their success and profitability goals instead of reaching and following the IT development like international companies do .

4.2.1.5 How companies adopt to AI

In this part the most common responds are

Ad Tunisia : “We didn’t use any integration techniques we just bought the robot and put it on work. Increase in our business profit buy 250% in 3 years ,Decrease in non-compliant products from 30% to 4% in 3 years (40 unit per 1000) , We had temporary shutdown for all the company production for a period of one months. After that we started working using robots in production and a very limited number of worked and it was a successful experience.”

Delice danone “we had different worker’s training in 2 years before we start to uses robots. After using robots :we had 90% decrease in the numbers of defaults units (from 100 out of 1000 to 10 out of 1000) . We had 400% increase of the production cycle (from 250 to 1000 daily final products) we increased the use of robot by multiplying it’s functions to cover the shortage of workers force.”

DHL : “we get familiar with AI by bring In Experts and Set Up a Pilot Project”

PHILIP MORRIS :”We start with machine learning ,identify problems , form a taskforce to integrate data and of course make AI a part of our day-to-day tasks.”

LEONI :” Bring in experts and start a machine learning pilot project.. Start with small parts and gets bigger and bigger.”

Decathlon :”we begin by identifying the problems that AI may to solve”

Machine learning is the most widely used AI technology among Tunisian enterprises, with over half of non-Tunisian companies employing it. This could be due to its wide variety of applications, As a result, a wide range of applications has emerged across the value chain. Supervised machine learning is the most common sort of machine learning, inside this case, the system is given structured data and requested to find models that may be utilized to understand and clarify new findings.

4.2.1.6 Describing the Company’s General AI Maturity

Given the enormous impact of AI, 60% of the sample indicated that AI was actively involved in many processes and now supports many complex tasks in international companies, but 40% have reached the “released” stage in which the AI was used. Tunisian companies in a few business activities, which is why they are still considered less mature, which means that they do not currently take into account that AI has advanced in many processes.

How would you estimate your company‘s AI maturity level is?

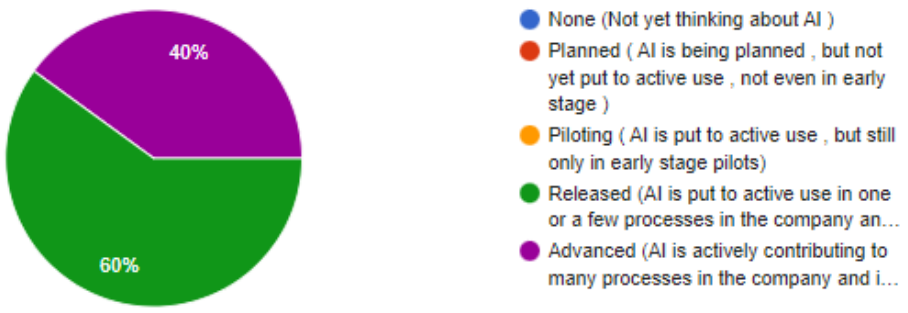

Figure 4.2.1.6: Organization's general AI maturity

Source :our research

4.2.1.7 Investigation of the company's business activity currently using artificial intelligence and a variety of functions

IT/Tech/Digital, Activities & Logistics, Management, Marketing, Sales, and R&D operations are among the functions represented by the responders. Such functional variety enriches the study by providing insights into a wide range of AI topics, reflecting the diversity of viewpoints that influence an organization's knowledge of AI (Figure 4.2.1.7.).

The following ratios are almost identical, with very minor variances between Tunisian and non-Tunisian firms. The Operations and Logistics unit reported the greatest AI implementations (80 % percent), followed by product management , manufacturing and customer services function (50 % percent), and Sales by 40 % then there is Strategy , marketing (30% percent). Finally we have 20 % use on general management , R&D and procurement . Surprisingly, AI is not used sparingly in numerous areas like HR and financial services according to our survey and our companies 's answers .

We can note here that international companies reach the AI in the almost fields talked about in analysis but still Tunisian companies uses the AI and robotic in the field of manufacturing and logistic .

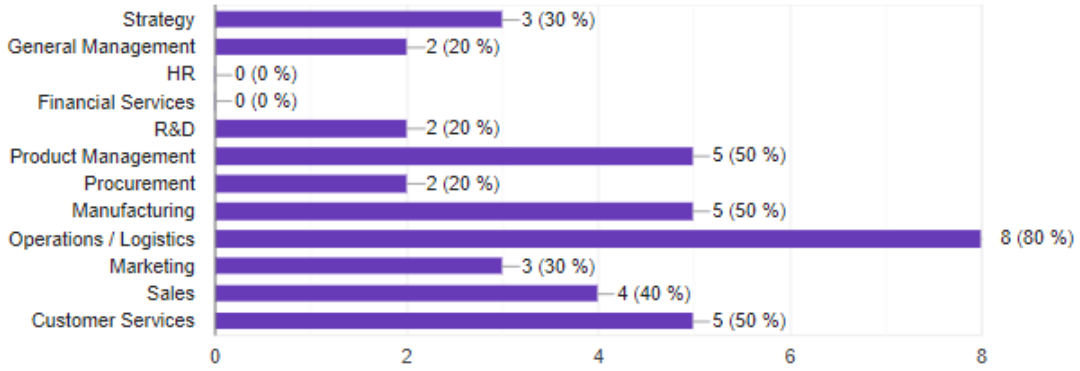

Figure 4.2.1.7: company's business functions currently use AI

Source :our research

4.2.1.7.1 Including AI in Operations Is the Field for Efficiencies

In difficult financial times, managers in lots of markets are under stress to enhance productiveness and performance throughout all running sectors - even a tiny percent extrade ought to offer great tangible incentives for businesses with huge operating capital economic statements. Operations and Logistics AI applications, in line with companies, take care of system and assets in a greater proactive manner, and enhance retail conditions in particular. In again and center offices, AI gives deeper insights and higher decisions, together with early achievement in non-business dealer control. When it involves supplying economic services, regulatory compliance and danger control are early essential elements for device learning and intelligent robotics.

4.2.1.7.2 AI is used in a variety of IT/technology functions: R&D

Many early pilots recognition on IT procedures as a part of new generation trying out and additionally centered on simple needs inclusive of cyber risk management. In addition to its projected excessive occurrence in IT departments, AI is extensively hired in R&D and Product Management (or further specialised areas). This is due to three key factors: R&D team of workers are frequently engineers with a solid information of AI; R&D and Product Management are frequently already targeted on the experimental approach this is essential to AI; and R&D frequently consists of massive portions of data that can be beneficial and motive excessive promising use.

4.2.1.7.3 Some Partial Use in Group Functions

Human resources, general administration, and finance are some of the “group operations” in which participating organizations under-use artificial intelligence, not because artificial intelligence applications are not valuable, but because other tasks and goals take precedence.

4.2.1.7.4 Interaction with Customers Creating Data for the Front End: CUSTOMER SERVICES

Customer touch and commercial enterprise capabilities along with marketing, income and client service,that are in part pushed through their degree of digitization, are even heavier customers of AI.

call centers, along with chatbots and roboassists, appeal to new technology that take care of client inquiries and use sensible automation to control post-interplay activity.

4.2.1.8 AI's Potential Impact in the Next 5 Years

Tunisian and non-Tunisian executives who participated withinside the observe had been on the whole wonderful about the enhancements in an effort to be made with the aid of using AI (slight to excessive effect expectations) over the following 5 years,while some business executives Tunisian women had lower but still positive expectations, with 30% predicting that AI will have some impact and 70% predicting significant impact over the next five years

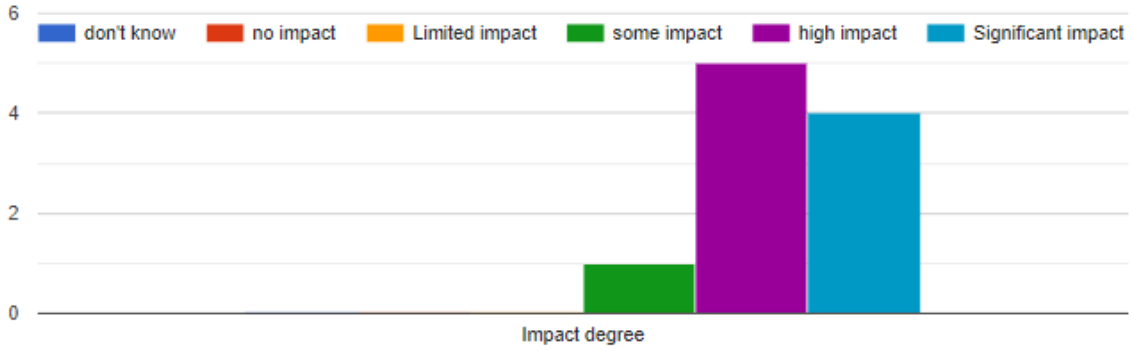

Figure 4.2.1.8 : AI’s potential impact in the next 5 years

Source :our research

4.2.1.9 The Expected Benefits Generated By AI

According to the Microsoft-Digital-Transformation Framework, taking part companies may also count on to take advantage of all 4 essential areas: operational efficiency, client engagement, carrier and product transformation, and group of workers development. The

reasoning of getting to know and conclusions with imperfect facts; the 'perceptive' of facts meaning, consisting of text, speech, and image; and the natural 'interaction' with employees, customers, and different stakeholders are all primarily based totally on center AI qualities. The software of artificial intelligence in sure domains has the strength to convert a company's version and industry. The following evaluation clarifies the advantages.

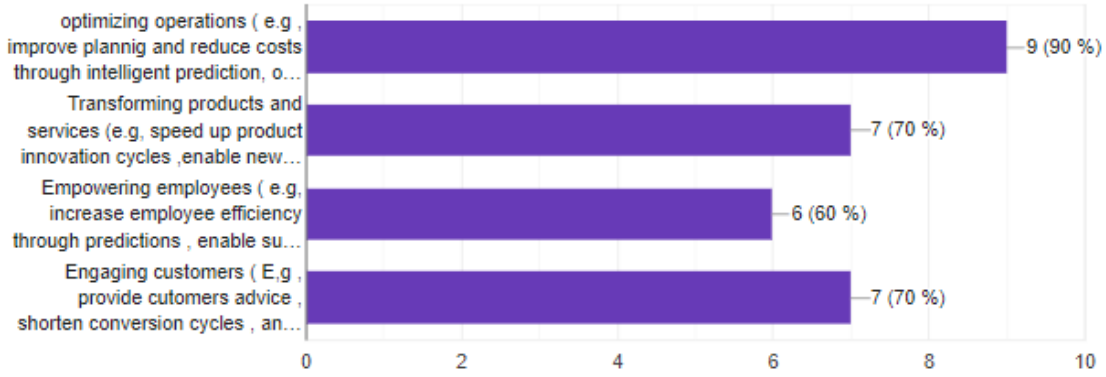

Figure 4.2.1.9 : the expected benfits generated by AI

Source :our research

4.2.1.9.1 Optimizing Operations ends up in Improved Production and efficiency

60% of Tunisian groups and 70% of non-Tunisian groups stated that optimizing operations is the predicted gain of AI. on positive assisting technologies, such as: smart forecasting (for example, forecasting non-acting merchandise or adaptive modeling to label corrective actions), operational efficiency (for example, enhancing forecasts and 'success of orders in the course of the cost chain o control of huge units of documentation), information (for example, detecting fraud or figuring out new possibilities earlier than competitors).

4.2.1.9.2 Empowering Employees

80% of the non-Tunisian organizations surveyed in our observe and 50% of Tunisian organizations confirmed that the subsequent advantage of the use of AI is to make personnel extra effective and efficient. Boosting Human Creativity and Ability to Perform a Specific Function In order to alternate the design, transformation and income of on line and offline stores, AI allows B2C agency personnel to growth organizational attention through reading client behavior. , powered through AI technology that display real-time client insights, perceive the following great steps in leads, and offer predictive fashions that offer a 360 ° view of the client through combining client facts and attitudes and growing particular offers.

4.2.1.9.3 Engaging Customers

Some famous examples of intelligence programs are utilized by 40% of Tunisian groups and 50% of non-Tunisian groups that had been tested in our study, with client engagement being visible because the place in which the best business gain is received as: conversational agents (e.g. chatbots that provide suggestions and commands on transactions); private assistants (e.g. manual decision-making and shorten conversion cycles); Self-service (for example, to assist clients reduce research time).

4.2.1.9.4 Transforming Products and Services

70% of Tunisian organizations and 40% of non-Tunisian organizations surveyed indicated that the transformation of services and products need to generate destiny commercial enterprise benefits. In all the RandD-targeted industries, wherein organizations see synthetic intelligence and superior studies as a device to boost up product creation and improvement processes, it's miles very essential to convert goods and offerings, which leads to ultimately cause absolutely new commercial enterprise models. In the B2C market, AI is supporting new offerings through the usage of multilingual cognitive applications, geolocation suites, behavioral analytics, cognitive robotics consulting capabilities, private carrier companies and lots of more, to outperform l enterprise in a brand new degree of delivered value, on a extensively large scale. and in actual time.

4.2.2 Supply Chain Management and AI

In each of the following areas, to what extent do you believe AI will have an impact on your company?

Many of the taking part companies offer a large kind of merchandise and services, in addition to a number commercial enterprise regions. We desired to recognize where AI will effect: the numerous supply chain control operations. This segment examines the direct effect of the usage of AI in supply chain control that allows you to recognize the precise commercial enterprise advantages and have a look at the limitations, dangers and limitations that save you the spread of AI technology. As proven withinside the following subsections, we've got decided on six regions of affect to degree effect from which a conclusion may be drawn. Participants will determine the effect in those regions in phrases of integrating AI into their business.

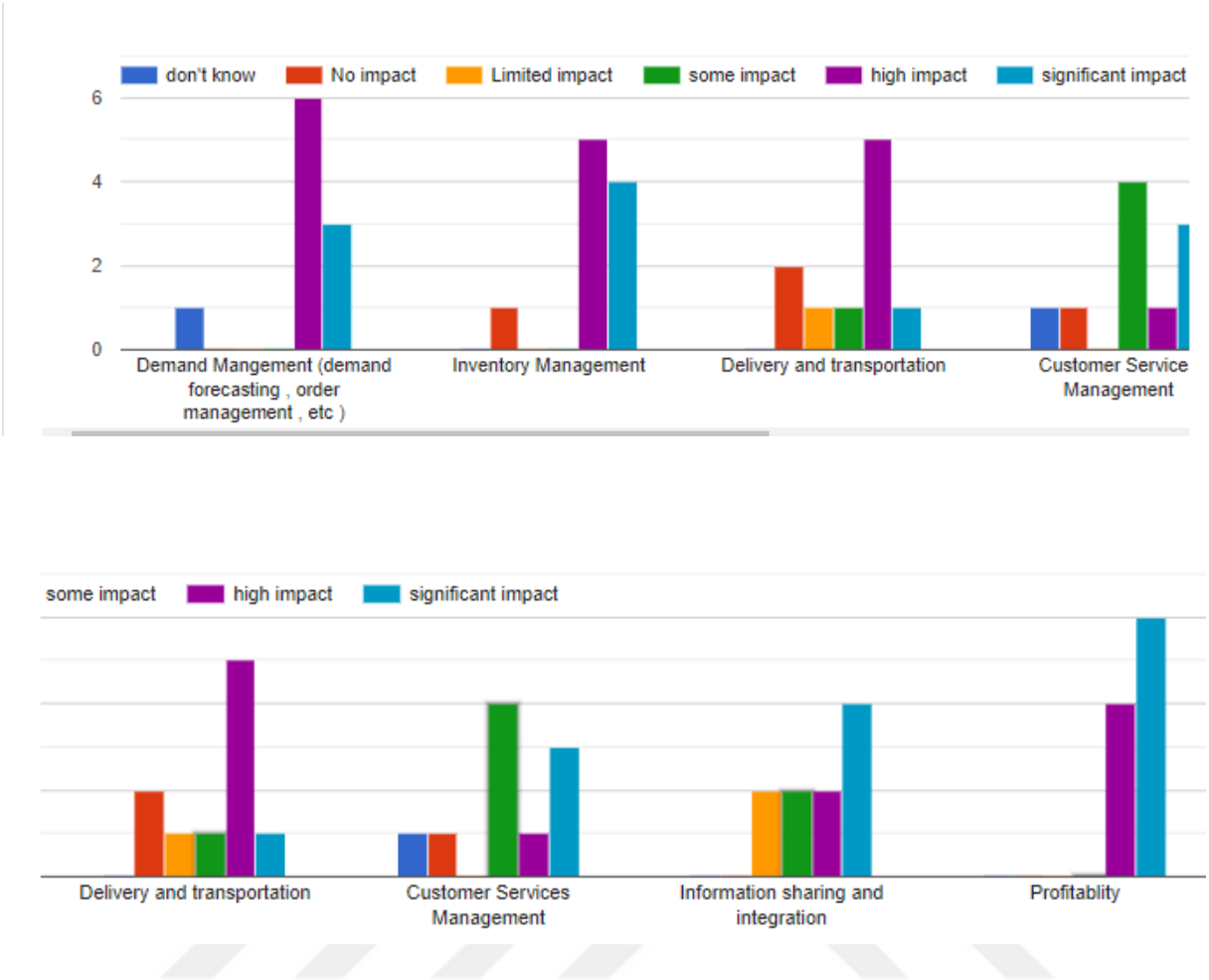

Figure 4.2.2 : Supply chain and AI

Source :our research

4.2.2.1 The Expected Degree of Impact AI to Create on Company's Demand Management

Organizations usually want to expect the future to take gain in their competitiveness. AI permits organizations to higher forecast their supply chains and expand higher offerings. Reliable demand forecasting is the manner to apply AI to digest specific records and routinely adapt it to new information. which, we are able to distinguish developments and fashions on which we are able to act. Tunisian organizations surveyed in our studies pondered a mild effect of AI on demand control (maximum of them replied with a high effect and one replied with I don't know) Tunisians have observed a excessive effect of AI on call demand effect). Businesses these days are ignorant of the giant impact call for control has at the performance of the complete supply.

4.2.2.2 The Expected Degree of Impact AI to Create on Company's Inventory Management

By optimizing inventory, this is wherein AI is to be had in on hand as it ensures that the risks of overstock and out of stock are stored to a confident minimum. An important gain additionally may be obtained, this is to make certain get right of entry to to coins wherein possible simply so it could be managed for specific profitable businesses. Another gain of artificial intelligence is that it could help to assess the overall performance of inventory level, artificial intelligence is able to estimate the demand of customers and vendors based mostly on previous orders with the market trend . Suppliers to optimize their plan and be prepared whilst the market goes down because of the truth they already have facts on future demand through the decision for forecast. Tunisian companies surveyed in our research contemplated a moderate impact of AI on inventory management (most of them spoke back with immoderate impact and one spoke back without an impact), at the same time as non-Tunisian companies contemplated low impact. first-rate AI on inventory management (which most of them spoke back with extensive impact to excessive impact).

4.2.2.3 The Expected Degree of Impact AI to Create on Company's Delivery and Transportation

In many industries, which includes transportation, AI has increased in productiveness and performance. AI allows growth of the safety, reliability, performance and cleanliness of transportation. Tunisian agencies surveyed for our examine confirmed a slight effect of AI on shipping and transportation (in maximum cases). spoke back with some effect and one spoke back without an effect and the opposite spoke back with a few effect) whilst non-Tunisian agencies meditated a giant effect of AI on shipping and transportation (with the majority responding with significant effect to high effect), and only a few spoke back with limited effect). Note that "I do not know" turned into overlooked in calculating the effect.

4.2.2.4 Expected impact of artificial intelligence on the company's customer service management

Today the whole thing is networked and the real-time revolution has made clients' lives extra comfortable and modified the manner they interact. Now clients count on statistics to be easily available. The first nearly intuitive results of AI on client revel in The Tunisian agencies tested in our have a look at confirmed no massive results of AI on customer support management (maximum answered with some effect and few answered with a significant

effect on a limited effect), whilst non-Tunisian agencies had a totally high effect. Impact of AI on customer support management (to which the majority answered with massive effect on a few effect and few with limited effect). Note that "I do not know" become ignored withinside the effect calculation.

4.2.2.5 The Expected Degree of Impact AI to Create on Company's Information Sharing and Integration

When company skills generate AI-powered insights, they want to be included throughout the company to take benefit of it. This normally entails remodeling procedures to consist of AI records into the workflow. It entails automation in sure situations. In others, it calls for that an appropriate records be made to be had to the right employees in the company. In each cases, it's miles crucial to optimize the interface among guy and machine.

The Tunisian corporations studied in our studies discovered a excessive effect of AI on records sharing and integration (to which maximum of them answered with a excessive effect and few of them answered with limited effect), at the same time as non-Tunisian corporations discovered a completely excessive effect of AI on records sharing and integration (which maximum of them answered with significant effect to some effect, and just a few answered with limited effect). Noting that the "I don't know" has been ignored withinside the effect calculation.

4.2.2.6 The Expected Degree of Impact AI to Create on Company's Profitability

Tunisian corporations tested in our studies meditated a mild effect of AI on profitability (to which maximum of them answered with a high effect), at the same time as non-Tunisian corporations meditated a mild effect of AI on profitability. profitability (which maximum of them answered with a sizable effect on high effect,) Noting that the "do not know" or "limited effect" turned into ignored withinside the effect calculation

CHAPTER 5 CONCLUSION

It has been decided that the general notion of AI and its applications in supply chain management has a positive influence. Furthermore, top management are already giving interest to study and gaining more professional expertise in this field. They believe that Tunisian businesses need to be taking the initiative in adopting AI. In our research, it is been concluded that AI is considered as one in each of many digital priorities, but now not the most important, and best few of the worldwide corporations surveyed advised that they are "advanced" with AI.

In addition, large ability for AI has been discovered in lots of organizational functions. Reliable demand forecasting, the use of AI to process extraordinary records and routinely adapt to the new data, enable to distinguish traits and trends we are able to act on. As studied in our research, Tunisian corporations pondered a slight effect of AI on demand management, whilst non-Tunisian corporations pondered an excessive effect of AI on demand management. Optimizing Inventory, that is in which AI is available in accessible because it guarantees the chance of non out of stock or overstock which are saved at a secure level. In doing so, it guarantees get admission to cash anyplace so that it could be controlled for different worthwhile businesses. Also the capacity to evaluate the performance of the stock level, as measured in our research, Tunisian organizations pondered a slight effect of AI on stock management, whilst non-Tunisian organizations pondered a widespread effect of AI on stock management.

In the transportation sector, AI will increase in productiveness and performance. AI allows to growth the safety, reliability, performance and cleanliness of transport. Tunisian organizations

tested in our studies determined a mild effect of AI on shipping and transportation, whilst non-Tunisian organizations pondered a giant effect of AI on shipping and transportation.

Today everything is connected and has modified the manner clients interact. Customers anticipate information to be easy available. This is a nearly intuitive effect of AI at the customer experience. Tunisian organizations studied in our studies have proven a low effect of AI on customer support control and are taken into consideration the use of synthetic intelligence applications in the future, whilst non-Tunisian organizations have determined an excessive effect on customer support management.

The optimization of the interface between human and machine, and delivering the correct information to be made available to the correct staff within the company, both are considered one of the powerful benefits of the AI applications in the information sharing and integration. Tunisian organizations studied in our studies pondered a high effect of AI on information sharing and integration, whilst non-Tunisian organizations pondered a totally excessive effect of AI on this field.

Applying AI in an organization , is a part of the virtual transformation method of any business, calls for a large capital investment. In addition, Tunisian and non-Tunisian organizations surveyed as a part of our studies confirmed a mild effect of AI on profitability.

These elements provide an explanation for why the transformation to the software of AI remains in its early levels and why many organizations are nevertheless withinside the pilot levels. AI programs are commonly taken into consideration in Tunisia on the starting stage and aren't broadly implemented. it turned into mentioned that they have been particularly implemented withinside the logistics and manufacturing modules. One of the primary motives is that the investments are significantly excessive for the software of AI. It is obvious that Tunisian and non-Tunisian groups, in almost all the sectors surveyed dominate the retail trade, they have permitted that they're already withinside the use of AI in the purchaser service, that is the area from which maximum groups start. Tunisian groups are nevertheless withinside the making plans or piloting segment regarding the software of AI in demand and stock management, whilst non-Tunisian groups are greater superior on this sector.

For retail warehouse control and manage structures, as our studies has supplied documented data, Tunisian organizations aren't interested by those AI programs, even as large outlets like

Amazon, Alibaba and Walmart have verified a complicated technique to synthetic intelligence programs on this area, inclusive of clever robotics and clever imaginative and prescient packages. As a end result of our studies on shipping and delivery, we observed that non-Tunisian organizations have commenced to use AI in lots of areas, inclusive of call for forecasting, clever site visitors structures and maintenance. Predictive, as indicated in maritime, rail and air affairs. While Tunisian organizations operating withinside the identical zone have simplest implemented AI withinside the area of CRM, they should positioned extra capacity in those aggressive sectors.

As concluded, we located that the tunisian and non-Tunisian banks are not shifting with the equal speed, in making use of AI withinside the customer support area. And each additionally have established advances in making use of AI in system automation/optimization, reporting, complaint cases handling, and document classification. While, withinside the regions of Anti-Money Laundering reputation and monitoring, machine ability limit prediction, fraud prevention, and cyber threat prevention Tunisian banks are nonetheless withinside the making plans and launched level in comparison with non-Tunisian banks which they may be withinside the launched and superior phase.

To summary it has been found that the general perception of AI and its applications in supply chain management has a positive influence. Tunisian companies are still either in the planning or piloting phases regarding the application of AI in demand and inventory management, while the non-Tunisian companies are more advanced in this area.

The contribution I have made which is unique will be on how essential AI applications are to an organization's performance and how they affect supply chain (SC) in order to encourage less development countries to invest in artificial intelligence.

The limitation of the study is that there is not enough big companies in Tunisia to be investigated.

For the future studies on artificial intelligence in Tunisia, in spite of a few barriers to this sort of researches, the conclusions are normally confirming the above-stated research. Furthermore, a few potentials for the approaching research for example, a centered take a look at on a pilot implementation of AI application(s) in call for control or client care carrier for distinctive sectors in Tunisia. Or, an research for a way AI can have an effect on and be carried out in marine/airfreight quarter in Tunisia.

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APPENDICES

AI & robotics application Survey

Description du formulaire

I-FISRT PART :

Description (facultative)

1-Name *

Description

Réponse courte

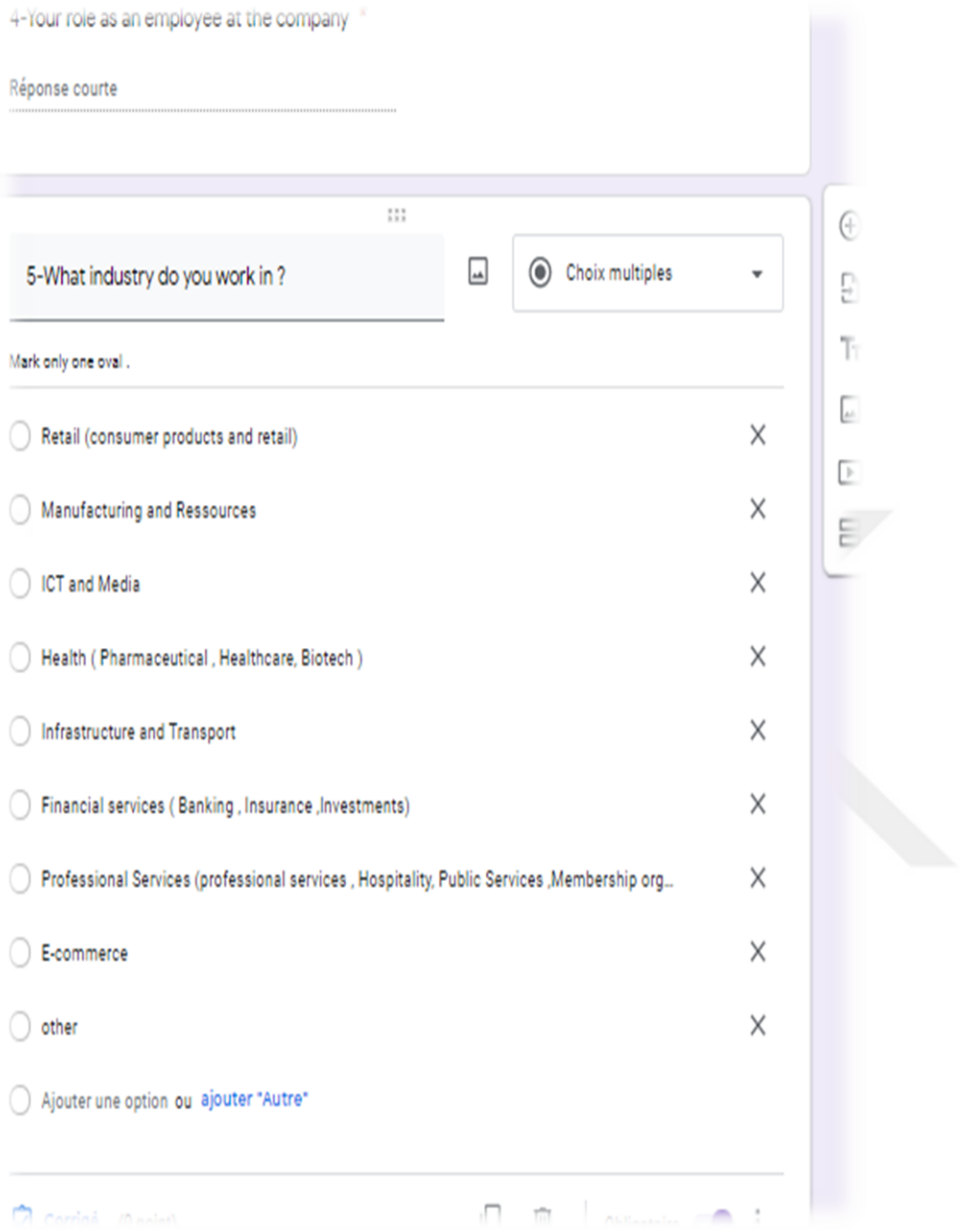
2-Company' s name ? *

Réponse courte

3-Location ... ? *

Réponse courte

4-Your role as an employee at the company *


4-Your role as an employee at the company *
Réponse courte
5-What industry do you work in ?
Choix multiples
Mark only one oval .
Retail (consumer products and retail)
Manufacturing and Ressources
ICT and Media
Health (Pharmaceutical , Healthcare, Biotech)
Infrastructure and Transport
Financial services (Banking , Insurance ,Investments)
Professional Services (professional services , Hospitality, Public Services ,Membership org...
E-commerce
other
Ajouter une option ou ajouter "Autre"

II-SECOND PART :

Description (facultative)

6-Since when do you start using AI and robotic ? *

Réponse courte

7-How did your company adopt to AI ? *

Réponse longue

8-On what hierarchical levels in your company is AI an importatnt topic ? *

Mark only one oval .

- Board of directors level
- Executive management level
- Managerial level
- Employee (non managerial level)
- other

9-How important is AI relative to your company's other digital priorities ? *

9-How important is AI relative to your company's other digital priorities ? *

	1	2	3	4	5	
not important	○	○	○	○	○	very important

10-What are the effects of using robotic and AI instead of human : weaknesses , opportunities ,threats ,strength ?

Réponse longue

11-How would you characterize the way AI is being managed in your company ? How would you * the wayAI is being deployed in your company ?

	business driven	IT driven
top-to-down	☐	☐
down-to-top	☐	☐

12-How would describe your company's general AI maturity ? *

Mark only one oval .

○ None (Not yet thinking about AI)

- ○ None (Not yet thinking about AI)
- ○ Planned (AI is being planned , but not yet put to active use , not even in early stage)
- ○ Piloting (AI is put to active use , but still only in early stage pilots)
- ○ Released (AI is put to active use in one or a few processes in the company and or not supporting advance...
- ○ Advanced (AI is actively contributing to many processes in the company and is supporting advanced tasks)

13- Which of your company's business functions currently use AI ? *

- ☐ Strategy
- ☐ General Management
- ☐ HR
- ☐ Financial Services
- ☐ R&D
- ☐ Product Management
- ☐ Procurement
- ☐ Manufacturing
- ☐ Operations / Logistics
- ☐ Marketing
- ☐ Sales

- [ ] Marketing
- [ ] Sales
- [ ] Customer Services

14- How much impact do you expect AI will have on your industry /company within the next 5 years ? *

	don't know	no impact	Limited impa...	some impact	high impact	Significant i...
Impact degree	○	○	○	○	○	○

15- What business benefit do you expect AI to generate ? *

- [ ] optimizing operations (e.g , improve plannig and reduce costs through intelligent prediction, operatioanl e...
- [ ] Transforming products and services (e.g, speed up product innovation cycles ,enable new value add servic...
- [ ] Empowering employees (e.g, increase employee efficiency through predictions , enable support , and auto...
- [ ] Engaging customers (E.g , provide cutomers advice , shorten conversion cycles , and reduce time to resol...

16- To what degree do you expect AI to create an impact on your company's ...? *

	don't know	No impact	Limited impa...	some impact	high impact	significant i...

16- To what degree do you expect AI to create an impact on your company's ...? *

	don't know	No impact	Limited impa...	some impact	high impact	significant i...
Demand Ma...	○	○	○	○	○	○
Inventory Ma...	○	○	○	○	○	○
Delivery and ...	○	○	○	○	○	○
Customer Se...	○	○	○	○	○	○
Information ...	○	○	○	○	○	○
Profitablity	○	○	○	○	○	○