Artificial Intelligence and Virtual Logistics for Business Automation

By: **Adel E. Elaraby**

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Supervised by

Prof. Salvatore Fava PhD

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LIST OF ABBREVIATIONS

3PL	Third Party Logistics
4PL	Fourth party logistics
AI	Artificial Intelligence
ANN	Artificial Neural Networks
BMA	Bulk Mail Acceptance
BME	Business Mail Entry and Payment Technology Organization
BS	Base station
CDCs	Central Distribution Centers
CDMA	Code Division Multiple Access
CRM	Customer relationship management
DL	Deep Learning
DSP	Digital Signal Processor
DVR	Mobile Digital Video Recorder
EDGE	Enhanced Data rates for GSM Evolution
EDI	Electronic Data Interchange
EPC	Electronic Product Code
ERP	Enterprise Resource Planning
FDD	Frequency Division Duplex
GPRS	General Packet Radio Service
GPS	Global Positioning System
GSM	Global System for Mobile Communications
ICT	information communication technology
IoT	Internet of Things
IT	Information Technology
JIT	Just-in-Time
KPI	Key Performance Indicator
M2M	Machine to Machine’
MEMs	Microelectromechanical System
ML	Machine Learning

NFC	Near field communication
OEM	Original equipment manufacturer
OS	Operating System
PIR	Passive Infrared
RAT	Radio Access Technology
RDC	Regional Distribution Center
RF	Radio frequency
RFID	Radio Frequency Identification
SC	Supply Chain
SCM	Supply Chain Management
SCOR Model	Supply Chain Operation Reference Model
SCP	Supply Chain Planning
SKU	Store Keeping Units
SQL	Structured Query Language
SS	Safety Stock
SSB	Single-Sideband
TDD	Time Division Duplex
TSP	Traveling Salesman Problems
VMI	Vendor Managed Inventory
VR	Virtual Reality
VRM	Vendor Relationship Management
VSM	Value stream mapping tools (VSM)
WCDMA	Wideband Code Division Multiple Access
WIP	Work In Process
WSN	Wireless Sensor Networks

ABSTRACT

With the rise of flourishing trade, booming economies, and complex societal structures, humans long ago realized the need for logistics. A critical component in regulating and assisting every aspect, it existed for as long as trade and commerce has. Even from the days of the Silk Road, trading in goods and spices from China and India, logistical movement of products has always played a crucial role in imports and exports. As the magnitude of trade and population increased, the need for automation became critical, particularly with the increase of governmental and health regulations. Due to the increasing list of trading complexities, a small percentage of traders try to find the means to make quick and easy monetary gains by bypassing governmental regulations in logistics that would otherwise undermine their profits.

With the introduction of modern transportation, the internet, and an international market, global demand of international goods increased for worldwide economies. No longer limited to what was available locally at fixed prices, the desire for accessible and international has exponentially increased within the past few decades.

Throughout this thesis I will attempt to go over major governmental agencies as to highlight the need for both automation and utilization of the latest technologies to efficiently facilitate business automation, as well as emphasize the critical need for logistics for business automation.

Chapter 1: Introduction

A critical component of any business is the supply chain management (SCM). Contemporary supply chains have developed towards extremely sophisticated frameworks, including numerous shipment rates, standards of planning, multimodality, and continuous data interactions at each sub-system of the network. The main issue of supply chain management is to sustain an orderly and constant stream of commodities, data, services, and fiscal inputs whereas also reducing expenses. In conjunction with elaborations, large amounts of limitations are associated with capabilities, time, manufacturing feasibilities, distribution outputs, and shipping which depicts modern supply chains. (Lee, 2015), (Wang, 2006)

The notion is that supply chain management encapsulates the collection of organizations that are united through flows of services, products, information, or finances, from the source to the ultimate consumer. The flows in current days' supply chains are often fast-moving and dynamic. Despite this, the flows are in many cases handled in old systems, or legacy systems, where a majority of the job is still done manually. This can inhibit the organizations' capability to adapt to quick changes in demand that is inherent in today's economy. Many companies are also afraid to share company-specific information with other parts of the supply chain, since the information could be used in ill-meaning ways. (Cooper, 1997). This obstructs the cooperation between organizations. There are advanced technologies that could be applied to SCM, such as technologies within AI. Especially learning algorithms, which can find patterns and adapt to different situations independently, could be suitable for the changing flows of today's supply chains. They could see patterns that humans have a hard time finding, and thereby help humans understand why a certain outcome took place. Many companies have access to large amounts of data that could potentially

be used to solve the problems they are facing. This can, however, be difficult, as to process all the data required manually would take an immense amount of time to analyze. This indicates that the solution to a problem will be quite difficult. If, however, an organization used this valuable data to build a learning scheme, some of the problems currently occurring in SCM could potentially be reduced, and the solution would be more dynamic.

The figure below depicts how SCM performance could be impacted by the number of systems and data, as it is the central backbone of any business success

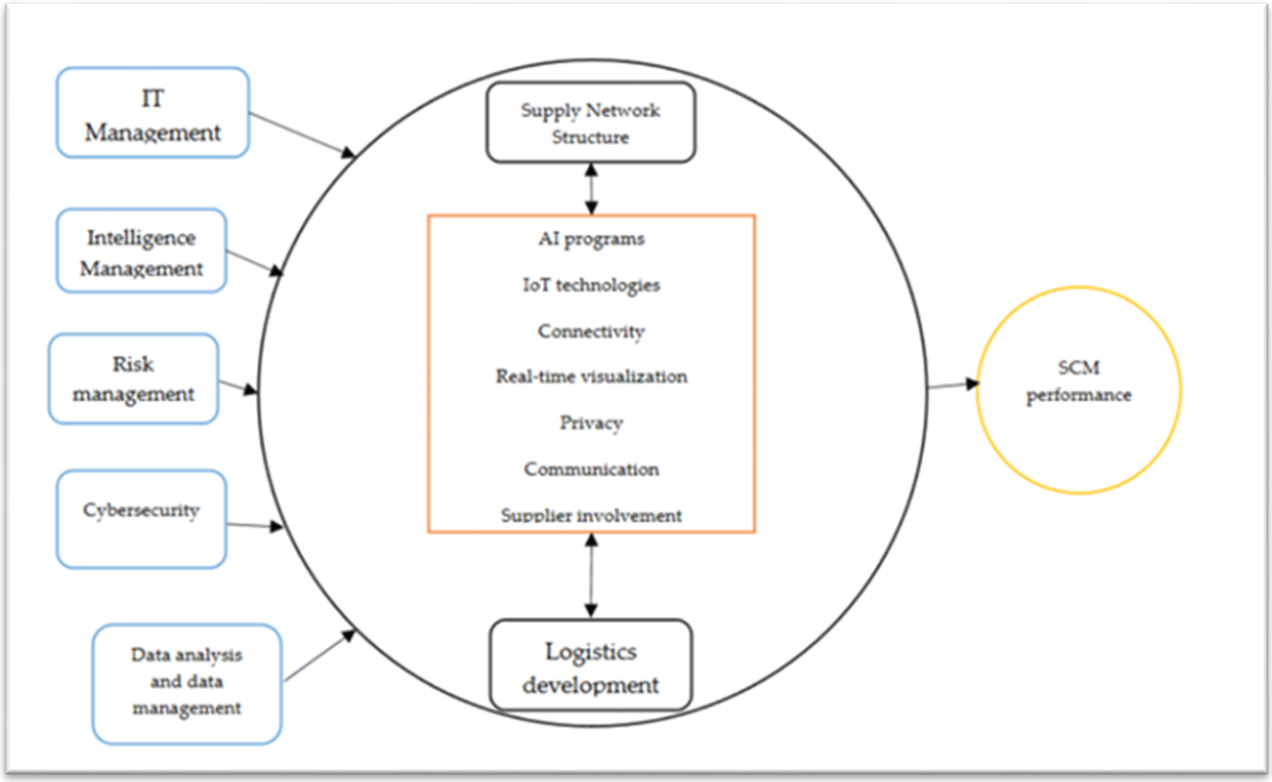


Figure 1: A framework of supply chain management structure with integrated AI and IoT technologies (Chen, 2004)

In order to improve the logistical problem, considering automated logistics system as a research platform, a new optimization algorithm is proposed for the route planning of multi-goods picking operations for stackers in a stereotypical warehouse. First, the hardware composition of the

automated logistics system is introduced, and then the characteristics of the picking operation of the stacker is deeply analyzed (Xiaomo Yu, February 2018)

Debilitating issues in SCM automation and optimization is not on the priority list of chief executives, although it plays a major role in the failure of the distribution channels both to end users, and buyers, as well as influencing the whole chain - from the order to the delivery.

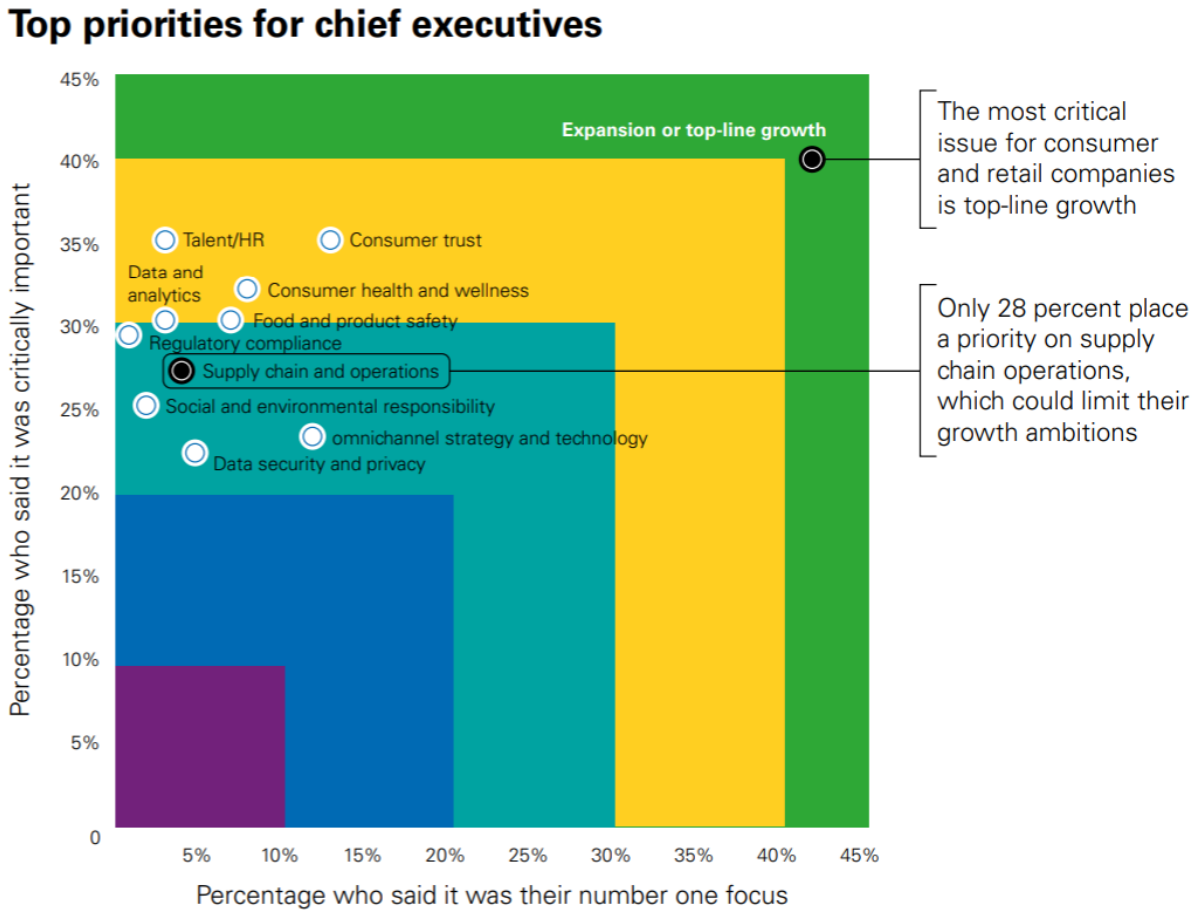


Figure 2: To Priorities for chief executive] (Gampenrieder, 2016)

In Germany, a Berlin start-up called SO1 is doing similar things with its AI system for retailers. It claims that nine times more people buy AI-suggested goods than those offered by traditional promotions, even when the discounts are 30% less (Wakefield, 2020)

The fact that the global economy, and the corporate world, have been very integrated by information technology requires the exploration of online marketing as an improved platform to

effectively integrate marketing communication across organizations. As noted earlier, online marketing provides platforms for the organization to integrate various promotional tools of the organization in advertising the organization products to the customers, and the general public. (Goldfarb, 2011)

On the one hand, the $11.2 billion online display advertising market has evolved beyond traditional banner ads. It now includes many visual, and audio, features that make ads more obtrusive and harder to ignore. On the other hand, Google has developed a highly profitable non-search display advertising division (called AdSense) that generates an estimated $6 billion in revenues by displaying plain content-targeted text ads: 76% of US internet users are estimated to have been exposed to AdSense ads This paper explores how well these divergent strategies work for online advertising, and how consumer perceptions of intrusiveness and privacy influence their success, or lack of it, both independently and in combination(Goldfarb, 2011)

Companies adopting heavy data processing and data driven techniques to capture demand into their supply chain enjoy increased sales, reduced operating expenses and improved working capital

Artificial Intelligence and virtual logistics for business automation

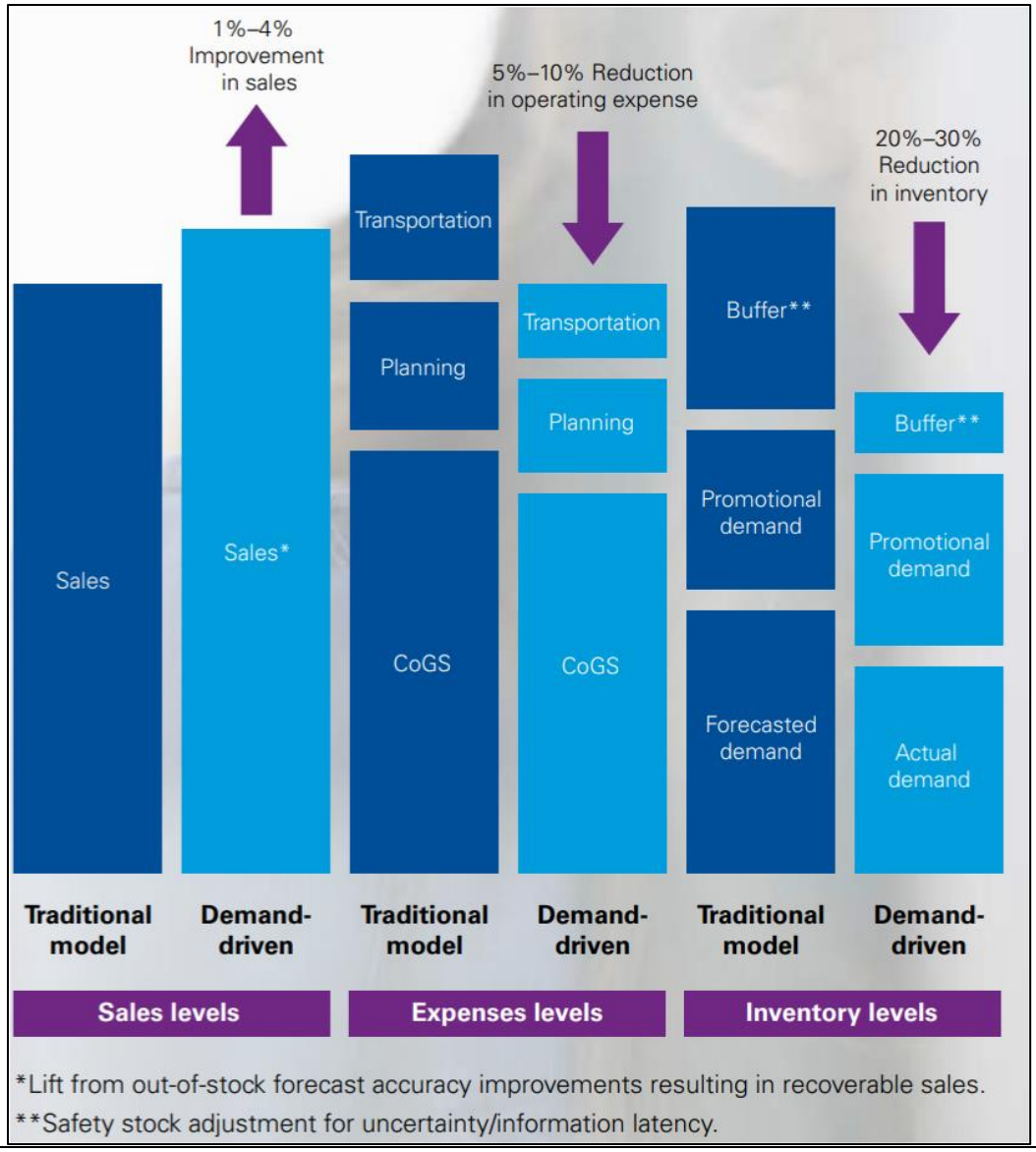


Figure 3 A Demand driven supply chain can enhance performance(Gampenrieder, 2016)

As global economies get tougher, and international competition gets higher, the need of data and self-optimizing systems becomes a mandate for organizational success. Companies resist automation and feel comfortable with revenue levels will inevitably be forced out of the competition, without even realizing, since demands are not being monitored.. Any small deviation in customer demand to other brands or products reflect an unseen market shift. Here is where data becomes critical for all businesses that seek to be ahead of market. The more data analytics are needed, the more data is required from the market, machines, consumers, … etc.

Artificial Intelligence and virtual logistics for business automation

The creation of Artificial intelligence supplements the need to utilize information technologies to be able to learn the behavior of consumers, employee, and other market drivers. The enormous amount of data required to manually process this information would require large, and expensive, processing devices, and as the hardware of computing gets cheaper, companies have to invest in data crunching computing. This is where AI comes in to play, to assist in the processing of data without the large burden. Since 1956, The conceptual phase of AI has been in place without gaining much traction, although recently the growing economy has pushed for quicker and more universal adaptations to process all the data needed.

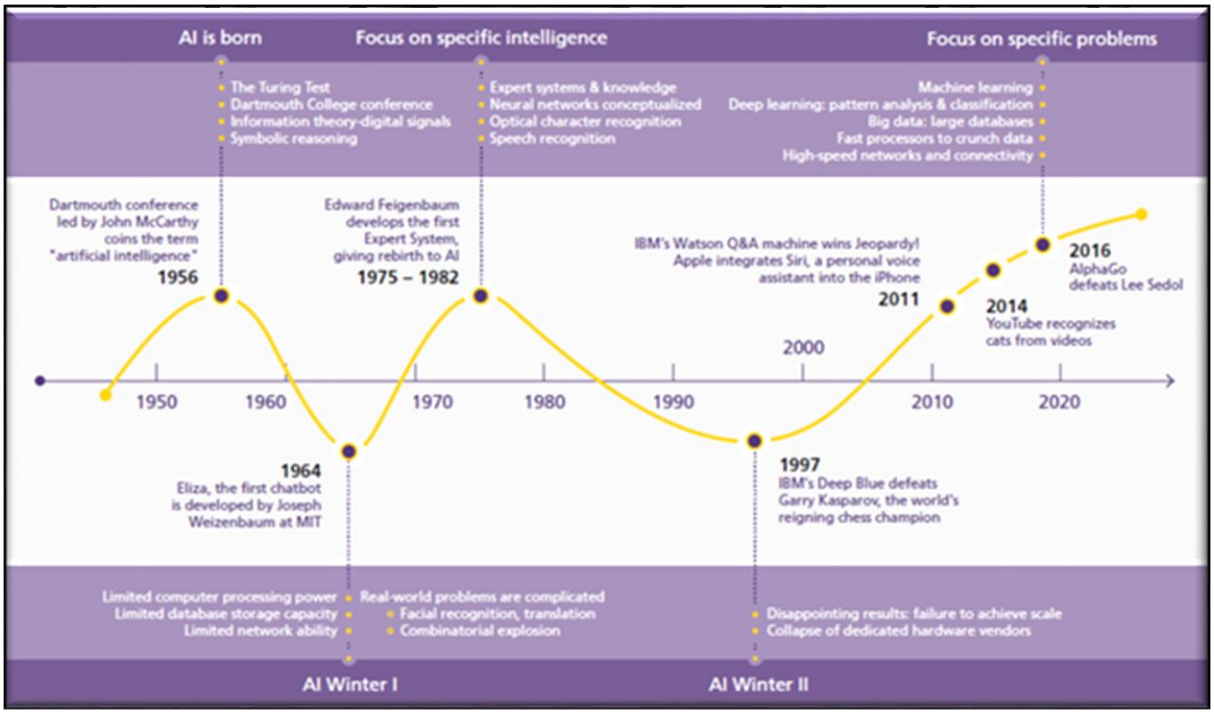


Figure 4: The Rise of AI (Ben Gesing, 2018)

Through smart automatic services, like artificial intelligence and IoT tools, one could tackle the need to utilize information technologies to learn the behavior of consumers, employees,

and other market drivers. However, this is not an easy task, and the adoption of these methods to any organization needs to be done succinctly, as the data and behavioral capture needs to be focused to the benefit of the business as to lower operational expenses (OPEX), or lead to shifting products to meet higher demand. This is a learning cycle for the organization or company, otherwise known as the thought adoption and adaptation phase. Companies have to be ready for the investment, as it would need dedication of resources to keep operational processes optimized, and as more data comes into the company domain continuous improvement needs to be adopted. Losing the momentum of continuous improvements would lead to the company losing both focus and investment. The critical piece for any top management in an organization is deciding when to lower expenses versus implement new processes, as well as adopting tools to penetrate a wider market exposure.

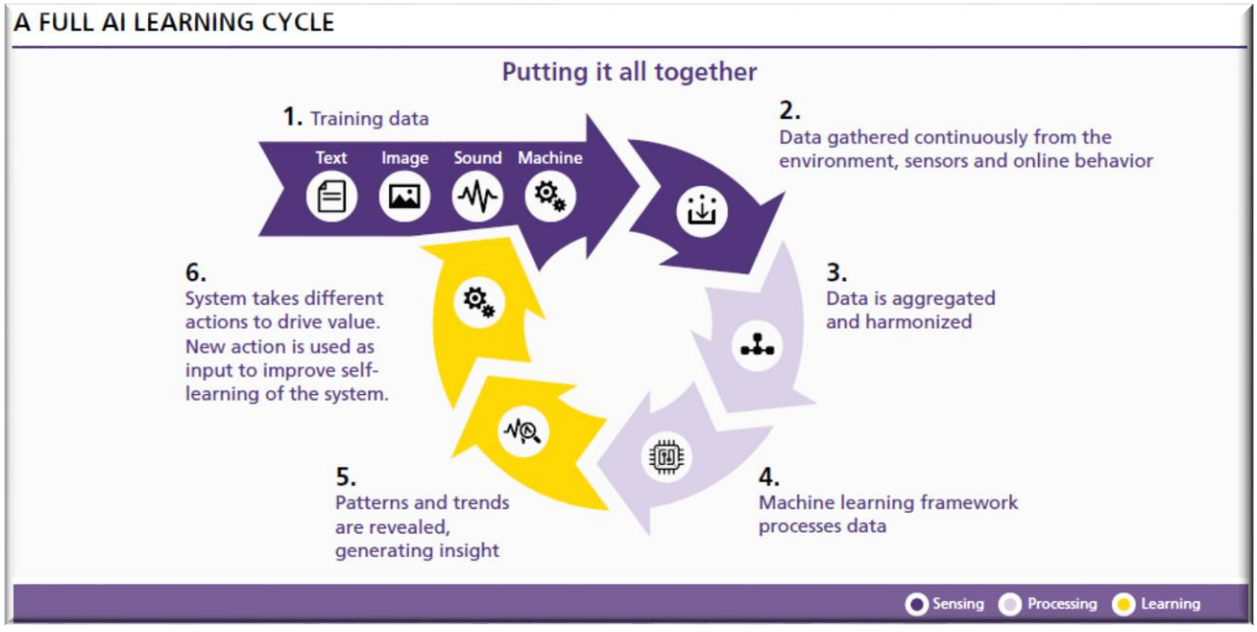


Figure 5 Full AI Learning cycle (Ben Gesing, 2018)

Research Question

This thesis will cover different sectors as case studies to try to highlight the major question of the benefits of automation tools, including artificial intelligence with its supporting inputs and data metrics, as well as utilizing virtual reality to achieve best business automation practices for both national and global organizations and governmental entities. This thesis will cover the trending tools and automation tools utilized in different industries and government organizations.

It will also seek to cover and compare the variance of technologies between Western developed countries, and third world developing countries. Essentially, the mega corporations versus the growing local businesses in different nations. With the introduction of global internet shopping (e-Merchandise) and social application linked the gap of societies, technological utilization must be adapted as to stream-line processes for commerce and shipment between technologically advanced countries and still developing ones.

Chapter 2 Tools for Artificial Intelligence

Tools and Technologies for AI Implementations

To discuss in-depth the artificial intelligence implementation and its technological progression, we first have to lead with the enabling technologies and concepts that led to the birth of AI, both introducing and examining them. There has been a marked increased in consumer and business awareness of the methodology of efficiency, and of the experience of consumer shopping. With the exponential progress of the Internet of Things (IoT), Artificial Intelligence (AI), and the worldwide spread of smartphones and mobile payments, a new trend of unstaffed online retail shopping comes into play. IoT technology provides the possibility to connect sensors, intelligent hardware to the internet, it is a growing ubiquitous concept which has influenced many aspects of human life (Lizheng Liu1, 2018)

Internet of Things (IOT)

The term Internet of Things was first coined by Kevin Ashton in 1999, who was working in the field of networked RFID (Radio Frequency Identification) and emerging sensing technologies. However, IoT was “born” sometime between 2008 and 2009. (Jordi Salazar, 2017). In 2010, the number of everyday physical objects and devices connected to the Internet rose to around 12.5 billion. Nowadays there are about 25 billion of devices connected to the IoT - nearly one smart device per person (Evans, 2011). The IoT introduces a step change in individuals’ quality of life by offering new opportunities to data access, as well as specific services in education, security, health care and transportation. (Jordi Salazar, 2017). The number of smart devices connected to the IoT is only expected to increase to a staggering 50 billion by 2020.

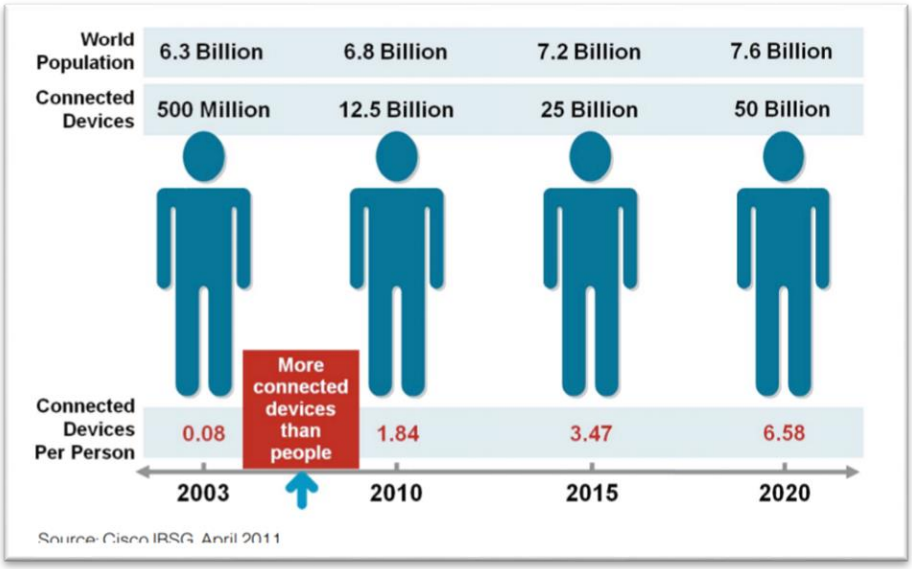


Figure 6: The Internet of Things Was "Born" Between 2008 and 2009 (Evans, 2011)

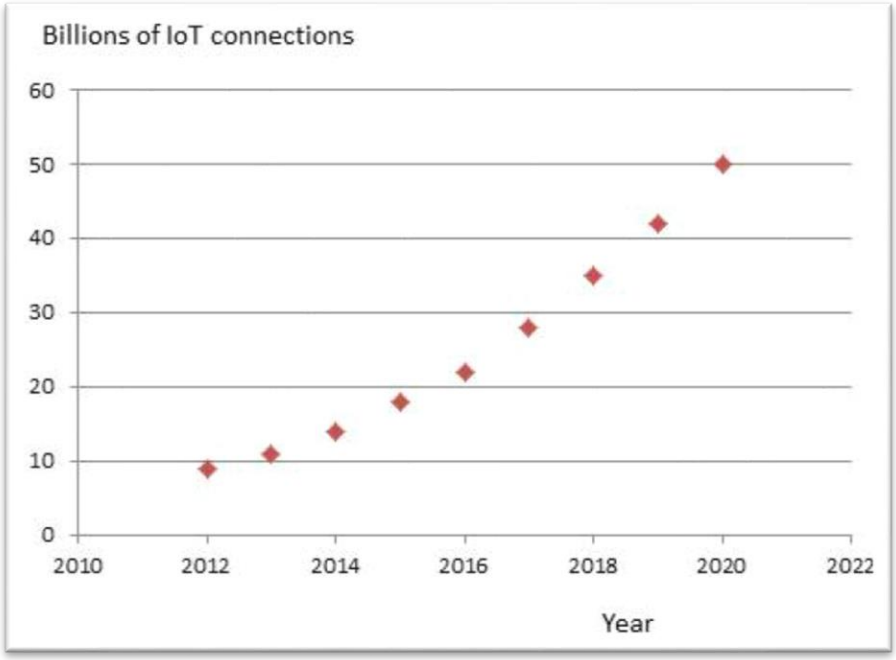


Figure 7: Number of IoT connections (Evans, 2011)

The information and data organizations collect and process during recurring business activities, yet don't directly utilize for other purposes such as monetization and analytics, is known as "dark assets". When organizations decide to illuminate these "dark assets", vast amounts of information

emerge, along with potential new insights and business value. For example, a connected smart-shoe can tell its owner , researchers, or manufacturer the number of footfalls in each period of time, or the force with which the foot strikes the ground. This information could then be used to directly monetize on the buyer, research better practices to create a second generation of smart-shoes, or understand how to better build the shoe for resistance to increased use.

Figure 8: IoE, the Networked Connection of People, Process, Data, and Things (Dr. Markus Kückelhaus, 2015)

IPv6 Introduction

IPv6 (Internet Protocol version 6) is the most recent version of the IP (Internet Protocol), which is the communications protocol that provides an identification and location system for computers on networks, and routes traffic across the Internet. (Jordi Salazar, 2017) IPv6 uses a 128-bit address format, allowing 2^{128}, or approximately 3.4 10^{38} addresses, approximately 8 10^{28} times as many as

IPv4. While increasing the pool of addresses is one of the most important benefits of IPv6, there are other technological changes in IPv6 that will improve the IP protocol: easier administration, better multicast routing, a simpler header format and more efficient routing, built-in authentication and privacy support among others. (Jordi Salazar, 2017) IPv6 will coexist with the older IPv4 for some time.

Figure 9: IPv6 Header Format (Jordi Salazar, 2017)

To properly translate communication from devices into servers via channels of protocols, as to secure data communication and to create a translation standard, the IoT devices and data translators have to comply to an IoT standard architecture. This standard acts as means of compliance and uniformity across hardware and software manufacturers.

Four-layer architecture of IoT	
Object Sensing Layer	Sensing the physical objects and obtaining data.
Data Exchange Layer	Transparent transmission of data through communication networks.
Information Integration Layer	Processing of the uncertain information acquired from the networks, filtering undesired data and integratation of main information into usable knowledge for services and final users.
Application Service Layer	Provides content services to users.

(Jordi Salazar, 2017)

Examples of IoT Enabled Applications

- Education: Linking virtual and physical classrooms to make learning more efficient and accessible through e-learning. Students have access to services like virtual libraries and educational portals. Interchange of reports and results in real time. Lifelong learning. Foreign languages learning. Attendance management.
- Consumer electronics: Smart phones. Smart TV. Laptops, computers and tablets. Smart refrigerators, washers and dryers. Smart home theatre systems. Smart appliances. Pet collar sensors. Personalization of the user experience. Autonomous product operation. Personal locators. Smart glasses.
- Health: Monitoring of chronic diseases. Improvement of the quality of care and quality of life for patients. Activity Trackers. Remote diagnostics. Connected bracelets. Interactive belts. Sport and fitness monitoring. Intelligent tags for drugs. Drug usage tracking. Biochips. Brain-computer interfaces. Monitoring eating habits.
- Automotive: Smart Cars. Traffic control. Advance information about what is broken. Wireless monitoring of tire pressure of car. Smart energy management and control. Self-diagnosis. Accelerometers. Position, presence and proximity sensors. Analysis of the best way to go in real time. GPS tracking. Vehicle speed control. Autonomous vehicles using IoT services. Agriculture and environment: Measurement and monitoring of environmental pollution (CO_2, noise, contaminant elements presents in ambient). Forecasting climate changes based on smart sensors monitoring. Passive RFID tags attached to agriculture products. Sensors in pallets of products. Waste management. Nutrition calculations.

- Energy services: accurate data on energy consumption. Smart metering. Smart grids. Analysis and prediction of energy consumption behaviors and patterns. Forecasting future energy trends and needs. Wireless sensors networks. Energy harvesting and recycling.
- Smart Connectivity: Data management and service provisioning. Use of social media and social networking. Access to email, voice and video services. Interactive group communication. Real time streaming. Interactive gaming. Augmented reality. Network security monitoring. Wearable user interfaces. Affective computing. Biometric authentication methods. Consumer telematics. M2M communication services. Big data analysis. Virtual reality. Cloud computing services. Ubiquitous computing. Computer vision. Smart antennas.
- Manufacturing: Gas and flow sensors. Smart sensors of humidity, temperature, motion, force, load, leaks/levels. Machine vision. Acoustic and vibration sensing. Compound applications. Smart control of robots. Control and optimization of fabrication processes. Pattern recognition. Machine Learning. Predictive Analytics. Mobile logistics. Warehouse management. Prevent overproduction. Efficient logistics.
- Shopping: Intelligent shopping. RFID and other electronic tags and readers. Barcodes in retail. Inventory control. Control of geographical origin of food and products. Control food quality and safety. (Jordi Salazar, 2017)

Use Cases of IoT

- Pervasive Remote Tracking/Monitoring
- Asset Tracking

- Process Control and Optimization
- Resource Allocation and Optimization
- Context-aware Automation and Decision Optimization

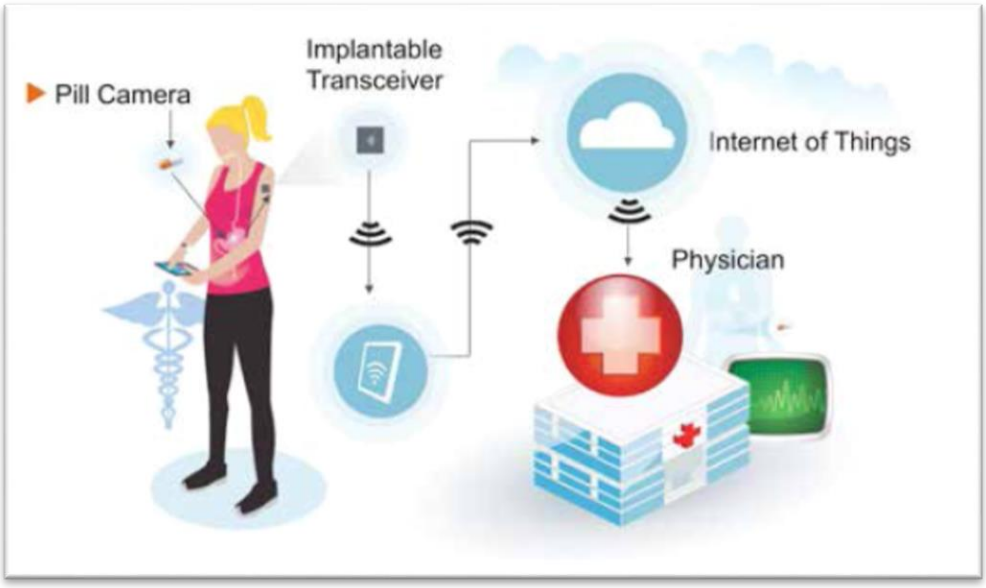


Figure 10: Remote Patient Monitoring (freescale, 2014)

Future of IoT

As a general trend, as it becomes less expensive to integrate technology into physical objects, we will see increased applications and adoption of IoT. In consequence, IoT will have major implications for both business-to-business and business-to consumer companies in the next years. (Jordi Salazar, 2017)

Block Chain in Business Collaboration

Blockchain can be defined as a distributed ledger technology that can record transactions between parties in a secure and permanent way. By ‘sharing’ databases between multiple parties, blockchain essentially removes the need for intermediaries who were previously required to act

as trusted third parties to verify, record, and coordinate transactions. By facilitating the move from a centralized to a decentralized distributed system, blockchain effectively liberates data that was previously kept in safeguarded silos.

Achieving excellence in logistics involves working collaboratively with others to optimize both the flow of physical goods, as well as the complex flow of information and financial transactions

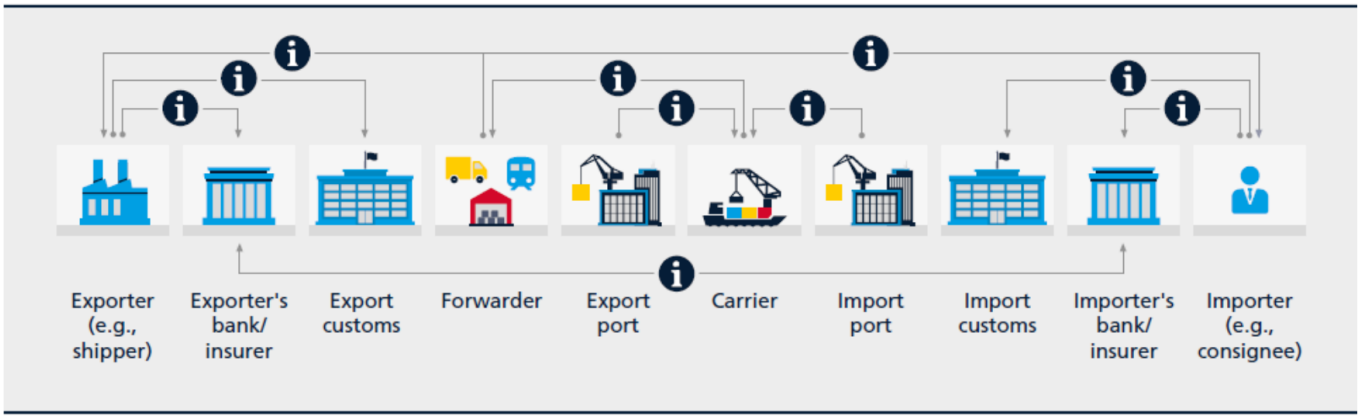


Figure 11:The information flow in international trade is complex, involves many parties, and is documentation heavy (Heutger, 2018)

Chapter 3 Transportation Automation

Automation needs in Transportation with proven case studies

Various transportation issues arise when the transportation system versus the users' behavior is too difficult to predict, and this makes it difficult to model travel patterns manually. Therefore, AI is deemed to be a good fit for transportation systems to overcome the challenges of an increasing travel demand, CO2 emissions, safety concerns, and environmental degradation. These challenges arise from the steady growth of rural and urban traffic due to the increasing number of populations, especially in the developing countries. In Australia, the cost of congestion is expected to reach 53.3 billion as the population is expected to increase to 30 million by 2031 (Australian Infrastructure Audit, 2018). In Melbourne, Australia, alone more than 640 km of arterial roads are congested during peak time with a CO2 emission of 2.9 tons per year (Linking Melbourne Authority, 2015). Many researchers in the 21st-century attempt to accomplish a more reliable transport system, with less effect on people and the environment by using cost-effective and more reliable methods by AI techniques. It has a massive potential application for road infrastructure, drivers, road users, and vehicles.

A fleet of such vehicles forms a cybernetic transportation system for passengers or goods, operating on either a simple route or an elaborate network to provide on-demand door-to-door transportation. Cybercars are precursors of drive-by-wire vehicles. Computers control the acceleration, braking, and steering. Project participants have already developed new hardware for implementing these functions safely. Obstacle avoidance is the main difficulty in cybercar deployment, particularly when the cars run in unprotected environments—that is, environments with pedestrians, cyclists, or even other vehicles (Parent, 2007)

Artificial Intelligence and virtual logistics for business automation

The AI applications in transportation have been continuously developing in the last few years, and have been implemented in a variety of ways. Among those, this research paper aims to address three main examples: (1) The use of AI in corporate decision making, planning, and managing. This is important to overcome the issue of a continuously rising demand with limited road supply, which includes better utilization of accurate prediction and detection models aiming to better forecast traffic volume, traffic conditions, and incidents. (2) Applications of AI aiming to improve public transport is also discussed, since public transportation is regarded as a sustainable mode of mobility. (3) The next promising AI applications in transportation are connected and autonomous vehicles, which aims to enhance productivity and safety by reducing the number of accidents on highways. (Rusul Abduljabbar, January 2019)

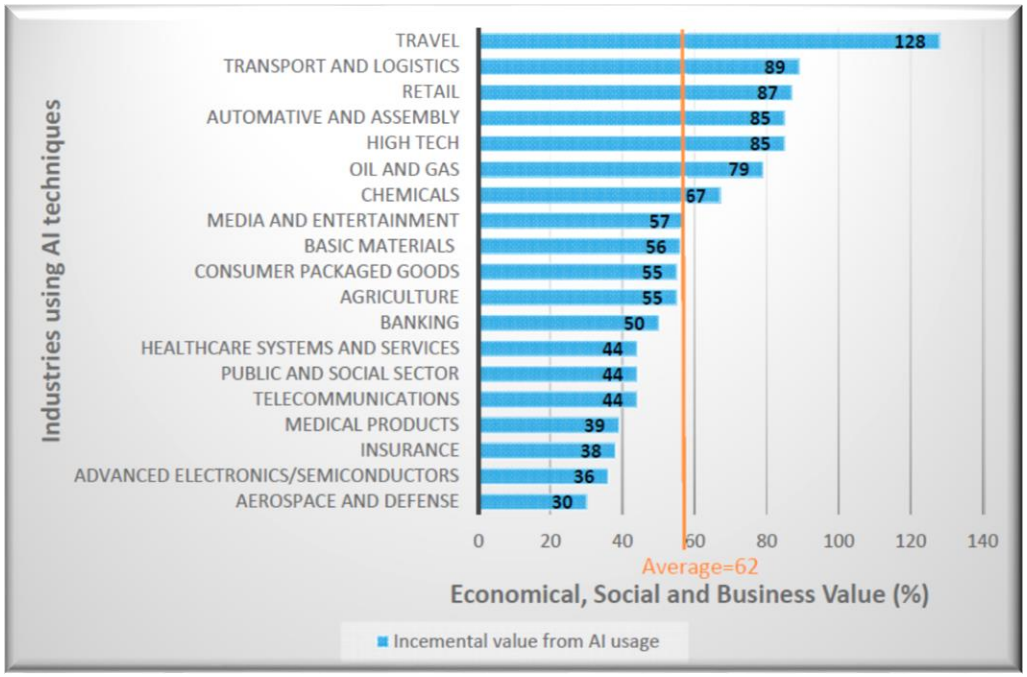


Figure 12: Industries using AI Technologies (McKinsey, 2018)

Freeways also comprise a complex network of dynamic systems that are increasingly becoming instrumented and interconnected. An “Internet of Things” comprising sensors, video surveillance, and other smart devices, all communicating with each other, capturing vast amounts of data on movement of people and their travel choices, and providing unprecedented opportunities for better management of vital transport infrastructure on road networks. (Rusul Abduljabbar H. D., 2019).

Below I will provide the proof of the need of IOT, and smart transportation, as the volume and demand for intelligent transportation services exponentially increase.

Emirates Transport Case Study

Emirates Transport operates one of the largest public and private school bus transportation services in the UAE. Encompassing 708 schools throughout the Emirates, with over 4,851 buses transporting more than 22,000 students daily, the company is seeking to implement a turnkey solution to monitor and ensure the safety of the students, the compliance of the bus drivers and supervisors, and better manage their contracts and agreements with their customers.

Some of the struggles Emirates Transport could possibly encounter include inaccuracy in their contract agreements and service levels, leaving a student behind in school, a student getting off at a stop that is not theirs (for example, going over to their friend’s house), inefficient route planning, and panicked parents when their kids aren’t home on time, or if the bus is late. For these reasons, and many more, it is important for school transportation operators to incorporate smart tools such as IoT and AI to ensure automated corrective actions to facilitate the effects of these inaccuracies. Such tools could be used in the automation of their services to attain maximum efficiency in their operations, as well as increased safety for the students.

School bus transportation technology has greatly advanced in the past few years. Real time vehicle monitoring that encompasses artificial intelligence technology has made school buses the safest method to get to school for students. With the implementation of further IoT and AI, tracking progress and efficiency of the route is easier, and more effective, than ever.

Transport Authority (Egypt)

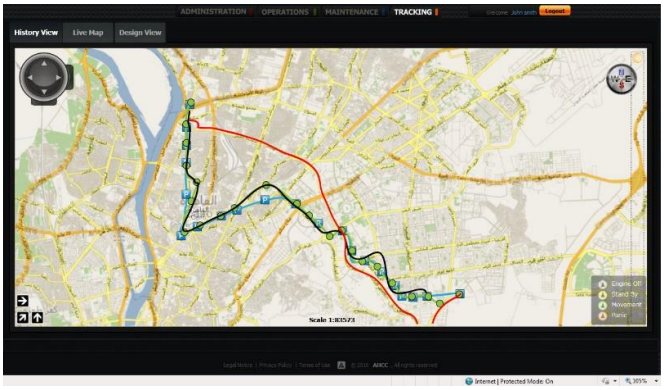


Figure 13:Route 1 case study

The Transport Authority in Egypt is another case which proved the necessity of the utilization of IoT and AI services to make its services more efficient. A study was conducted where transport authority drivers were given ticketing devices with smart intelligence to capture routes, rider's capacity, and route compliance. The study was conducted for two routes over the period of 30 days. The amount of deviation and violations in the routes by the drivers were staggering. The two figures for Route 1, and Route 2, highlight the route allocated by the authority and the red is the actual driven route.

As a result of the study, the transport authority made the case very clear to incorporate more automated intelligent monitoring with machine learning to learn behavior of allocated drivers to anticipate and alert the authorities of deviations. The staggering amount of revenue loss due to the drivers' deviations justified the cost of including automation and AI tools to help facilitate adherence to routes and procedures. Other than safety compliance, which is a critical component for all governmental transport authorities, the loss of revenue due to skipping stops, changes in routes, and extended breaks and deviations, was in the magnitude of millions annually. By implementing intelligent IoT and AI procedures, they could curb this behavior drastically and monitor drivers and routes efficiently.

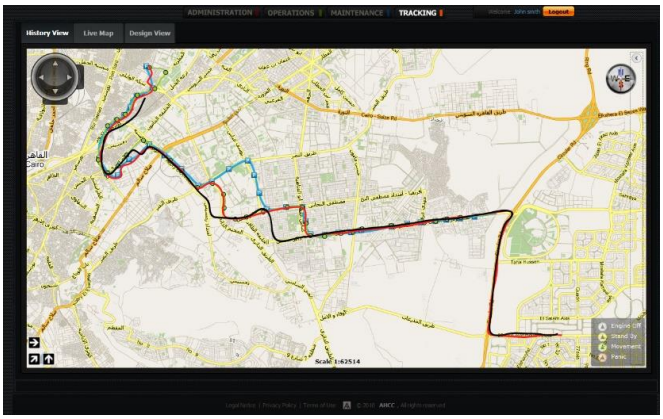


Figure 14: Route 2 Case study -

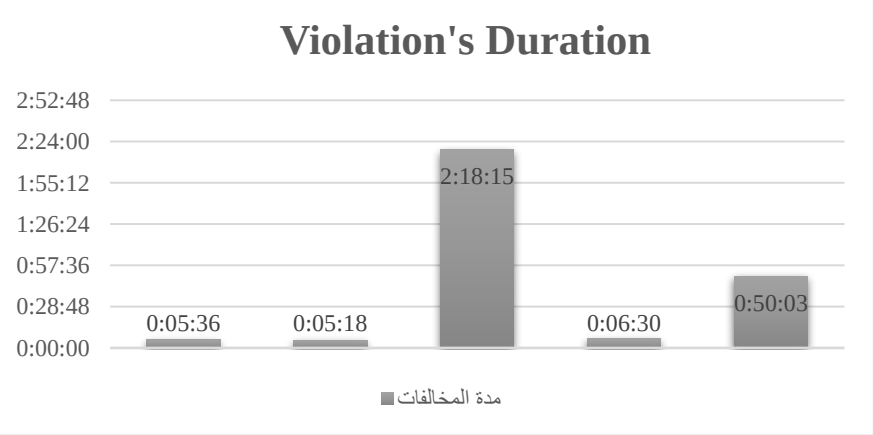


Figure 15: Drivers Violations

Kingdom of Saudi Arabia Case Study

In Saudi Arabia, school bus tracking and student attendance components support a wide range of services, while backend management components ensure maximum efficiency in route

planning and resource optimization. Additional parent applications allow parents to be assured about the safety of their kids and where they are. This software can be operated by the school admin, parents, and even the bus drivers and supervisors to maintain a close eye on the students.

The school bus transportation industry is large, with agencies providing increasing competitive services and prices on a regular basis. To make sure that transport operations run smoothly and competitively, AHCC developed a complete one source solution, The Integrated Logistics System, ILS, to help facilitate the needs of all areas in one clean application.

A number of solutions was provided, ranging from low cost semi-automated solutions to fully fledged end– to–end automated monitoring, management and optimization solutions. ILS consists of several modules that can be customized, configured, and integrated with several different systems or hardware to provide a tailored solution these agencies are looking for. All solutions are built on the Integrated Logistics System Platform and powered by ILS Tracking (IOT Based solution).

Dynamic Demand and Automated Bus loading selection

Urban transportation companies face the fact that, at the end of the day, they are a key component to society, even if they don't profit out of the returns. Citizens have to be picked up and delivered into city centers, and even if the bus is empty, the route must be driven, which only makes the task on urban planners more difficult. The only solution is to incorporate the latest smart technologies to merge stops and build dynamic loading schedules to try and counteract these ill effects. In the case of Saudi Arabia, low season presented with a bus load of only 3%. The urban transport company had subcontracted AHCC to integrate IoT devices, and loaded with this smart transportation system, as well as ticketing, digitally built geofences around the bus stops helped to ensure the capture of unwanted driver behavior, and enforce the proper abiding by policy. After running the system for a year, the adapted Integrated Logistics System (ILS) provided the

Figure 16: Public Transport route capacities (KSA)

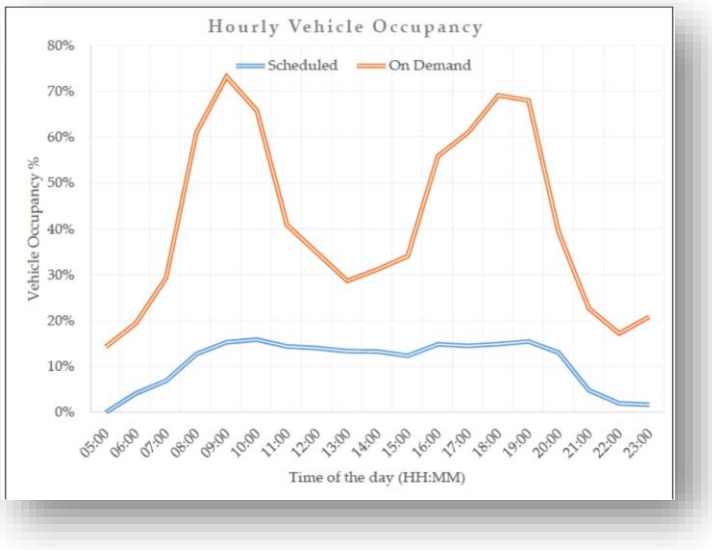


Figure 17: Hourly vehicle occupancy for scheduled and on-demand bus services (Dia, 2020)

governmental agencies smart reporting capabilities, where they were able to efficiently combine routes and allocate different bus capacities based on the demand forecast, all done automatically by the systems analysis. They found that the demand varies per hour, per season, and based on economic condition of the city, which was previously unknown.

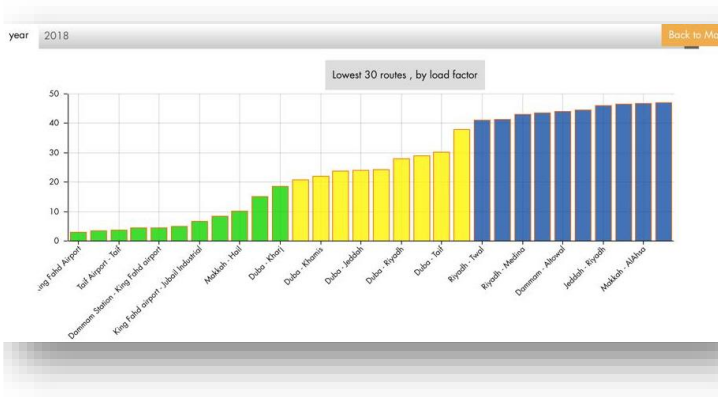


Figure 18: Route Load Variations

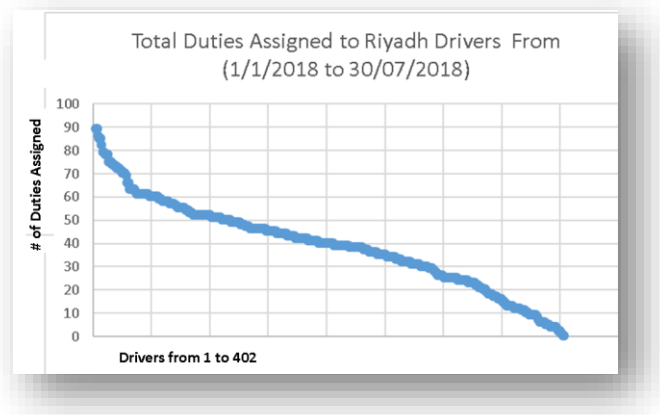


Figure 19: duties assigned in urban transport

Please refer to Appendix A for supporting tables

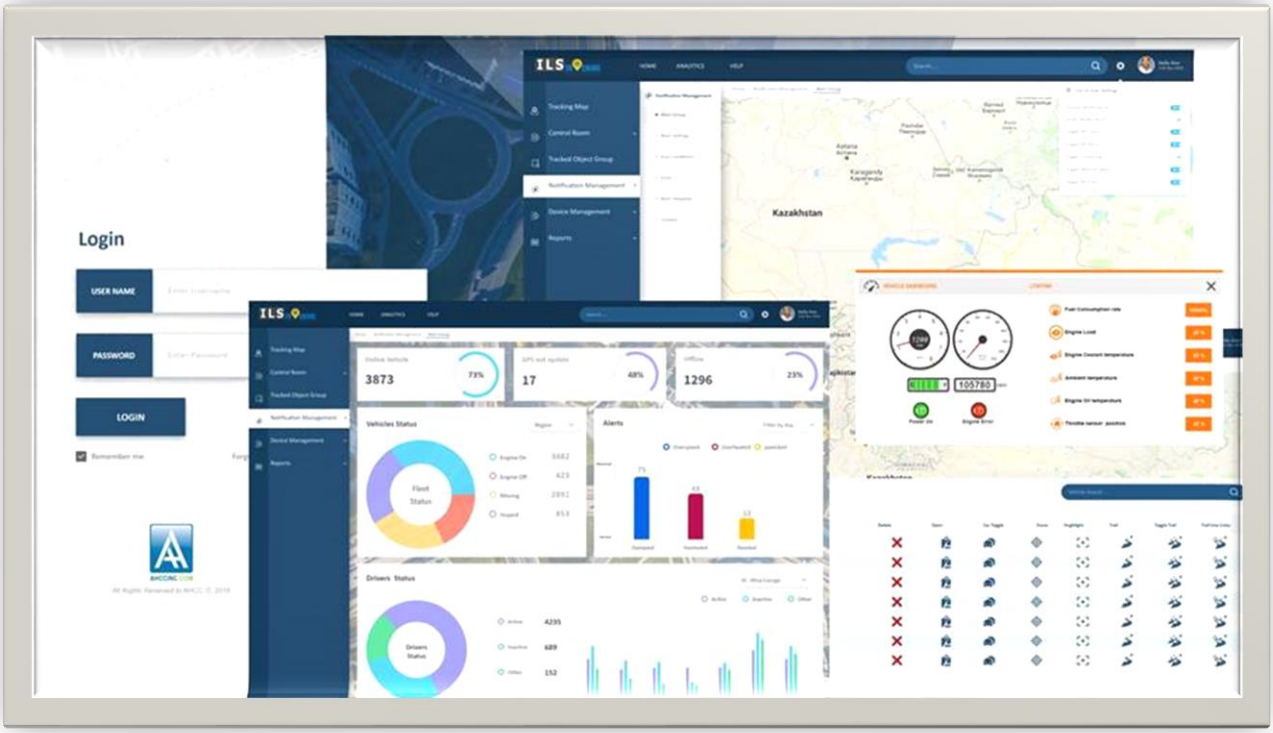


Figure 20 ILS- Automated KPI Capture Tools

Fleet Maintenance Automation

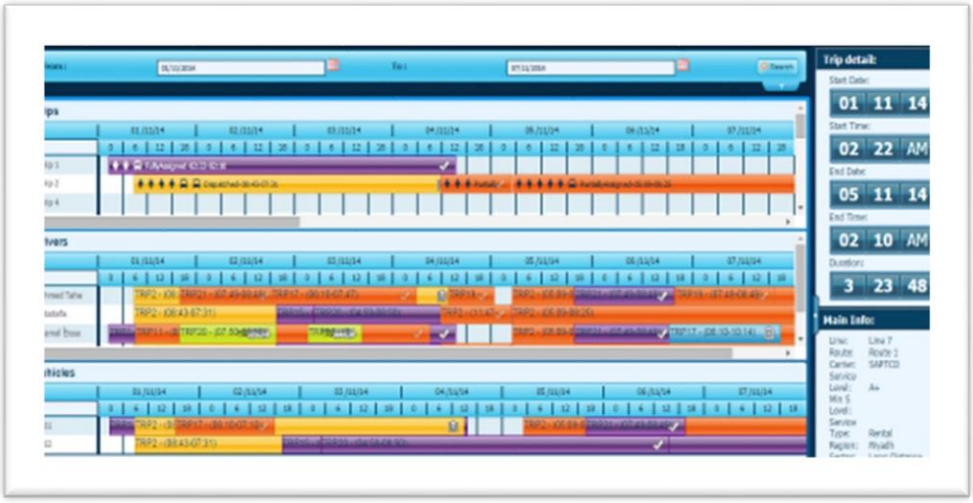
The most daunting of all operations to any transportation firm is their vehicle maintenance operations. The biggest cause of failure in this area is mainly the lack of proper preparation and compliance to policies. Successful firms understand the importance of overseeing the maintenance operations of fleets, manufacturing operations, and/or facilities, but they also understand how daunting, difficult, and costly it can be - especially when they can't foresee potential issues, or properly plan preventive maintenance. In these common events, firms suffer from downtime and lower Return on Investment (ROI) from their assets than expected. However, the introduction of maintenance software has been able to change the way maintenance managers operate. The Built-in maintenance management engine allows the defining, managing, and the tracking of labor, spare

parts, equipment, and tools, as well with all associated attributes such as insurance, warranty, and scheduled repairs.

Figure 21: Telematics for Maintenance Automation

AHCC provided a comprehensive system as part of the solution for smart transportation automation, the ILS Maintenance, which ensures that the most is made out of investments. With the ability to track spare parts, record asset history, capture asset status, scheduling preventive maintenance, and knowing which assets are better fit for specific tasks using IoT sensors allow a sense of ease, efficiency, productivity, and profitability to enter the system.

Figure 22: Planning and Scheduling with AI Plugins



Yard Management

Another major dilemma for urban planners and

fleet managers alike is the parking and storage of fleet vehicles. With over 2000 fleet vehicles, the adherence to government and city regulations, and addressing necessary schedules for the following morning, the simple issue of parking can escalate to a major inhibitor of efficiency. Paired with the necessity to track the state of the vehicle, arrival time, schedule departure time, driver health condition, and weather conditions, many variables and copious amounts of data become compounded and mixed.

Smart yard management with AI components have to be incorporated to ensure fulfilling different urban transportation needs, such as government employees, army schedules, school schedules and emergency responses. With such a massive amount of variables and regulations, it is the only way to ensure organization.

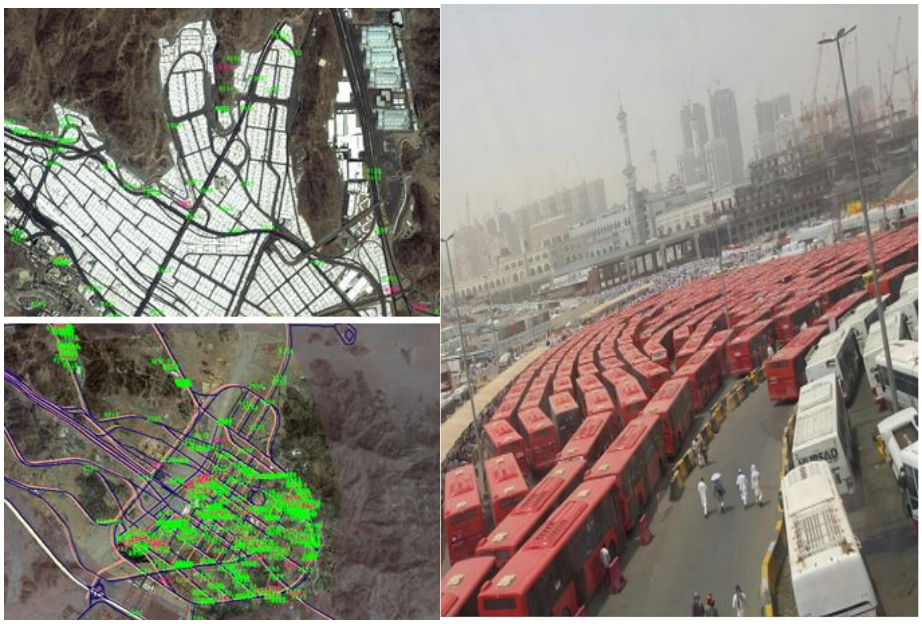


Figure 23: Yard Management

As populations increase, and more cars take to the road, car accidents are on the increase. As part of general governmental mandates to ensure the safety and livelihood of its citizens, a way to combat these accidents were necessary. An alert system had been developed to combat this issue.

The created “Intelligent Driving System Using AI” consisted of a large collection of functions, such as Active Blind Spot Assist (which can warn driver if it detects a car in driver’s blind spot), Attention Assist (designed to alert the driver when they begin showing signs of fatigue behind the wheel), and Lane Keeping Assist (which will stop the driver from drifting across lanes into other traffic). With these potential functions in the “Intelligent Driving System” , it can improve a driver’s behavior and decision making, which would in turn reduce car accidents. (Bulla, JUNE 2019).

AI Transportation technologies and their stages of development will affect the fleet and Route optimization, Car driver Communications, Autonomous vehicles. (Sprouse II, 2019)

On Demand Transportation Management

In the past, the concept of providing door-to-door transportation services have been attempted across different cities around the world with variable degrees of success. Known as demand-responsive transport (DRT), Diala- Ride Transit (DART), and flexible transport services (FTS), they have evolved over the last decade or so, from operating as a service for elderly and disabled users who have difficulties in using conventional public transport, to today’s app-based services which allow users to book and track their trips online on a single mobile platform. (Dia, 2020)

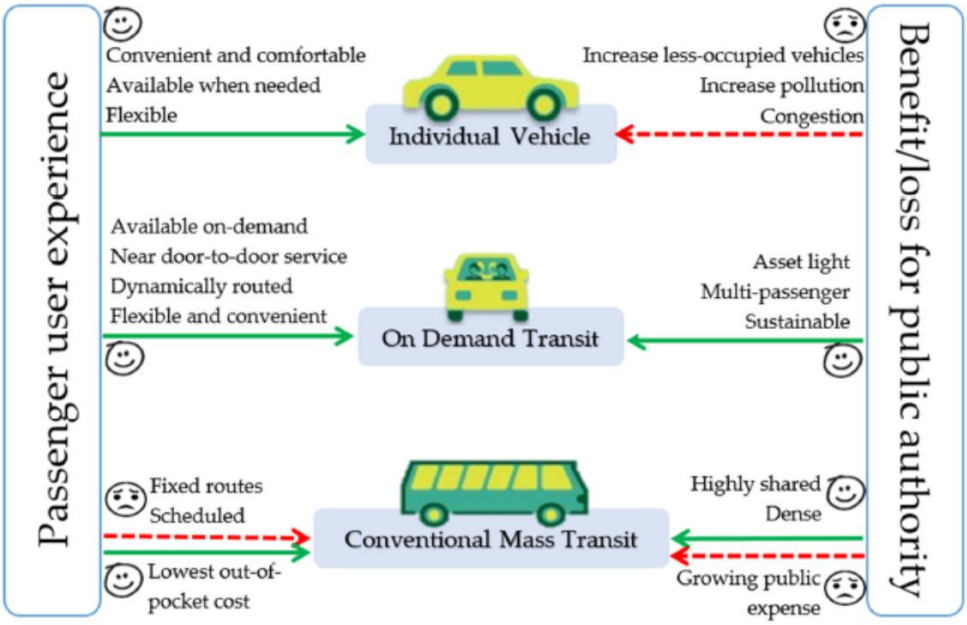


Figure 24 On-demand transit; a mid-way approach for customer and public needs. (Dia, 2020)

The cost advantage of resource allocation and scale economy in collaborative logistics network make it possible to perform mixed centralized transportation, as well as decentralized transportation contemporarily. There are route optimization problems of mixed transportation, like centralized and decentralized transportation control in the background of collaborative logistics networks. A linear programming model is proposed to yield minimum total costs, consideration of cost discounts, overload penalty cost, and advance delivery cost.

Furthermore, a hybrid genetic tabu search algorithm has been presented combined comprehensive advantages of both heuristic algorithms, for purpose of high efficiency and rational speed of convergence. (Deng, Zheng, & li, 2019)

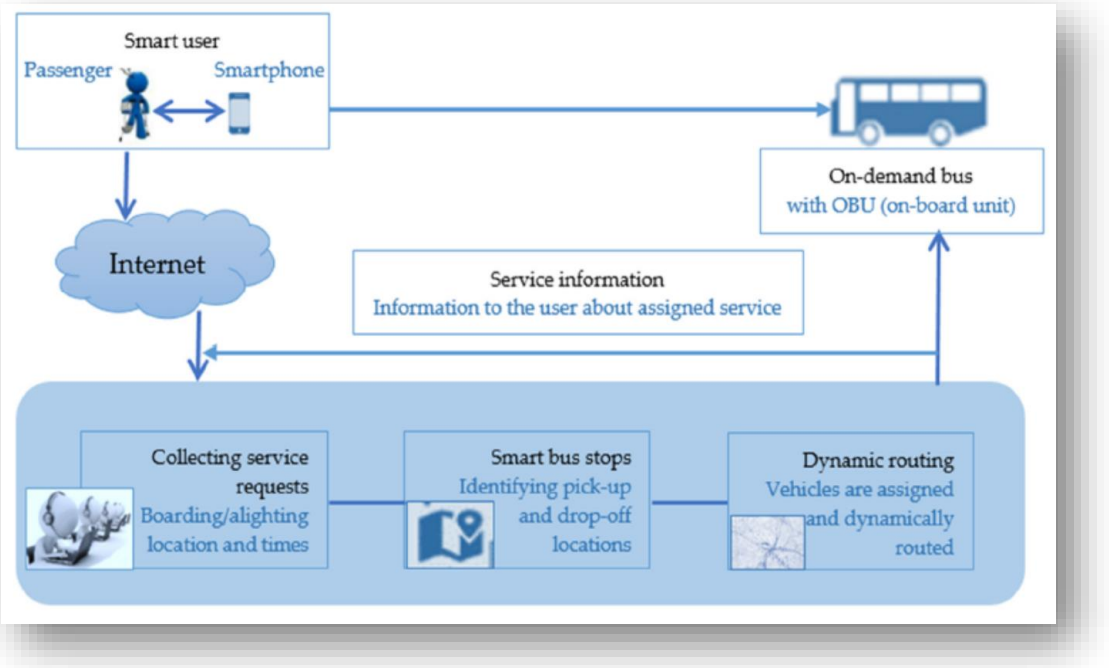


Figure 25: Architecture of an on-demand bus system. (Dia, 2020)

The future vision for intelligent urban mobility is smarter decision-making based on real-time information, and network optimization by efficient use of infrastructure. Importantly, fostering a better, safe, and healthier transportation system which creates an intelligent connectivity to achieve a sustainable, seamless and environmentally friendly network. Recently, the world was at the cusp of emerging autonomous vehicles (AV), that is, vehicles capable of moving without the support and guidance of a human driver. (Zhang, Guhathakurta, Fang, & Zhang, 2015)

Chapter 4: Supply Chain Management and Automation

Introduction

Supply chain management is a major portion in many industries, especially as firms realize the importance of creating an integrated relationship with their suppliers and customers. Managing the supply chain has become a way of improving competitiveness by reducing uncertainty and enhancing customer service. The role of planning and coordination in complex integrated systems, and information technology, to synchronize the supply chain is described in a framework that creates the appropriate structure, and installs proper controls in the enterprise and other constituents in the chain. Logistics is an evolution through four distinct areas: warehousing and transportation management, total cost management, integrated logistics management and supply management (Su, 2002)

All businesses that are part of a supply chain are linked by physical or information flows, and AI tools can augment or automate those flows. However, the dynamic characteristics and behavior of supply chains are case based. They vary with every business and sector, for instance, from bio-medical industry to aeronautics to manufacturing. Thus, there cannot be a standardized AI solution. AI can be applied in various end-to-end supply chain activities with tools that help in augmentation [connectivity between businesses and analysis (finance, production, warehousing and so forth)] to automation [use of machine learning and robotics]. (Andersen", 2018)

Supply chain management has come a long way from the ‘creation era’ of formalizing supply chain activities among businesses, to information communication technology (ICT) driven ‘globalization’ of supply chain management. AI is now the next transformer of supply chain

management which follows the customer-driven philosophy.

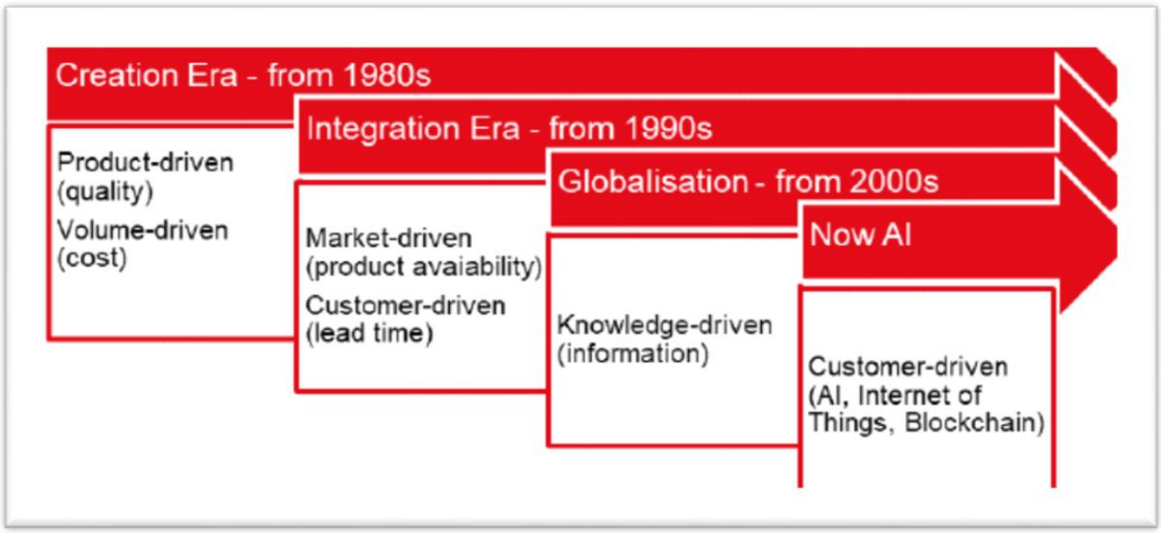


Figure 26: Evolution of Supply chain management disciplines (Andersen", 2018)

Customer-experience (end to end) being the key today, the success of supply chain management is completely driven by demands like customized and personalized products which are delivered almost instantaneously. (Andersen", 2018)

The concept of Supply Chain Management (SCM) aims to manage efficiently the physical, financial and informational flows exchanged between all the actors of a supply chain (suppliers, subcontractors, wholesalers, retailers, customers, etc.), for an intra/inter-organizational coordination. Nowadays, this concept is a strategic challenge for any company seeking to achieve its objectives in terms of economic competitiveness, delivery, and quality of service; especially in an economic environment characterized by the globalization of trade, the complexity of trade flows, the increased competition, and the sustainable development requirements.

Artificial Intelligence and virtual logistics for business automation

In this complex and uncertain environment, characterized by the massive data exchanges, the use of information technologies and systems to interact with all supply chain partners is crucial.

Among these systems, there are Electronic Data Interchange (EDI), Enterprise Resource Planning (ERP), Radio Frequency Identification (RFID), and Artificial Intelligence (AI)

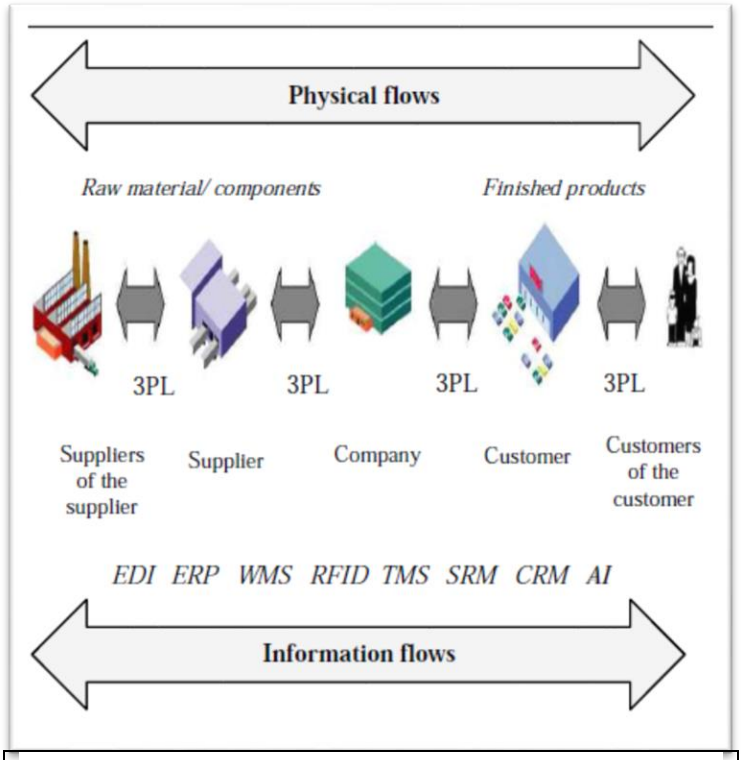


Figure 27 Global Supply Chain Flow

The Figure gives an overview of a global supply chain of a given company, as well as products flows and information flows exchanged between its various partners: its suppliers and their suppliers, its customers, and their customers, and also the 3PL. (AGUEZZOUL, 2019)

There definitely exist various possibilities to use self-learning algorithms for business operations in different industries

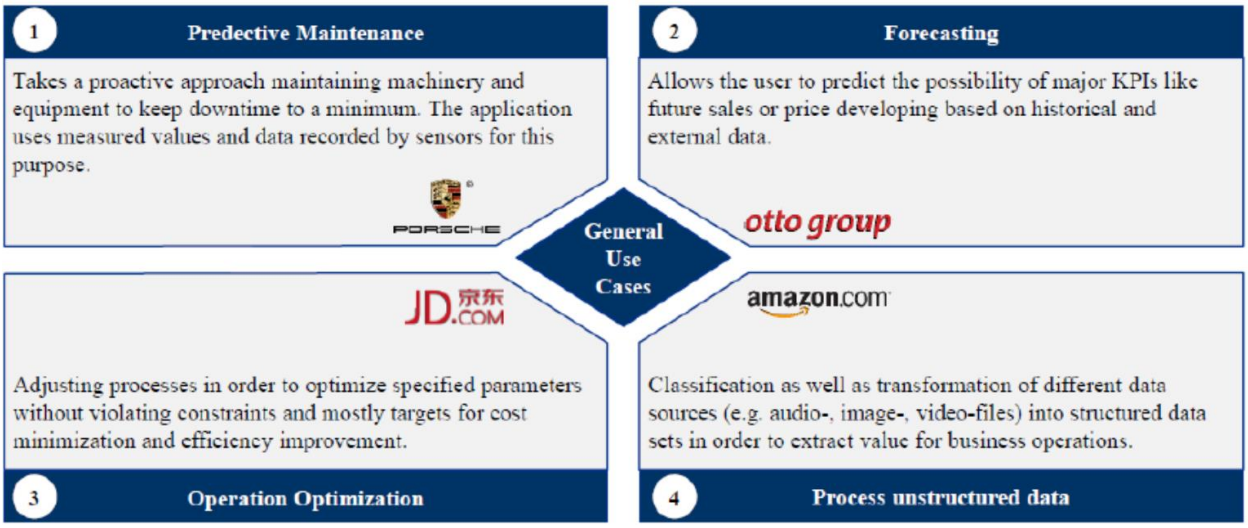


Figure 28: General application fields of machine learning (Hoppe, 2019)

To understand the complexity of supply chain and logistical needs we need to cove the different level of logistical fulfillment as in the following sections.

Type of Logistic Levels

The concepts of 3PL (the third-party logistics), and 4PL (the fourth party logistics) reflect the evolving demands of the manufacturer to own and handle all logistics functions, such as trucking and warehousing

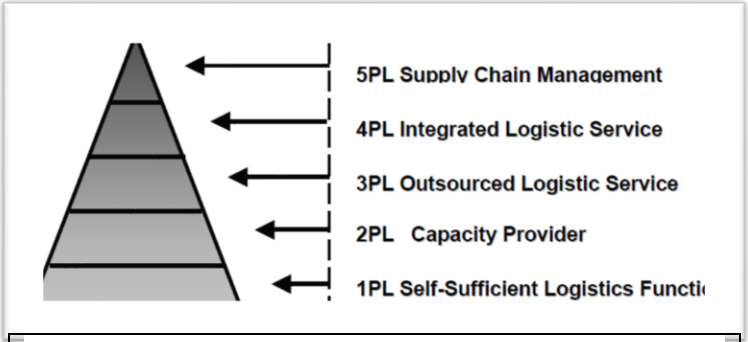


Figure 29: From 1PL to 5PL 5PL (Su, 2002)

Outsourcing strategy has become an increasingly important issue pursued by companies seeking for improved efficiency. In the field of logistics, it involves using a key player in the SCM, named Third-Party Logistics (3PL) services providers, to carry out all or part of the logistics activities of

a company, such as transportation, warehousing, and product returns management (reverse logistics).

The company can then focus on its core business tasks such as research and development, manufacturing, and marketing, and thereby improve its responsiveness as well as its performance. However, to integrate the 3PL in its supply chain, the company must select an efficient set of them by choosing those that must meet its requirements in terms of cost, expertise, innovation, delivery time, quality of service, flexibility, and information technologies. The 3PL selection and performance evaluation is a complex process that depends on several quantitative and qualitative criteria, business sectors of the company, and outsourced logistics activities.

Omni Channel Logistics

Logistics and supply chains are the backbone of every omni-channel strategy. They are the key enablers to consistently, and cost-effectively, deliver personalized service and flexible fulfillment. They also enable retailers to achieve cross-channel inventory visibility and optimization (crucial to the success of omni-channel implementation) and meet customer expectations, generating higher satisfaction and loyalty. (Yee, 2015)

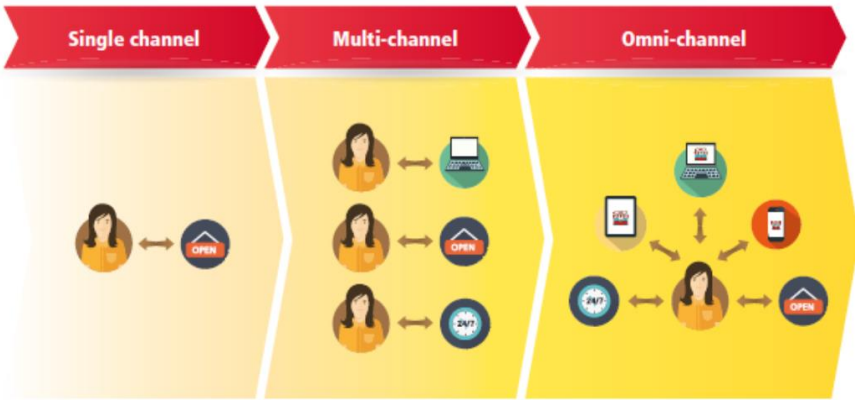


Figure 30: Omni-channel delivers a seamless customer experience across all channels (Yee, 2015)

Artificial Intelligence and virtual logistics for business automation

The modern shopper's journey cuts across different channels, including the physical, online, and mobile stores, as well as understanding Omni-channel and social media, which brings into focus several new factors that influence sales and consumer decisions (Figure below). It is the shifting from a sequence of actions in a single channel to a continuum of action across multiple channels. A 2013 study by Accenture found that 88% of US consumers admit to "web-rooming" – browsing online and then buying in-store. On the other hand, Best Buy, a US-based electronics multi-channel retailer, found that almost 70% of its consumer electronic products in the United States are purchased via showrooming – consumers visit a physical store to touch and feel the product before purchasing it online. (Smith, 2012)

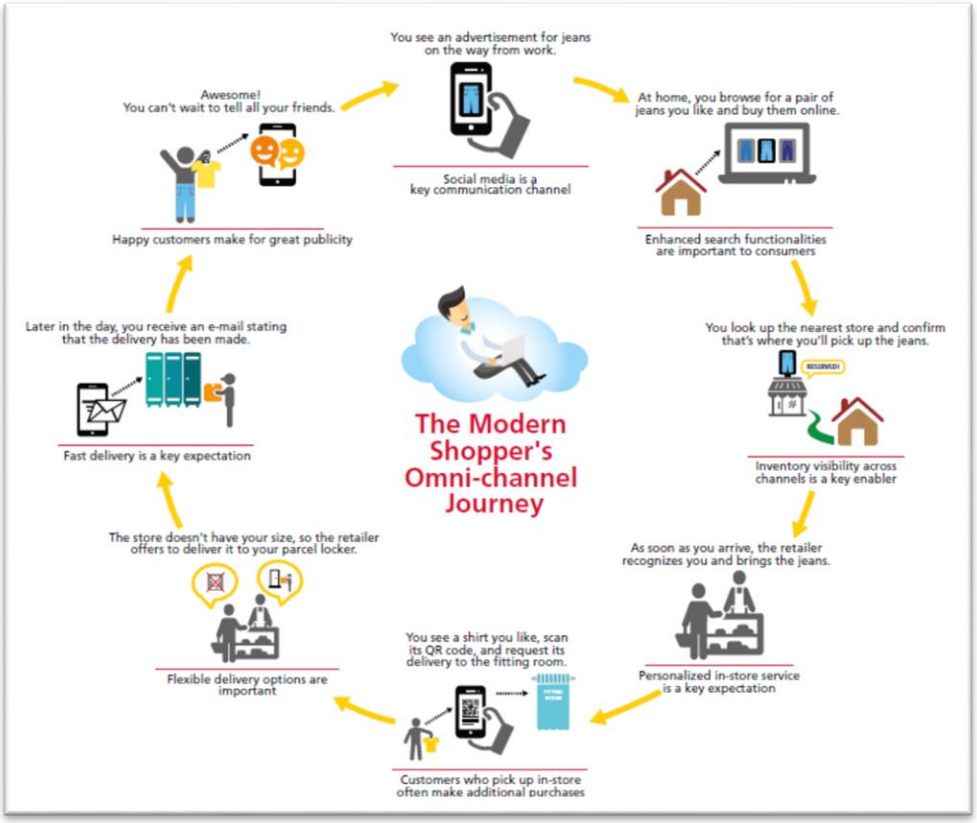


Figure 31: The modern shopper 's omni-channel journey (Yee, 2015)

It becomes evidently critical to personalize in-store shopping experience, as a study conducted by IDC Retail Insights in June 2015 found that more than 2,600 consumers in Asia found the top two reasons that prevent shoppers from actually buying products in shops are the time it takes, and the inconvenience of the shopping experience. The omni-channel approach has the potential to overcome both these objections.

- Merging Online and Offline Experience in the Store
- Easing Navigation with In-store Robots using Artificial Intelligence

This ease of navigation to assist shoppers is a prime example of how artificial intelligence helps to personalize customer experience, and improve in-store navigation. Originally a pilot project by one of the largest hardware store chains in the United States, Lowe's stores are typically quite large, and have found that customers find it difficult to find the right products. To address these friction factors, Lowe's has installed robots to greet consumers at the door, field product inquiries, and escort shoppers to the exact in-store location of the merchandise. To optimize omni channel logistics, some aspects need to be addressed, such as :

- Driving Traffic to Stores with 'On-the-Go' Promotions
- Providing Store Shopping Assistance from Home
- Offering Virtual Expert Advice through AI Engines
- Utilizing Social Media
- Leveraging Customer Loyalty (Smith, 2012)

Understanding Artificial Neural Networks and impact on supply chain

AI is known for its ability to think like humans, act like humans, think rationally, and act rationally. Thus, with respect to these distinctive features, AI can be further classified into several

sub-fields: (1) artificial neural networks (ANN) and rough set theory ("thinking humanly"); (2) machine learning, expert systems, and GAs ("acting humanly"); (3) fuzzy logic ("thinking rationally"); and (4) agent-based systems ("acting rationally"). These sub-fields are discussed below. The theory of an ANN was predicated on the way that the living organ's brain cells, namely neurons, function. Using the interconnected network of computer memories, ANN can learn from experience, distinguish features, recognize patterns, cluster objects, and process ambiguous or abstract information. To elaborate, an ANN is composed of a number of nodes which correspond to biological neurons. Those nodes are connected to each other by links. Each link has a numeric weight assigned to it. The links and their weights are the primary means of the long-term memory storage. The network processes information in such way that the output of one neuron is an input to another neuron linked to it. The weights are responsible for the strengthening or weakening of the information passed via the link. The links are placed and the values of weights are set in a process called learning. ANN can be taught to respond to various data patterns according to our wishes or to learn hidden interrelationships among the data. Once the network is initialized, ANN can be modified to improve its performance using an inductive learning algorithm and be trained in either supervised or unsupervised environments (Min, 2009)

While the entire area of SCM has many different aspects, four main applications are surveyed where ANNs are used as the problem-solving methodology. These areas summarily included are :

Forecasting: This is necessary in SCM, since inaccuracy in one echelon is propagated to the others in the chain, and amplified.

Simulation: This relates to analyzing the dynamics of supply chain through discrete event simulation.

Decision Support: in this area, we examine the applications of ANN s in facilitating the decision-making processes of SCM.

Optimization: it can be shown that usually among existing ANNs techniques, Hopfield neural networks and SOM have applied for optimization. Some of the many ANN applications that have been reported for optimization problems include Assignment Problems, Clustering Problems, Scheduling Problems and Traveling Salesman Problems (TSP).

ANNs also continue to keep great promise for practical applications, as well as major improvements in engineering practice. One of the most important applications, forecasting discussion, is to increase coordination between firms in chain in order to access lower costs and higher satisfaction of customers through on-time delivery. On the other hand, ANN can represent more accurate results than traditional techniques. Since existing tools have limitations and different capabilities, ANNs can be a hybrid between other techniques to improve results. It should be kept into consideration that making RFIDs and collecting the right data has eliminated one of the most crucial barriers to doing research through use of ANN in supply chain environments. Therefore, it is believed that ANN can attract further interest from the industry than ever before, where the real potential provided by the technology can be better exploited to benefit the management task (A.R. Soroush - Nakhai Kamal-Abadi and LA- Bahreininejad, 2009)

In the following sections, we will cover the components that facilitates supply chain management where artificial intelligence can play a major role in self-automating and monitoring, to avoid complexity of operational decision needs, keep up with the high demand of global competition, and push an organization to reach high levels of profitability.

Customer relationship management full cycle

In general, the entirety of the supply chain focuses on the customer. With increased demands and competition, that central customer focus becomes a critical component of any industry or retail operation. Businesses and organizations need to focus on how to both bring in more customers, and how to retain highly satisfied customers, to be able to upsell those same customers further products, including locality and trend analysis. Data needs to be collected to ensure running heuristic rules and AI engines to suggest new product lines, and to determine a degree of satisfaction and tolerances by the customers.

Microsoft is one of the top players globally that introduced the concept of a Customer relationship management (CRM) tool. The solution provides integrated, real-time data in open, standard formats that can be easily shared using common communication and collaboration tools to synchronize the entire supply chain. That means there's transparency both within the organization, and across organizational boundaries, so trade partners can work together effectively to satisfy customers, respond to changes, and profitably meet the challenges of competitive markets. (Dynamics, 2008)

All software tools for logistics automation are striving, and needed, to establish the next state of Artificial intelligence needs. Without these basic automation data collections, organizations cannot evolve.

Sales Opportunity Management

Based on the sales pipeline management methodology, opportunity management allows one to optimize their opportunities pipeline workflow. This is possible by giving one the ability to standardize their sales process, and the flexibility to match it with their customer's buying processes. A sales team will have the tools to properly assess, plan, develop, and implement best sales practices tailored to your clients or industry.

From the moment a new customer enters a sales cycle, the software provides a sales "road-map" that will guide the field force's efforts in the right direction. The management team will have a visible pipeline to view for each customer individually, providing them real time reports and an overview of where all the company's opportunities are and how they can increase the chance of a sale.

With this process, organizations will improve their win rates, enhance opportunity insights, and overall optimize the pipeline workflow by focusing on the opportunities that matter the most, by knowing what a sales team need to do next to complete the sales cycle and win the deal. AHCC was able to build such an integration with web-based CRM software, such as ILS CRM or MS Dynamics CRM, which adds more value to an organizational solution by both providing management at a centralized location to view all the information in graphs, and charts all of it cohesively in an automated process.

Strategic Customer Account Management

In general, customers are grouped into folders in distinct customer categories which one has the flexibility to create and customize. New customers and customer categories can be configured on an ad-hoc bases to allow sales personnel to create customer accounts immediately as to not slow down any sales process.

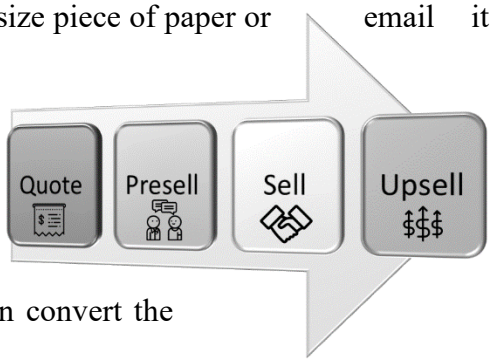
Sales professionals will have the most relevant and useful customer information in front of them, such as the interaction history, planned activities, future orders to be made, attached files, and everything else one thinks is necessary. The solution also allows one to create "Customer Cards", which could be in the form of a printed barcode that is provided to the customers, so when a sales employees meet them, all they must do is scan the barcode, and they will get the customer information right away. This feature is used to ensure the long-term development of customer accounts and increase the retention of current customers.

Contact Management

Contact management and account management components are linked, but independent of each other. This is the best way to allow a sales employees to switch between contacts screens and account screens without mixing the two together. In the same way account management allows a sales agent to link documents and view history, the contact management will let you do the same.

Quotations, Order Management, and Sales Forecasting

Streamline quotes and order process with a fully integrated quote-to-order, cash and fulfilment solution. For customers who are looking for a quick quotation, an organization should want to give it to them as quickly as possible. This solution allows one to predefine rates for customers, while the sales associates simply have to fill in the blanks of basic customer information and needs. Once this is done, they can print it on a receipt size piece of paper or email it directly from their mobile devices. AHCC's EnRoute Sales Force Automation accomplishes above and beyond those tasks for automatic and organizing those needs. Using the EnRoute Sales Force Automation, one can even convert the quotation into a sale immediately from the same screen, to allow no time wasted switching between screens. Additionally, one can create a workflow which requires all quotes to be approved before they can be turned into sales. If the item is not in the sale's representative's current possession, the order will be made from the backend systems.



Using this system, the sales employees will have the power to create a sales order for a customer directly from their vehicle's inventory or warehouse inventory. They can have a complete catalogue of a company's products, with prices and stock counts to make the order quickly. By using AHCC's personal digital assistant, an organization's employees will be able to create the order, take a credit card or cash payment, and print a receipt all through the same device. This allows the field force, who knows the customers the most, to be empowered and be able to take the actions required to satisfy and deliver. The purpose of the recommended all in one mobile solution is to add value and decrease order

processing time. The quicker the order is made, the more orders a sales team can make – this is ideal situation of automated solutions using AI.

The system does all this by a built-in sales forecasting engine that processes the sales information in detail to give one more predictable results based on actual real time activities. These forecasts are for the management to see, so they are displayed in the backend systems on graphs, charts, or excel sheets, depending on your preference. All data collected from the field is passed on to AI engines for automated decision making and continuous improvement of customer centric operations.

Merchandising

All organizations have a policy and strategy to best display products at a store in a way which would stimulate interest in customers to purchase it. This necessitates having merchandisers who regularly check to see if the shelf space is correct and following those guidelines. Whether they are merchandisers or sales personnel who do the merchandising, an automation solution that has customizable workflows will guide the employee with a step-by-step process to ensure that on shelf availability and share of shelf are exactly the way they should be. This is done with a unique planogram engine that displays diagrams of the required product positioning at a store level. The need of artificial engines here is to keep monitoring customer demands and self-monitoring customer movements and selection and depending on environmental, economic, seasonal adaptation the shelf stocking could be adapted. All customer purchases get plugged into big data repositories that feeds AI engines for continuous improvements of demands.

Cost Control and Promotions

To ensure that excessive costs aren't incurred by sales teams, software solutions such as AHCC's ILS solution allows end users to define cost groups corresponding to the sales activities they perform. One can allocate periodical budgets for groups and individuals alike. This will ensure that the employees stay within budget, and only incur the important costs that will lead to a sale.

The supplier will also be able to plan promotional offers and give sales teams the functionalities they need to properly present the promotions to leverage sales results. Moreover, if one wants to provide samples or gifts to customers, then the system will be able to define gift inventories which can allocate individual items to those customers. This could even be further categorized by specific customer types that would be the ones eligible for those gifts.

When offering promotions and gifts, detailed planning and compliance checking is essential. The solution needs to constantly collect real time information, and format them into reports for managers and AI engines to be able to conduct a random real time audit at any time.

Figure 32: Budget, Promotions and Control

Inventory and Returns

A sales team will have a full inventory of the warehouse stock, and more importantly, their vehicle stock (Mobile Sales force). They will know what they have and when they will have what they don't possess. They will also be able to view the product catalog by clicking on it directly from the inventory. Quick filters and stock ordering capabilities are built in to make the process more efficient.

Besides inventory, sales employees will be able to register returned items and enter their return reasons, and the inventory will be updated automatically with each return. They can make a return by scanning the barcode or registering the return manually. When a sales person registers a return, it is updated as in his possession in his vehicle. When he goes back to the warehouse, he can then transfer liability automatically to the warehouse, and the stock is updated accordingly.

Knowledge Management, Tasks, and KPIs

The solution facilitates quick and efficient knowledge transfer between sales force employees by having a centralized knowledge base where users can upload and download information. They will also can quickly search for specific information they are looking for and filter between different categories. This way one can ensure that the sales force always has the information they need to close a deal and improve their skills. Such knowledge includes marketing materials used to optimize the sales offer, coaching materials, situation handling information.

Figure 33: KPIs Focus

The solution also has a built-in job management component. The sales person's predefined visits are visible to him to view. This can be in the form of individual customer follow ups, or a general route that the sales person goes through to try and sell to new clients. Setting proper tasks or objectives for the field force is important to contributing in sales success. They will also be able to update in real time about the status of each task either individually or as a whole.

They will also be able to know what their targets are, and where they stand against them. A built-in compensation calculation engine will allow sales personnel to see their commissions per each sale automatically so that they do not waste time calculating them manually.

The recommended mobility solution has a built in GPS and time stamp feature that allows the software to capture the location and time any action has been taken by the sales personnel; this will let one accurately know which employees are not where they say they are, when they say they are.

Sales and work force Automation

There are many challenges that face distribution and outdoor sales operations. However, experts have agreed that the proper use of technology to automate the field personnel can in fact boost revenue, improve workflows, and enhance employee performance. Employing the right software is challenging in today's sea of software vendors, so purchasing decisions should be based on the solution's ability to facilitate a team's day to day operations.

In order to facilitate the sales team efficiency, they need the kind of system that empowers them to get a quick price approval, to be able to check their inventory, to create new orders, to

register their sales, view their KPIs, and more importantly, to have more transparency in their job tasks and statuses.

Unlike all other solutions available in the market today, EnRoute (AHCC Sales force automation tools) gives a sales team limitless visibility into every aspect of the supply chain to better manage their customers. It makes back office information available, such as contract agreements, warehouse inventory, and even regional sales reports. It allows any organization to sell more efficiently at higher margins. It does this by letting the field force know which customers to visit and when. It also lets them know their daily tasks such as merchandising, data capturing, new prospect visit; it allows them to print receipt and take payments, and even send price quotes. It will give them insight into which products and promotions they should offer to specific customers by letting them know what level of products has been sold to that customer along with the interaction history. Moreover, these fully automated systems are capable of integrating with the leading ERP solutions in the industry, or even locally made ERPs, so no changes are needed to an organizations current software. The rest of the simple, yet powerful, features will be explained in the rest of this document.

Companies such as AHCC and Microsoft, Oracle and SAP offers organizations the ability to synchronize supply chain processes, automate for faster execution, reduce cycle time, increase customer satisfaction, enhance trade partner collaboration, and gain business insight.

Key solution areas include:

- Supply chain management
- Financial management

- Manufacturing
- Warehouse management
- Distribution
- Sales force automation

Transportation Management

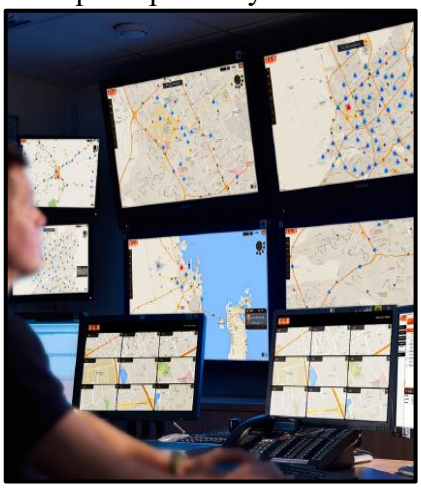
One of the most critical components in any supply chain management is the movement, or the transportation means, of either its trucks, busses, small cars, limousine, plane, ships, and so on. In these regards, top management in any organization also must consider whether to decide to buy, versus utilize a subcontracting model (3PL). However, for specific industries, they do not have the luxury of those two options. For example, if the organization is into heavy distribution, or people moving, then subcontracting is a major burden, and self-owned fleets are usually utilized. However, depending on different seasonal demands, organizations may combine models via owning, leasing and subcontracting some of the distribution needs. This creates the need of adopting automated tools and artificial engines to keep monitoring demand supply cycles. An integrated automation tool can do this by providing executive management recommendations via AI engines, KPIs, and reporting to continuously enhance the cost models. This brings us to the discussion of components for smart transportation management systems, which will be discussed in the next few sections.

Monitoring Transportation

The control room feature lets any organization view multiple tracking screens at the same time from one computer screen, or display them on different screens to monitor all of their business

sectors. The component provides multiple screens that can be used to track different vehicles or vehicles groups, in different regions, at the same time.

Since organizations almost always plan on expanding across the country or globally, they will be able to monitor all their expanded locations from one location instead of needing to operate multiple separate systems.



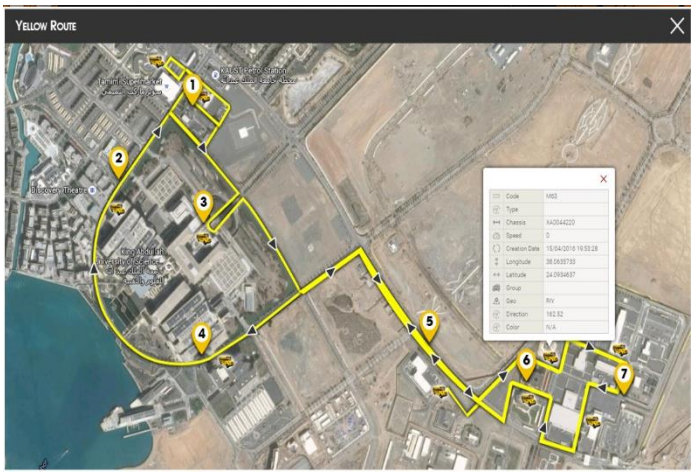


Figure 34: ILS Control Room

Secure and Environmentally Friendly Transportation System

GPS-enabled trucks or busses provide safe and friendly transportation operations for everyone involved. Real-time tracking of the fleet helps in optimizing routes, thereby reducing fuel consumption and time to complete tasks. It alerts the admin and operators on excessive idling of the fleet, which helps control the wastage of fuel as well. The Tracking system ensures the fleet safety by sending notifications for over-speeding, route deviation, and traffic conditions and driver behavior.

The ability to configure all types of alerts makes the tracking system highly competitive in terms of monitoring the driver's performance. The system has the capability to allow users to configure different alerts, and for installing additional sensors.

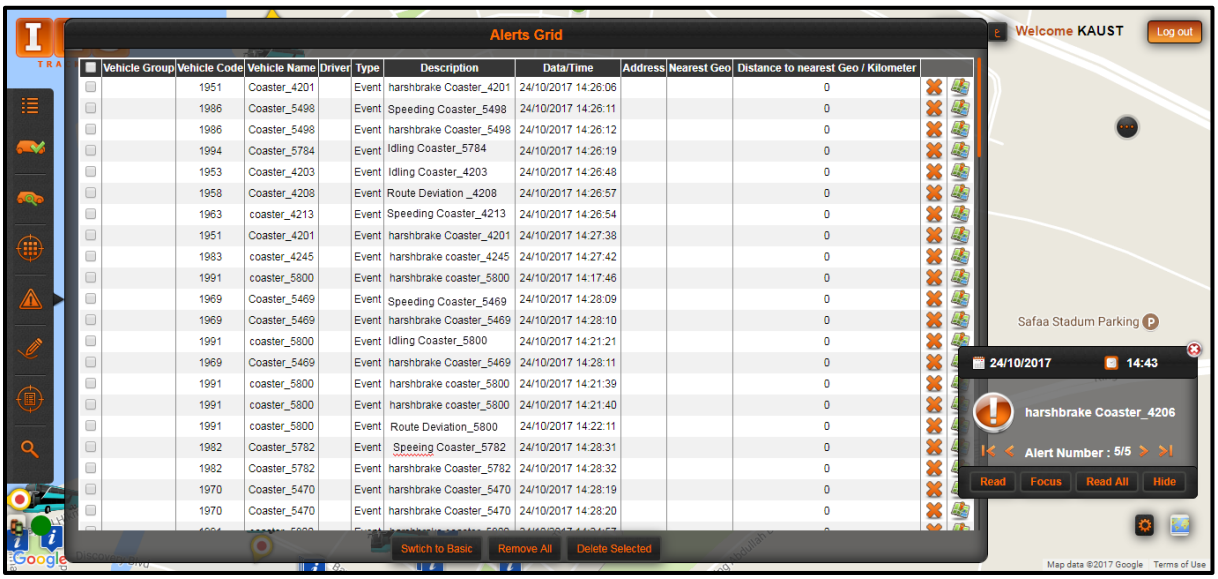


Figure 35: Transportation Alerts

Passenger Verification and Parent Application

This system is a low-cost solution consisting of three different components tightly integrated together which ensure accuracy and transparency of vehicle and passenger locations in real time. The solution is built through utilizing the advanced vehicle tracking technology developed by companies such as AHCC, the ILS Tracking. The vehicle tracking system is a highly customizable platform which allows bus admins to view the bus's location in real time, as well as show parents where their kids are on the road in case of student transportations.

The three-part solution consists of ILS Tracking to monitor the real time location of the vehicle, a student verification app for supervisors to be able to take attendance of the students who board and leave the bus, and a parent application to monitor the bus's location and the status of

Figure 36: Student Transportation

their children on the bus.

Student Verification App

The student verification app is used to take attendance of the students who ride the buses in the morning, and map it with the students who are leaving the bus on their way home. Its built on a mobility platform, meaning it can be downloaded on the supervisor's mobile phone and not require you to deploy any additional hardware.

Each student is given an ID card with a unique barcode printed on it that is mapped to their information. When the student boards the bus, the supervisor scans their ID card with the mobile app on supervisor's phone. This records the student as "attended", and update's the parent's mobile app notifying them that their child is on board, and keeps a record at the school that the student has attended, and their card is scanned one more time when they have reached the school.

On their way back home, the students who were recorded in the morning are listed for the supervisor so that they can verify which students have not yet boarded the bus. After scanning all the students, they will be able to view a quick grid showing them the list of students which were scanned in the morning, and notify them who has not boarded. This allows the supervisor to check and see where the child is to make sure they aren't left behind. Parents will appreciate knowing their kids are always looked out for.

Student Name	Status	ID No.
Ahmed Gammal	On-Board	4585698
Hussein Abbas	On-Board	4445856
Omar Abbas	Not On-Board!	8898558
Mohammed AbdelRaou	On-Board	8888878
Kamal Jassem	On-Board	5552689
Kamal Hussein	On-Board	5245256
Marwan Ramadan	On-Board	2524452
Ali Hussein	On-Board	5658895
Ali Abbas	On-Board	2688456
Mohammed Khalil	On-Board	3355688
Ahmed Zarouni	On-Board	4589482
Abdulla Yassin	On-Board	6262922
Hussein Ammar	Not On-Board!	8898558
Malek Hassan	On-Board	8898589
Seif Abdullah	On-Board	4588895
Abdulla Shoeib	On-Board	8885898
Ahmed Seif	On-Board	8854758
Ahmed AbdelJawwad	On-Board	5688858

When a student is scanned on their way back home, their parent's mobile app will let them know that their child has boarded the bus and is enroute home. The parents can then track the bus on their own, and know if there are any delays. This way the school will have reduced calls asking about the status of their kids or why they are late.

Transportation Supervisor Mobile Application:

Supervisors such as parents have only one concern, their children or goods. When it comes to young children going to school, parents are always anxious about their well-being. Especially on the way to and back from school. A mobility solution application that is tightly integrated with ILS Tracking and EnRoute in order to provide parents with up to date, real time information regarding their children's whereabouts, will help alleviate any anxiety the parents may feel. Parents will be able to view when their children got on the bus, through integration with the student verification app, and when and where they got off. The mobile application aims to provide parents with bus schedule information, bus location, estimated arrival time, and their route pattern. It allows parents to have an "eye in the sky", following their kids to ensure their well-being.

Figure 37: Supervisor Mobility Solution

- Push Notifications of the student's status (Boarded / Not – Boarded).
- No more waiting at the bus stops; The application Current location of designated vehicle and estimated arrival time so that the parents don't need to wait too long before their children arrive at their stop.
- Identify loading and unloading points which allows them to communicate with the school to ask to relocate their stop point.
- Shows the bus schedule and estimated arrival time.
- Find other bus routes and request changes from the school.
- Find points of interest around the stop point.

- Allows parents to know if their children went on a different bus.
- Gives parents a peace of mind knowing their children are safe going from point to point.

This provides the supervisor or a parent with a mobile app for a dynamic always on the move world will allow them to view where their kids/products have been, will be, and when they will arrive, will increase their satisfaction and trust in the schools and transport operators. It will give them an increased sense of security and reliability in who is handling their kids. It is a must have for any organization looking to increase customer and business collaboration, built on trust and accessibility.

Driver Navigation & RFID Integration

Another system is the driver mobile data terminal and journey planning component, where barcode cards are substituted with Radio Frequency Identification (RFID) enabled cards. The RFID enabled cards will make it so that the supervisors have little to no interference in scanning the students ID cards. The students will only need to tap their card on the RFID reader installed near the door on the bus when they're entering and leaving the bus. With each scan students make while entering the bus on their way back home, their drop off point is recorded. Based on all the students who boarded, the system will automatically generate an optimized route using AI based

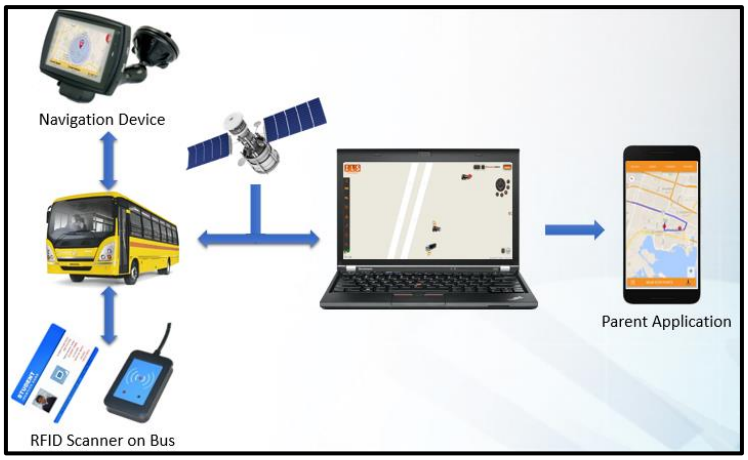


Figure 38: Transportation Visibility Automation Components

on the students who boarded and present it on the driver's mobile data terminal. This makes route planning more accurate as it is based on the students who boarded. All data collected from IOT enabled devices are pushed into further AI engines to continuously improve the operations and keep adapting route models for optimized costs. If there are any students missing, the mobile data terminal will display an attendance sheet to show the driver which students are missing. This automates the attendance / product capture taking process and lets supervisors focus only on the students getting in their seats and the overall environment.

RFID Cards

In terms of general movement of students or goods, RFID (Radio frequency identification) cards provide a unique identification number, which can be tracked to give information about the status of the students / packaged products. The cards have a built-in storage which allows the writing of information about the student / package in the card. Through integration, the originations can benefit from the use of RFID technology to provide to package information and even staff with contactless cards that can save the information related to package or student, drop off point, and assigned route.

When it's time to move the package or shipment, the driver will scan the package cards while getting on the truck, and the information will be stored and processed in the backend or AI systems. Once all the packages / students are on board, the driver will be able to get a list of all the packages / students that on the truck or bus. Right away missing packages that are allocated for that route or drop off will be identified and alerted to control or supervisors. Based on packages

allocated for that truck, their drop off points will be processed and the route will be optimized to give the driver the best way to drop off all deliveries in the shortest time.

Companies and their partners will be able increase the security of the package deliveries by ensuring that they are on the right truck at the right time, and only dropped off at their assigned points. Users will know if packages are on the truck they should be on. All information of pickup and drop off to be sent to AI engines to drive demand patterns that may help executive management to optimize fleet size and readjusting allocated routes.

RFID Bracelets and Antenna

Silicon RFID bracelets are given to students which they can wear on their wrists like a watch, and not have to worry about it getting lost or damaged. It is soft on the skin and will not cause any irritation to the students. Moreover, these passive RFID bracelets don't radiate any signals or waves which could be harmful to the students. Each RFID bracelet has the student's information saved on it by the school administrator so that each student has a unique ID their information is mapped to.

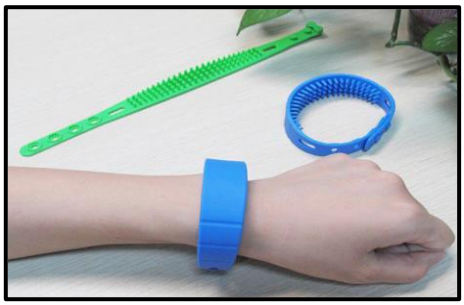


Figure 39: RFID Bracelet

RFID reader antennas can also be installed on the doors of the buses so that it automatically scans the bracelet when the student walks in and out of the door, without the need to manually scan the bracelet. The installation of a RFID-enabled system in school bus transportation enables the school bus attendance tracking, with which it becomes possible to track students boarding/de-boarding

Figure 40: RFID Antenna Reader

the bus automatically, without relying on manual scanning. It not only helps in maintaining safe commute, but can also be helpful in tracking the students in case they de-board at the wrong stop.

Ultra High Frequency passive RFID braceletes and antennas will require zero intervention by supervisors and drivers, and will ensure a quciker boarding or loading times since no one needs to be stopped at the door to be scanned. Moreover, one wouldn't have to worry about a student forgeting to swipe their card on the reader.

Driver Mobile Data Terminal (MDT) and Journey Planning (Operations Management)

Another system is for operational optimization and driver communications, as to plan the driver's actual journey, with a mobile data terminal to display routes to the drivers.

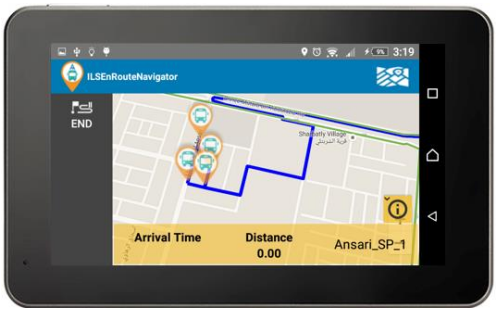


Figure 41: MDT Sample

Based on the packages on board, the Operations management component will process all the drop off points and create an optimized route which fleet managers can approve and use to dispatch the vehicles. Fleet managers or school administrators also can override the created route and rearrange the stop points if needed. Drivers won't have to worry about taking a long route, or getting distracted and accidentally passing by a

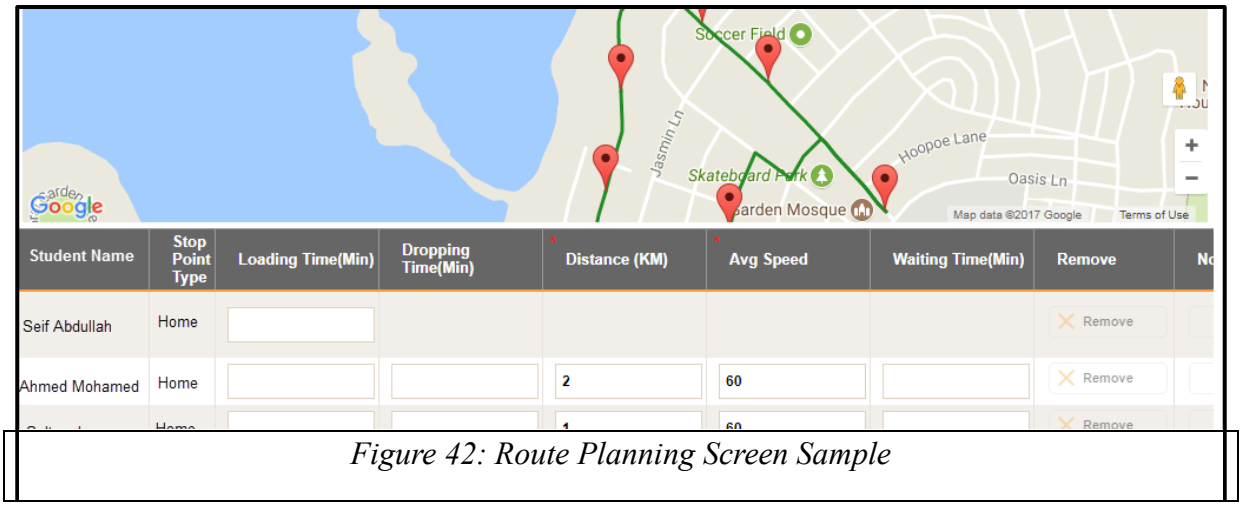


Figure 42: Route Planning Screen Sample

house of a student who did not board the vehicle, and supervisors can focus all their attention on the well-being of the students on board the vehicle.

Mobile Digital Video Recorder (DVR)

Optimizing an organizations fleet, and adopting the best practices and standards of the industry, require all security measures to be considered. Especially when the assets being transported are children, high value shipments, or cash transport. Implementing a secure and stable DVR system on the buses or trucks not only allows admins to monitor what's going on inside the fleet, but also what is going on outside the fleet. This will allow them to be able to investigate incidents much more effectively and quickly take any necessary actions.

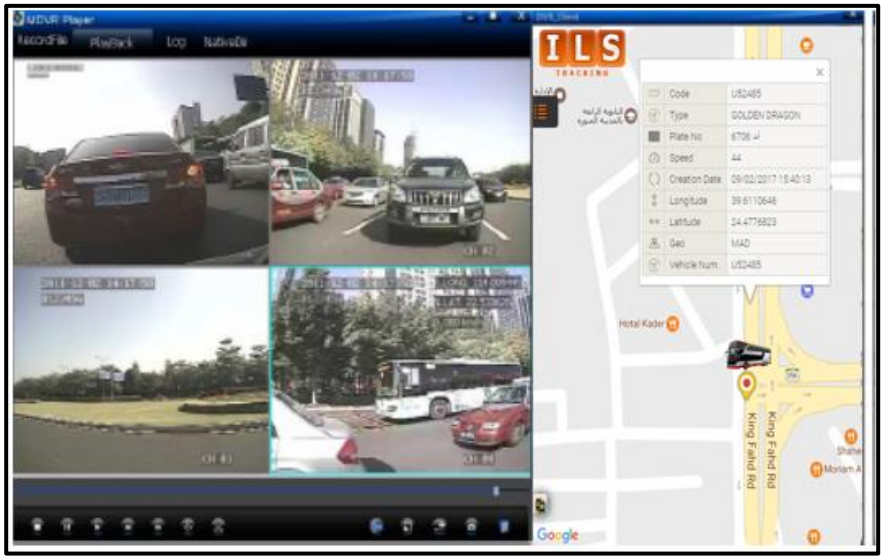


Figure 43: Cameras with DVR

Admins will be able to manage devices, see a live view of what's going on, store videos and playback, and even link events to alarms. There are various DVR types and camera types available that can fit the needs of different organizations. These range from small cameras that cannot be seen, to highly rugged vandal proof cameras that can be installed outside the buses. These devices can:

- Monitor Driver Behavior
- Monitor road conditions
- Investigate accidents or complaints

- Keep students safe from bullying
- Ensure bus regulations and safety standards are being met

Passenger Counter

The highest revenue generating movement of people are transportation busses. This system helps boost the efficacy of busses by integrating a smart system, where on board passenger

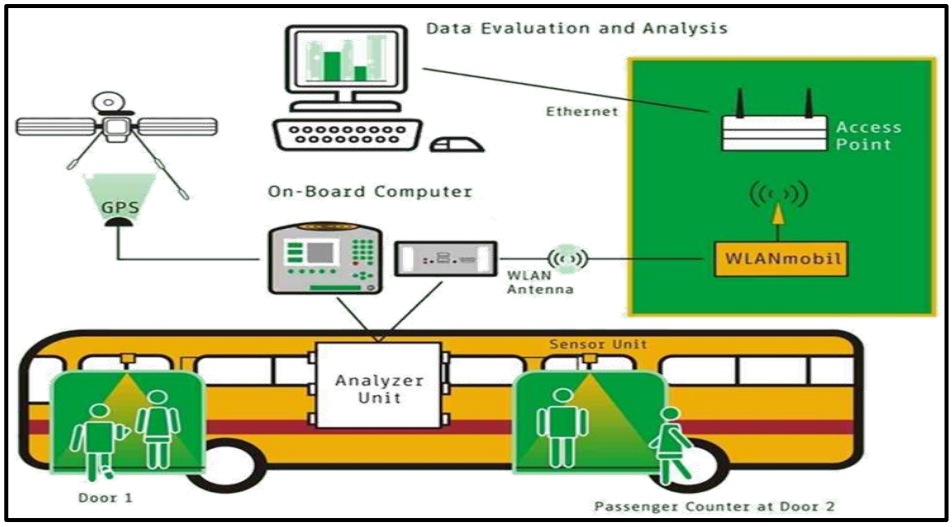


Figure 44: Passenger Counters

counters can be added on the doors of the buses to count the people going in and out of the bus. The benefit of this is to ensure that no unauthorized person gets on the bus. For example, if the bus driver stops on the route and picks someone up, the counter will count an additional person and record the place they were picked up, which would mean that there was an unauthorized pickup. Such incidents compromises the safety of the students and allow the appropriate authorities to take quick and decisive actions to protect the students.

Contract Management Tools

ILS Contracts & Charter is another one of AHCC's contract and charter management applications, used by some of the largest firms in the Middle East to manage their agreements and contracts between them and their clients. It utilizes a powerful web-based software that keeps

vehicle rental operations running smoothly and efficiently. It will help operate the business efficiently in a process-controlled environment and support all of the employees to provide their customers with a high level of customer service. In addition, the solution facilitates the saving of attachments with all transactions on customer accounts to archive operational documents. It will streamline business processes, optimize fleet availability, reduce operational costs, optimize ROl and increase customer satisfaction.

ILS Contracts & Charters give the luxury of managing school accounts, vehicle allocation, contracts, reservations, dispatching, payments, and invoices. It even has the capability of generating real time reports. Moreover, if a company decides to work with 3rd party agents, the system can manage the different agent accounts as well all information collected are fed into artificial decision-making tools as to facilitate business growth and safety. Some of these tools included are:

- **Account Management:** One can create and save customer information so that it doesn't have to be repeated anywhere else throughout the system. It allows one to keep track of the customer's transactions and create agreements between your two organizations.
- **Contracts:** This feature allows an organization or employee to create contracts with all the information about the account, financial data and schedules details. Pricing modes can be automatic or manual. Contracts can include variables such as: operation start and end date & time, region, destination, vehicle count and schedule type, stops and pickup dates & times.
- **Rental Agreements:** This feature allows one to create rental agreements for customers, using their account information. Here it can be specified of the various financials, payments, schedules, and relevant personnel.

- **Reservations and Quotations:** Reservations & Quotations are virtual rental agreements given to customers with no commitment and doesn't go to finance. Reservations and quotations can be converted to rental agreement after approval.
- **Payments & Payments Return:** This feature allows an employee to create payments, or return payments, through selecting the account code and payment method from predefined methods.
- **Dispatching:** Dispatchers are be able to dispatch a contract trip service, rental agreement trip service, and unplanned trips.
- **Invoices and Billing:** Financial and accounting teams within an organization are constantly struggling with the large number of invoices and financial documents coming from many different revenue streams. This usually results in billing and invoice errors. The Invoice and Billing management software turns those financial operations into an advantage, rather than a nuisance, by providing a fully integrated workflow and a flexible billing platform. Performing financial audits and billing customers will be streamlined and nearly automatic, organized to its utmost potential.

Postal Service Logistics and distribution case Study

In support of the Postal Service strategic direction, as described in Ensuring a Viable Postal Service, 2010, the Business Mail Entry and Payment Technology Organization (BME/PT) is providing documentation and Business Process Reengineering (BPR) for the Business Mail Acceptance (BMA) business process. The BME/PT goals are to identify changes to Business Mail Acceptance that will increase mail acceptance and verification effectiveness, improve operational efficiencies, reduce operational costs, generate revenues, and increase customer service.

With decreasing volumes and increasing delivery points, it is critical that acceptance and verification inefficiencies be minimized or eliminated. In support of this goal, this document identifies and analyzes acceptance office functional customer support operations for business mailing products and services.

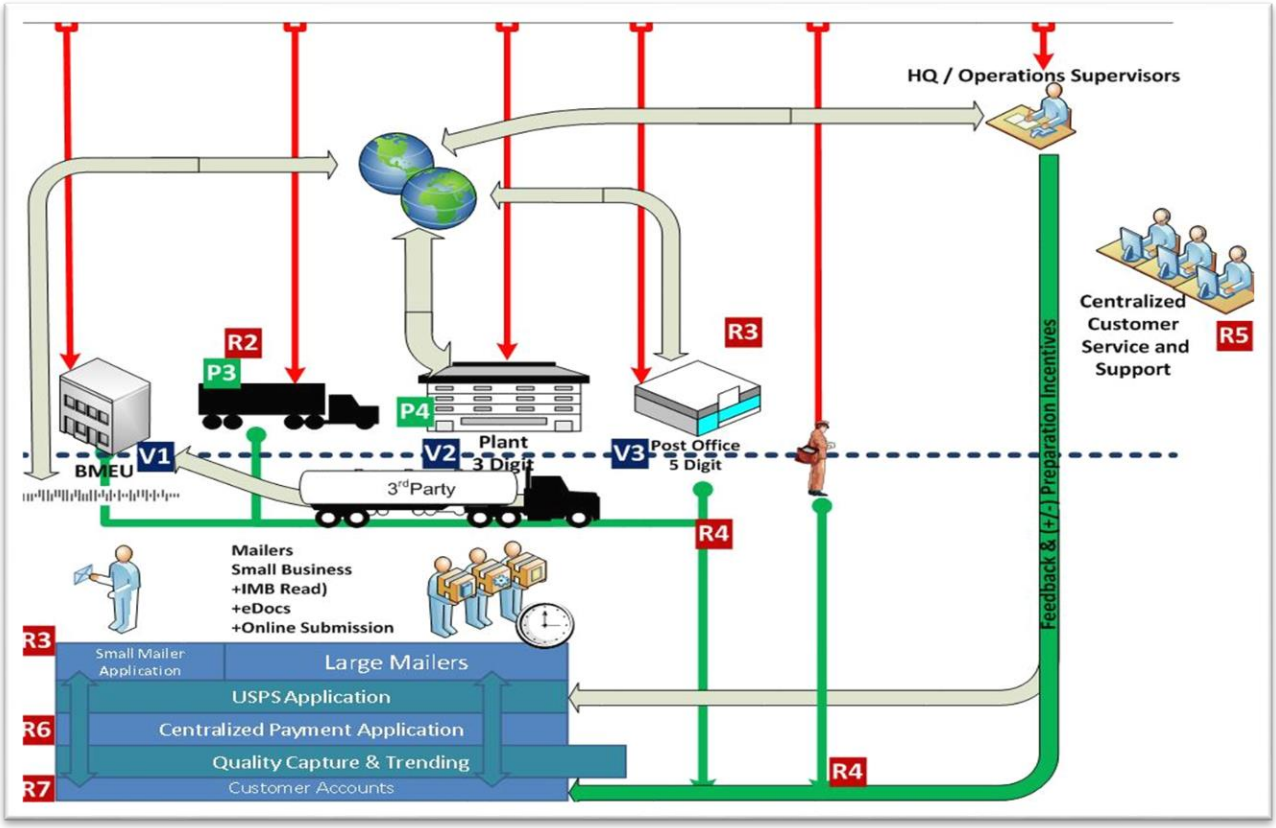


Figure 45: Bulk Mail Enterprise

Postal service utilized latest technologies as to capture and optimize the arrival times for truckers as they have used their own fleet and subcontracted fleets. Postal services have to implement value stream mapping, and feed all the information to smart systems, to ensure fulfillment of customer needs and demands. Here, they have had to use automation and smart tools to implement network optimization. In the logistical sense, network optimization is where there is

heavy customer density that is allocated from actual data that needs to be served and the distance to be driven from other areas with lower coverage. All data points collected from the field are to be mapped in from the value stream mapping tools (VSM), then those data paints collected are drawn on density mapping, or heat maps, as to represent the served areas versus demand areas.

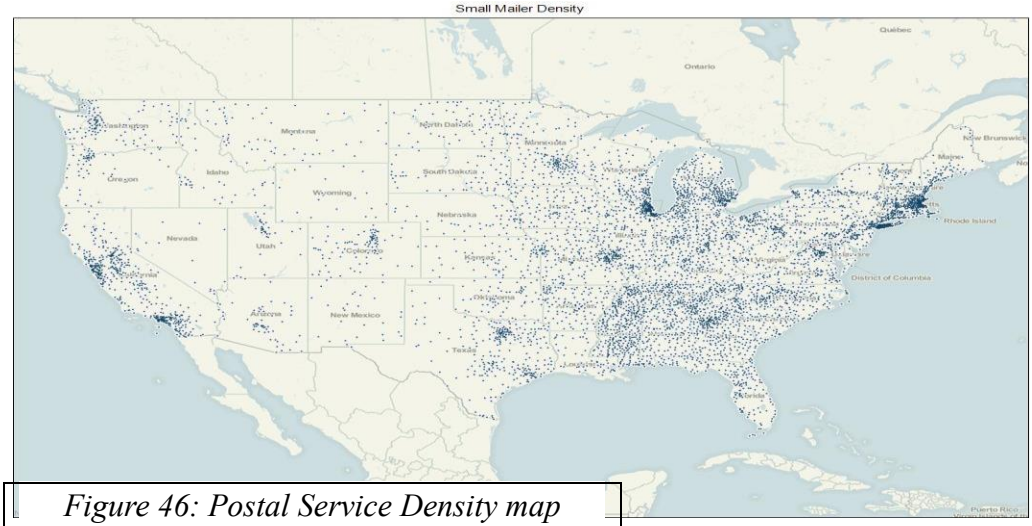


Figure 46: Postal Service Density map

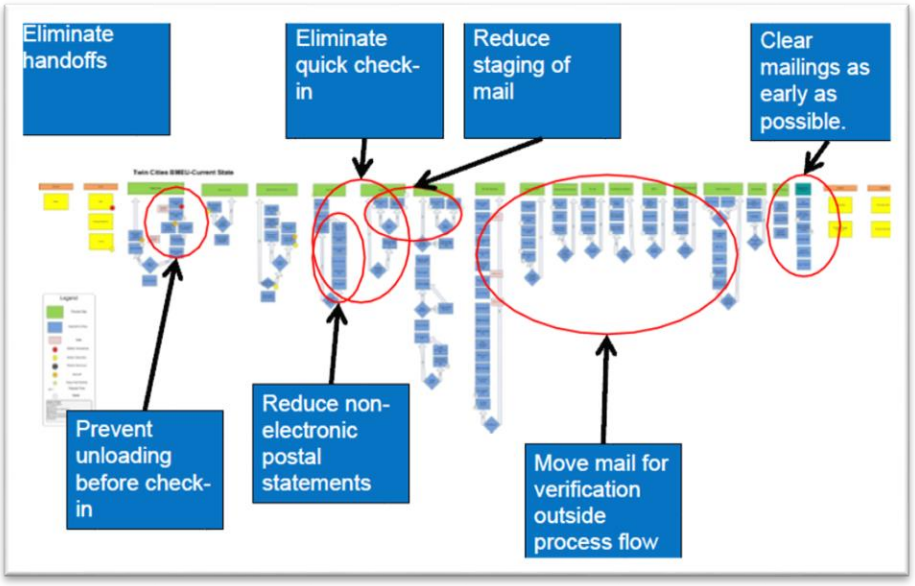


Figure 47: Value Stream Map

Product Distribution (News Papers) Use Case

Another use case in Saudi Arabia proves the dilemma of critical time window distribution. Newspapers must be distributed before 8:00 am country wide. The historical

solution was to keep increasing the fleet size, however, the biggest cost to the organization was the size of the fleet that would become idle around 10:00 am. After installing IOT and smart tools on their vehicles, what was captured on a density map (indicated in the figure below for 2 routes) revealed the inefficiencies of the planned manual routes.

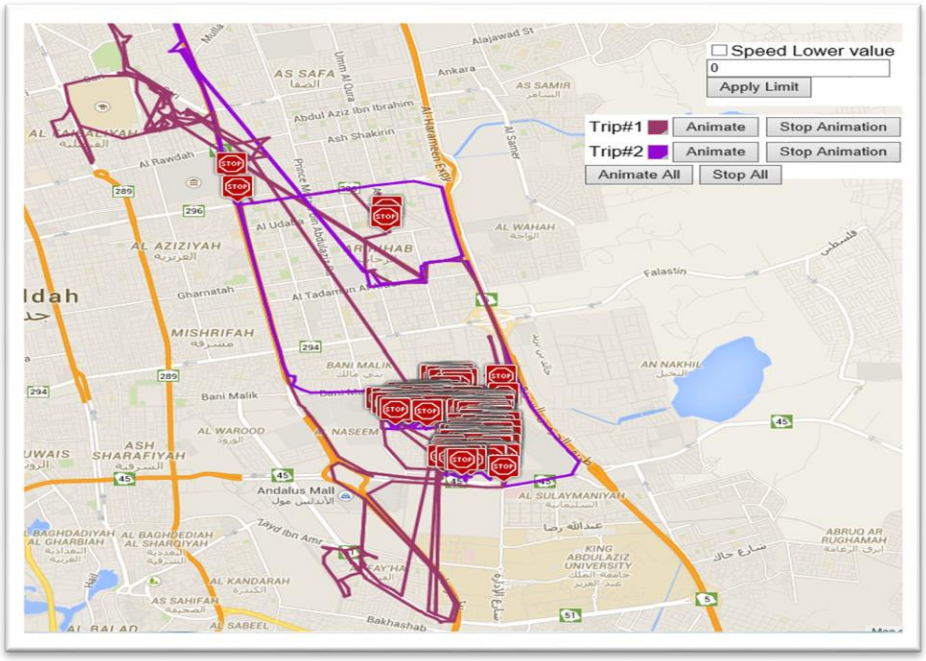


Figure 48: Bad Distribution Example

The company had asked AHCC and the expertise of the ILS team to install smart distribution tools and route optimization. They requested optimized routes that are simple, where all pickups and drop off are sorted in an order where the driver does not have to go back in a street twice and all drop off points are captured for continuous improvements. The result of the case study is recommendation for the organization to utilize the fleet for other means of distribution such as food products, advertising, and books.

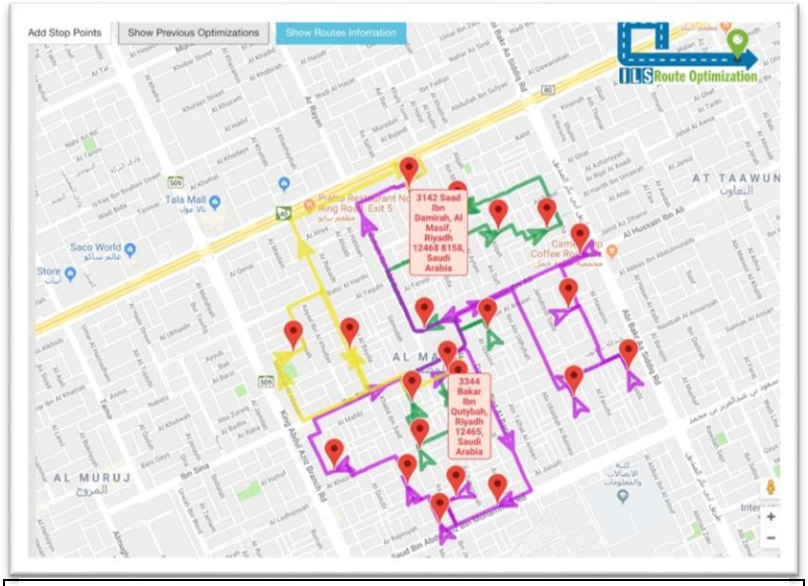


Figure 49: AHCC ILS route Optimization

Egyptian National Railway Use Case Study

The Egyptian National Railways (ENR) and equipment for a Rail Cargo Sales Management (RCSM) Solution desired a way to improve cargo operational efficiency which could be fully accomplished with a single customized solution by solution providers. AHCC configured its suite of shelf products to implement a customer-focused solution that will streamline planning and sales activities, improve on and increase service delivery, and position ENR as a competitive freight transport operator. In this case, however, the train routes are pre-determined. Due to the different locomotive capacities, and type of Rail cars it complicated the matter. Rail cars have the following types:

Figure 50: Railways IOT Automation tools

- Autorack.
- Boxcar.
- Centerbeam.
- Covered Hopper.
- Coil Car.
- Flatcar.
- Gondola.
- Intermodal Equipment.
- Flatbed

Which is determined by the type of cargo. With these various rail cars types, paired with limited routs (train tracks), the demand had to be determined accurately, and planned accordingly. Many other factors play in the fulfillment of cargo management such as locomotive maintenance track maintenance, accidents, seasonal demands, political demands, and even some critical livelihood

cargos such as wheat or oil. Contributed with other negating factors such as weather, fluctuating demands, inspection, trained driver, and sick leaves by employees, the previously done manual system had become heavily convoluted and inefficient.

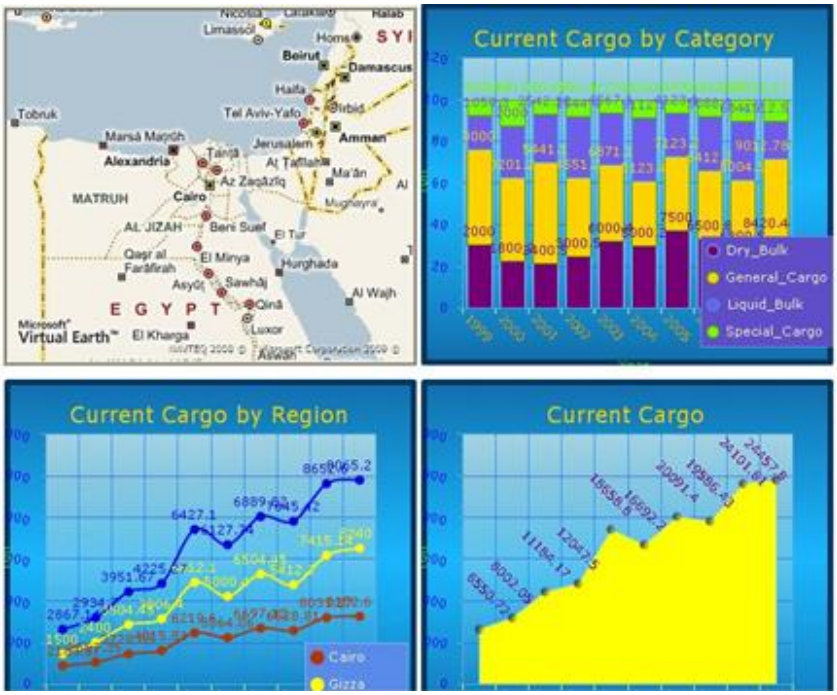


Figure 51: Demand / Supply Forecasts with AI

Conclusion

It is generally agreed upon that automating any part of a business reduces costs in the long term, makes operations more efficient, optimizes the use of resources, increases compliance, and overall increases revenue both directly and indirectly.

It is certain that AI has been moving at an exponential rate in recent years. AI has created the value chain for the supply chain management and persuading the corporate revenue growth and cost savings in current industries. Companies are using multiple kind of applications in their daily operations. Even the use of Chat-bots has been found highly effective in procurement.

Predictive capabilities are enhancing the demand forecasting. Operational costs are reduced with the use of it. In this modern era, smart warehouses are becoming the special need for the effective supply chain management activities. The companies are increasing revenue due to automated warehouses. Data collection and inventory process is being improved with the adoption of AI technologies. For strengthening the logistics process, genetic algorithms can be used which are improving delivery times and reducing costs. AI is helpful in the identification and solving of big problems in supply chain management. The study shows that the embracing of other AI technologies and machine learning offers new perceptions into a wide range of aspects, comprising warehouse management and logistics, collaboration, and supply chain management. Intelligent robotic sorting and AI-powered visual inspection have brought great facilities in supply chain management. (Chen, 2004)

At the Operational level, the use of AI in SCM can provide:

- Optimization and greater dynamicity in the traceability of transport routes (both in the internal scope of the company in its inbound and outbound material flows);
- Improved quality management of products/processes and inventory management by using, for example, new methods of object detection/recognition of visual patterns;
- More precise demand management through the continuous use of Machine Learning algorithms;
- Improved monitoring and visibility of the operations carried out in the supply chain, allowing decision making and optimizations much more dynamic;
- Improved shop floor scheduling and control, allowing more dynamic, broad, and optimized operations management;

- Improved predictive management of assets, maximizing its use and avoiding interruptions in supply chains due to the shutdown of machines and equipment. (AGUEZZOUL, 2019)

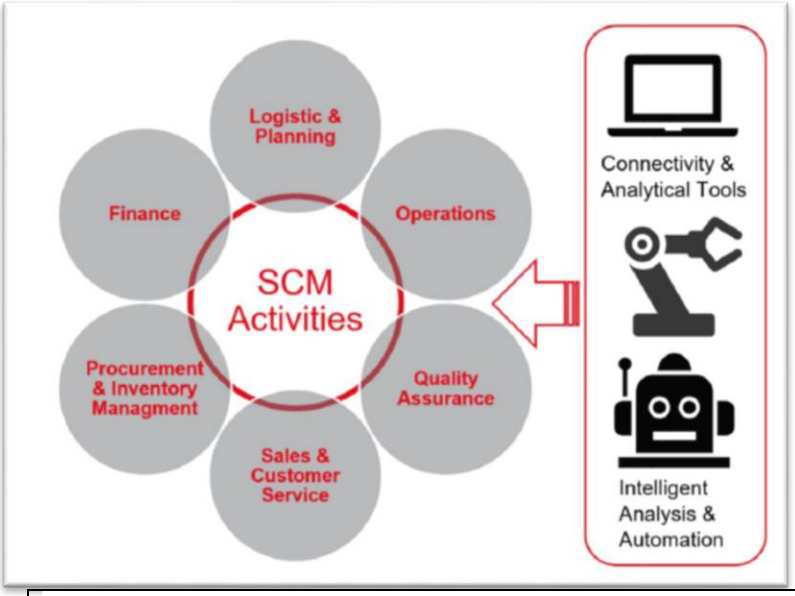


Figure 52: End-to-end supply chain management activities with the potential AI Tools (Andersen", 2018)

The intensive use of the ML-technology (Machine Learning) currently lays the groundwork for fundamental changes in the way managers will organize the flow of goods across the SC (ACCENTURE, 2017). Especially the transparency at each stage of the chain will increase massively through fast evaluation of data and reliable forecasts. This will constantly lead to a proactive SCM in warehouses, on the road, and in the store, and has the potential to significantly reduce logistic costs and shipping times. The connection of various applications in one integrated infrastructure, instead of independently working algorithms in one stage of the SC, will be the standard in mainly all industries according to the data scientist from Porsche AG. Innovative approaches to bridging the last mile will allow retailers to provide even better customer service and new shopping models. To do justice to this expectation, the companies will have to increase

the autonomy of the algorithms and will constantly look for a close linking of deep learning algorithms with data collecting tools like sensors, voice and image recognition. (Hoppe, 2019)

Chapter 5: Factory Automation Towards Industry 4.0

Industry 4.0, the current movement of intelligent automation and collection of data in manufacturing, will bring reflective changes to our society, including an important digital shift in the manufacturing sector. At present, several manufacturing firms are trying to adopt the practices of industry 4.0 throughout their supply chain. The Fourth Industrial Revolution and artificial intelligence at its core are fundamentally changing the way we live, work and interact as citizens. The complexity of this transformation may look overwhelming and to many threatening (Dagnaw, 2020)

The global industries have gone through multiple revolutions. The first revolution was the mechanization with water and steam power, followed by the second revolution involving mass production assembly lines and electricity. The third revolution heralded the beginning of computer

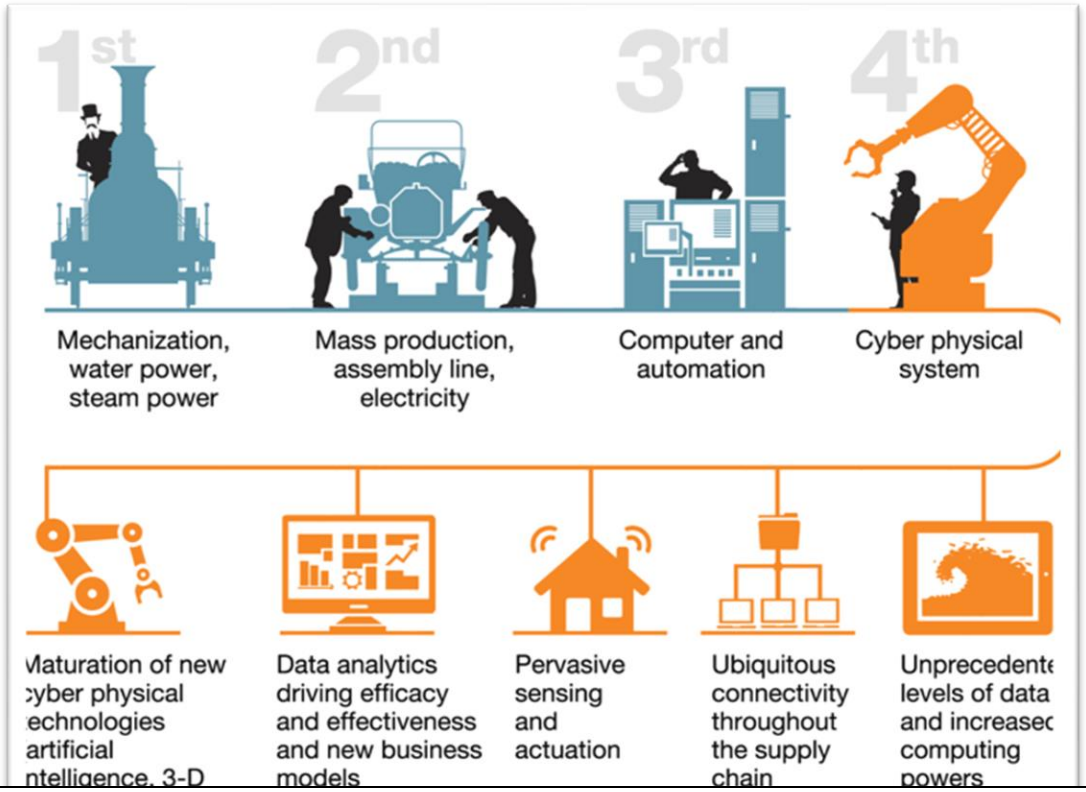


Figure 53: Revolutions of Industries (World Economic Forum - McKinsey & Company, 2019)

automation. Finally, the ongoing fourth revolution is the Cyber physical systems, where the future of smart factories comes into major play.

Most of the current global manufacturers range between the 2nd 3rd revolution, with only the minority mass manufacturers starting to trend towards the 4^{th}.. Since the first industrial revolution, technology has been changing the nature of work, and the impact of AI in this domain is arguably significant. It is estimated that 47% of jobs in the USA, and a higher percentage in developing countries, will be at risk with AI advancements. The growing concerns on this topic put it in the spotlight of the 2016 World Economic Forum. However, the impacts of AI progress go beyond the changes in the nature of work, but also regarding the economic mechanisms and business models. (Bellini, 2018)

Another related discussion involving AI is how companies will be affected depending on their abilities to understand, adopt, and benefit from the technological advances. In this sense, established companies often struggle to adapt their business models to new economic mechanisms (Loebbecke & Picot, 2015). For example, many players in a variety of industries suffered to adapt to the Internet, among them the traditional retail sector, which is still facing losses and adaptation costs. In the USA alone, 57 chains, including originally large entities like Sears and Toys'R'Us, filed Chapter 11 bankruptcy protections since 2015. However, some thinkers see this as just the beginning of the retail apocalypse, with AI potentially being the key driver of the new organizational model (Bellini, 2018)

Artificial Intelligence Opportunities & Challenges in Businesses

Artificial Intelligence (AI) is a key driver of the Fourth Industrial Revolution. Its effect can be seen in homes, businesses, and even public spaces. In its embodied form of robots, it will soon be driving cars, stocking warehouses and caring for the young and elderly. AI holds the promise of solving some of society's most pressing issues, but also presents challenges such as inscrutable "black box" algorithms, unethical use of data, and potential job displacement. As rapid advances in machine learning (ML) increase the scope and scale of AI's deployment across all aspects of daily life, and as the technology can learn and change on its own, multitasked holder collaboration is required to optimize accountability, transparency, privacy, and impartiality to create trust. The automation platforms bring together key stakeholders from the public and private sectors to co design and test policy frameworks that accelerate the benefits and mitigate the risks of AI and ML (Dagnaw, 2020)

Application of AI for smart industry

In the nearing future of Industry 4.0, smart factories using additive manufacturing such as 3D printing through selective laser sintering and other computer-driven manufacturing systems are able to adaptively manufacture parts on demand, direct from digital designs. Sensors keep track of needed components and order them based on patterns of demand and other algorithmic decision trees, taking "just-in-time" manufacturing to a new level of optimization. Optical sensors and machine-learning-driven systems monitor the quality of components with more consistency and accuracy than potentially tired and bored humans on the product line. Industrial robots work in synchronization with the humans, handling more delicate tasks, or can replace them entirely. Entire supply chains can pivot with the introduction of new products, changes in consumption, and

economic fluctuation. The machines can even tell humans when the machines need to be fixed before they even break, or tell people better ways to organize the line, all because of artificial intelligence processing the massive amounts of data generated by the manufacturing process. (Dagnaw, 2020)

3D Printing

Regular finished goods pass through several steps in the supply chain, usually being stored in warehouses before delivery to stores, or directly to the end-customer once an order has been placed. 3D printing, in contrast, can greatly reduce complexity in manufacturing and holds several additional advantages over conventional production techniques . A major benefit of 3D printing is the ability to produce a variety of products from a single 3D printer. This reduces the number of steps in the production chain, essentially enabling companies to leverage on-demand and decentralized production concepts. As a result, potentially significant economic savings can be made on logistics and production costs (Dr. Markus Kückelhaus, 2016)

3D Printing Benefits

3D printing brings about numerous benefits. One of the initial benefits is the lower number of production steps to design, prototype, and manufacture highly complex and/or customized products. It also allows for faster delivery time through on-demand and decentralized production strategie, lower logistics and production costs (e.g., reduced shipping and storage costs, potential elimination of import/export costs through localized production, elimination of new production tools and molds and costly modifications to factories), higher sustainability, and even efficiency

in production through using the least amount of material and energy in production. (Dr. Markus Kückelhaus, 2016)

Robotics Systems with AI and Industry 4.0

Most traditional industrial robots are programmed with teaching. Programming of industrial robots for complex tasks does not meet the requirements. For this reason, it is necessary to increase the capacity of the robots to make their own decisions in real time by being equipped with sensors. With the application of AI in industrial robots, robots have gained the ability to move autonomously. Industrial robots can create their own task planning and processing sequence with AI (Elmaraghy, 1987) Industry 4.0 will lead to improvements in the field of production and innovation by increasing the effectiveness of robotic systems. The factories of the future will provide raw materials and production line communication with the I4.0. In the future, smart factories with I4.0 and robotics systems will be established, and productivity will increase (Otles, 2019) Digitalization will be increased by establishing human robot interaction with I4.0. Humans and robots will share and analyze information using big data and cloud systems. (McKinsey., 2015) In addition, artificial intelligence-equipped robots will be in human form. Although humanoid robots can be used as a guide in some airports and serve as waiters in bars, they will probably come into our lives as individuals who may think and decide in the future (Linert, 2018) In the future, industrial robots will be able to perform complex operations by controlling them with AI, and robots will make every stage of production. The robots will decide on their own, and will be involved in all areas from raw material input to product output. Robots using AI according to the data they collect with sensors will manage their own job descriptions, concepts such as processing time, and sequence. (Dr. Hasan DEMİR - Dr. Filiz SARI, 2020)

Decentralized and on-demand manufacturing

The ability to produce complex objects autonomously in a remote environment is highly sought after by resource extraction companies, space agencies, and the military alike. First working applications exist, and many more are being developed and field tested. 3D printing can be used to bring manufacturing to remote, hard-to-access areas. In 2014 the US Navy installed 3D printers on the USS Essex to train sailors to print needed spare parts and weapon components, reducing lead time and enabling access to critical parts in remote situations. Another experimental project by the US Navy is the concept of 3D printing drones 'on demand' on board ocean-going vessels. The idea is that a ship would leave port already carrying a small number of electrical components and parts common to most drone designs. Then, depending on any given need – e.g., surveillance or intelligence – the sailors would be able to print and assemble the required drones themselves. (Dr. Markus Kückelhaus, 2016)

Adaptive manufacturing.

Today's customers demand products customized to their needs or taste. AI technologies are the key to making today's rigid manufacturing and assembly line processes more flexible and able to adapt to changing demands quickly, and with far less human intervention using human-robot collaboration. For some tasks, humans can't be replaced. The ability for humans and robots to work together is likely to be a key requirement for adaptive manufacturing. In current factories, manufacturing robots can be a physical threat to human workers, and are often isolated using cages or other barriers to prevent accidents. Artificial intelligence and improved sensing capabilities will

enable new or updated robots to work more closely with humans, quickly learning new tasks as needs change and making the whole process more adaptive. (Nutanix, 2018)

Figure 54: adapted intelligent and flexible approach (Dagnaw, 2020)

Industry 4.0 Value

The value drivers to move to the fourth level of automation are:

- Big data decision-making
- Democratized technology on the shop floor
- Agile working models

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- Minimal incremental cost to add use-cases
- New business models

The four scale-up enablers are:

- Fourth Industrial Revolution strategy and business case
- IoT architecture built for scale-up
- Capability-building through acquiring new skills
- Workforce engagement (World Economic Forum - McKinsey & Company, 2019)

Figure 55: Impact of Fourth Industrial Revolution use-cases on select KPIs in lighthouse factories (World Economic Forum - McKinsey & Company, 2019)

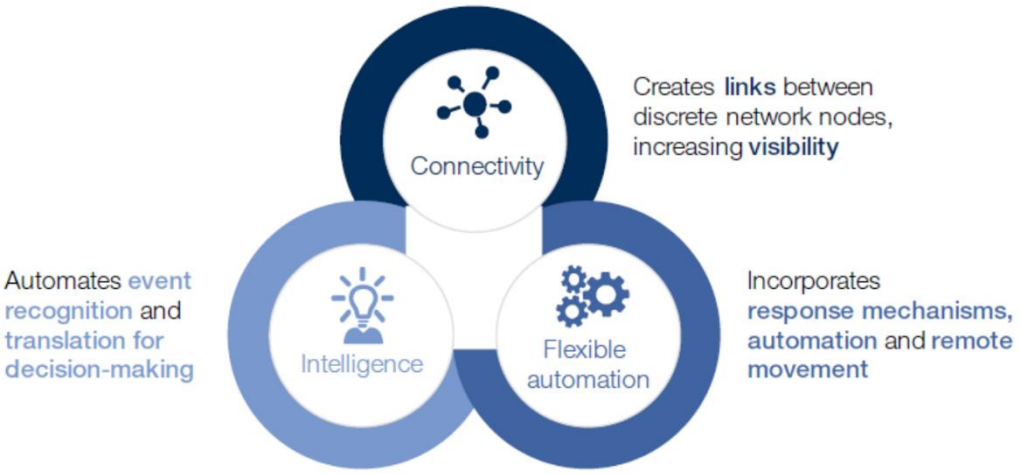

Figure 56: Key technology megatrends transforming production (World Economic Forum - McKinsey & Company, 2019)

In an increasingly digital world, companies are justified in being concerned about their proprietary systems and technology. However, lighthouses (premium leading market manufacturers) recognize that the benefits of transparency and growth opportunities far surpass the potential for competitive threats. By developing good IP and cybersecurity policies and protocols, lighthouses have managed to maintain effective security to mitigate risk while enabling collaboration. Not only do they open their doors to close partners, but they also welcome thousands of visitors per year.

Benefits of the Fourth Industrial revolution

Innovation experience showcases the kind of substantial impact that can be achieved by a lighthouse facility embracing Fourth Industrial Revolution approaches and technology. In three years:

- Productivity has increased by 160%.
- Customer satisfaction has increased by 116%.

- Customer complaints have been reduced by 63%.
- Full plant cost has been reduced by 20%.
- Inventory has been reduced by 43%.
- Off-quality products have been reduced by 42%.
- Time for changeover has been reduced by 36%. (World Economic Forum - McKinsey & Company, 2019)

Manufacturing Automation challenges

Manufacturing does not come without its challenges. Of some of these are:

- Choosing solutions. Automation products and solutions are evolving quickly, with new vendors threatening to disrupt the market. Navigating a rapidly changing landscape presents risks along with opportunities.
- Incorporating legacy equipment. It does not make sense to discard automation equipment that is already in place and start over. Instead, figure out how to update existing equipment, or add new solutions that complement existing automation.
- Cost. Succeeding with automation may require big investments in new hardware and software. Those expenses can extend beyond sensors and tooling to include upgrades to IT infrastructure or incorporation of cloud technologies.
- Skill sets. Successful automation projects will require new skill sets that ideally include IoT and AI (as described in the previous chapters). Because skills are in high demand, you will have to hire people with experience where you can, train existing staff where possible, and partner with vendors that can fill the gaps in specific disciplines. (Nutanix, 2018)

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As in the figure below, to achieve industry 4.0 one must somehow achieve some, or all, components to receive the benefit of the overall automation inherent in Industry 4.0

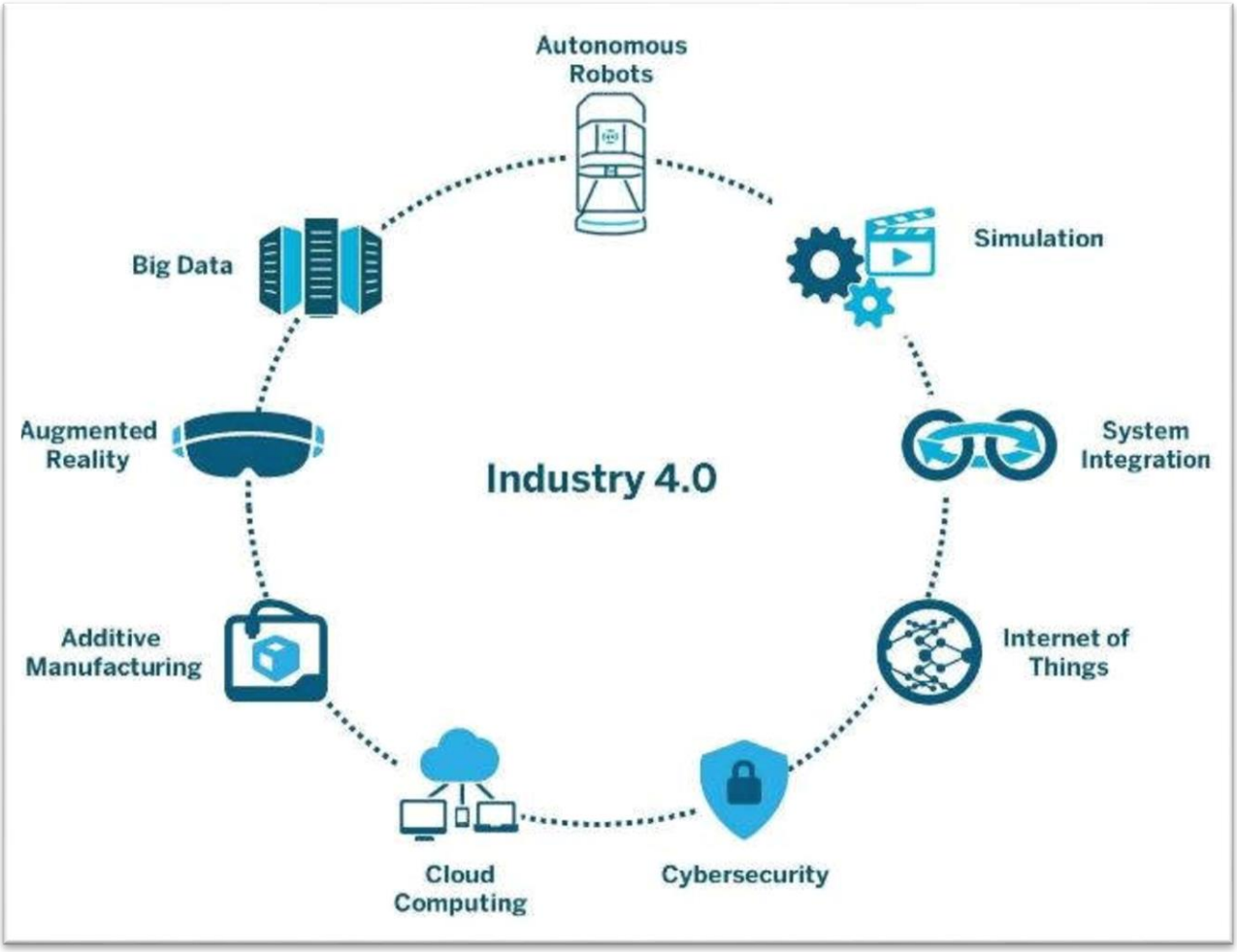

Figure 57: The Schematic Representation of Industry 4.0 (Dr. Hasan DEMİR - Dr. Filiz SARI, 2020)

Artificial Intelligence Challenges in Industrial Automation

Some of the AI challenges that become present with industrial automation are:

- Machine-to-machine interactions

- Data quality: AI algorithms require massive and clean data sets with minimum biases. By learning from inaccurate or inadequate data sets, the downstream results can be flawed.
- Cybersecurity: The increasing use of connected technologies makes the smart manufacturing system vulnerable to cyber risks. Currently, the scale of this vulnerability is under-appreciated and the industry is not prepared for the security threats that exist (Jay Lee, 2018)

Conclusion

The Manufacturer's Annual Manufacturing Report 2018 found that 92% of senior manufacturing executives believe that "Smart Factory" digital technologies – including artificial intelligence – will enable them to increase their productivity levels and empower staff to work smarter (Nutanix, 2018)

Smart manufacturing is critical in improving the quality of the process industry. In smart manufacturing, there is a trend to incorporate different kinds of new-generation information technologies into process-safety analysis. At present, green manufacturing is facing major obstacles related to safety management, due to the usage of large amounts of hazardous chemicals, resulting in spatial homogeneity of chemical industrial processes, and increasingly stringent safety and environmental regulations. Emerging information technologies such as artificial intelligence (AI) are quite promising as a means of overcoming these difficulties. Based on intelligent and flexible AI methods, and the complex safety relations in the process industry, one can identify and discuss several technical challenges associated with process safety: knowledge acquisition with

scarce labels for process safety, knowledge-based reasoning for process safety, accurate fusion of heterogeneous data from various sources, and effective learning for dynamic risk assessment and aided decision-making. Current and future works are also discussed in this context. Embracing ‘Industry 4.0’, makes it possible to assemble and analyze data across machines, enabling rapid, more flexible and more efficient processes to produce higher-quality goods at minimum possible costs. This manufacturing revolution will undoubtedly boost productivity, shift economics, promote industrial growth, and reshape the profile of the workforce eventually shifting the competitiveness of companies and regions. (Dagnaw, 2020)

Chapter 6: Agriculture and AI

Across the globe, farming has always maintained an unequivocal aspect of daily life. Farming has always been manual, but with the rise of new technologies, can adapt and benefit from intelligent solutions powered by Artificial Intelligence. Globally, AI solutions enable smart irrigation, precision farming, intelligent processing, automated pest surveillance, secure storage, distribution analysis, and consumption analytics of agricultural products. The implementation of artificial intelligence in agriculture has been used more effectively for post-harvest productions, minimizing the wastage, and simplifying the transportation of output products and other related goods. Implementation of AI in agriculture could also be boosted by other advanced technologies such as big data analytics, internet of things, sensors, cameras, drones and satellite images. From the analysis of various data sources, such as weather data, temperature, soil analysis, moisture and growth characteristics of a crop, AI technologies will be able to predict highly accurate crop insights, and will also provide historical analysis of particular crop for particular region, time. (I.M. Bhar, 2019) According to the UN Food and Agriculture Organization, the population will increase by 2 billion by 2050. However, only 4% additional land will come under cultivation by then. In this context, use of latest technological solutions to make farming more efficient to keep up with the increasing demands remains one of the greatest imperatives. While Artificial Intelligence (AI) sees a lot of direct application across sectors, it can also bring a paradigm shift in how we see farming today. AI-powered solutions will not only enable farmers to do more with less, it will also improve quality, and ensure faster go-to-market for crops. AI can change the agriculture landscape, the application of drone-based image processing techniques, precision farming landscape, the future of agriculture and the challenges ahead. (Bagchi, 2000)

Over the past 50 years, there has been a sustainable development in artificial intelligence due to its robustness in its applications, and it has become pervasive in every field. Agriculture faces many challenges daily and is not a smooth-running nor cut-and-dry business. Some of the main problems faced by farmers range from the steps of seed sowing to the harvesting of crops are as follows:

1. Crop diseases infestations
2. Lack of storage management.
3. Pesticide control
4. Weed management
5. Lack of irrigation and drainage facilities (Kirtan Jha, 2019)

Agricultural Crop Predictor and Advisor using Artificial Neural Network (ANN)

Agriculture is one of the most important streams based on which a country's economy, and livelihood, is decided. However, today we see that the sector of agriculture is gradually coming down. One of the drastic factors for that decrease is the "Crop Loss", where many cases of crop loss is due to the illiteracy in reading the land condition of the farmers. Hence to resolve this problem, a system has been proposed which guides the farmers to understand the status of the land, and to make them aware of the crops that could benefit them. This proposed system uses the Artificial Neural Network, which is one of the most effective tools in modeling and prediction. There are various parameters that decide the crop productivity. These parameters are considered as the input for the proposed system and based on the manipulation with these inputs, the desired output must be produced. The parameters include pH, phosphate, potassium, nitrogen, depth, temperature, rainfall. Also, the proposed system suggests some fertilizers that could improve the

productivity. Since the system developed should be portable and easy to be used by a common man, the system is developed as an Android Application, which could be installed in a Smart Phone and could be easily checked out. The overall accuracy of the proposed prediction system is 90%. (Giritharan Ravichandran, 2016)

Global Challenges

Data Science and Big Data analytics along with AI technologies enables the most accurate predictions for the farming community. International statistical institutions, as well as research and development centers, are already working on various data resources. The challenge in Research & Development to use Artificial Intelligence in Agriculture can make wonderful outcomes

Major challenges of the agricultural sector include:

1. Deficient demand prediction.
2. Lack of guaranteed irrigation.
3. Maltreatment of pesticides and misuse of fertilizers.
4. Crop yield improvement using real time advisory systems.
5. Prior detection of pest attacks.
6. Crop damage detection and analysis.
7. Prediction of markets for best crop practices.
8. Weed control and Weed -Crop discrimination. (I.M. Bhar, 2019)

Water as Challenge

There is a major problem of water wastage and a scarcity of water in conventional irrigation methods employed. To give an example, Egypt faces a problem of water distribution

from the Nile river with neighboring countries. Ample research had been carried out to solve the problems faced in the irrigation process. Many companies have developed a sensor-based smart irrigation system. These systems have been developed for optimal water usage, monitoring of water pollution, and to take care of some other grave problems. Soil moisture and temperature sensors interact directly with embedded components in the field and take care of required water distribution among crops without farmer's interaction. Water which is to be fed to the farms, either by the means of smart irrigation or any other conventional method, should be of a good quality. Researchers have started implementing IOT systems and Artificial intelligence techniques in aquaculture sector along with agriculture. (Kirtan Jha, 2019)

Agriculture is seeing rapid adoption of Artificial Intelligence (AI) and Machine Learning (ML) both in terms of agricultural products and in-field farming techniques. Cognitive computing in particular is set to become the most profound technology in the agriculture services as it can understand, learn, and respond to different situations (based on learning) to increase efficiency. Providing some of these solutions as a service like chatbot or other conversational platform to all the farmers will help them keep pace with technological advancements as well as apply the same in their daily farming to reap the benefits of this service. (Bagchi, 2000)

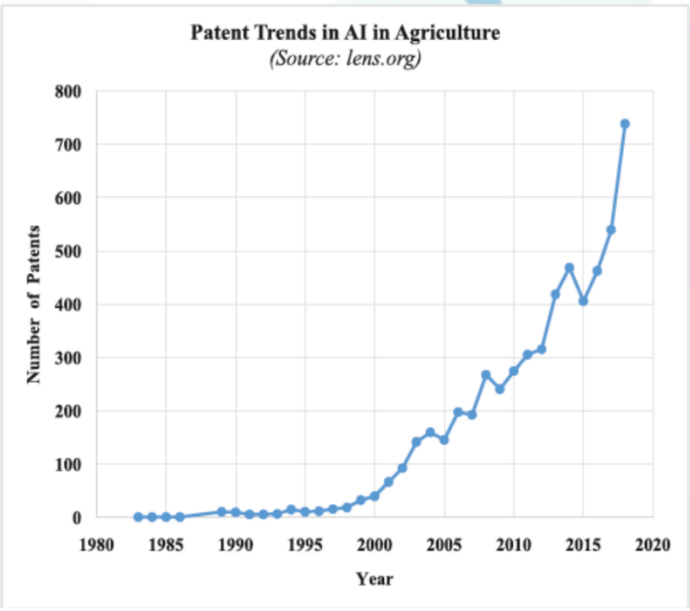

Figure 58: Patent Application Trends in AI in Agriculture

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(I.M. Bhar, 2019)

Sensors Driven AI-Based Agriculture

Introduction of the usage of sensors reduces the cost and time involved in assessing the land suitability in the traditional manner. The uses of sensors are plenty, and it is possible to use as many sensors in the field of agriculture. Soil sensors, water sensors, and biosensors are few that have been shown to have a significant role in measuring nature. These sensors contribute to the smart farming system, especially in the handling of appropriate irrigation systems to help farmers. The Radio Frequency Identification (RFID) technology can even be used for the detection of animals entering the farmland to help counter negative consequences from their presence. The Global Positioning System (GPS) position-based seeding recommendation is emerging as another benefit in the field of agriculture benefiting from the latest technological developments

As a revolutionary change, the sensor-driven network has a considerable role in precision agriculture. Timely forecast based on soil parameters will ensure proper irrigation systems. IoT even has a significant role in handling the recorded data from the sensors. (Durai Raj Vincent, 2019)

Precision Farming

The phrase “Right Place, Right Time, Right Product” sums up precision farming. This is a more accurate and controlled technique that replaces the repetitive and labor-intensive part of farming. It also provides guidance about crop rotation, optimum planting and harvesting time, water management, nutrient management, pest attacks and so on.

Key technologies that enable precision farming include:

- High precision positioning system
- Automated steering system
- Geo mapping
- Sensor and remote sensing
- Integrated electronic communication
- Variable rate technology (Bagchi, 2000)

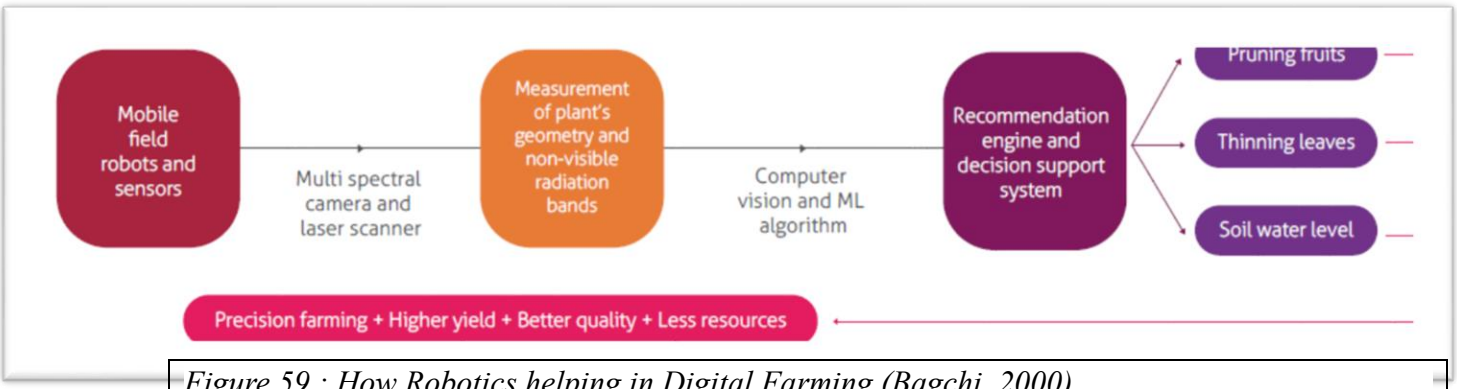

Figure 59 : How Robotics helping in Digital Farming (Bagchi, 2000)

Agriculture monitoring is necessary in reducing human interventions in practice. Day by day demand for food is reaching its high peak as global populations swell, and the without execution of modern methods in agriculture, meeting that increased demand will become impossible. Agricultural monitoring is the prime concern, as it helps to reduce labor, and increase the production. Artificial Intelligence has been implemented in crop selection, and to help the farmer in the selection of the fertilizers. With the help of the database which the user has gathered and specified to the system, the machines communicate amongst themselves to decide which crop is suitable for harvesting, as well as the fertilizers which promote the maximum growth. Deep learning has wide reach, and its application in industry has received tremendous advancement.

Using deep learning is an added advantage over machine learning, and it adds depth to machine learning. (Kirtan Jha, 2019)

Creating "Smart Farms"

Farmers who have adopted Precision Agriculture (PA) techniques are already using some of the most sophisticated spatial technology. Precision sustainable agriculture (PSA), builds on this knowledge, allowing farmers to become active participants in developing agricultural systems and practices. With cloud-based GIS powering it, PSA fosters the development and application of new analytic approaches to farming.

The United States Department of Agriculture is putting PSA to the test with a pilot program in Maryland(USA) that focuses on a community of farmers growing "cover crops," plants cultivated in the off-season to protect the soil. The major components are a sensor network and geographic information system (GIS) software. The sensor network tracks variables like humidity, soil temperature and water levels. Sensor-equipped tractors measure the crops' height, greenness, and biomass. And a weather station gathers data related to wind, rain, and temperature.

"Our goal is to have at least 80 percent of the continuous monitoring data we're collecting in the field transmitted to our cloud and GIS-based infrastructure," says Mike Buser, head of the USDA's Partnerships for Data Innovations (PDI) and National Program Leader for Engineering. "We would collect near-real time data, process the data through a semi-automated quality assurance and quality control software. This system would make the data accessible to the

agricultural community more rapidly, while automatically informing researchers when there are potential in-field sensor problems." (Harman, 2020)

The Cognitive Farm

Advances in AI, and other related technologies, has led to smart farms or farming models with high cognitive ability. This terrain is now characterized by enhancements such as:

Extensive data capture and analysis – farms now can set up, track, and analyze a multitude of data points, thereby helping farmers make better decisions. This boosts information accuracy and aids in decision making. For example, a farm manager can use a drone to scan a large track of land and identify the exact location of plant disease or pest infestation in real time.

Automation and robotics - in order to speed up manual work or manage manpower shortages, robots are used in farm activities such as fruit picking and lettuce thinning among many others. This can lead to productivity gains with minimization of errors, and consistency of work quality.

Predictive analytics – AI tools have been created to predict changes in weather patterns, pest infestation or soil erosion in order to improve planning and farm management. These tools help farmers take a glimpse of the future and assist them in making informed decisions.

Similar to other industries, farms face constraints relating to the use of AI, such as investment costs, compatibility with current tech infrastructure, skills and resource availability, privacy, security, and possible regulatory issues. (Munoz, 2020)

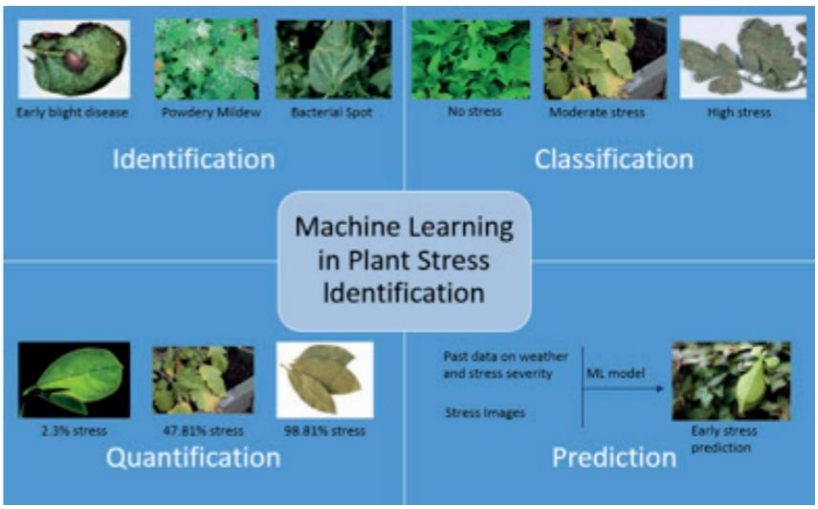

Figure 60: Machine Learning in Plant Stress ID (Munoz, 2020)

Despite these potential constraints, the stage is set for cognitive farms, precision farming, and agricultural intelligence. Farmers are now super-empowered to find the right crop, for the right place and at the right time (Bagchi, 2000)

Table 1: Examples of farming activities and AI companies

Farming Activities	**Examples of AI Companies**
Weed control	Blue River Technology
Harvesting and packaging	Harvest CROO Robotics
Diagnosing pests and soil defects	PEAT
Soil analysis	Trace Genomics
Crop health monitoring	SkySquirrel Technologies
Lettuce thinning	Blue River Technology
Self-driving tractors	Autonomous Tractor Corp
Weather, pests and disease prediction	aWhere

(Munoz, 2020)

Image-based Insight Generation

Precision farming is one of the most discussed areas in farming today. Drone-based images can help with in-depth field analysis, crop monitoring, and the scanning of fields. Computer vision technology, loT, and drone data can be combined to ensure rapid actions by farmers. The drone image data can generate real time alerts to accelerate precision farming. These artificial intelligence systems not only save time and increase safety but also reduce potential human error, while improving effectiveness. Thus, automation, sensors, drones, loT, and solar power aided with AI can provide new opportunities for business entrepreneurs to deliver innovative service solutions at affordable prices to the farmers. (Kirtan Jha, 2019)

Computer Vision

Facial recognition helps dairymen to monitor herd. By using this visual imaging analysis, one can identify how cows eat, where they eat, how long they spend eating, and how cows react to the environment. Since cows can train themselves, one can change how cows feed, drink, or milk. How feed is distributed and how well the feed mixer mixes also makes a difference in feed consumption, as does the feed formulation itself. (Kirtan Jha, 2019)

Drone Utilization

In the system planned for Artificial Intelligence (AI) associated with IOT using drones over the Agricultural lands, drones help to check the current status of the farm lands and sends the information's through image Processing. Drones helps mostly in soil field Analysis, crop Monitoring, health assessment of the crops in the field. This helps the farm lands by all odds. The Artificial Technique helps in progress of the crops. The current status of the crops can be observed

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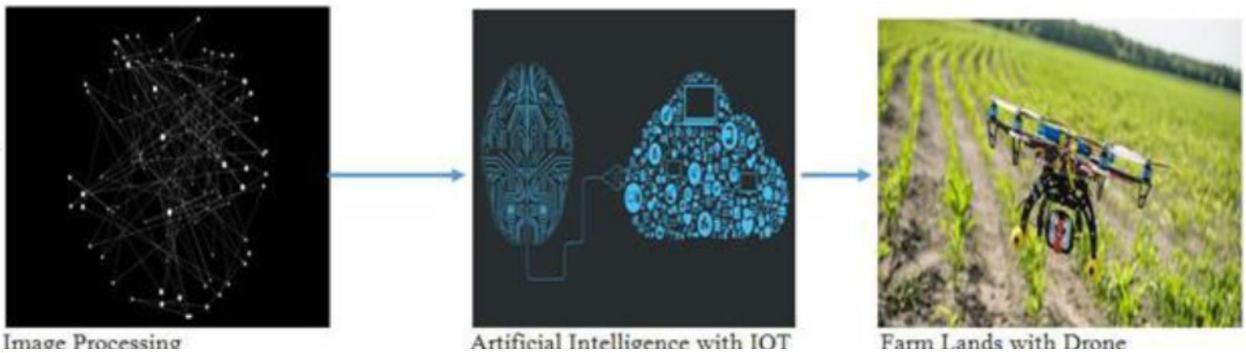


Figure 61: Processing Stages (Niraj Prasad Bhatta, 2019)

through Image Processing Technique. Overall, whole farm lands can be controlled by IOT as indicated in the figure above. Therefore, the plants growing in an unhealthy way can be observed

Figure 62: ESRI Drone & Image Processing for Future Farm (Harman, 2020)

and necessary treatment is automated were required. (Niraj Prasad Bhatta, 2019)

Chapter 7: Smart Cities & Municipalities

As population increases, the demand for high end facilities and comfort goes along with it, and with the new technological innovation and social connectivity through complicated social networking platform, citizens are more informed than ever with the advancements of cities, and how they could live in in advanced societies. Governments and municipalities are faced with higher demanding citizens as to ensure happiness and satisfaction of their wellbeing. Ministers and municipalities are now faced with many dilemmas with increasing population in cities, while maintaining public safety and happiness. Cities are being faced with problems in transportation, parking, licensing, providing utilities, maintain utilities, safety and policing, road protection, building facility management and health issues. Governmental entities and municipalities have had to become like business owners that ensure customer satisfaction as to safeguard the interests and happiness of its citizens, and ensure that all collected taxes and fees are put to the best interest of its citizens.

Smart City: From the Metaphor of Urban Development to Innovative City Management

A “smart city” can be defined as a modern concept of urban development, characterized using digital technology and the significant role of the intellectual capital. Today Barcelona, Stockholm, Amsterdam, Songdo and several other cities are estimated as the successful examples of smart cities, which is largely due to the high level of their technical and social base, as well as the information culture of the population. (Mukhametov, 2019)

It is possible to propose the use of a three-level model of urban benchmarking. The first level consists of sensors, whose function is to collect data. The second level is machine learning

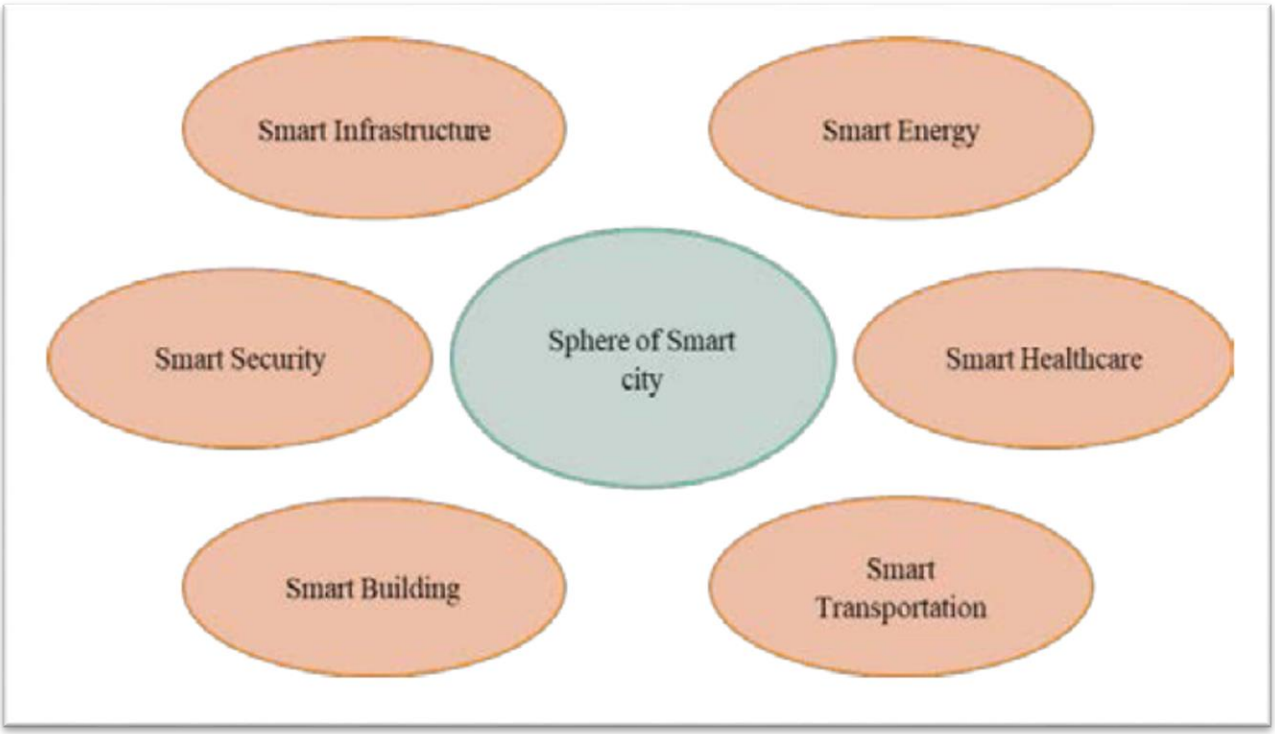


Figure 63: Smart City System (Mukhametov, 2019)

algorithms, which determine behavior patterns and possible trajectories of the changes. The third level is the actuators, with the help of which the impact on the environment is carried out without human involvement. Due to the development of the Internet of Things and artificial intelligence technologies, this model can be implemented to collect and analyze data from various areas of urban economy, as well as to timely response and act to changes in the situation. (Mukhametov, 2019)

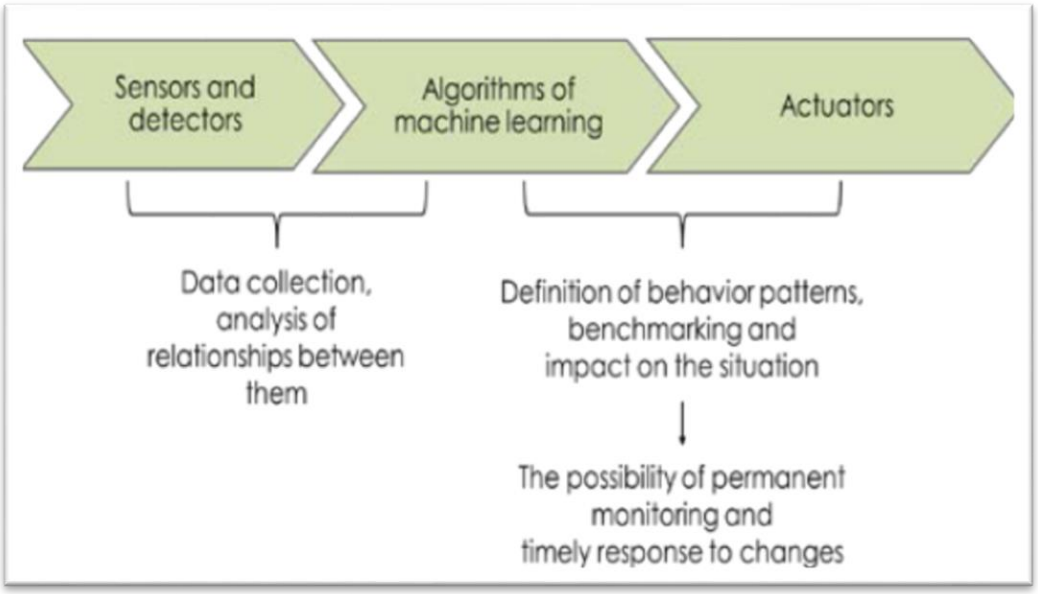


Figure 64:City Benchmarking Model (Mukhametov, 2019)

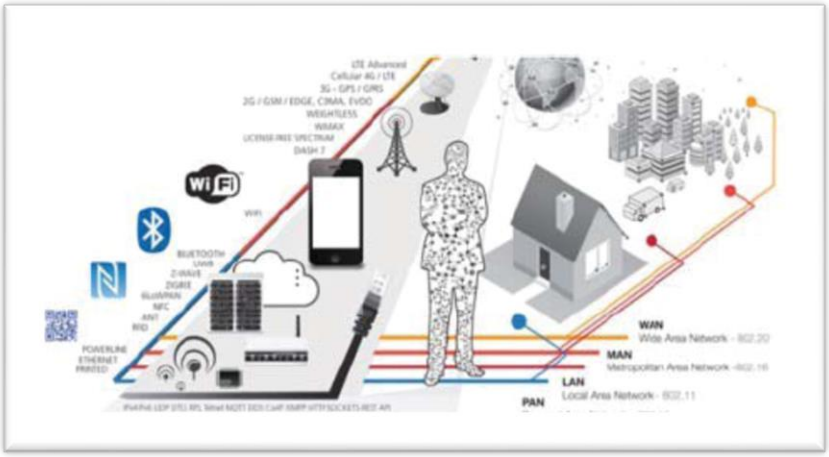
Facility Management

Facility Management (FM) has come a long way in establishing itself as a new business opportunity, particularly with the advancement in IT operations, commercial buildings, and gated community residential buildings. What used to be an on-call basis for operation and maintenance activity in the past has now become a new business opportunity. With the advancement in technology, international competition, and tight budgetary controls, every organization wants to concentrate only on core business activities. That gives the opportunity for FM businesses to grow leaps and bounds. It also calls for seasoned professionals with both technical and soft skills, coupled with the right attitude, for making the business areas more user friendly and likeable by the premise occupants (Shaikh Shamser Ali, September-2020)

Figure 65: Activities of Facility Manager Source: IFMA

Traffic Congestion Reduction in Smart Cities

In an IoT world, sensor enabled objects are connected via the Internet to participate in performing a particular task, mainly by sending and receiving data from one to other. Artificial intelligence empowers agents (the machines or devices) to perceive the surrounding environments that will lead to taking calculative decisions



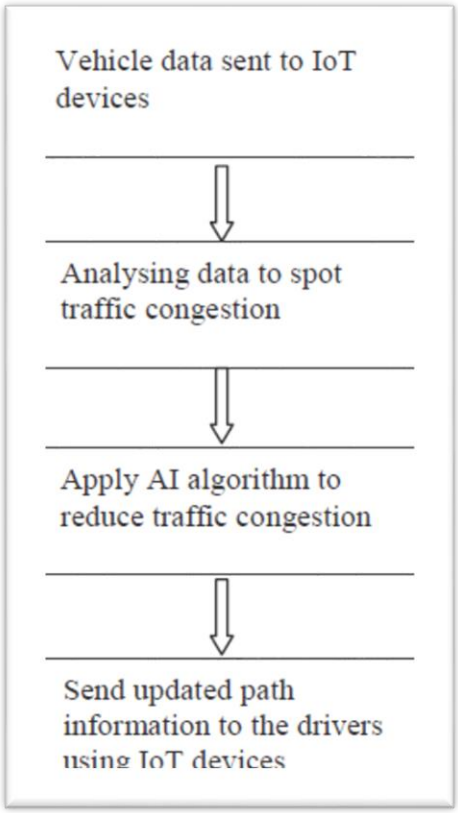


Figure 66: Structure for Traffic Congestion Reduction

Once a congestion is sensed, the system makes use of an algorithm to re-route the cars in a balanced way to bring the traffic back to normal. The IoT devices communicates with systems using various wireless communication systems, including WIFI. Based on the current traffic

congestion scenario, an algorithm calculates the best alternative route, and instructs the drivers accordingly to clear the congestions and reroute traffic. (Safeeullah Soomro-Mahdi H. Miraz-Anupama Prasanth- and Mirza Abdullah, 2018)

Parking Surveillance System with Edge Artificial Intelligence on IoT Devices

Another major issue that is tied with transportation and urban management is parking management and safety management There are two major groups of pipelines in camera-based parking occupancy detection methods. In the first group, binary occupancy classifiers are developed to determine the status (occupied or vacant) of every parking space region in the camera view. The second group applies vehicle detection to localize vehicles in the whole camera view and then determines the status of parking spaces based on the matches of detection results and parking space locations. Both pipelines need a manual labeling process to mark the region of parking spaces. Note that automatic labeling has been attracting some research interests, but still far away from being practicable. (Ruimin Ke - Yifan Zhuang- Ziyuan Pu and Yinhai Wang, 2020)

Figure 67: The enhanced SSD-Mobilenet Detector implemented at the edge of our system has a significantly improved detection performance (Ruimin Ke - Yifan Zhuang- Ziyuan Pu and Yinhai Wang, 2020)

Pavement Management Utilizing Mobile Crowd Sensing (MCS)

Machine Learning method is getting increasingly popular in the field of academic research, and is widely used in automated reasoning and pattern recognition. (Boquan Tian- Yongbo Yuan- Hengyu Zhou - and Zhen Yang, 2020) Utilization of Mobile crowd sensing will reduce cost of the development of monitoring and reporting systems.

Diagnosis of Infection with IPC Implication

Chest radiography is a fundamental component of tuberculosis (TB) screening and diagnosis programs in both community and hospital settings. Improvements in TB detection enable timely instigation of anti-TB therapy and appropriate IPC precautions. AI offers the opportunity to standardize and improve this process, especially in TB-prevalent regions with suboptimal access to radiologists, increasing its' citizens safety, precautionary, and reactive methods to ensure optimal outcome.

Deep learning with convolutional neural networks has been used to classify TB on chest radiography with discrepant results reviewed by a radiologist. This type of process offers opportunities for the developing world and other regions that lack radiology expertise, whereby AI could interpret most investigations with radiologist review of equivocal cases only.

In the clinical microbiology laboratory, machine learning algorithms developed from population genomics could be used to predict infection risks from the genomic features of Staphylococcus epidermidis, and potentially identify high risk genotypes preoperatively to target pre and postoperative preventative programs. AI-enhanced laboratory microscopy could

streamline the rapid diagnosis of patients with infection, and assist AMR prevention programs by facilitating targeted antimicrobial management and IPC intervention. In one proof of concept study, a convolutional neural network (a type of AI used to analyze visual data) was trained to categorize bacteria in blood culture specimens at the gram stain stage with over 90% accuracy (Fidelma Fitzpatrick- Aaron Doherty- Gerard Lacey, 2020)

Wastewater Management:

When creating water waste management classically for a governmental organization, it would take an immense amount time-consuming costly policies and regulations. Some of these considerations are:

- Water consumption
- Rainfall
- Water level in the tank
- Discharge of the tank
- Need for lawn irrigation
- Discharge of water from the toilet
- Supply of greywater to the tank
- Consumption of greywater in the tank
- Drainage of greywater
- Draining the water into the infiltration or drainage system

Therefore, if governments were to use the means of artificial intelligence represented by the fuzzy cognitive map, they could streamline the process. The proposed fuzzy cognitive map for the making of a water management decision system is depicted in figure below (Markovič, 2018)

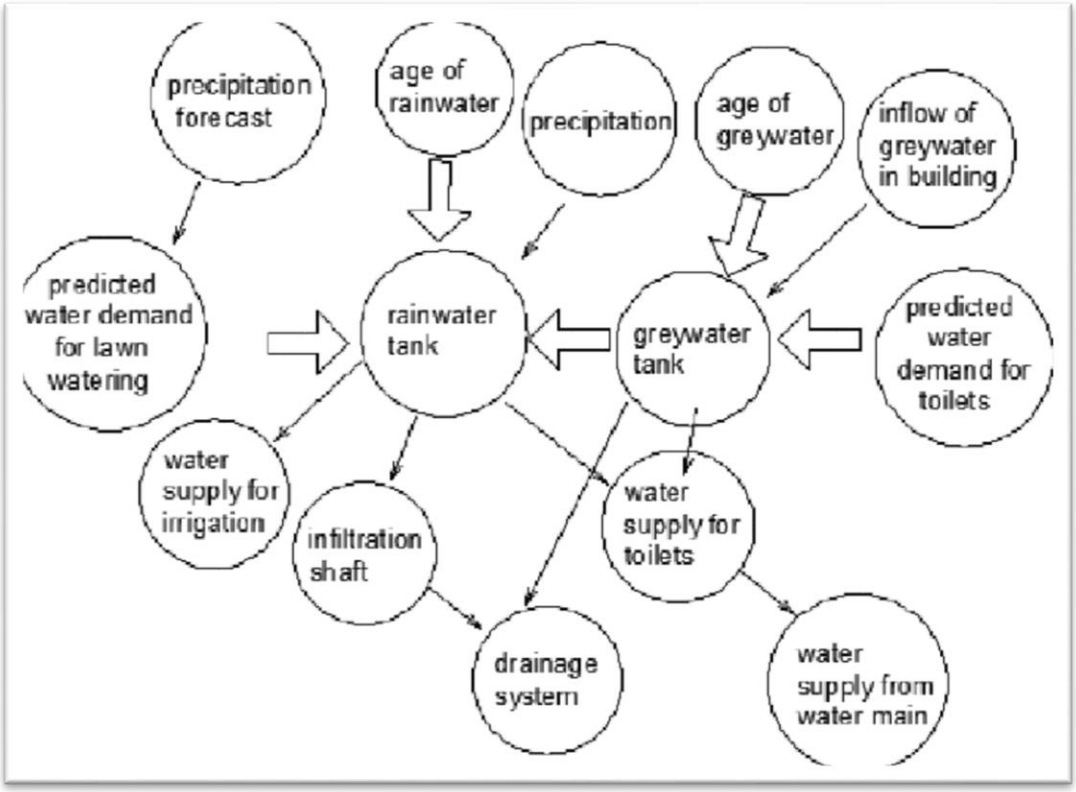


Figure 68: Proposed fuzzy cognitive map for a decision-making water management system

In the following section, case studies of different cities and municipalities attempting customer satisfaction will be provided.

Dammam Utility repairs case study

The city of Dammam was seeking a fully customer-engaged solution, through integration with social media and messaging applications, as to keep its citizens informed. In a large percentage of the citizens' complaints, the issue would stem from the individual, however he would

report to be unhappy with the city management itself as he had no feedback. The city engaged technological and operations companies to create a system of informing the citizen through a simple, yet complete, automated solution. AHCC recommended a solution where as soon as a complaint comes in, it would be triggered in an operational response team. The system would involve AI and intelligence solutions that was developed to trigger dispatching and scheduling for the proper teams depending on series of question that would be asked to the citizens. The total system as depicted below would include the following modules:

1- Citizen's social and messaging integration
2- Field Dispatching
3- Automated workforce and equipment dispatching
4- Automated inventory management
5- Estimated completion time with notification to citizens.
6- Control rooms to observe and direct any deviations
7- Mobility solutions for field and supervisory teams.
8- Integration with GIS to feed AI systems for future complaints and analytics.
9- Automated equipment maintenance
10- Loop back to citizens' feedback

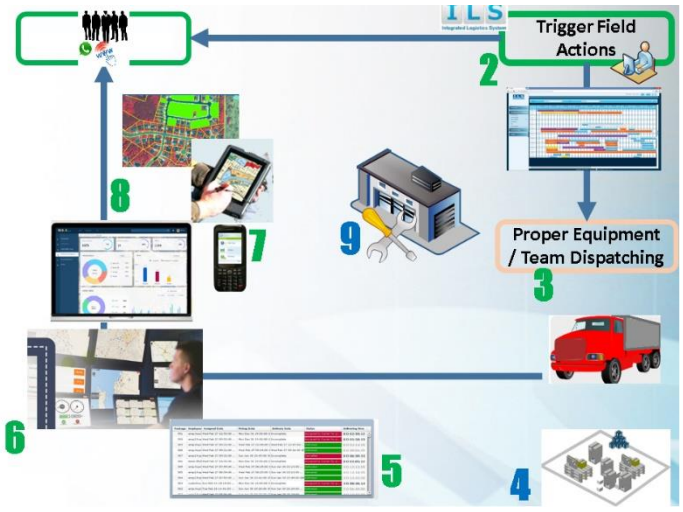


Figure 69: City Utility Repair Management Total Solution

Figure 70: GIS Capture for Road and Utility Repairs

Police Response Case study

In multiples cities around the world, police departments are utilizing artificial intelligence to allocate police response teams. It was found through multiple case studies, as in the city of Rockville, Maryland, that allocating police vehicles in higher rates of incoming calls to the 911 centers had reduced the number of criminal activities in the region. However, the systems that were utilizing AI systems in response to different situations would require different response teams. The total solution in using this system would save US tax payers money in movement, workforce scheduling, and mostly higher safety and securities for the cities by automating the police force.

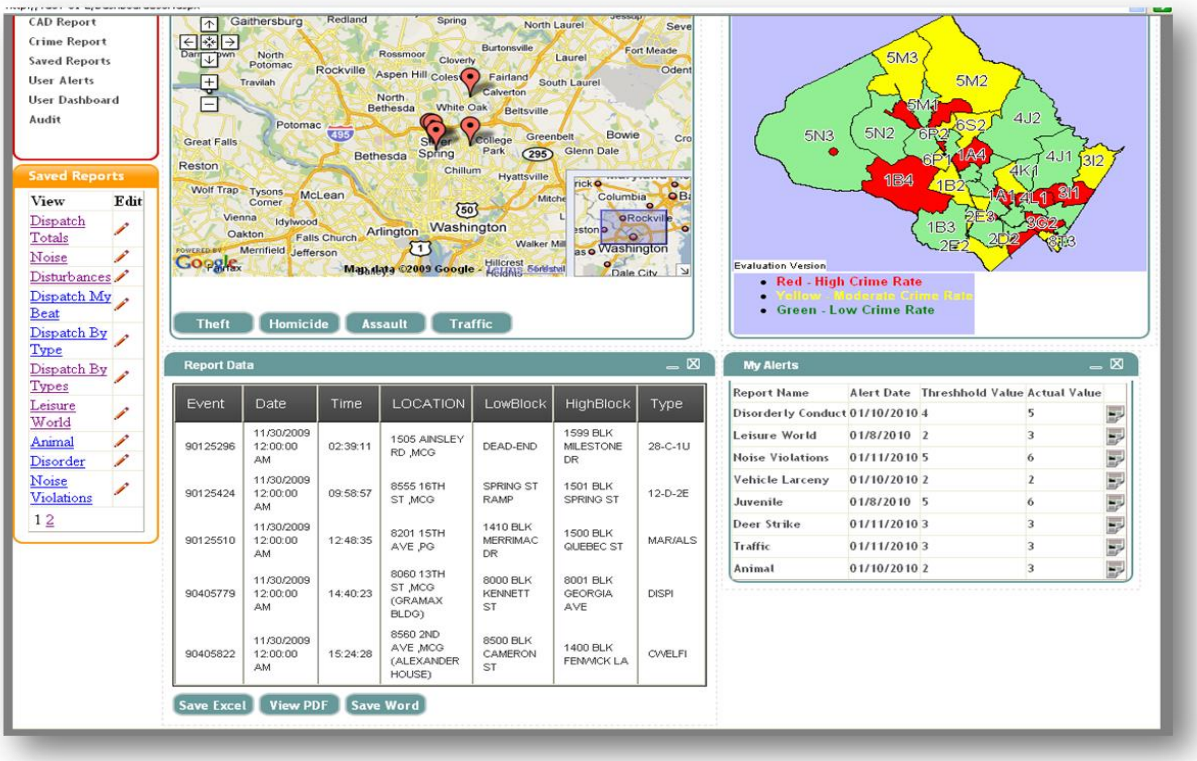


Figure 71: Police Response Smart Analytics

Dubai Economic Development Case Study

With an increased number of citizens and visitors arriving to the UAE, a multitude of new organizational issues arose in the region. The country, for one, has condensed areas of services which are not needed. For example, one street would be filled with barbers, while other areas would have none. The city of Dubai has asked companies to devise an artificial intelligent solution where systems are tracking licensing and permits of such businesses, which would also ensure that dues are paid on time. These systems would even track repeat offenders based on the regional laws and permit rules. The business intelligence system would as well track the highest unpaid amounts as to save inspectors and collectors time and effort for recovering unpaid amounts due. The systems are able to integrate with other government entities such as immigration, interior , and taxation as

to ensure proper paperwork is acquired and no violations has been made, while ensuring efficient placement of businesses.

Figure 72: AHCC Smart Automated Business Intelligence (InSight)

Chapter 8: The Future – What's Next

With technological advancements in many areas, researchers and industry leaders are focused in many spheres of development as a means to provide artificial intelligence engines with more data capabilities since richer data can provide better decision making and better automation strategies. There are many areas as materials are lighter and manufacturing capabilities are more complicated and advanced. May areas are still going under development as to better utilized and we will be listing below some of the areas. Such as on demand 3D printing closer to end user as to save in logistical costs. Automated workforce placement and assignment. Also, utilization of unattended smart automation such as drones and chatbot and remote process automation (RPA) are in focus. With many areas depending on the field of implementation, industry leaders focus in high demand high return industries such as factory automation, agriculture, surveillance and many more.

Implications of 3D Printing for Future Supply Chain

Future supply chains focus on supply material near to where it is needed. The utilization of demand forecasting and manufacturing near to the end users are critical to ensure savings. When 3D printing devices are more sophisticated they can use different materials for printing. Cheaper industrial 3D printing devices make it more viable for everyday utilization for a variety of different sources and goods, and making centers to supply those on demand manufacturing needs can be applicable in areas such as:

- Spare parts on demand
- Individualized direct parts manufacturing
- Product postponement services

- End-of-runway services: End-of-runway services typically encompass integrated

logistics solutions located at specific warehouses in direct proximity to important airport hubs. This is how logistics providers can achieve fast response times and speed to market for time-sensitive shipment of critical parts, even after latest order cut-off times. In addition to conventional warehousing services, a major focus for end-of-runway services are sector-specific service offerings and integrated return and repair services. This is where the strengths of 3D printing can be leveraged. 3D print shops for businesses and consumers. (Dr. Markus Kückelhaus, 2016)

Growth driven by lot in Agriculture

Huge volumes of data get generated every day in both structured, and unstructured, formats. These relate to data with historical weather patterns, soil reports, new research, rainfall, pest infestation, images from drones and cameras and so on. Cognitive lOT solutions can sense this data and provide organizations richer insights and recommendations to take the appropriate action for optimum yield improvement. AI can be used to create intelligent systems which can also be embedded in machines that can work with higher accuracy and speed than humans, but with same responsiveness. AI, together with Internet of Things (lot) and Sensor Technology, can be a great enabler of precision agriculture. AI can also play a critical role along with remote sensing technology in wide scale implementation of Climate Smart Agriculture. (Kirtan Jha, 2019)

Chatbot in Agriculture

With the emergence of streaming analytics capabilities, most of the AI / ML algorithms for specific use cases need to be deployed in edge devices. The outcome of that deployment of

Artificial Intelligence can be integrated in farm advisory, conversational systems (such as chatbots), and control level integration.

Some benefits of providing AI based Chatbot service to improve digital experience to users include:

- Will help to improve their speed of service, and reach out to farmers on channels they are most comfortable with.
- No need to install mobile apps, which are seeing a clear decline in usage. Chatbots are available anywhere, anytime. These are easy to use by today's digital citizens
- BOTs insights on usage of BOTs, which region / locations are engaging with BOTs more, which channels (website or mobile app) are being used more, which queries are being asked more frequently, which queries are being unanswered so that the BOT can be trained appropriately, most popular user phrases, and other such applicable uses.
- Leveraging Chatbots can speed up interactions, and reduce wait times for users, by way of answering queries with complete accuracy, pulling knowledge instantly from a database, and freeing up valuable time of the farmer and call center executives.
- Can help farmers get clarifications to their queries instantly from the knowledge base, eliminating waiting times to talk to call center agents, and providing self-service
- Provide 24/7 availability and high accessibility to farmers on their preferred channel, hence ensure stickiness and improved services. (Kirtan Jha, 2019)

Urban development future

Urban governance will face many challenges in the near future, including a constantly growing urban population, the need to attract additional funding, improvement of monitoring

systems and data analysis mechanisms, etc. All this requires a qualitatively new approach to the management process in order to optimize it. The concept of a “smart city” emphasizes the importance of innovation and the introduction of modern technologies in urban life. (Mukhametov, 2019)

Future Pavement and Roads management

Mobile Crowd Sensing provides a good implementation environment and timeliness at a low cost to help with pavement management. The issues in each phase of both experiment and implementation stages can be overcome with the gradual deepening and diverging of researches and the development of hardware, algorithms, and wireless communication. Beyond that, multiple parties, including the citizens, the road management departments, traffic departments, and the construction contractor, are involved in the pavement management, so that the improvement of participation willingness plays a vital role in the promotion of a proposed approach. In conclusion, the development of pavement management utilizing MCS from experiment to implementation still has a long way to go, accompanied with great potential and a bright future. (Boquan Tian- Yongbo Yuan- Hengyu Zhou - and Zhen Yang, 2020)

Distributed Intelligence

This suggests a promising path forward for AI; the creation of distributed intelligent programs that can sense, learn, recognize, and aggregate information when deployed throughout the network in the service of particular goals. Examples can be the sensing of local anomalies that are aggregated intelligently in order to decide on a given action, the collective detection of malware in parts of the network, sensor fusion, and effective responses to predetermined traffic and content

patterns, to name a few. Distributed AI is not an illusory goal. A few such systems have already been designed and tested, and have shown large improvements in the times needed to solve hard computational problems, such as cryptarithmetic and graph coloring. These are problems characterized by the fact that as their size increases linearly, the time to finding a solution rises exponentially. A common example is the travelling salesman (design pattern) problem, which can be seen as a metaphor for the laying of networks in such a way that they minimize the number of traversals needed to cover a number of cities and users. While there are several powerful heuristics to approach this optimization problem, for large instances one can only hope for solutions that while not optimal, satisfy a certain number of constraints. (Huberman, 2018)

Big Data

Across industries, Big Data technology has tremendous potential to leverage Machine Learning capabilities in enabling accurate decision-making for superior performance. There are many applications of Machine Learning techniques in the manufacturing industry, but successful implementation requires commitment from top management to enable changes in processes, active involvement of operational resources, availability of data, and collaboration with academia and technology partners with expertise in Machine Learning models and Big Data technology. Recent developments in advanced computing, analytics, and low-cost sensing have the potential to bring about a transformation in the industry. The implementation of Machine Learning and Big Data may drive the next wave of innovation and may soon prove to be an unavoidable tactical move in achieving higher levels of optimization. (Hussain & Manhas, 2016)

Artificial Intelligence and virtual logistics for business automation

The rapidly growing interest from both academics and practitioners in the application of big data analytics (BDA) in supply chain management (SCM)

In logistics, transportation management prevails, with particular focus on three fundamental functions of ITS: routing optimization, real-time traffic operation monitoring, and proactive safety management. It is noteworthy that the big data analytics (BDA) -driven routing problem is mainly studied in static environments based on historical databases. The study of how BDA can optimize order-picking processes, such as order batching, routing, and sorting, is still scarce. (Nguyen, ZHOU, Spiegler, Ieromonachou, & Lin", 2016)

Augmented Reality (AR)

With an increasing number of 'smart' objects connected to the Internet, and with new ways of accessing digital information, more and more people want to work with AR devices and data. Therefore, our fourth cluster, virtual interfaces, focuses on AR technologies that offer new options for controlling real-world objects through digital means. Essentially, this allows a mixed reality where real objects can be altered and controlled.

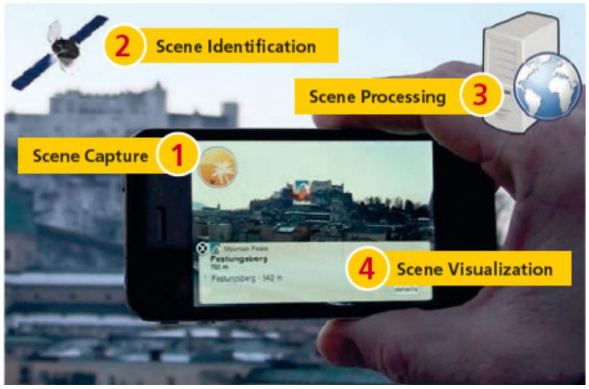


Figure 73: Basic Functionality of Augmented Reality; Source:

In the near future, AR-enhanced parcel service applications could enable customers with an AR-capable device to volume scan the measurement of goods to be shipped, and estimate the weight to establish the perfect size and lowest price parcel box from their logistics provider. In

addition, this app could display different shipping and insurance price options. While such an elaborated app is not yet available today, there is a simpler version in use. The DHL Paketassistent11 lets the user print a sheet containing an icon that is like a QR code. Using a webcam, holograms of available DHL parcel boxes are projected for customers to then match their items to the right-size box. In conclusion, AR has a promising future in the logistics industry. Ranging from picking-by-vision in warehouses to assisting customers with after-sales activities, it is clear that AR can play a part in almost every step of the logistics value chain. Although only a few of these use cases are currently being developed, there are encouraging first signs of AR adoption in the logistics industry. This trend will continue to grow, and one hopes that more logistics providers will participate to drive the AR revolution. (Dr. Markus Kückelhaus - Gina Chung - (DHL), 2014)

Block Chain and the Future

In contrast, blockchain is a shared, distributed ledger among a network of stakeholders that cannot be updated by any one administrator. Instead, it can only be updated with the agreement of network participants and all changes to the distributed ledger are auditable. To illustrate how this operates, the figure below shows a financial transaction recorded on a blockchain. A similar process can be used to trace other types of asset transfer, to commit new data to a blockchain, and to update data in a blockchain. This ‘mutualization of data’ in a blockchain-based system is only possible with strong cryptographic techniques that make certain that copies are identical, transactions are not duplicated, and specific permissions are enforced to access stored data. Here, public and private keys are used to ensure confidentiality and privacy. In simple terms, a public key can be likened to the address of a physical mailbox, which is publicly

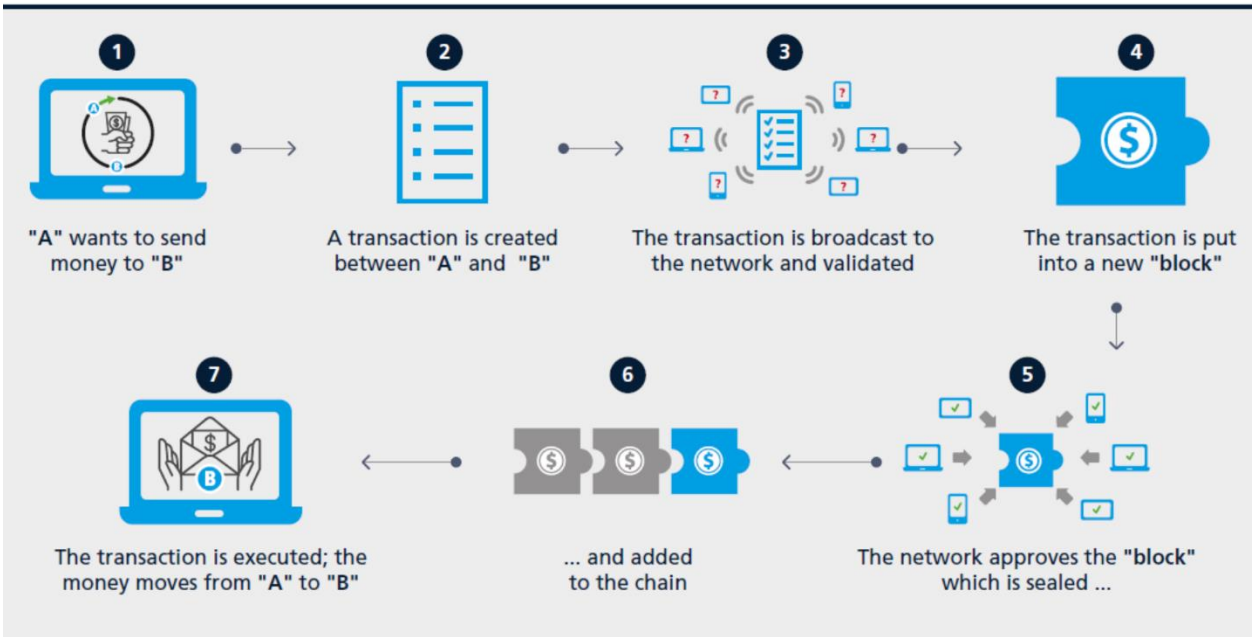


Figure 74: Illustration of a blockchain transaction; Source: DHL / Accenture

Figure 75: The information flow in international trade is complex, involves many parties, and is documentation heavy; Source: Accenture

known by senders. A private key is like the key or password required to unlock the mailbox; it is always safeguarded by the owner, and must not be shared with third parties. In the future we can anticipate blockchain technology will intersect with other innovations to amplify impact. Imagine how the physical flow of goods can be more effectively orchestrated and synced with information and financial flows when blockchain is combined with the IoT, artificial intelligence, robotics and more (Dr. Markus Kückelhaus - Gina Chung - Bastian Gockel, 2018)

Robotic Process Automation (RPA)

Robotic Process Automation (RPA) is the new technology that aims to create software robots (bots) that mimic human behavior. Transitioning to RPA, enterprises aim to reduce labor costs, increase productivity, reduce error rates and improve customer satisfaction. Collaboration between RPA and AI allows for complex capabilities to emerge. While automation mainly aims to restructure and organize rule-based repetitive processes; defining and handling exception cases are still highly manual tasks. At this point, AI can help the automation software for processes that do not require complex decision-making and analysis, such as natural language processing (NLP), or online customer support RPA, which makes sense when we speak of simple processes, with a high volume of repetitive transactions, and a type of process in which human participation is not necessary. This means that there is no decision process in the transaction itself that can condition it, or that this decision process is very simple. With this in mind, it is a good idea to consider the use of RPA when we want to:

- Eliminate repetitive tasks
- Reduce those small errors, that can come at a high cost for the proper functioning of the company
- Perform simple but repetitive calculations (Doguc, 2020)

Group with RPA	Number of Agents	22
	Mean case duration (seconds)	431
	Total number of cases	7163
	Cases per agent	326
Group without RPA	Number of Agents	13
	Mean case duration (seconds)	440
	Total number of cases	3505
	Cases per agent	270

Table 2: RPA implementation results (Doguc, 2020)

The main benefit of RPA is cost reduction, based on productivity improvements as the case study reveals. Other benefits such as process agility are relative to the RPA configuration, hardware capacity and response time of the applications that the robot needs to access. Error reduction is also a measure. (Doguc, 2020)

Drone Utilization

There is a broad range of possible applications and benefits for Unmanned Aerial Vehicles (UAVs), which means that many different industries are interested in them. The following use cases give an overview of the broad usability of UAVs, and can serve as an inspiration across industry boundaries.

Energy/Infrastructure

For big energy players, it is tedious and costly to constantly monitor their infrastructure. This can be due to the vast size of energy sites (mining), the scale of the infrastructure (power lines, pipelines), or the challenging environment (offshore wind parks). Integrating UAVs will assist in autonomously monitoring infrastructure.

Agriculture and Forestry

Probably the agriculture and forestry industries don't spring to mind when considering potential applications for unmanned aerial systems. However, in precision agriculture, UAVs are already playing a vital role today. They allow farmers to gather real-time data on crops, detect irregularities as early as possible, and take better decisions about using fertilizers, herbicides, and pesticides. In addition, animal tracking is another task well suited to the capabilities of UAVs to ensure keeping them away from vital crops.

Site and Layout Planning; Construction Sector

Site and layout planning in the construction sector, and in other industries, can benefit in several ways from the use of unmanned aerial systems. The simplest application is analyzing a site from above, using live footage from a UAV. This gives an overview of the site and indication of site specifics. Footage and data collected by a UAV can also be used in mapping of the area (UAV-based data collection).

Environmental Protection

UAVs can play a vital role in environmental protection; for example, in the safeguarding of an endangered species. Already, conservation parks and private game reserves in South Africa are using unmanned flying systems to protect endangered rhinos from poachers by keeping a diligent eye on the surroundings.

Emergency Response and Police

A double blow of natural disasters hit Fukushima in 2011: The strongest earthquake in Japanese history, followed by a tsunami which claimed the lives of more than 15,000 people, and a whole region devastated. A big problem in the aftermath of natural disasters is that decision makers often lack information on which to base their decisions. In Fukushima, this was exacerbated by radioactivity leaking from damaged reactors, putting every human being who entered the power plant area at high risk of radioactive contamination. In such emergency response and disaster situations like this, UAVs could be utilized to quickly gather aerial information, survey damage, and scout for survivors and areas in need of immediate relief and response by the appropriate authorities.

Film and Photography

Aerial film and photography service providers are probably the heaviest commercial users of unmanned aerial systems today. The technical requirement is comparatively low – in many cases, off-the-shelf cameras are attached to the UAV with ready-made or makeshift mountings (see Figure 11). For a better focus and improved results, the camera and the UAV can be handled by different operators.

Development Aid

"We will bring to the world its next-generation transportation system." This immodest statement is made on the homepage of Matternet, a California-based start-up that is seed-funded by investors such as Andreessen Horowitz (with previous interests in Skype and Groupon). UAV like drones assist development aid in scanning areas to detect grounds that needs assistance and for verification.

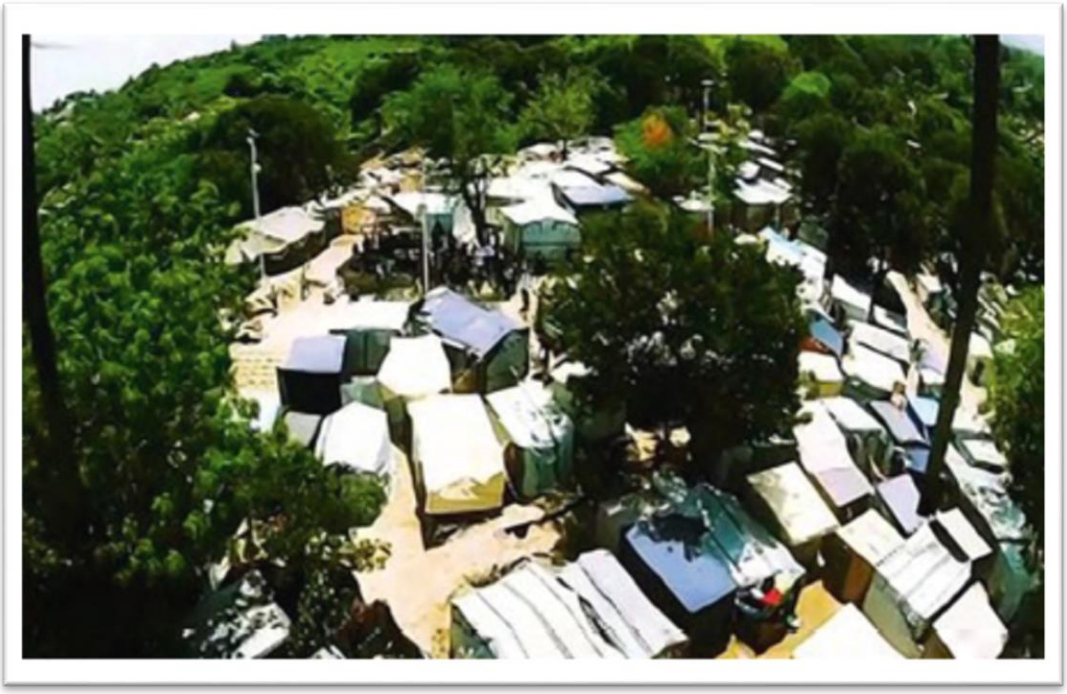


Figure 76: Matternet field test in Haiti; Source: SciDev.Net

Surveillance of Infrastructure

As in other industries, organizations in the logistics industry must monitor their infrastructure. UAVs can help with security and safety surveillance in large-scale facilities such as warehouse sites, yards, docks and even pipelines. They can also help to guide various operations (e.g., the movement of trucks and forklifts on site). Probably the most promising application is

using UAVs to provide customers with a value-added service (VAS); for example, on oil fields.

Figure 77: BP using UAV; Source: Modelairplanenews

BP, British multinational oil and gas company, will routinely use UAVs to patrol their Alaskan oil fields, which is the first authorized commercial UAV operation in the United States (see Figure)

Intralogistics

UAVs could play a vital role in intralogistics. Consider the automotive industry with its massive production sites, just-in-time processes, and mind-boggling cost of idle production lines: UAVs could support intraplant transport as well as the supplier-to- plant emergency deliveries which are typically performed by helicopter today. Large-scale mining areas could also profit from the on-site express delivery of items that are crucial to maintaining operations (such as the delivery of tools, machine parts, and lubricants). (Dr. Markus Kückelhaus (DHL), 2014)

Conclusion

Companies are constantly making investments in technology to be a part of their operation cycle. These technologies have proven to fill the gap and ensure a sense of efficiency, speed, and ease in their day-to-day processes. Tying all these solutions together with advanced business technologies such as AHCC's Integrated Logistics Solution, business automation tool could propel organizations further than ever before. Automation solutions can surely increase the productivity in any business. These solutions have to augment with AI leaders of enterprise platforms, such Oracle, Google, and Microsoft, as to ensure standard progression of technologies provided to the end user. By doing so, an organization will guarantee its own exponential success and productivity.

A burgeoning global population, combined with the challenges of environmental sustainability, have put the world under great stress in the 21st century. As the World Economic Forum Founder and Executive Chairman Klaus Schwab explained, "The challenges associated with the Fourth Industrial Revolution are coinciding with the rapid emergence of ecological constraints, the advent of an increasingly multipolar international order, and rising inequality. A report from the United Nations Intergovernmental Panel on Climate Change (IPCC) states that rapid, far-reaching, and unprecedented changes in industry are required to limit global warming to 1.5°C, to avoid challenging impacts on ecosystems, human health and well-being associated with a higher temperature rise. Similarly, a study from the Global Footprint Network highlights that current global resource consumption is exceeding available resources by a factor of 1.7" (World Economic Forum - McKinsey & Company, 2019)

Even the future of farming depends largely on adoption of cognitive solutions. While large scale research is still in progress, and some applications are already available in the market, the industry is still highly underserved. When it comes to handling realistic challenges faced by farmers and using autonomous decision making and predictive solutions to solve them, farming is still at a nascent stage. In order to explore the enormous scope of AI in agriculture, applications need to be more robust. Only then will it be able to handle frequent changes in external conditions, facilitate real-time decision making, and make use of appropriate frameworks and platforms for collecting contextual data in an efficient manner. (Bagchi, 2000)

Distributed AI will allow for the solution of a number of practically intractable problems, many of them connected with the smooth and safe functioning of our cable networks. Imagine applying different AI solutions to search for security anomalies, and combining them in order to identify and act on them. Even monitoring distal parts of the network with different kind of sensors whose outputs are aggregated by intelligent agents. (Huberman, 2018)

Gartner (a global research and advisory firm providing information, and data analytics) have identified that AI, as a transparently immersive experience and digital platform, is a trend that will enable businesses to survive, and thrive, in the digital economy over the next 5 to 10 years. This degree of innovation comes, however, with a heightened level of risk. Whilst traditional risk, control frameworks, and IT process models can still help, it is believed that there are new risks and different ways to control some of the existing risks. Businesses urgently need to recognize this new risk profile and rethink their approach to the risks and controls relating to this technology in a structured way (Shefford & Holland, 2018)

There are many positive impacts of AI and its integration into society, some of which are-

- Providing new jobs
- Bridging the language divides
- Government transformation
- Health care delivery
- Creating art (Wang & Siau, 2019)

As with anything, the negative impacts of artificial intelligence that could present itself are:

- Unbiased systems and integrity
- Access to data, knowledge, and technology
- Privacy
- Technological unemployment
- Control over data and disproportional data
- Security

AI carries out impressive applications, with the remarkable advantages for all humans, society, science, however, there are many notable unanswered questions with the political, social, and ethical facets. Risks are existential from the artificial normally intelligence. Existential risks from the artificial intelligence is a hypothesis with substantial progress in the artificial general intelligence (AGI) may someday outcome in human elimination or some of the other type unrecoverable global disaster (Wang & Siau, 2019)

The mass adoption of AI is resulting in a world which is smarter and more innovative. Route and traffic mapping by Google maps, price estimation of rides by Uber and Lyft, friends' tag suggestions at Facebook, spam filters in our email, recommendation for online shopping and cancer detection are only a few examples of AI technological innovations simplifying our lives. The incredible

speed with which AI is entering every sector is forcing companies to get into the race to make their company an AI company. This is also impelling business, strategists, pioneers, entrepreneurs, and investigators to use AI to design new strategies and create new sources of business value. (Soni, et al., 2019)

It is evident from our numerous studies, in-depth analysis, and exposure to different verticals around the world that business and government environments are changing inherently, and in rates that is unprecedented. Increased population, new diseases, and less resources pose a critical new demand on businesses and government stake holders alike. The only way to keep up with this increasing demand, maintain safety, and accelerate productivity. The mass utilization of Artificial intelligence and virtual logistics would propel governments and businesses alike, providing them with the power to not only keep up with, but surpass, any demands and desires places on them. With the increase of facilitating underline internet speeds, IoT devices, and faster computing power, the ability of easily integrating nearly every aspect of society is well within reach. Solutions have to be provided to save time, reduce costs of production, and increase optimization for all types of efficiency. It's not only in the best interest of businesses and products, but of livelihoods and general societal safety as well. A society that is fully integrated with AI will be one that will no longer focus on mundane tasks, but be able to withdraw and look at the bigger picture, ask the bigger questions, and make the tougher decisions. Instead of wasting time, energy, and investments on manual labor, and attempting to sift through an unparalleled amount of data and variables, the potential to allow AI to not only automatically aggregate all information but calculate the best choices will safe an immeasurable number of resources. With menial tasks now being attached to AI, this even opens up the door to higher complex jobs opening up that AI won't be able to solve, providing new growth and employment opportunities across all sectors of life. AI can only ever secure our investments, increase our safety, and make our general lives easier.

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Appendix A

Garage	Garage Code	Total 2018 Duties	Total 2018 Duties (From 1/12018 to 29/07/2018)	Total 2018 Duties (From 1/12018 to 29/07/2018) (Fully assigned but not dispatched)	Total 2018 Duties (From 1/12018 to 29/07/2018) (Partially assigned)
			Duties (From 1/12018 to 29/07/2018)	(Fully assigned but not dispatched)	Total 2018 Duties (From 1/12018 to 29/07/2018) (Partially assigned)
Riyadh garage	100	49488	28299	5486	13441
Makkah Garage	200	22940	13199	2025	4808
Dammam Garage	300	38384	22148	884	7162
Al-Ahsa Garage	350	332	200	79	17
City garage	400	20178	11768	1578	7091
Yanbu Garage	450	1481	865	87	339
Jeddah garage	500	42869	24589	3205	14684
Taif Garage	600	3978	2604	67	1213
Aseer Garage	701	13073	7590	1281	1589
Hail Garage	850	917	389	2	94
Al Qassim Garage	900	203	137	2	84
Tabuk Garage	950	2509	1357	49	1268

Table 3: Driver Duties in Transport Case Study

Garage	Garage Code	Drivers	Total Working Drivers	Idle Drivers This Year
Riyadh garage	100	447	402	45
Makkah Garage	200	214	189	25
Dammam Garage	300	314	296	18
Al-Ahsa Garage	350	11	9	2
City garage	400	178	168	10
Yanbu Garage	450	8	8	0
Jeddah garage	500	333	291	42
Taif Garage	600	33	29	4
Aseer Garage	701	101	93	8
Hail Garage	850	10	10	0
Al Qassim Garage	900	10	3	7
Tabuk Garage	950	25	16	9

Table 4: Driver Count and distribution

Artificial Intelligence and virtual logistics for business automation

Month/ Year	No. Of Orders	Total Amount	Customers Count	Employees Count
1/2017	11,096	2,319,658	969	20
2/2017	8,478	1,941,098	2,099	18
3/2017	7,525	2,292,203	2,110	19
4/2017	9,412	2,630,658	1,612	21
5/2017	8,920	3,210,370	2,126	37
6/2017	9,593	3,840,044	2,863	33
7/2017	12,943	2,250,579	2,276	34
8/2017	9,500	2,089,457	1,809	32
9/2017	9,755	3,677,678	1,374	33
10/2017	12,092	3,321,051	2,586	40
11/2017	9,354	2,152,534	1,829	34
12/2017	11,394	3,637,401	1,666	37
1/2018	8,605	2,450,185	1,758	43
2/2018	10,669	2,689,745	318	43
3/2018	11,636	2,972,372	261	41
4/2018	11,625	3,069,304	238	37
5/2018	11,291	3,975,309	441	45
6/2018	10,854	3,785,670	308	45
7/2018	9,973	2,624,547	263	37
8/2018	6,901	3,133,174	151	34
9/2018	8,443	3,100,049	228	38
10/2018	5,220	3,937,426	301	41
11/2018	3,156	2,567,664	252	43
12/2018	1,918	1,669,357	178	35
1/2019	770	806,110	75	21

Table 5: Limousine Demand vs Customers and Drivers

Artificial Intelligence and virtual logistics for business automation

Date	Orders Count	Service Count	Customer Count	Users Count	Trips Count	Total value in SR
1/2017	804	3155	315	22	28,106	18,965,669
2/2017	748	2451	432	22	23,785	16,416,909
3/2017	895	3223	420	23	14,324	10,299,487
4/2017	883	3183	357	23	28,702	18,256,928
5/2017	914	3618	412	23	19,529	16,745,051
6/2017	738	2335	334	24	5,844	8,289,275
7/2017	228	621	159	22	2,890	3,025,532
8/2017	133	321	92	20	1,618	2,640,360
9/2017	234	566	142	21	9,788	7,730,756
10/2017	463	1287	290	20	14,364	10,336,774
11/2017	644	2254	306	24	28,812	18,768,570
12/2017	697	3106	310	23	13,957	11,537,074
1/2018	828	5401	320	24	21,240	15,428,042
2/2018	936	5797	478	24	25,163	18,799,935
3/2018	910	5684	440	23	25,197	19,954,591
4/2018	819	3803	382	24	26,652	21,987,151
5/2018	998	4454	443	26	14,632	15,488,263
6/2018	602	2323	319	25	6,480	9,811,102
7/2018	238	610	162	19	2,502	4,973,256
8/2018	103	295	71	18	4,786	4,294,188
9/2018	395	1157	222	21	13,339	11,663,518
10/2018	591	2299	295	23	20,019	15,193,448
11/2018	709	2979	307	24	32,314	22,009,853
12/2018	1070	4797	417	23	18,834	16,348,556
1/2019	791	3308	299	21	7,746	10,747,787

Table 6: Contracting and Rental IOT Capture for Orders and Values