

# The Rise of Robotic Process Automation and its Application in a Business Model

Harsh Kansara  
Lakehead University  
955 Oliver Road, Thunder Bay, P7B 5E1

**Abstract:-** In recent years, majority of the processes conducted by the organizations are done with the help of computers and are primarily focused on improving productivity, efficiency and customer satisfaction. The processes are not only the production processes but also the processes that are done in the back-end. These back-end automation systems are called Robotic Process Automation (RPA). It automates the straightforward tasks thereby reducing human intervention. This chapter begins by explaining the concepts of RPA and how it came into being. It then goes on to show its features and a roadmap to implement RPA into an organization. It also depicts the functioning of RPA with the help of an OSI Reference Model (Open System Interconnection). The second half of the chapter mentions the areas of an organization where RPA can be incorporated along with their benefits. The chapter concludes by highlighting the limitations and future scope of the technology.

**Keywords:-** Robotic Process Automation, Industry 4.0, Business Process Outsourcing, Business Process Management, Artificial Intelligence.

## I. INTRODUCTION:

Technology is rapidly increasing, and so is the complexity of maintaining a business, globally. Computers have started to perceive human sound and robots can mimic human actions. Organizations have begun investing in technologies that can respond to customer needs and requirements more quickly and efficiently. It is said that human error is one of the most unreliable factors, but once it has been taken care of, the precision, accuracy and quality automatically improves. Organizations that still implement methods such as Enterprise Resource Planning (ERP) spend much time in understanding and developing the processes. When robots or software handle these repetitive, routine and manual tasks, the employers can be assigned more value-adding jobs. Hence, Organizations are turning towards automating the processes. (Anagnos, 2017)

According to Helge Jalon (2017), 17% of the work done by an organization is data collection, and 16% is data processing. These are the tasks that are usually done entirely by humans. Hence, these processes take up a significant amount of time and energy of the workers. With the help of Robotic Process Automation (RPA), these tasks can be automated. RPA is a software that simplifies the delivery of the business process. Implementing RPA would improve the efficiency and data security by automating the repetitive and tedious tasks without making changes in the existing software logic and the other systems. RPA is

where the virtual workers are built, and repetitive human tasks are reproduced. Rather than having working individuals interacting with various applications, RPA utilizes software to execute the same thing. It is not restricted to console and mouse tasks; the software depends on a set of guidelines and has its own programming and security level. (Pricop, 2017)

Today, high-volume, multistep processes with various approval principles, and manual procedures are automated from end-to-end with the help of RPA. This innovation will continuously utilize components of artificial intelligence for refined decision making in the future as well. For instance, inside a couple of years, RPA will work more like a human mind, which can adjust and survey, and perform cognitive tasks by detecting, foreseeing and deriving; it may even have a specific level of emotional intelligence.

The literature review of the paper shows how the world of automation came into being and what were the critical highlights of each of the industrial revolution. It also explains the meaning of RPA and how can it benefit the organization. The review paper indicates some of the areas where the organizations can integrate RPA into their business module along with a roadmap to successfully implement RPA. Limitations and the future scope of the technology have also been listed.

## II. LITERATURE REVIEW:

### *The Advent of Automation:*

The importance of automation is dated to as back as since World War 2 where an intensive use of sophisticated control devices was seen in the military. Developing a specific way in which people can manufacture goods or provide services more easily and efficiently is called production technology. After the beginning of the Industrial Revolution, the working conditions and the lifestyle of people changed drastically. Since then, the word 'Automation' speaks for itself, and the industries have not stopped to develop and implement new and innovative methods to improve their business. (Li Da Xu et al., 2018)

The First Industrial Revolution also called as Industry 1.0 and was seen towards the end of the 18<sup>th</sup> century. This type of revolution replaced the muscle power of animals and human beings with machines powered by steam and electricity. Private ventures developed from serving a

predetermined number of clients to huge associations with proprietors, supervisor and workers helping a more significant amount of customers. This industrial revolution was the beginning of a new era, wherein the focus was now mainly on efficiency and productivity. (Li Da Xu et al., 2018)

The Second Industrial Revolution also called Industry 2.0. It began in the 19<sup>th</sup> century. It introduced the concept of mass production with the help of electrical energy. In this revolution, the worker/ labourer became the one who operated the machines and supervised the automated control systems. The mechanisms that helped in mass production were far more efficient and resourceful in a friendly way as compared to the steam machines. The other inventions that were concerned with this revolution are the first assembly line for mass production, Just in Time manufacturing (JIT) and Lean manufacturing. These mainly focused on optimization of workers and the resources. (Li Da Xu et al., 2018)

The Third Industrial Revolution also called Industry 3.0. It was first seen during the early stages of the 20<sup>th</sup> century. The breakthrough of this revolution was the development of transistors and the Programmable Logic Circuits (PLC's) which helped in syncing the software with the electrical and hardware systems. These new developments created ways in which higher accuracy could be achieved at a faster rate with reduced human interaction. The integration of electrical, mechanical and software technologies gave rise to the term, 'Automation.' There was widespread adoption of Computer Numerical Control (CNC) and Industrial Robots which allowed the manufacturing systems to be flexible. Technologies like Computer Aided Design (CAD) and Computer Aided Process Planning (CAPP) allowed the manufacturing processes to be integrated with computers. The use of software systems also allowed the organizations to keep track of the inventory (inventory planning), logistics planning, scheduling and tracking the various activities. To further their businesses, the organizations completely automated their production with the help of electronics and software. By doing so, the organizations became more versatile and opened their businesses easily around the world. This evolution prompted the development of the idea of Supply Chain Management. (Li Da Xu et al., 2018)

The Fourth Industrial Revolution also called Industry 4.0. This provides new paradigms for the production and management of the organization. It has drastically changed the way in which an organization operates. Interoperability, virtualization, decentralization, real-time capability, service orientation and modularity are just a few things that have been developed during this revolution. Technically the developments made during this revolution are what is being used in the industries in the present times. It represents how the industries evolved from the use of embedded systems to Cyber-Physical systems (CPS). The CPS are the mechanisms which are controlled by algorithms mainly run by computers and can easily transfer

data or make the same data available on different platforms at the same time. This revolution has seen the maximum amount of technological developments regarding automation and digitalization of organizations. The main aim of Industry 4.0 is to provide end-to-end digitization and reduce the human interaction with the non-value adding and mundane tasks to a minimum. This is justified with the development of the Internet of Things (IoT), Cloud Computing, Business Process Management (BPM) and Robotic Process Automation (RPA). (Li Da Xu et al., 2018)

The digitalization of the processes related to an organization is of keen interest and is the top priority for them to transform their factories/businesses into smart factories/businesses. The key to success in achieving this goal is dependent on how they run their processes and how flexible they are. Digitalization of the functioning of an organization cannot take place within the nick of time. It is a slow, thoughtful process that can take up to a couple of years for implementation, but once integrated into the system, it will reap benefits for an extended period.

We have seen how the automated tools and machinery made its way into the manufacturing processes and almost how seamlessly they have been integrated into the system. IoT and Cloud-based manufacturing have revolutionized the production processes, and with the help of CPS, the machines can communicate with each other to use the resource optimally.

Hence, we can say that automation is an invention wherein there is minimal human intervention during the processes performed in the organization. Automation is categorized into two different forms, i.e. automation of physical systems and automation of software-based systems. CNC, Industrial robots, Automated Guided Vehicle (AGV) are few of the examples that can be classified as physical systems. Whereas IoT, Business Process Automation and Robotic Process Automation are categorized as software systems or can also be called software automation systems. (Marina Indri et al., 2018)

According to Ruchi Issac et al. (2018), automation is divided into two categories, i.e. Hard Automation and Soft Automation. Hard Automation also called Fixed Automation refers to the production and manufacturing processes performed by a robot or a machine. Whereas Soft Automation also called Flexible Automation refers to the programming part of the process which can be changed according to the needs of the customer. Automating the methods of processing the transactions, addition and removal of information, retrieval of data, response triggers and communication are as important as the automation of manufacturing and production processes. Service Automation is a part of Soft Automation and is the latest Industrial Revolution that promotes the development of automation. Service Automation is the new technological development that aims to deliver an optimum user experience by automating the redundant manual labour.

There are various tools and terms associated with Service Automation, some of them being, Artificial Intelligence, BPM, Machine Learning (ML) and RPA.

### *Before Robotic Process Automation:*

Helge Jalonen (2017) has briefly explained the idea that led to the rise of RPA in the organizations. According to him, the primary sources of value are the core functions of the organization and since internet and networking are being integrated into the daily operation of the organization, prioritizing the core functions is becoming inevitable. Due to this, the organizations started to implement the method of Business Process Management (BPM). As the name recommends, it helps in overseeing the entire processing of the business holistically. With the help of BPM, the processes are continuously analyzed, designed, implemented and improved.

There are two developmental paths for categorizing the management discipline of BPM:

1. Process Improvement: During the earlier days of BPM, the primary focus was towards studying and reviewing the already existing business processes to improve them continuously. These methods include Total Quality Management (TQM), Lean Manufacturing and Kaizen.

2. Process Re-engineering: With this method, there were constant changes and improvements made to the existing processes to optimize Information Technology to its maximum potential.

The two developmental paths are supportive of each other, and an organization utilizes both of them to achieve their goals. To improve business, it is essential to keep a constant check on their processes and update them whenever necessary. However, there is always a limit up to which a specific technology/process can be updated and to improve beyond that point, the need for a radical change in the technology/process is required. As the technology changed, new risks and critical components arose. To eliminate these risks, BPM classified and evaluated alternate methods and also decided when would be the right time to bring in the next invention. (Jan vom Brocke, et al., 2015)

The following representation shows the graph of Performance vs Time. The life cycle of technology is from 0 to  $t_1$  or from  $t_1$  to  $t_2$ . For this specific technology, at point  $t_1$ , there is no more scope for improvement in performance, and that indicates the need for innovation. The innovation will have better performance criteria, which defines the gap in the graph.

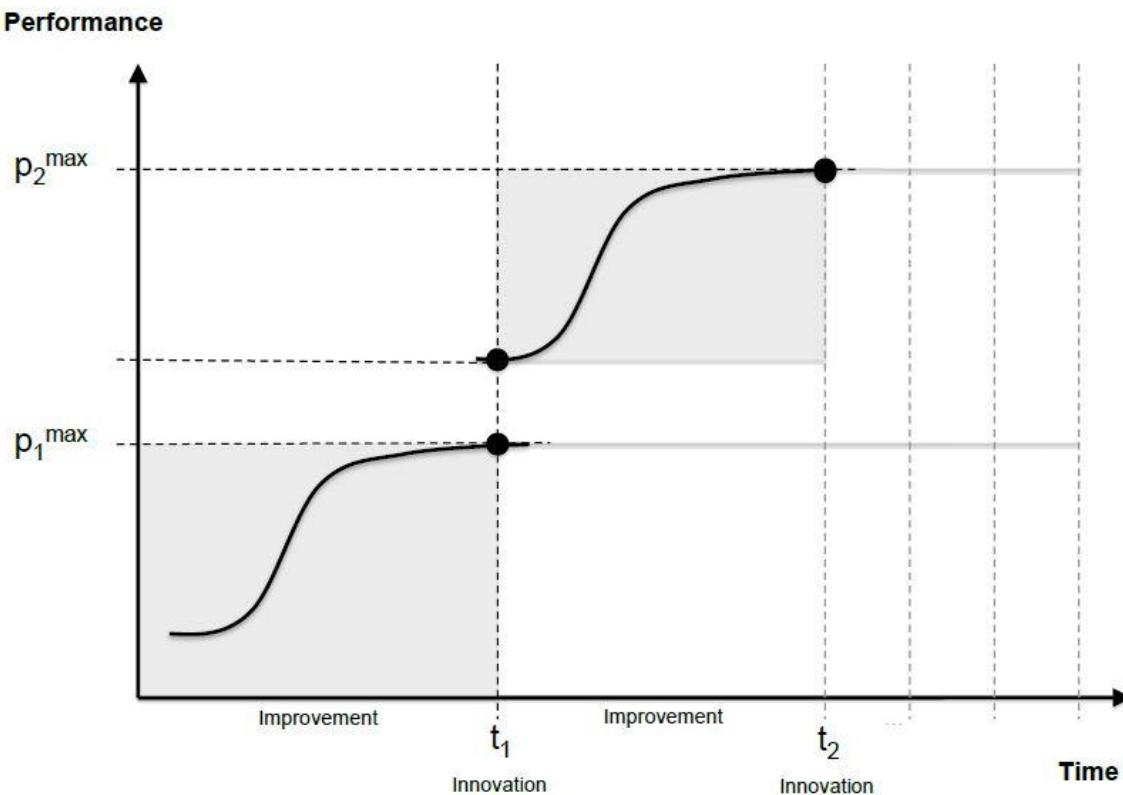


Figure 1. Process Improvement and Process Re-Engineering in BPM (Jan Vom Broek et al. Business Process Management, 2015)

Now, if the organization does not have enough resources to implement Process Improvement and Process Reengineering, they usually hire professionals to do the task for them. This is called Business Process Outsourcing (BPO). Outsourcing the project means that the labour intensive work is allocated to a different entity. Most of the times these entities would be in countries where the cost of energy and other resources are low and so that the parent organization can focus more on the vital work. (Helge Jalon, 2017). Outsourcing is also referred to as Offshoring, and it alludes the transferring of activities to locations outside of their original headquarters who deal with make or buy aspects of the process (Bals et al., 2015).

Sometimes outsourcing can be a risky bet as there is not much guarantee on the quality of the product or service that is provided by the entity. By outsourcing, there can be unexpected and unavoidable risks that can come up at any point in time. According to Nassimbein et al., (2012), there is a higher possibility of generating conflicts regarding information systems, and most of these problems were concerned to the selection of activity, drafting of contract and failure to select the correct location. Hence, the organizations started to come up with solutions to this problem and developed a method which can automate not only the processes but also can handle the backend work of an organization, automatically. This method is called Robotic Process Automation (RPA).

#### *Robotic Process Automation:*

According to IEEE Standards Association, Robotic Process Automation is defined as “A preconfigured software instance that uses business rules and predefined activity choreography to complete the autonomous execution of a combination of processes, activities, transactions, and tasks in one or more unrelated software systems to deliver a result or service with human exception management.” (Moffitt et al., 2018)

For customer satisfaction, organizations must complete the given tasks within a specific time, with the right amount of dedication, following a particular set of standards and maintaining the quality of the outcome. The tasks may include, Customer Relationship Management (CRM), maintaining spreadsheets, collecting data from various databases and other such repetitive tasks. Now imagine if these tasks were done automatically so that the workers could be assigned to more value-adding positions which will be beneficial for the organization and also keep the talented worker involved more towards their forte (Santiago, 2017). This is what RPA does. It automates the routine tasks which require the worker to follow a set of rules and regulations. RPA can generally be confused with the physical robots that help in the manufacturing and production processes. Hence, it is essential to understand what exactly RPA means. Unlike the physical robots, RPA is a software-based solution with the configuration of carrying out repetitive tasks which are more inclined towards the backend processes of the organization. The robotic automation software does not replace the already existing systems of the organization. As a matter of fact, they work in coherence with the system. RPA can be coordinated with any software utilized by people, and it very well may be executed in a brief time frame to carry out operational techniques. The benefit is that RPA coordinates with the system correctly in the way a human would but only in a much faster and an efficient manner (Guðrún Lilja Sigurðardóttir, 2018).

For example, if the task mentions that a person needs to sign in to the system, search for a specific set of data, retrieve it and forward it to the next operation for further processes and it must be done repeatedly throughout the day (The process is depicted in figure 2, below). It is quite evident that a human worker would not be so efficient in performing the task continuously. In such a case, RPA can come into play and perform the task for as long as necessary with the same efficiency from start to end.

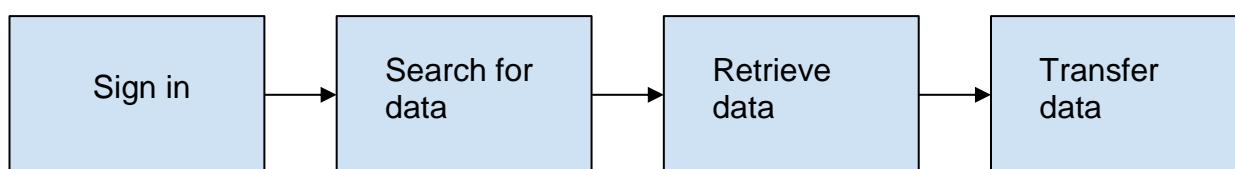


Figure 2: Example of a specific task in an organization (Anagnoste, 2017)

With the help of RPA, the organizations can implement robots to automate the extensive work in the back office as well as the activities in the front office. By doing so, they will reassign workers to more value-adding tasks. The RPA software can perform processes that would require sending out daily emails which are saved in a particular location, extracting information from a specific file, verification of data received from the vendors, making decisions based on predefined set of data and creating pre-filled documents for the organization. (Anagnoste, 2017)

There are two methods of approaching the automation of a business process, and they are, semi-automation also called attended automation, and full-automation also called unattended automation. In semi-automation, the software depends upon the communication with a human administrator to complete an entire task efficiently. The arrangements for semi-automation software are situated at the administrator's workstation and are activated by specific tasks or actions. This automation is meant to be agile and easy to understand with the end goal to give the worker a chance to navigate between the various screens

and interfaces. For instance, the software robots can be utilized to aid the customer service managers for accumulating the data from numerous sources.

The other method, full-automation does not depend upon any kind of human intervention, and the robots initiate the actions on their own to execute the tasks continuously. The main advantage of this method is that the robot can perform the tasks 24\*7 throughout the year autonomously. This method is usually used where excessive amounts of data must be collected, categorized and distributed over a large period (Khramov, 2018).

The specific features of RPA are:

1. *Easy configuration*

Organizations are not required to hire professionals with excellent programming skills as working with the interface of RPA is very basic. One can easily drag, drop and link the icons which represent the steps of a process. The code is generated automatically once the icons are placed and linked with each other.

2. *Non-invasive software*

RPA technology does not require a new and expensive platform to be implemented into the system. It runs in tandem with the existing

systems. It only requires a separate set of login id and passwords for those who will be working on the RPA software. RPA software uses a different presentation layer to access the system, and hence it does not make any changes in the programming logic of the system.

3. *Enterprise safe*

RPA can be integrated into the system because it meets the requirements of the enterprise IT regarding security, scalability, change management. The IT supported infrastructure centrally monitors the RPA bots that have been deployed to maintain the integrity and framework of the enterprises' business model (Mary Lacity, 2016).

The software can be classified as Lightweight IT and Heavyweight IT. Since the RPA software does not disturb any of the existing software systems and architecture, it is classified as a Lightweight IT. Due to their operating principle, the RPA system is also called Software Robots, and every robot is considered as a single software license. Given below is a detailed description of the difference between Lightweight IT and Heavyweight IT. (Guðrún Lilja Sigurðardóttir, 2018).

Table 1: Differentiation between Heavyweight IT and Lightweight IT (Bygstad, 2017)

Criteria	Heavyweight IT	Lightweight IT
Profile	Mainly used in front-end which supports all the work processes	Mainly used in back-end for supporting the documentation required for work
Owner	Department of Information Technology	Customers and third-party agencies
Technology	Usually works on computers, database management systems and integration technology	Usually works on phones, tablets and smartboards
IT Architecture	Developed centrally keeping in mind the holistic approach of systems integration.	It has a different presentation layer, and hence it is a non-invasive architecture.
Development Culture	Based on the security of the organization and service provided	It believes in innovating and experimenting with new processes
Problems	Integrating the system is complex and can sometimes be costly	Security concerns can be an issue, and it cannot incorporate complex processes

RPA has become a cutting-edge technology that is being integrated by the organization into their system. Once RPA has been implemented, the organization becomes self-sufficient, i.e. it does not need to depend upon other companies or service providers to complete a specific set of tasks on their behalf (Aleksandre Asatiani et al., 2016). The

main questions that arise during the planning stage for implementation of RPA are: What are the needs of the customers? What should be the strategy to implement RPA? How much can the organization invest in this technology? What would be the best tool for integrating RPA in the business processes?

### Roadmap to implement RPA into the organization's system:

To deploy RPA into the system; an organization needs the help of another company unless they know how to do so by themselves. That means the implementation process of RPA must be outsourced. Now, consider that an organization will be hiring another company who will do the task for them. Before implementing RPA for the client

organization, the company must thoroughly understand what the needs of the organization are, who are the target audience and what are the challenges the organization is currently facing are. Hence, the implementation of RPA is divided into 4 phases which helps the company to develop a clear business proposal for the organization. The 4 phases are briefly explained below.

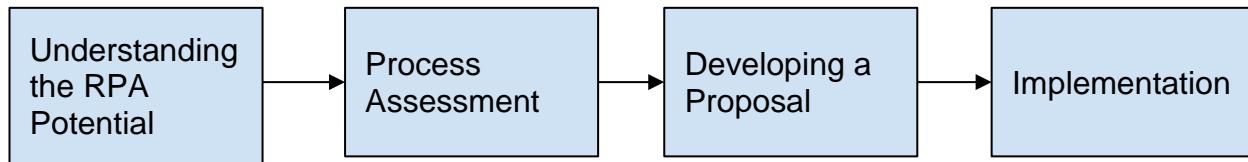


Figure 3. Steps to implement RPA (Aleksandre Asatiani et al., 2016)

#### Phase 1: Understanding the RPA potential

In this phase, the company conducts research and workshops within the organization to understand the potential and identify the major problems and obstacles facing them. During this phase, the company also evaluates the current processes that are performed. By doing so, they can identify the areas where RPA can be implemented. For efficient use of RPA, it is imperative to understand the business problem of the organization, and only then they should start looking for possible solutions and the right RPA software tool to automate the business.

This phase can take up to a day or two (Aleksandre Asatiani et al., 2016).

#### Phase 2: Process Assessment

The most critical part is assessing the main tasks of the organization and how precisely the employees are performing them. This helps the company to understand whether the implementation of RPA would be beneficial for the organization. After the assessment, there could be a list of processes that could be automated. This list is then prioritized based on the potential. An RPA professional must conduct process assessment, else the processes that cannot be automated or do not need automation would also be added to the list, hence wasting the precious time. RPA has its limitations, and it is essential to understand that. If the process is too complicated, the RPA software would not be able to automate them. Hence the company professional must be able to see the broader picture of the potential. The RPA software is such that one can build objects in the software which would come handy in the future. For example, if the person is not sure whether a particular task needs to be automated, for the time being, he/she can build a base for it to be looked into in the future and thus preventing the start from scratch.

To avoid any failures during the RPA implementation, specific processes should not be chosen, and they are as follows:

- Processes that are too complex
- Applications that are not compatible with the RPA software
- Where human judgement is required

- The process has many exceptions and varies from time to time
- When every customer needs the output according to their satisfaction

Before the assessment of processes begins, the company should give a brief idea of what they have understood by their client's explanation while researching the previous phase. This is done to make sure that the company and the client are on the same page before furthering into the assessments. Time taken to complete this phase depends on the size of the client and how many company representatives are conducting the assessment. Once the evaluation is completed and the information is gathered, the company must develop a Proof of Concept (PoC). This PoC indicates whether a particular tool is suitable for automating the process. As the name suggests, the company must prove to their client that RPA is the correct strategy that the company must adapt to automate their services. The primary focus while drafting a PoC should be on indicating that how RPA aligns itself with the organizational policies (Aleksandre Asatiani et al., 2016).

#### Phase 3: Developing a proposal

The business case gives all vital data that must be known to comprehend whether the task is justified regardless of the required venture. Two things are quite often a part of a business case: a business need and a money-saving benefit analysis. From all the information that is gathered in phase 2, a business proposal is developed. The business proposal would indicate how the company would go about in automating the processes and how the different systems can work collectively to achieve the maximum level of customer satisfaction, cost efficiency and improved productivity. It is better if the company includes a working model or a prototype of how the system would operate after the implementation of RPA. This helps the company to develop a trust in the minds of the organization. The proposal must also include the expenses that the organization would have to bare and the time that would be needed to develop and implement the software (Aleksandre Asatiani et al., 2016).

#### Phase 4: Implementation of RPA

If the organization approves the proposal submitted by the company, then the company can go ahead and build an operating RPA software. The experts of the company develop a step by step guide for the robot to follow in order to complete the specific set of tasks. This step by step guide is called an internal library (Aleksandre Asatiani et al., 2016).

#### Functioning of RPA:

As said above, the RPA technology is called Lightweight IT. This can be explained with the help of an Open System Interconnection Reference Model (OSI). The International Organization of Standardization introduced this model which provides a base to communicate and exchange the information between the systems. The OSI model consists of 7 layers which are used as a technique to structure and illustrate what each layer serves as during data transfer between devices. All the layers of the system have an exclusive function and value addition before the information is passed on to the proceeding layer (Bora et al., 2014). The first layer is called the application layer. The data passes through all the layers and is broken down

into smaller bits of data before being sent to the receiver via a physical layer. The receiver will collect the data through its own physical layer. To restore the data, it is passed through all the layers after which it becomes readable and can be used by the application layer. The layers of the OSI model are explained below: (Bora et al., 2014).

#### Layer 1: Physical Layer

This layer handles the sets of data that are sent between the hubs and computers in a network. It is responsible for transferring the data bits across the hardware. This layer depicts the hardware of the system such as storage devices and ethernet cables, and its function is to transfer to where it belongs.

#### Layer 2: Data Link Layer

The layer allows the data movement over a network. It establishes an error-free connection between devices to transfer the data. This layer receives the data bits sent by the physical layer and transforms it into frames. When bits are arranged in an order, they are called frames (Bora et al., 2014).

## The 7 Layers of OSI

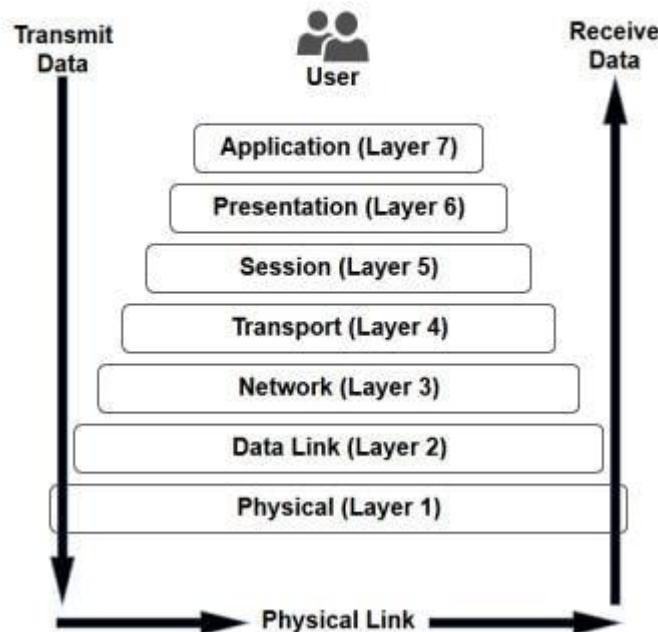


Figure 4. Representation of OSI Reference Model (Bora et al., 2014)

#### Layer 3: Network Layer

This layer is responsible for routing the data bundles to the correct address. The address of a device can be found with the help of IP addresses. What physical path will the data takes to reach the destination is decided by the network layer.

#### Layer 4: Transport Layer

Transport layer ensures that the data is in the right arrangement and ready for transportation. It is responsible

for detecting and removing any error present in the data. The information is transported through the active protocols in the transportation layer. Transmission Control Protocol (TCP) is the most widely used protocol to transfer data over the internet (Bora et al., 2014).

#### Layer 5: Session Layer

Session layer comes into play when the devices on a network start communicating with each other. This layer is responsible for contacting, communicating, establishing

and terminating the connection between the devices. For example, when a user accesses a webpage, this layer becomes active to communicate with the webpage server and determine the encryption of the data (Bora et al., 2014).

#### *Layer 6: Presentation Layer*

This layer formats the data in a way so that the application layer can use it. This layer converts protocols, translates data, interprets commands and encrypts and decrypts data whenever necessary.

#### *Layer 7: Application Layer*

This layer is responsible for providing communication between software which is running the device and the

networking protocol. It allows the applications to interrelate with the network. This is the highest layer in the OSI model and is used by applications to open the received file or create a file to be sent (Bora et al., 2014).

#### *The Application of RPA in a Business Model:*

We have understood how the organization would go about in implementing RPA into their system. However, the question now is, what are the areas that an organization can automate or what are the areas that an organization should automate? According to Anagnoste (2018), the deployment of RPA has been seen the most in the areas of finance and supply chain management. The following data shows what services can be automated in those departments.

Table 2: Services that can be automated in the finance department (Anagnoste, 2018)

*Finance Department:*

Accounts Receivable	<ul style="list-style-type: none"> <li>Processing of order</li> <li>Preparing cash receipts and sending notifications via email for late notices</li> <li>Credit endorsements</li> </ul>
Accounts payable	<ul style="list-style-type: none"> <li>Setting up and maintaining the accounts of vendors</li> <li>Automating the work process procedures and endorsements</li> <li>Data selection and payment methods</li> </ul>
Journal entries	<ul style="list-style-type: none"> <li>ERP posting</li> <li>Validating accounts and journal entries</li> <li>Using pre-filled templates to create journal entries</li> </ul>
Operational finance and accounting	<ul style="list-style-type: none"> <li>Gathering the information for transactions of revenue and information of lease agreements</li> <li>Generating outcomes and reports on the internal analysis</li> <li>Verifying the monthly sales data and calculating the commission</li> </ul>
Bank reconciliation	<ul style="list-style-type: none"> <li>Handling discrepancies while creating journal entries</li> <li>Reconciling balances</li> <li>Gathering information from different systems and uploading the details of the transaction</li> </ul>

Table 3: Services that can be automated in the supply chain management department (Anagnoste, 2018)

*Supply Chain Management Department:*

Spend analytics	<ul style="list-style-type: none"> <li>Pre-filling the requirements of a periodic report</li> <li>Gathering data from various sources for automated filling of reports</li> </ul>
Payment requisition	<ul style="list-style-type: none"> <li>Matching and reconciling the payment receipts and invoices</li> <li>End to end automation of the purchasing process for the customer</li> </ul>
Scorecards	<ul style="list-style-type: none"> <li>Collecting information from various sources</li> <li>Automatically creating dashboards and scorecards</li> </ul>
Expense management	<ul style="list-style-type: none"> <li>Preparing sheet for standard expenses</li> <li>Auto-forwarding of usual expenses</li> </ul>
Procurement Management	<ul style="list-style-type: none"> <li>Managing data of the inventory for procurement purposes</li> <li>Updating the Bill of Materials</li> </ul>

Apart from the departments mentioned above, there are other areas in an organization where RPA can be implemented. These areas could be server processing, storing information and security (Fung, 2015).

Table 4. Use cases for automation in a business (Fung, 2015).

Server automation	<ul style="list-style-type: none"> <li>Automate server provisioning and de-provisioning to perform server discovery and capturing and cloning server image</li> <li>Automate server restart and shutdown to reduce energy consumption</li> <li>Automate server and disc space clean up to remove the server activity log and temporary files</li> </ul>
Storage automation	<ul style="list-style-type: none"> <li>Automate file and folder handling to avoid accidentally deleting, moving or archiving of data</li> </ul>
Network automation	<ul style="list-style-type: none"> <li>Investigate and find poor configurations through the system so solutions can be sent before they affect the entire system</li> <li>Performing automatic system upgrades for updated interface configurations.</li> </ul>
Testing automation	<ul style="list-style-type: none"> <li>Automate end to end application testing</li> <li>Automate the setup of pre-defined test schedule for quicker results</li> </ul>
Security automation	<ul style="list-style-type: none"> <li>To secure the design, configuration, auditing and other IT services</li> <li>Allow automation and adjustment of technical security operations</li> </ul>

Santiago Aguirre, (2017) conducted a case study on a Business Process Outsourcing Firm, and the results showed significant differences between the two conditions. The conditions being, when the BPO Firm did not make use of RPA and when the Firm made use of RPA. The task given to the Firm was to generate a payment receipt when requested by a customer. Now, in the first case, the team was divided into two. One that receives the request from the customer over a phone call and the other team which works in the back-end gathers the data from the various locations, compiles them and then prepares a payment receipt. In the second case when the Firm made use of the RPA technology, there was a need of only one team, and

that is the front-end team which interacts with the client, while the RPA technology takes care of the back-end tasks of collecting the data and generating the payment receipt. According to the case study, where the results were taken continuously over a week, it was noticed that the time when RPA was implemented, there were 40% more customers catered to as to when RPA was not implemented. This shows a significant improvement in productivity in just over a week. Productivity improvement is one of the many benefits of implementing RPA into the organization. The table below shows the results of the case study mentioned above.

Table 5: Results after conducting the case study (Santiago Aguirre, 2017)

Implementing RPA	Total team members	22
	Total customers catered to	4907
	Customers per member	224
Without implementing RPA	Total team members	44
	Total customers catered to	3505
	Customers per member	80

The primary aim of the RPA software is to help the organization achieve its mission. RPA can evolve the organization strategically and aid in increasing its business value. According to Kämäräinen (2018), this can be achieved by developing an RPA Center of Excellence (CoE). The RPA CoE is accountable for the organization's tasks such as, to ensure stability, alignment with IT governance, and measures to make RPA successful. The CoE again has different teams working coherently, but the

core of RPA is its Robotic Operation Team (ROT). ROT has different roles, and every role is responsible for some specific work. The roles can be divided into 3 groups namely, RPA enabler, RPA Creator and RPA Controller. The RPA enabler instigates the idea of RPA and ensures effective adoption throughout the organization. The RPA Creator is responsible for making the entire RPA project go live. The RPA Controller provides supervision and support to the implemented software robots.

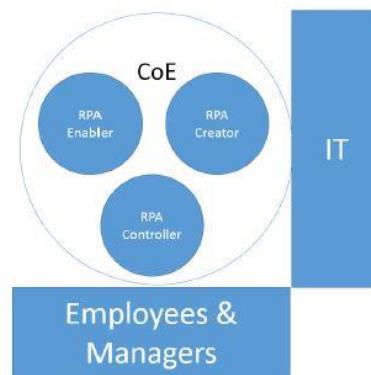


Figure 5. RPA Center of Excellence (Kämäräinen, 2018)

The figure shows the vital shareholders for an RPA management team. Once the concept of RPA has been approved by the IT department, the software robots get integrated into the company's technological contributions (Kämäräinen, 2018). As per Phil (2012), the IT department provides assistance in resolving the technical challenges and enables the traditional architecture planning and security. It is essential to have an IT department as it affects the functionality of the software robot by keeping it updated regularly.

Employers and Managers are the second vital shareholder of the RPA management team. The role played by the employers and management is vital as it helps in developing the robotic software and also creates new jobs for competent individuals. To have more individuals in the developing team, the employers can even be educated on the RPA technology to achieve the full potential of RPA (Phil, 2012).

#### *The RPA Market:*

The RPA marketplace is comprised of RPA technology vendors and service providers (Oosterheert, 2017). The vendors are the organizations who aim to develop and deliver the automation software to the businesses. The service provider must consult and support the businesses who want to implement RPA. In rare cases, the vendors and service providers work independently, and, in this case, they offer their own automation technology which has been developed in-house. But in most of the cases, the vendors and service providers work together with a coopetition strategy (Le Clair, 2017). Coopetition is a combination of cooperation and competition in a market. According to Dadnino et al. (2012), if an organization works together and follows a coopetition strategy, they tend to achieve more as this would allow them to research and develop new strategies. The coopetition strategy is also further categorized into two forms. The first is when the vendor and creator work together to design an automation solution according to the specific needs of the customer. In the second form, there is a license agreement signed by the vendor and service provider and every software sold to the client, the service provider receives some amount of compensation by the technology vendor.

Le Clair (2017) conducted research and calculated a total of 38 RPA technology vendors. These vendors usually give

solutions which differ in characteristics and complexity. The first type of solution is a desktop-based solution which requires a minimal amount of programming, and these types of solutions are based on license agreements between the vendors and service providers. These solutions integrate data and applications but have restricted the ability to automate a process. The second type of solution is an enterprise-oriented solution, and these are hosted on a server. It allows the automation of tasks that have multiple subprograms and subsystems. The third type of solution is a combination of the first and second type. In the third type, it depends upon the client whether they want to deploy the software on a desktop or on a server.

#### *Limitations of RPA:*

There are significant benefits that can be seen once an organization implements RPA, but like every technology has their shortcomings, RPA too is not the only solution to the business models that help the organizations to improve their productivity and customer satisfaction. (Penttinens, 2018). Limitations of the technology are as follows:

- As RPA is a computer-based arrangement, the information sources must be computerized, and there must be a predefined set of rules and regulations. The programmed robots can, for instance, move and tap the mouse, decipher content and pictures on the screen, and can copy and paste characters. This means RPA cannot interpret any information that has come in a non-electronic manner with an unstructured input. For example, when a company receives a request via a handwritten letter, the RPA software cannot comprehend it, and hence the request has to be solved manually. Else, the company will have to use RPA along with other technologies which first transform the paper-based input into a digital input. This can become costly, and hence the organization would prefer using other solutions such as Straight Through Processing (STP). (Penttinens, 2018)
- Organizations should know about information originating from different sources. For instance, during the procurement of goods, the vendor invoices might have various arrangements, with

fields put in various regions. For the software to have the ability to comprehend the receipt, all vendor invoices must be received in a similar format. It is difficult for the operators to be aware of all the changes being made in the invoices and implement into the automation code. (D'Addona, 2018)

- RPA is different from Artificial Intelligence (AI) and Cognitive Computing Solutions. It is necessary to understand that RPA technology cannot make decisions based on its judgement and previous experiences. Therefore, this technology has a 'shelf life.' As the environment changes, the software may become redundant and obsolete. That means RPA can only be utilized in areas that do not have many variations and the procedures are strictly defined. Hence, working with RPA can be a tricky solution as one first needs to categorize the work and then select the one that has maximum repetitive procedures. (Penttinens, 2018).
- RPA is not ideal for taking care of the vast transaction masses, and, thus, at present, it is, for the most part, a temporary solution to conquer any hindrance between largescale system improvement and running manual procedures on the small-scale systems. RPA cannot provide end-to-end solutions for inefficient processes. (Penttinens, 2018).
- When RPA is integrated into the system, the software replaces a Full-Time Equivalent (FTE) worker, the working of the software can be understood only by a few who know how to use the technology.

#### Future Scope:

The advantages of implementing RPA keeps on increasing, and there are more and more organizations starting their arrangements. However, RPA is still subjected to many speculations. Hence, organizations require an all-around planned methodology to turn from meeting room discussions to genuine achievement. Coordinated efficiently, RPA selection is preparing to accomplish the profits and operational efficiencies wanted by global organizations. (Willcocks et al., 2015)

As of the current scenario, RPA has not developed as much as Artificial Intelligence (AI) and Cognitive Learning. AI is the part of computer technology that is concerned with creating machines and systems that are intelligent, i.e. that have the ability to replicate the activities of a human in a working environment. It can even replicate a human's consciousness allowing the system to think, learn and grow from its environment and past experiences. (Pottala, 2018). RPA is referred to as automating transactions, and AI is the automation which handles the decision-making process. According to Oosterheert (2017), RPA has immense

potential, but currently, it is being used just to connect the gap between the new and old method of processing.

With the help of AI and machine learning algorithm, the systems become cognitive and thus can be trained to perform specialized tasks. The tasks could range from anywhere between sensing, predicting, preventing and the system can have emotional intelligence. In the following decade, it is believed that more workgroups will be made from both human and automated FTEs, each performing processes for which they are most appropriate. The robots will rapidly gather, cumulate, and rearrange information for workers to evaluate and follow up on upon. People will manage new business prerequisites, investigate issues and tackle unstructured problems. We are as of now observing a portion of this today, however going ahead robots will not require as much pre-design or as much point by point guidance as devices develop and as RPA moves to the cloud. (Willcocks et al., 2016).

It is necessary for organizations to have a process-centric view especially when digital technologies have become a significant consideration. To implement RPA with a broader scope for process management and digital manufacturing, it will have to consider technologies such as Intelligent Automation and Machine Learning. By doing so, the software would be able to provide end-to-end solutions and comply with the organization's governance.

With time, the real potential of RPA would be seen where it would become more knitted with the enterprise software. Application Program Interface (API) will play a significant role to allow technologies to exchange data. As the integration of different technologies and software increases, there will be more developmental opportunities (Willcocks et al., 2016).

#### III. TECHNICAL DISCUSSION:

This entire report was aimed at how RPA came into being, how to successfully implement it and what are some of the areas where organizations can plan to implement the technology. Since RPA is a relatively new concept, it was essential to define the idea of RPA and differentiate between RPA and traditional methods such as a BPO. After studying various reports and journal papers based on companies that have already integrated RPA into the system, we can now talk about the things that are necessary and what are the things that should be avoided if one needs a successful RPA roadmap.

According to Guðrún Lilja Sigurðardóttir, (2018) when the implementation roadmaps of BPM and RPA are compared to each other, the only difference that can be seen is that BPM is more focused on developing a Heavyweight IT software to automate the entire process of the organization and it takes care of end-to-end business solutions. Whereas, RPA uses a robotic software solution which is a Lightweight IT software mainly used to automate the back-end processes. Since RPA is a Lightweight IT software, it

has a different presentation layer and does not affect any of the underlying system logic.

To avoid any risks or failures during the implementation stage of RPA, there should be a separate department that only looks after the area with automation capabilities. This department is called the Center of Excellence, and the main aim of the CoE would be to identify the processes and build a plan that can be considered while developing a roadmap for the implementation of RPA. An organization should also have the financial potential to maintain the technology and also to update it with the frequent changes in the trend. More the number of automation tasks more is the complexity in implementing the RPA operating model. The CoE will investigate the processes that require automation and then develop software before the production starts. Operation and maintenance of the software should also be the duty of the same department. This department must only include those who have prior knowledge about the software or those who have been previously trained in operating the RPA technology. This will ensure that the software will have an optimum life cycle. (Guðrún Lilja Sigurðardóttir, 2018)

The key to successful RPA roadmap is the different stages. One must realize that all the stages are interrelated to each other. Therefore, if the previous stage has given false results, but it has been overlooked, the next phase will also be affected and thus will interfere with the testing stage which leads to failure. The first stage of identifying the processes is the most vital stage.

The advantage of using RPA is that it can even suggest new strategies for the future and how-to re-engineer the current processes for better productivity. The upside of having a process re-engineered as a significant aspect of the guide for RPA is very direct; process re-engineering can emphasize on opportunities for processes that are reasonable for RPA in the organization and making sure the process is prepared for automation. If due to some reason, the processes are not prepared for automation, it could negatively affect the development. There must be a set of standards that must be followed for the tasks involving RPA. The re-engineering process consists of two parts, re-thinking and re-designing. With the help of both, the efficiency of automating the processes can be improved.

There are three primary RPA tools in the market, and they are as follows:

- *UiPath:*  
An organization which started in 2005 as an outsourcing company. As the market demand increased, they developed an industry standard platform for planning and training software bots. They launched their first RPA platform in 2013. Currently, there are numerous machines in the world embedded with their source code. These machines are the ones that are used in call centres, healthcare, data extraction, process automation,

etc. (Ruchi Issac et al., 2018). Their automation platform comprises three products; Studio, Orchestrator and Robot. A Studio is a software providing automation library and configured tools to develop a coding-free robot. Developers can use VB.NET or C# to create new functions and develop reusable content for the automation library. The Orchestrator is a web app server to orchestrate the robots. The robots can be attended or unattended and can be used for automation purposes in the front as well as back offices (Tran Duc et al., 2018).

- *Automation Anywhere:*

A company which started as Tethys Solutions re-branded itself to Automation Anywhere. The organization's products are intended to permit execution of automated business, and IT forms over different machines, considering varieties in frameworks, application stacking times and Internet speeds. The server edition of the software developed by them enables clients to create electronic forms with collaboration concentrated security, client administration, deployment and backup (Ruchi Issac et al., 2018). Automation Anywhere specializes in re-coding rule-based processes for the front-end automation system. They utilize IQ Bots and Language Bots which are high-end cognitive tools used for making decisions in partly unstructured tasks. Their RPA development tool provides various functional components for the automation library. This company has a significant number of clients as their license cost is the cheapest among the RPA vendors (Tran Duc et al., 2018).

- *Blue Prism:*

Blue Prism was established in 2001 by a team of process automation specialists to develop software that could be utilized to enhance the proficiency and adequacy of associations. Their attention was on the executive back office where they perceived a huge unfulfilled requirement for automation (Ruchi Issac et al., 2018). The Blue Prism automation robots operate through cloud platforms which gives them an opportunity to interact with different software applications and data centers that are designed using JAVA, CITRIX and HTML. The configuration language of this software is such that the business users can automate a specific process just by dragging and dropping pre-configured objects. Blue Prism works in collaboration with firms that use smart industrial machining such as Optical Character Recognition (OCR) which gives them a competitive edge over the other RPA vendors (Tran Duc et al., 2018).

The automation technology creates two scenarios which show how it has affected the future of employment, i.e. a

pessimistic and an optimistic scenario. Pessimistic scenario depicts that the automation technology would take away the jobs and replace them with robots thus leaving a significant amount of people unemployed. Frey et al., (2017) conducted research which estimated that around 47 percent of the jobs in the United States is vulnerable to the automation market. This is because there are certain areas in an organization which provide employment to a high number of labourers but these areas can be entirely automated. Hence, Frey et al., (2017) said that automation would lead to high scale unemployment situations. The optimistic scenario emphasizes the improvement in productivity and job creation. Joel Bilt et al., (2018) states that the penetration of technological advancements into an organization may destroy some jobs, but it will spawn new industries and create new jobs. The automation sector will give the able young individuals a chance to showcase their talent. The artificial intelligence and cognitive technology will work together and complement human skills rather than replacing them entirely. It is believed that even though automation would take away the repetitive and less intellectually challenging jobs, it will create new opportunities and forms of employment for the individuals (Joel Bilt et al., 2018).

#### IV. CONCLUSION:

With the rapidly changing customer requirements and the ever-increasing industrial developments, the organizations are considering different approaches in which they can accomplish the maximum number of processes and while consuming a minimum amount of time. This leads the organizations to the technology of RPA. RPA is considered a software tool that imitates the human action which performs tasks that are repetitive in nature and does not add much value to the organization. The tasks can be as simple as copying and pasting data from one place to another, recovering information from the system or merging various sets of data. The primary advantages of RPA are; reduction in expenses, increasing throughput time, increasing efficiency and increasing productivity. Also, if most of the

tasks are conducted by the robots, the quality and control increases.

Organizations must realize that RPA is more suited for tasks that have high volume and low variations and there is no need for external judgement or any decision making involved with the task. While implementing, the organizations need not worry about the underlying system control codes as the RPA technology has a separate presentation layer, and it sits on top of the existing systems. Unlike the other Business Process Management systems, RPA does not need the operator to have programming skills. One can simply drag, drop and link the items to configure the software.

RPA technology is an ideal substitute for outsourcing various tasks. The organizations would only have to bare the initial investment, but it later leads to lower operating cost, improved cycle time and improved customer satisfaction.

A dynamic roadmap has been discussed which shows the stages for a successful RPA implementation. The roadmap even indicates what the vital components of the stage are. Every organization must also have a dedicated department that handles, monitors and maintains the RPA software and keeping it up and running always. If the organization decides to improve a process, it must be done before the development begins.

There is still a lot of scope for the development of RPA as a system. It can be integrated with other systems such as Artificial Intelligence and Machine Learning to make the technology self-reliant for end-to-end services. It is said that organizations that implement automation would kill over a million jobs and would replace the full-time employees, but on the other hand, it will also create opportunities for more talented employees and the others would get opportunities to learn and develop new skills which are beneficial to the organization and to themselves.

V. ABBREVIATIONS:

ERP:	Enterprise Resource Planning
JIT:	Just in Time
PLC:	Programmable Logic Circuits
CNC:	Computer Numerical Control
CAD:	Computer-Aided Design
CAPP:	Computer Aided Process Planning
CPS:	Cyber-Physical Systems
IoT:	Internet of Things
BPM:	Business Process Management
RPA:	Robotic Process Automation
AGV:	Automated Guided Vehicle
ML:	Machine Learning
TQM:	Total Quality Management
BPO:	Business Process Outsourcing
CRM:	Customer Relationship Management
OSI	Open System Interconnection
PoC:	Proof of Concept
STP:	Straight Through Processing
FTE:	Full-Time Equivalent
AI:	Artificial Intelligence
COE	Center of Excellence
ROT	Robotic Operation Team
OCR	Optical Character Recognition
API:	Application Program Interface

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