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A comparison Study Between Cloud Enterprise Resource Planning and Edge Enterprise Resource Planning to Create Value for Egyptian Business Firms: Value-Based Approach

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Abstract:

Businesses must contend with a constantly evolving technological environment. The enterprise resource planning (ERP) system is one area where these recurrent adjustments occur. The next generation of ERP systems is powered by technologies like machine learning, Internet of Things (IOT), and business intelligence (BI). Two enhanced business resource planning systems have been studied in this study: an edge enterprise resource planning system and a cloud enterprise resource planning system. What constitutes an intelligent ERP system, and what opportunities does it present for businesses to enhance value? To answer these questions an explanation was conducted. The results showed replacing convential ERP with advanced ERP Systems are not strait forward, Organizational cloud ERP initiatives present a range of considerations. These systems are thoroughly integrated, primarily providing benefits such as enhanced privacy and security, cost reductions, expanded brand reach, resource optimization, and user-friendly interfaces. While these improved systems offer numerous advantages, they also come with certain drawbacks. Tradeoff between cans and pros should be conducted to show what is better for business firms to create value. Future studies should concentrate on creating a brand-new ERP system based on edge computing reference architecture that has all the necessary capabilities to get over the drawbacks of both cloud and edge ERP systems.

Keywords: Enterprise Resources Planning, Cloud ERP, Edge ERP, Intelligent ERP, Value Creation.

1-Introduction:

ERP Systems are among the most often used information technologies in commercial organizations. These are a neatly arranged group of programs that manage business transactions. Extensive business process utilizing standard procedures, a common database, and data sharing between and among functional domains. It acts a central location for storing, departments and business process to manage transactions and data exchange across and within different functional areas. Implementing an enterprise system represents a significant investment and a complex undertaking. It involves considerable risk and entails substantial costs, impacting both the core functionalities and supportive operations of the organization. Although, business operations technology and functional integration to synchronous the flow of information with the content

flow of products or services in very benefit for the companies, representing one of the significance reasons for ERP adoption and implementation.

Organizations may find considerable value in adopting ERP systems enhanced by advanced technologies such as cloud and edge computing. These systems offer several compelling advantages. Firstly, they possess the capability to store and analyze extensive volumes of data efficiently. Secondly, they enable continuous and real-time exchange of information between vendors and purchasers, enhancing operational transparency and responsiveness. Thirdly, these systems can rapidly adapt to shifts in consumer behavior and evolving business demands.

It is crucial for the core principles and functionalities of cloud and edge computing to be meticulously tailored to meet the specific needs of ERP frameworks. Furthermore, both cloud-based ERP (C-ERP) systems and edge-based ERP systems incorporate respectively an operational host ERP along with a robust infrastructure supported by a cloud or edge provider.

This integration ensures seamless operation flow across various business processes. These infrastructures, which can overcome the drawbacks of conventional centralized ERP Systems, consist of software, hardware, storage, networks, and other resources. Recently, solutions have been created for a wide range of application domains, such as the internet of things (IOT) and smart factories. Indeed, resolving the increasingly complex difficulties of the economy and industrial revolution requires integrating data and cyber physical processes while adhering to business needs. As a result, research initiatives ought to be created to advance our understanding of how cloud computing and ERP integrate.

This study aims to further the body of knowledge on cloud-based Enterprise Resource Planning (ERP) and edge ERP systems, areas that have yet to be thoroughly explored. It also forecasts the future trajectories of these technologies. This paper commences with an exhaustive overview of both Cloud ERP (C-ERP) and Edge ERP (E-ERP) systems, examining key factors influencing organizations' decisions to migrate their ERP solutions to cloud or edge environments as a strategy for enhancing business value.

The document is organized into several sections: Section Two delves into the theoretical frameworks underpinning C-ERP and E-ERP. The third section discusses the benefits, challenges, opportunities, and limitations associated with deploying C-ERP and E-ERP in enterprise settings.

Additionally, this paper outlines prospective research avenues pertinent in the era of intelligent ERP catered towards demanding business environments.

2-Research Problem:

In today's global market, it is imperative for a modern business to integrate an Enterprise Resource Planning (ERP) system. This system has become foundational as trading operations have transformed with the adoption of various IT systems, including ERPs. Over time, ERP systems have undergone significant evolution; they originated as simple accounting systems but have since developed into comprehensive tools that support nearly all aspects of business operations. The intelligent ERP system (IERP) is the next development of the ERP systems that are in use today, according to Jenab et al. (2019, p. 151). In contrast to a more conventional ERP system, an I-ERP system leverages technologies like machine learning and business intelligence to improve business choices and better support digital transformation.

Carlsson-Wall et al. (2018, p.177) characterize the shift from the conventional ERP system as a digitalization process brought on by automation and artificial intelligence. Another area that requires improvement is the realm of Internet of Things (IoT) devices. Almost every device can send data to a system and establish a connection to the Internet. According to Ching-Hai et al. (2018), p. 246-247, the objective of an IoT device with respect to ERP systems is to provide the system with automatic data input. The data could be organized and gathered via technology such as barcodes, RFID technology, and various sensors. (Ching-Hai et al. 2018, p. 246-247). IoT device data creates new possibilities for enhancing an ERP system's effectiveness (Ching-Hai et al. 2018, p. 246-247).

Along with IoT, machine learning is also a new frontier in the ERP industry. The next step of the ERP systems lifecycle is currently pointing towards machine learning (Jenab et al. 2019 p.151). The basic premise of machine learning, according to Lee et al. (2018, p.111) is to transform into useful predictions. An example of machine learning within the ERP field is demand data forecasting enabled by using customer data to predict when sales will occur (Lee et al. 2018, p111). Integrating machine learning technology into an ERP system represents a novel approach within the industry. Jenab et al. (2019, p.152) explains machine learning can be applied to enhance the planning for a company by learning from its previous experience. An ERP system that leverages machine learning is more intelligent and gives businesses more important information than a typical ERP system, claims Jenab et al. (2019, p. 151). An ERP system that leverages machine learning is more intelligent and gives businesses more important information than a typical ERP system, claims Jenab et al (2019, p. 151).

Business intelligence (BI) is the practice of using computerized systems that are powered by data to make business choices, according to Rahimi & Rostamib (2015, p. 8). Typically, there is close integration between ERP and BI systems (Rahimi and Rostamib 2015, p9). Although these two systems have some fundamental differences, they are essentially two sides of the same coin. The objective of I-ERP systems, as briefly stated before, is to combine BI with machine learning and other technologies to provide businesses with relevant and practical insights (Jenab at el. 2019, p.154).

Due to business intelligence (BI), two choices for enterprise resource planning systems have emerged. Cloud ERP and Edge ER Pare are substitutes for conventional, centralized, and monolithic ERP systems in the enterprise space. Recently, E-ERP and E-ERP solutions have been created for a wide range of application domains, such as smart factories and the industrial Internet of things (I-I0T). An advanced ERP system can facilitate the integration of internal and external resources and management choices while streamlining business automation and facility operations. There haven't been many studies on this subject, therefore this study compares two cutting-edge ERP systems to see:

1-What are the differences between Cloud Enterprise Resource Planning and Edge Enterprise Resource Planning in greating Value for Businesses Firms?

2- What is the future Framework for Intelligent Enterprise Resource Planning?

3-Research Purpose and Method:

The purpose of this study is to provide a framework for understanding the effects of combining edge-enterprise and cloud-computing enterprise research. Additionally, this framework will highlight the capabilities and advantages of integrating different cloud service types with conventional ERP. Figure 1 will be used to present the study framework.

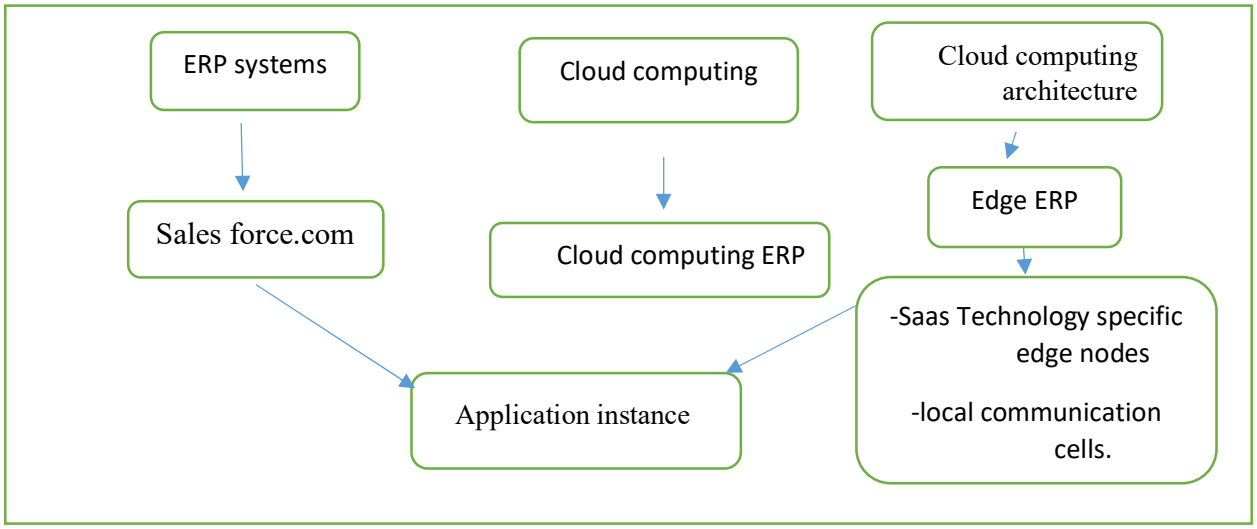

Figure 1. A research framework
Source:(The Researcher).

The objectives include:

1- To explore the theory, features, and essential technologies of cloud-based ERP systems, as well as to understand the architectures associated with cloud computing and Cloud-ERP.
2- Enterprise Resource Planning (ERP) through cloud-based application platforms.
3- Analyzing cloud-based ERP (C-ERP) and edge computing ERP solutions (E-ERP) as alternatives to the traditional, centralized, and monolithic enterprise resource planning systems.

An extensive analysis of the body of research on ERP systems and the distinctions between traditional and cloud-based ERP systems should be the first step. It also describes the cloud computing technology. It presents cloud computing architecture and cloud deployment models using this definition. Thirdly, discuss the architecture of cloud computing ERP and why it's a significant concern for organizations. Finally, it discusses cloud computing, Salesforce.com, and the kinds of businesses that could benefit from switching to Sales Force while showcasing the force platform application instance.

4-Research Methodology:

This paper employed a qualitative research methodology. A qualitative study approach is employed when the data collection is concentrated on softer data, such as found when conducting qualitative interviews, according to Patel and Davidsson (2011, p. 14). The quality three participants with expertise in ERP and BI were interviewed as part of the study's methodology, which also included reading through earlier publications on the subject that might be found in books and journals. This strategy was selected due to the relatively recent introduction of I-ERP into the ERP systems domain. Consequently, it is more appropriate to carefully review the theory and carry out qualitative interviews in order to derive a more thorough investigation of the phenomenon. According to Patel and Davidsson (2011, p. 14), another justification for selecting a qualitative study is to provide answers to the queries "what is this?" or "what constitutes a phenomenon? It is therefore possible to claim that this bachelor thesis's goal and providing a solution to the issue of what something is are related. As a result, the decision to conduct a qualitative study is evident in the kind of data that is analyzed as well as in the choice of the study's objective.

5-ERP Systems: Comparison between Conventional (Traditional) and Cloud Computing Enterprise Resource Planning:

ERP is the term for the technologies that have been developed to help management and staff achieve the needs of lower product costs and increased efficiency (Kiadehi and Mohammadi, 2012). In order to manage internal resources like finance, human resources (HR), manufacturing, and logistics, as well as to connect the company with clients and suppliers through supply chain management (SCM) and customer relationship management (CRM), ERP systems integrate the

departments of various businesses through various business functions (Dweib, et al.2014). The concept of the ERP system is shown in Figure 2.

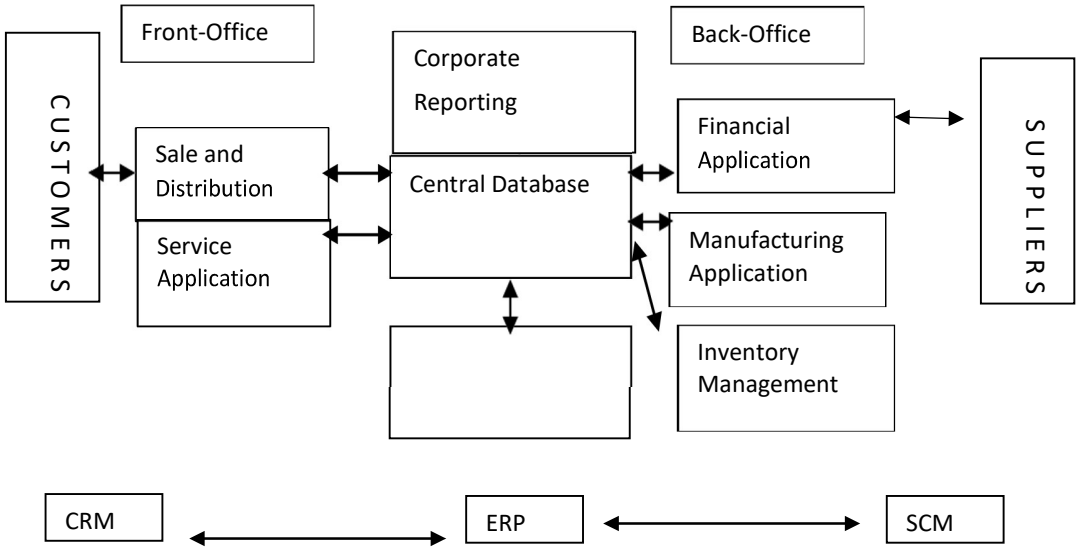

Figure 2. ERP System Concept
Source: (Rashid et al. 2002).

An ERP system generally encompasses all the necessary IT technologies required for the optimal functioning of ERP software. An enterprise information system can be designed, implemented, run, and maintained by an organization with the help of an ERP system. This system consists of back-end network architecture for data exchange between and within information systems, computing hardware for hosting and executing software applications, and software that supports business activities and procedures (Dweib,et.al.2014). Accounting information systems, financial information systems, production information systems, marketing information systems, and human resource information systems are just a few of the services and solutions that an ERP system may offer (Yen, et.al, 2002). ERP systems are being used by businesses or organizations to boost growth and revenues. ERM seeks to save costs and increase benefits for businesses. However, the effect of ERP is unsettling when it is used. According to Trunick (1999),20% of ERP adoptions are abandoned as complete failures, and 40% of ERP deployments only reach a partial completion. According to the survey, a large percentage of ERP implementations—between 60% and 90%—failed to achieve the ROI that was identified during the project, citing considerable risks and challenges.

The architecture and the ERP operating model have been crucial innovations in the field of ERP research in order to address these issues. Delivering services exactly as needed to clients is what cloud computing entails. It can be thought of as an abstraction of the underlying platform, sparing clients the headaches of designing, programming, and upkeep. In the meantime, one unique benefit

of cloud computing that can enhance ERP performance is its ability to dynamically modify the services (Yen, et.al, 2002). The cloud computing data centers that support the established strategies and client expectations can automate the adjustments. ERP in the cloud will be the ideal choice for businesses (Yen, et.al, 2002). The differences between cloud computing ERP and conventional (traditional) ERP are indicated in Table 1.

Table 1: Disparities between Conventional Computing (Traditional) and Cloud Computing (ERP)

Conventional Computing (Traditional)	**Cloud Computing ERP**
Applications: * Applications on the client side * Client/server software * Local server apps through a web interface * Data and processes are stored locally or on a PC.	End user cloud services 。 Rich internet application 。 Web 2.0 technologies 。 Software-as-a-services 。 Process and data are kept by the services provider.
Developer tools and techniques 。 Client-side development tool 。 Architecture focused on services 。 Composite application 。 Intellectual property APIs, like win 32	Application-Components-as-a-Services 。 software services hosted on the internet 。 Development tools hosted on the web 。 Community development tools for sharedtemplates and code 。 APIs and schema from proprietary service providers
Middleware 。 App sever 。 Storage of files and objects 。 Database 。 Integration sever	Software-platform-as-service 。 Hosted application platform 。 Hosted file, object, and data stores 。 Hosted database 。 Integration of Software as a Service
Infrastructure in physical form 。 Sever 。 Disks 。 Networks 。 System administration	Virtual-infrastructure as-a-service 。 Virtual sever 。 Storage shares 。 Configurations for virtual LANs 。 Administration as a severe

Cost ◦ High cost in implementation ◦ High cost in progress ◦ High licensing expenses ◦ High cost in licensing ◦ High update and modification costs for ERP	Cost ◦ Low cost in implementation ◦ Low cost in ongoing ◦ Low cost in support cost ◦ High cost in licensing ◦ Low cost in ERP update and modification
Others ◦ Internet independence ◦ Trials and audits are simple. ◦ Closed to commercial entities	Others ◦ Reliance on the internet ◦ Trials and audits are complicated ◦ Available to commercial entities

Source : (Okezie, et al2012 & Motalab and Shohag, 2011)

6- Cloud Computing Transform Model:

Cloud computing is a new business model that has a big impact on the whole IT sector. It can help firms obtain these services at a lower cost in addition to making high-performance IT services more affordable for small and medium-sized businesses than for large corporations (Saini et al., 2011).

6-1- Cloud Computing Systems Analysis:

Operating platforms, software, and infrastructure in a virtualized environment that allows users to access and use its components over the Internet is known as cloud computing. Cloud computing systems come in four varieties: private, public, hybrid, and communal.

***6-1-1- Public Cloud Computing*:** In this model, a company offering cloud services owns the cloud computing infrastructure, which includes storage, applications, and other resources. The public can access this infrastructure. Three examples of public cloud service providers are Microsoft, Google, and Amazon AWS. Web browsers are the only way for users to access this service, which they control and run the infrastructure for. The public can access a number of well-known cloud services, such as Salesforce.com, Google App Engine, and Amazon EC2 (Youssef,2012).

***6-1-2- Private Cloud Computing*:** The hardware and other IT resources that comprise the cloud infrastructure are run by a single organization. Either the business or an outsider could be in charge of it. Private clouds are regarded as more secure than public clouds since their

users are regarded as reliable members of the company. Users of hardware and IT infrastructures housed in an organization or used in physical isolation from other infrastructures will not share hardware or software with one another.

***6-1-3- Hybrid cloud computing*:** two or more cloud computing structures (private or public) are combined to form the cloud architecture. With the help of hybrid clouds, businesses can maximize their resource usage. As a result, the private component of the hybrid cloud can manage its essential functions, while the public component can handle other auxiliary duties (zissis, and Lekkas,2012). Hybrid cloud computing is contained by a secure network and is administered and supplied as a single entity.

***6-1-4- Community cloud computing*:** refers to the sharing of a cloud computing environment among multiple organizations under the management of a third party or another participating organization. The educational cloud, which is utilized by universities and other institutions worldwide to offer services for research and education, is an illustration of a community cloud (Youssef,2012). Models for cloud deployment are depicted in Figure 3, and Table 2 compares these models with one another (Subashini, et.al,2011).

Table 2. Models of cloud deployment comparison

Deployment Model	Scope of services	Owned by	Managed by	Security level	Location
Public	The general public and major industry associations	CSP	CSP	Low	Off premise
Private	Just one company	Just one company	Just one ompany or CSP	High	Off or on premise
Community	Organizations with similar goals, rules, and security specifications	Numerous institutions	Numerous institutions or CSP	High	Off or on premise
Hybrid	Public and Organization	Organizations and CSP	organization or CSP	medium	Off and on premise

CSP: Cloud Service Providers Source: (Singh,2012).

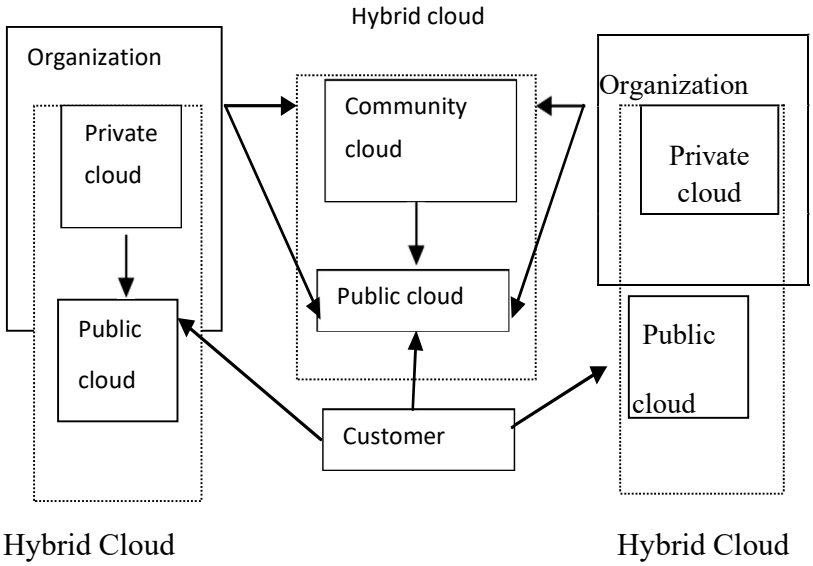

Figure 3. Models for Cloud Deployment
Source: (Singh ,2012).

6-2- Cloud Computing Services:

Any access to computer equipment or personnel, such as networks, software, hardware, and staff, that is predicated on a cloud computing delivery model is referred to as a cloud service. The process of configuring a physical server to enable the installation of several virtual servers on a single system is known as virtualization (Velte, et al., 2010). Cloud providers offer three distinct services which are as follows:

1- Software as a Service (SaaS) refers to the offering of an application to clients that is hosted (off premise) by a provider. SaaS is predicated on a multi-tenant model in which numerous clients share the same program code but have separate private data spaces (Margaret, 2014). Software that doesn't require a lot of customization or integration with other programs is the only kind of software that SaaS is best suited for ((Velte,et.al,2010& Iyer,et.al,2010)). For instance, browsers or client software can access the Google APP and Apple Cloud.
2- Platform as a Service (PaaS) is the provision of resources required to build applications and services (software development environment) to a customer by an outsourcing provider. Typical use scenarios are application design, development, testing and deployment (Velte,et.al,2010). Platform as a Service is the use of cloud computing to provide platforms for the development and use of customer applications (Salesforce.com. (2012).
3- Infrastructure as a Service (IaaS) is the term for the provisioning of computing resources (CPU cycles, memory, storage, and network equipment) to a customer by an outsourced provider. It is also known as hardware as a service. It is possible for multiple tenants to share a server under this service architecture. According to Velte et al. (2010), the service is normally priced on a resource usage basis, or utility computing basis

7- Cloud ERP:

7-1.Cloud Computing ERP:

The Cloud ERP provides a low-cost and simple implementation method. A brand-new, dynamic ERP system called Cloud Computing ERP arranges relevant resources in the Cloud Service Center (CSC) of the Cloud Computing Platform online to provide clients with specialized company information management services. Between SaaS ERP (EaaS) and Cloud ERP, there are differences: Cloud ERP is a hosted service that is made available online. According to Djohnson (2010), the ERP system in the EaaS paradigm is housed in the cloud, which also supplies the processing power needed to run it. While SaaS is not a must for ERP software, businesses can choose to buy the more adaptable Cloud ERP system when it is available as a SaaS model. There are three types of cloud ERP: web-based ERP without cloud, cloud ERP enabled by cloud, and cloud ERP without cloud (cloud infrastructure or cloud platform) (Djohnson,2010). Different levels of cloud computing are available for purchase by customers inside the service delivery stack. Suppose we have four different delivery layers: cloud applications (application resources developed specifically for the cloud), cloud platform (operating system resources for the cloud), client resources (user interface to the cloud), and cloud infrastructure (hardware resources for the cloud). Various forms of Cloud ERP are depicted in Figure 4. Three of them are referred to by the broad title "cloud ERP" in this study.

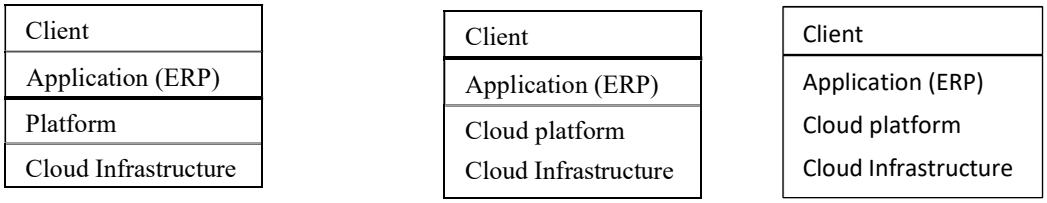

Figure 4. Various Cloud ERP Types
Source: (Lee, 2015, p.18).

- **Cloud Infrastructure:** such as that provided by GoGrid and Amazon, allows you to deploy and manage platforms and apps.
- **Cloud Platform:** This type of platform (like Windows Azure) allows you to install and manage your apps without having to worry about the operating system.
- **Cloud Application** (like Salesforce.com) provide an entire application; your client access program, which is usually a browser, is all that needs to be maintained. Vendors can use the three cloud infrastructures mentioned above to provide SaaS. A few suppliers, like Acumatica, provide all three categories of services. utilizing all three cloud infrastructures above. Some vendors such as Acumatica offer all three types of services.

- It's simple to offer SaaS using a cloud application. In this instance, the vendor creates an application that is inseparable from the hardware and infrastructure due to its tight integration.

• When a provider offers SaaS via a cloud platform, they are responsible for managing the application layer independently of the platform layer. The vendor has the option to transfer the application to another cloud platform provider thanks to this architecture.
• Using a cloud infrastructure to provide SaaS is comparable to managed hosting. In this instance, an operating system and the vendor's application are installed and managed on top of a hardware infrastructure shared by multiple tenants. Although this method offers the greatest flexibility, overhead may go up a little.

7-2. Cloud Computing ERP:

There were seven layers in the cloud ERP architecture, and the following is an introduction to each layer: (Dweib,2014).

1- 1. User layer: This layer provides the ERP cloud service requester for the application portal. The users' laptops or portable devices are connected to the ERP system.
2- Application ERP layer: To achieve segregated management, this layer uses ERP packages. One package includes inventory, sales, production, finance, manufacturing and logistics, and human resources.
3- Application workflow layer: This layer looks at the workflow inside the company. It provides the basis for workflow extraction and service definition.
4- Application cloud service layer: The end-user applies the service needs through this layer in line with the enterprise's procedures and receives the finished service. This layer facilitates communication between the enterprise ERP system and the cloud service. Another important function of this layer is that of dispatcher and organizer within the internal system.
5- Cloud manage layer: This layer serves as the architecture's cornerstone. The clouds that belong to different data centers must be arranged via programming APIs and dispatching operations with the Virtual Machine Monitor (VMM) under the standard service. The management of this laver's cloud services will determine whether the ERP system succeeds or fails.
6- Virtual resource layer: This layer is composed of a number of virtual resources. The data centers that are filled with cloud service resources are where the virtual resource is published.
7- On top of this layer, the entire system is constructed. It provides the hardware, including servers, required to run cloud resources. This layer supports the other layers by connecting the physical resources to a global network.

8-ERP Software providers:

Supply chain management, accounting, human resources, and customer relationship management are just a few of the critical services that ERP software combines onto one platform. Because of its intricate and standardized features, enterprise resource planning (ERP) software systems are commonly embraced by large enterprises and organizations. But in recent years, as market patterns have become more unpredictable, even small and medium-sized enterprises have felt forced to adopt ERP software. Table 3 displays the leading ERP software providers by specialization.

Table 3: Major ERP Software Providers in Market

Enterprise	Medium Sized	Small Business
SAP	Netsuite	Deltek
Oracle	Sage	Work(etc)
Microsoft Dynamics	Infor	Syspro
IFS Applications	Macola	Intacct

Source*:* Enterprise Resource Planning Software Buyer's Guide (2018).

The fundamental components of ERP software are the same and are organized into modules like supply chain management, finance and accounting, CRM, HR, IT, e-commerce, inventory procurement and control, order processing, and management. The functions change according on the industrial focus.

8-1- Benefits and Promises of Cloud ERP System:

The advantages of putting in place a cloud system are (Rakshit,2019 & Aulia, 2019):

a- Cost is the most crucial factor to take into account in every company activity. Cloud-based ERP implementation costs are covered by a subscription arrangement as opposed to an outright purchase. Because of the minimal initial capital cost, cloud ERP systems are also attractive to small business organizations. Because cloud-based products adapt to the demands of the enterprise, they are more user-friendly. The vendor handles all software and hardware maintenance, including updates and refreshes. Maintenance also includes user assistance, system maintenance, and backup services, so there are no additional costs for the organization's IT needs.

b- ERP systems, both online and in-house, must be configured and tailored to fit the unique business processes of the organization. This configuration and personalization is time-consuming and unsuitable for the quickly evolving market of today. On the other hand, cloud-based solutions are made to provide a basic setup that can accommodate most

business needs, and more business functionalities can be added as needed. Through web-based applications or app stores, vendors such as SAP and Salesforce.com offer bolt-on application processes for financial management, advanced analytics, and collaboration in order to enable fast software delivery processes. In summary, businesses with integrated ERP solutions are getting the most out of their investment. Additionally, they are seeing improvements and reductions.

c- Concentrate on key competencies: Because cloud ERP may identify the main business focus that pertains to its goal, it may enhance the flexibility of the company's performance.
d- Lower operating costs: Since everything is already listed in the database, implementing Cloud ERP could cut down on needless operating expenses.
e- Enhance accessibility, mobility, and usability: Cloud ERP could enhance these factors through an intuitive user interface.
f- Facilitate integration: Since ERP is primarily about integration, the deployment of a cloud system is highly pertinent to ERP.

***PROMISES**:

In particular, we'll talk about the following (Zhong & Rohde, 2014): ERP system promises, cloud computing promises, and cloud ERP promises.

1- ERP Promises: ERP is a thoroughly studied field, and the body of current literature offers a solid foundation for evaluating the benefits that ERP systems can offer. In this part, we address a few important promises that appear frequently in the ERP literature. we explain how ERP systems integrate heterogeneous information systems (Promise 1), how ERP improve business processes through business process reengineering (Promise 2), and how ERP provides information for better decision making (Promise 3).

Promise1: Integration of Heterogeneous Information Systems

One of the original value propositions on which ERP systems were built was integration. According to Umbel et al. (2003), it refers to integrating the enterprise system, procedures, and data inside the particular setting of an organization. According to Davenport (2000) and Davenport et al. (2004), the systems facilitate smooth communication between suppliers and customers, as well as across organizational processes and units. Inventory cycle times can be shortened, for instance, by integrating the manufacturing and logistical processes to enable prompt product delivery as soon as they are manufactured.

Promise 2: Improved Business Processes

Although ERP's technical capabilities hold immense potential for the company, its capacity to mold and enhance business processes is frequently cited as the platform's primary promise. Formal business process reengineering (BPR) is frequently implemented alongside ERP deployment. Using best practices integrated into corporate systems, BPR frequently results in

standardized business processes (Koch 2001). The benefits of enterprise systems can be fully realized through this kind of business process and system optimization. Businesses that prioritize business process reengineering throughout deployment will see improvements in their company performance (Davenport 2000; Davenport et al. 2004).

Promise 3: Better Decision Making

To aid in decision-making, organizations convert data into knowledge and useful information. One of the most frequently mentioned benefits of ERP systems is their ability to facilitate this information translation and, eventually, enhance decision making (Davenport 2000; Davenport et al. 2004). For instance, enterprise systems frequently support just-in-time manufacturing (JIT) well. This allows the company to eliminate excess inventory and production surplus while making prompt decisions based on data from the ERP system.

2- Cloud Promises: Compared to ERP, cloud computing is a very new and developing field. The literature currently in publication focuses mostly on cloud computing applications as a whole, without making a distinction between various types of cloud applications. The main cloud computing promises that we identified in the literature are presented in this section. In particular, we explain how cloud computing enables ubiquitous business applications that is accessible anywhere (Promise 1) and on-demand IT resources that adjust according to demand (Promise 2).

Promise 1: Accessible Anywhere

The widespread adoption of cloud computing has made IT resources accessible via the Internet at any time, from any location, and on any sort of device. As a result, business applications can be used whenever and wherever it is most convenient to meet workload expectations (Buyya et al. 2009; Mell and Grance 2009). The ability to present, buy, and pay for a product using a tablet computer will considerably boost the productivity of a door-salesperson's work by enabling on-the-spot execution and transaction at the consumers' locations.

Promise 2: On-demand IT Resources

Although ubiquity is a potential feature of cloud computing, it can be achieved in other ways. Because of this, cloud computing's on-demand IT resource is valued more highly by many companies than its general adoption. Cloud computing may turn IT resources into commodities. This service model sees IT resources as a typical utility, like gas or electricity, that is owned and maintained by the service provider in order to accommodate the various usage needs of several clients. There are no upfront fees; instead, services are billed based on the amount of IT resources consumed (Mell and Grance 2009). Many cloud computing solutions offer three flexibility aspects: resources, quality, and price. These can be customized to meet specific customer needs (Dustdar et al. 2011). Furthermore, the collection of IT resources into a single resource pool creates the illusion that clients have rapid access to an infinite amount of IT resources. Resource pooling

strives to increase the efficiency, flexibility, and dependability of IT resources in the spirit of "green computing" (Wischik et al. 2008). Additionally, it enables the reduction of IT operations' negative environmental effects, such as through increased electrical efficiency (Murugesan 2008).

3-Promises of ERP in the Cloud: Comparatively speaking, cloud ERP is a far more recent invention than cloud computing. There is a fairly small body of literature on cloud ERP. The goal of cloud ERP systems is to use cloud computing platforms to give businesses flexible business process transformations. The benefits of cloud computing and ERP are combined in ERP on the cloud. Recalling the earlier discussions, the cloud ERP model incorporates the following features: on-demand IT resources, enhanced business processes, better decision making, and integration of heterogeneous information systems. It is also available from any location. In addition, moving traditional ERP systems to the cloud reduces expenses associated with purchasing and maintaining hardware locally, turning capital expenditure into operational expenditure for the organization (Promises 1) as well as shortening the implementation period (Promises 2).

Promises 1: Cost Reduction

In general, cloud-based ERP is less expensive than on-premises ERP systems. Hardware, labor, and upfront expenditures are the areas where cloud ERP can save costs. Cloud ERP systems have lower initial costs than on-premises ERP systems (Armbrust et al. 2010). Because cloud ERP requires little in the way of upfront cash, it is therefore frequently a good option for small to medium sized businesses. Additional cost savings are noteworthy when it comes to the cost of hiring IT staff and buying and maintaining servers (Lenart 2011). By using cloud ERP, internal IT workers can avoid maintaining on-premises solutions and lower the risk of hardware and infrastructure damage (Buyya et al., 2009).

Promises 2: Shortened Implementation Period

In addition to overall cost savings, cloud ERP providers frequently assert that their systems may be implemented more quickly than on-premises ERP options. The flexibility to roll out deployments concurrently across various locations and the lack of need to establish physical IT infrastructure allow for faster implementation time (Lenart, 2011). Cloud ERP systems are frequently offered as standardized products, with several deployments demonstrating the system's quality. They are designed to be quickly and easily implemented (Raihana,2012). Traditional customized IT systems, on the other hand, take longer to set up and come with higher hazards. While traditional on-premises ERP systems take a year to implement, cloud ERP deployments typically take six months.

8-2-Limitations of Cloud ERP:

Since cloud-based ERP is still relatively new, its long-term prospects are unknown given the shifting landscape. The main obstacles are data risk, personalization, and updated functionalities.

Up until now, cloud-based ERP system suppliers have mostly focused on the essential features. As the market conditions change, creating sophisticated functionalities like media integration, constraint-based planning, statistical forecasting, etc., becomes more difficult. The continued existence of cloud ERP will be significantly impacted by the integration of these cutting-edge features.

Rather than providing a custom business solution, cloud-based ERP offers more standardized business process setup. One of the most important considerations for businesses selecting cloud-based ERP is perceived data risk. Modern security, according to cloud suppliers like SAP and Oracle, is far superior to on premise and hosted solutions. Data securities will fall under national law. Organizational resistance may arise when switching from on-premises ERP to cloud-based ERP. Strong organizational presence in IT departments may make it difficult for them to embrace the new infrastructure and application outsourcing, and they may even feel threatened.

8-3- Challenges of Cloud Enterprise Resource Planning:

In the section, we discussed the key advantages of cloud computing, ERP, and cloud ERP. In this section, we'll discuss the challenges associated with transferring ERP systems to the cloud. These challenges make cloud ERP adoption more difficult. Research from the same sectors that were examined in the previous section for the promises forms the basis of our examination of the challenges with cloud ERP. We will specifically look at the issues with ERP, cloud ERP, and cloud computing. In general, the following challenges (Aulia, 2019 & Rakshit, 2019):

a) The first need is that a business using cloud ERP must subscribe to the cloud services and pay a monthly fee, which includes paying for the cloud server itself.
b) The second security issue is that cloud systems are dependent on the internet, which is a highly risky and unstable environment. Because of this, the company's database needs to be protected from unwanted things like malware and human hacking activities with a high level of security. Internet-dependent businesses must also have fast internet connections, and cloud ERP users will surely experience problems during internet network disruptions.
c) Hidden costs, such as those associated with transition, monitoring, and coordination, provide another difficulty for businesses and will inevitably drive up operating expenses.
d) Choosing the cloud system that the business will use is the final item to think about. Because every cloud system has a distinct level, it becomes difficult for the business to decide which user is capable of using a cloud system and which one is the appropriate one.

***ERP Challenges:** Even though firms are using ERP more frequently, adopting ERP is frequently a challenging choice due to a few long-standing issues with the software. The main ERP challenges that we identified from the ERP literature are presented in this section. In particular, we address the possibility of software functionality not aligning with business needs (Challenge 1) and the intricacy of the implementation process (Challenge 2).

Challenge 1: Software Design Misfits

Gaps between the capability provided by the ERP software package and the needs of the business are frequently found during the installation of ERP systems. Software design misfits are a common term used to characterize these gaps.

Challenge 2: Complex Implementation Process

Misfits in software design are only one of many possible problems that can arise while ERP projects are being implemented. The process of implementing ERPs is frequently very costly and time-consuming, requiring large capital expenditures as well as considerable adjustments to current company procedures. Organizations frequently lose millions of dollars as a result of ERP implementation errors.

*** Cloud Challenges:** The concept of cloud computing is still in its infancy and is evolving. As a result, a significant amount of the research that has already been done on cloud computing is done to find or handle various problems and hazards associated with using the technology. This section presents the primary challenges with cloud computing that we found in the literature. The main cloud computing difficulties that we identified in the cloud computing literature are presented in this section. We go into detail on why companies are concerned about security that is under the hands of a third party (Challenge 1), how vendor lock-in affects the organization (Challenge 2), how inconsistently cloud services operate (Challenge 3), and the reasons why poorly written service-level agreements (SLAs) can put businesses at risk.

Challenge 1: Security Controlled by Cloud Services Provider

One of the biggest concerns for businesses when it comes to adopting cloud computing is security. For businesses thinking about implementing cloud computing, preserving security in the areas of access control, privacy, and identity management has become crucial (Takabi et al. 2010). Because cloud computing involves sharing resources, it can be challenging to track down activity in the transient virtualized environment, particularly when users lack control over the actual placement of their data (Kaufman 2009).

Challenge 2: Vendor Lock-in

While security is a primary concern, corporations carefully consider a wide range of other factors when choosing a cloud services provider. This stems in part from their concern about the costs associated with switching cloud service providers should they decide to do so. Vendor lock-in is frequently cited by organizations as a key barrier to cloud service adoption. In cloud computing, vendor lock-in happens when customers of a given cloud service find it difficult to switch to a different provider. This is typically because of the cloud service's proprietary technology (Hofmann and Woods 2010). Importantly, data in the cloud is typically not interchangeable with

other cloud services and is stored in a proprietary format (Armbrust et al. 2010). As a result, businesses frequently stick with one cloud service provider to save money on moving. Companies must also take into account if the vendor will be around in the long run to facilitate the ongoing delivery of cloud services (Hofmann and Woods 2010). For instance, data is stored in a proprietary format by Amazon's Dynamo service. It is not easy to transmit the data to another provider; Amazon is the only entity that can process it.

Challenge 3: Unstable Performance

Organizations are quite selective when choosing their cloud service providers in order to minimize switching costs, and one of the most important metrics that they evaluate is the performance of the cloud services. In cloud computing, "performance" relates to the services' speed, dependability, availability, and outage risks. The topic of performance fluctuation is one that is sometimes overlooked when talking about cloud computing. Nonetheless, research has demonstrated that cloud service performance is frequently erratic throughout the day (Hofmann and Woods 2010). Additionally, cloud service providers are yet unable to provide high availability guarantees. This can be a crucial component for high turnover, global enterprises where even 99% or 99.9% uptime could result in significant losses. These elements suggest that performance on par with on-premises solutions cannot yet be achieved by cloud computing.

Challenge 4: Poorly Defined Service-Level-Agreements (SLAs)

The aforementioned issues, such as cloud service provider-controlled security and erratic cloud service performance, have the potential to cause a lot of issues for enterprises. For businesses to be able to use and depend on cloud services, a legally enforceable contract between the cloud service provider and the user must include the necessary guarantees (Hofmann and Woods 2010). Service-Level-Agreements (SLAs) are the name given to these legally enforceable contracts. When disagreements or problems occur, cloud service providers may refuse to take responsibility if there isn't a solid SLA in place (Marston et al. 2011). As things are, SLAs sometimes offer clients very little protection.

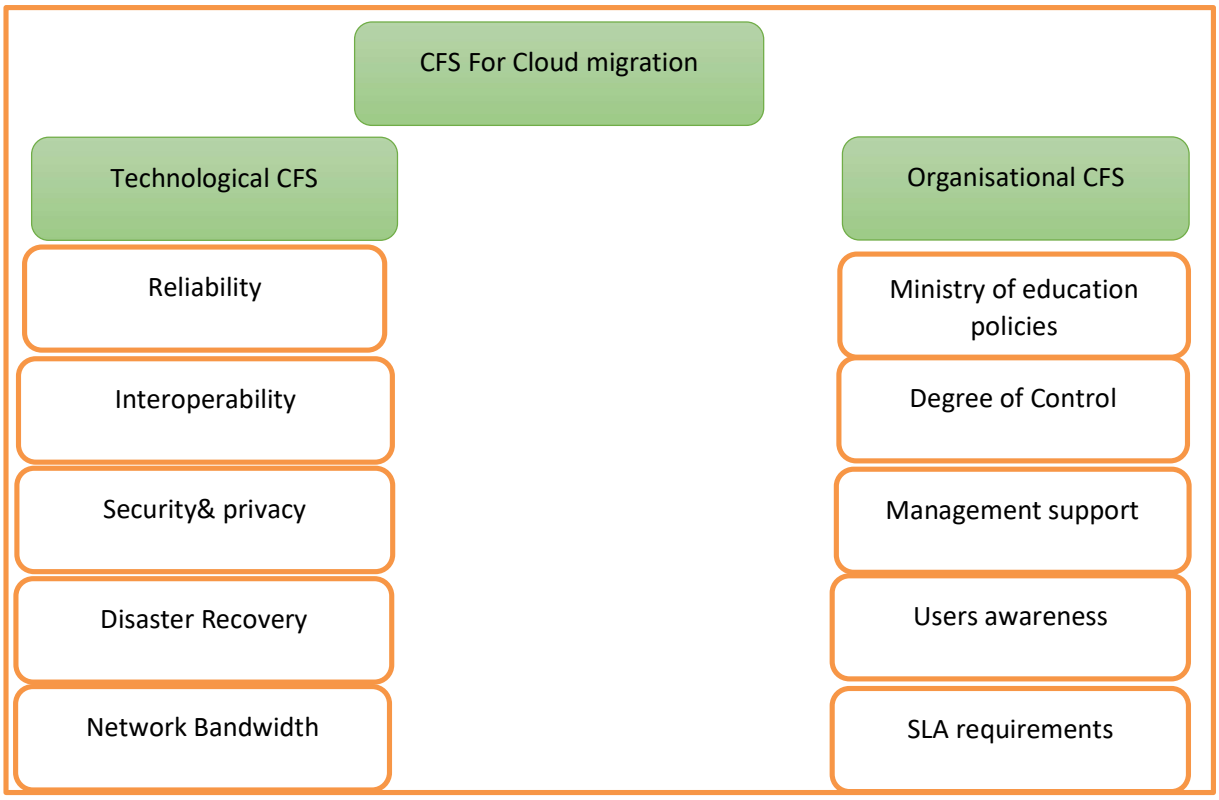

Figure 5: Technological factors for Cloud ERP
Source: (Alharthi,2017).

As seen in Figure 6, there are other elements that might be researched to better understand how Cloud ERP is implemented. We discover the core issue with enterprise resource planning, variables influencing cloud ERP, and justification for cloud ERP usage. The Enterprise Resource Planning (ERP) lifecycle comes first. There is no denying that we live in a digital age with internet connectivity for everything. The internet's speed and connectivity are becoming crucial factors. Aside from that, the ERP's deployment simplicity is required. Using a "cloud" system is the way to ensure that ERP is still relevant in this digital age. Everything was able to be centralized and dependent on the internet thanks to this technology. Using a cloud system could enhance availability, cost, flexibility, and reliability. Future research possibilities include the necessity for more investigation into the deployment of cloud ERP, as the advantages of doing so are already known. Especially when it comes to aspects of the Internet of Things (IoT) like database architecture, security, usability, and how well it works to give consumers useful information.

9- Cloud ERP Framework:

This section outlines a framework for evaluating cloud ERP adoption in light of the issues and promises that have been discussed. The proposed paradigm particularly focuses on the benefits and drawbacks of on-premises ERP versus cloud ERP along the four aspects of efficiency, flexibility, ubiquity, and security. The framework distills a very complicated phenomenon into four basic dimensions, encapsulating the main components of cloud ERP. While previous studies have examined cloud ERP's benefits and drawbacks to varying degrees (Porkert and Sutton 2013; Seethamraju 2013), our framework presents a simple and direct indication of the areas that must our framework offers a clear and concise representation of the aspects that need to be taken into account when academics and IT executives evaluate cloud ERP systems. As a result, our framework's special value is found in its ability to compile and synthesize existing knowledge into a format that is easily readable. The framework is presented here, followed by an explanation of each of the framework's dimensions and the corresponding degrees of obstacles and potential they bring.

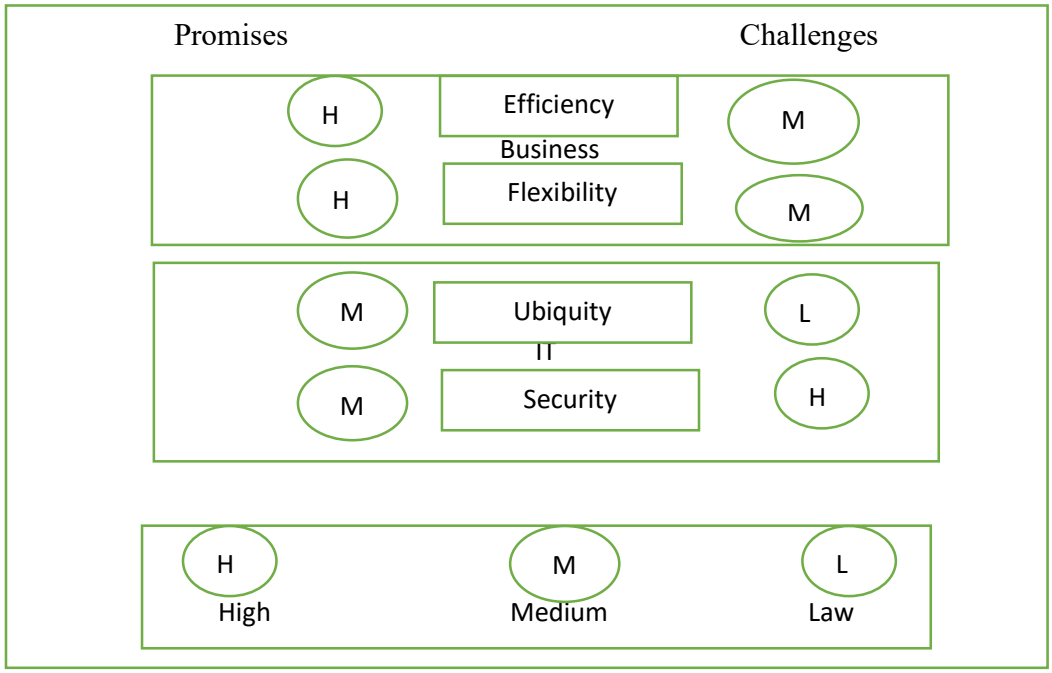

Figure 6: Framework for evaluating cloud ERP
Source: (Zhong & Rohde, 2014, p.6).

The Business and IT domains are the focal points of the framework. The two domains are derived from the Strategic Alignment Model (Henderson and Venkatraman 1993), which discusses the link between business strategy and IT strategy. In particular, business strategy is seen to be the catalyst for IT strategy, and IT strategy is believed to be the instrument that enables business plans. Our suggested framework takes these two areas as its primary boundaries since the Strategic Alignment

Model concentrates on them. Within this paradigm, four dimensions have been discovered. The four dimensions' corresponding levels of challenges and promises are evaluated and denoted by their impact levels (High, Medium, or Low). Efficiency and flexibility have been determined to be the two most important dimensions for the business area. We discovered that these two characteristics were present in the majority of the promises and difficulties through our literature analysis. We discovered that two recurring topics in the conversations on the benefits and drawbacks of cloud ERP were iniquitousness and security in the IT domain. We will go into greater detail about each of the dimensions Efficiency, Flexibility, Ubiquity, and Security in the remaining sections of this section.

***Efficiency:** The cost, time, and effort necessary to accomplish the goals of business applications is represented by the efficiency dimension (Ostroff and Schmitt 1993). When compared to on-premises ERP solutions, cloud ERP can significantly save costs, time, and effort while increasing organizational efficiency across a number of domains. Implementing standardized software packages, which are made for rapid and simple implementation and do not require the installation of physical IT infrastructure on site, is one way to improve implementation efficiency (Raihana 2012). Based on Armbrust ,et.al. (2010), cloud computing also changes the typical ERP adoption from a capital expenditure to an operating expense, which is seen to be easier to manage and require less effort and risk. Moreover, the centralized architecture improves the efficiency of managing IT resources, saving money on electricity and upkeep of on-premises hardware (Brynjolfsson et al. 2010).

* **Flexibility:** The ability of an organization to anticipate unanticipated developments in its surroundings and adjust to changing conditions is referred to as the flexibility dimension (Lucas Jr and Olson 1994). Because cloud ERP provides on-demand IT resources, it has the potential to significantly increase organizational flexibility. Clients are only charged for the amount of IT resources used under this service model, which takes into account fluctuations in resource utilization (Mell and Grance 2009). Businesses may quickly scale and adapt their IT infrastructure thanks to the nearly limitless and instantaneous supply of IT resources that are made available to them. This also solves the Therefore, compared to on-premises ERP solutions, cloud ERP frequently offers significantly more business flexibility.

On the other hand, the organization has very little control over the system because of the cloud's stringent environment. Therefore, compared to on-premises ERP systems, integration and customization are much harder to accomplish with cloud ERP (Saeed et al. 2012; Li et al. 2012; Peng and Gala 2014). Additionally, cloud ERP systems are proprietary, which limits organizations and results in switching costs if they decide to go to a different vendor (Armbrust et al. 2010). Thus, while cloud ERP has many potential benefits for organizational flexibility, it also comes with a number of issues that need to be resolved in order to avoid having a detrimental impact on organizational flexibility. Compared to the difficulties that the other dimensions provide, we grade the possible harm to organizational adaptability as moderate.

*** Ubiquity:** The degree to which the information system can be accessed from different client platforms and locales is related to the ubiquity dimension (Mell and Grance 2009). In general, cloud ERP increases traditional ERP's ubiquity. Because cloud ERP systems are constantly accessible online, they may be used on any device, at any time, and from any location. Because of this, companies can execute business applications on any device at any time and anywhere they deem most suitable (Brynjolfsson et al. 2010; Buyya et al. 2009; Mell and Grance 2009). This is very helpful when fulfilling complex commercial needs. Though a cloud-based system might offer more widely available services, many of the ERP systems in use today are made to be accessible from several places. As a result, we rank cloud ERP's ability to deliver more widely used corporate services as modest. Overall, there are very few new obstacles that cloud ERP systems present in the way of obtaining universal system access.

*** Security:** The degree to which the availability, confidentiality, and integrity of the information system are safeguarded is referred to as the security dimension (Gordon and Loeb 2004). The cloud ERP provider is in charge of cloud security. As a result, internal IT resources are released from the burden of keeping on-premises ERP systems secure. Because having security managed by the cloud ERP vendor may result in a higher level of protection, this is especially advantageous for businesses with lax security standards (Chen et al. 2010). All things considered, cloud ERP systems have some moderate potential benefits that may come true even though they won't significantly improve company security.

Organizations have relatively little control over cloud ERP system security, in contrast to on-premises ERP systems. Cloud ERP are frequently integrated into a shared system environment, making the system more vulnerable to potential threats and hazards than the isolated, on-premises IT infrastructure utilized by many on-premises ERP systems (Zissis and Lekkas 2012). When a company needs to maintain strict standards for data confidentiality and system security, this is especially crucial. Additional research reveals that businesses frequently have a very tough time trusting the cloud ERP vendor with their security (Kaufman 2009; Rabai et al. 2013). As a result, we consider the difficulty of upholding a high degree of security following the implementation of a cloud-based ERP system to be quite important. The domains of cloud computing and ERP are extensive and multifaceted, and it is highly unlikely that the four dimensions of the suggested framework can encompass all the factors that are crucial for cloud ERP adoption. Therefore, even though we do not assert that the dimensions provided are all-inclusive, we contend that they are crucial factors to take into account. As a guide and a point of departure for further conversation, we offer the varying degrees of influence of the various benefits and difficulties.

9-1- Conceptual Framework of Cloud ERP:

Figure 7 illustrates the conceptual framework that was created after the initial literature study to identify research areas concerning cloud ERP and the connections between various themes.

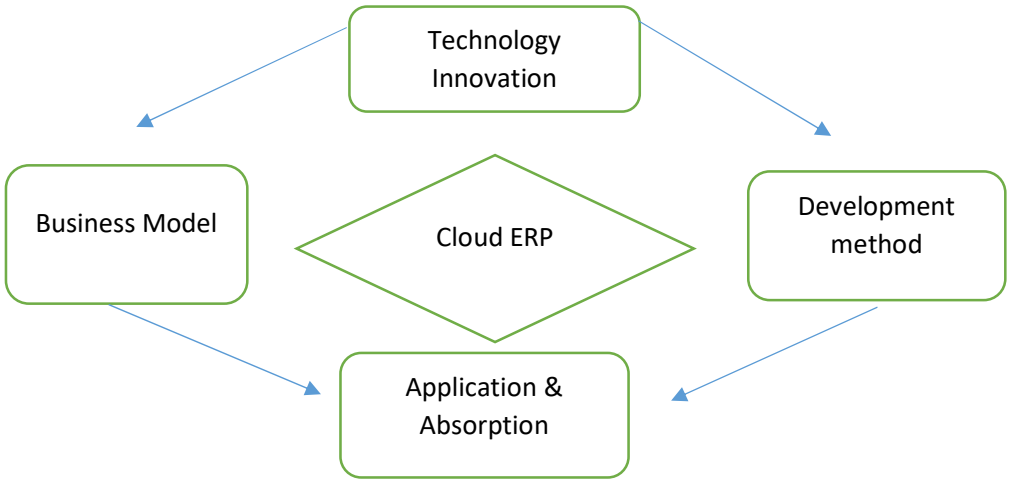

Figure 7: Cloud ERP diamond conceptual framework.
Source: (Yuqiuge,2014,p.188).

Four core domains of cloud ERP research—technology innovation, business model, development method, and usage & assimilation are used to construct this framework. Each of these topics offers a theoretical framework for further research as well as several research directions. This approach may also be used to pinpoint research gaps and create an agenda for future study to fill them.

9-2- Technology Innovation leads to a new Business Model:

Forward-thinking companies these days are moving toward a more flexible business model that needs cutting-edge technology to support it. This adjustment will boost competitiveness and produce outstanding business results. Both an innovation in and of itself and a driver for technological advancement is cloud computing. In contrast to the outdated ERP that had numerous limitations due to outdated technology, the new cloud-based ERP solution of today had to consider the breadth and depth of corporate operations. Investigating the innovation potential is essential to properly appreciating the capabilities provided by cloud computing (Clohessy and Acton, 2013, 2).It is anticipated that cloud technology will evolve into a more networked solution that facilitates communication across many enterprises in the next years. Thus, cloud ERP services will become more expansive. It is anticipated that cloud technology will evolve into a more networked solution that facilitates communication across many enterprises in the next years. Cloud ERP services will therefore have a greater commercial impact. Additionally, the organization should be able to increase its use of cloud ERP. The future of cloud ERP is in problem-solving and promoting cross-functional cooperation. A multitude of functional domains are dedicated to creating uniform baseline performance data.

9-3- Technology Innovation Affects theDevelopment Method:

The time, money, and complexity needed to implement IT services can all be decreased using the cloud. The word "cloud" suggests that there are technologies involved, such as load balancing and virtualization, which enable the deployment of programs over numerous servers and database resources. The development of cloud ERP must follow the same successful model as other enterprise system development projects. Cloud ERP can handle coordinated implementation on several business and organizational levels as well as cross-organizational planning. Certain cloud ERP solutions require industry-specific support and a certain level of customization.

The introduction of new technology will undoubtedly alter the development process. This is because the lifecycle's activities will be shortened and altered by cloud computing. It is going to market very quickly. Cloud ERP must operate quickly because to globalization, rapid information flow, and customer needs. There will be additional choices available to businesses with an ever-expanding roster of cloud ERP providers. However, even with the shorter implementation time, businesses still need to devote a significant amount of time to pre-implementation tasks including customization, negotiation, and selection. Nevertheless, assessing the caliber of cloud ERP providers is challenging. They have their own policies about billing, flexibility, price, support, and other crucial aspects.

9-4- Business Model and DevelopmentMethod Jointly Change the Usageand Assimilation:

The way consumers use ERP systems and go about their business has changed significantly as a result of cloud ERP. Changes in technology and business have an impact on how individuals work as well. With cloud ERP, users can work in a straightforward, practical, and adaptable manner from many places. People's productivity and dedication to the firm will increase with the use of cloud ERP (Dykshoorn and Nemani, 2013). Working flexibly drastically cuts down on communication time. There are clear differences in usage between cloud ERP and traditional ERP due to the features of cloud ERP and the fact that various development approaches are used. Obviously, this cloud ERP might not deliver the anticipated value in the absence of appropriate implementation and business decision. Assimilation refers to the process by which businesses advance from comprehending the potential and features of cloud ERP to mastering and using them in their critical value chain processes (Pishdad and Haider, 2013). Cloud ERP is institutionalized after it is deployed in a business and used routinely, becoming ingrained in the organization's value chain operations and work processes. Ultimately, it is critical to focus on the activities that follow implementation. When cloud ERP is used properly, productivity levels inside the company rise along with user happiness and motivation.

9-5-The Impact of Cloud ERP on Creating Value to Business:

Understanding ERP's development history is crucial to understanding how they might advance going forward. ERP systems are ideas that are pushed by the industry (Moon, 2007).

Manufacturing is where the ERP system got its start. ERP systems evolved as a result of the increased requirement for function integration inside the organization (Jacobs & Weston, 2007). ERP began as a back office system and has evolved into a crucial organizational backbone (Davenport, 2000). ERP systems need to adapt to new improvements in hardware and software as well as shifts in business strategies. This leads to a continual, sluggish evolution, according to Bahssas et al. (2015), Majstorovic et al. (2020), and Rashid et al. (2002).

Inventory control packages, an IS for inventory management, monitoring, and checking, can be linked to ERP's beginnings in the 1960s (Majstorovic et al., 2020; Rashid et al., 2002). Those straightforward algorithms might calculate safety stocks, lot sizes, and reorder points to maximize inventory (Jacobs & Weston, 2007). Material Requirements Planning (MRP I) systems helped to increase the efficiency of production process planning and material procurement in the 1970s (Majstorovic et al., 2020; Rashid et al., 2002). Manufacturing Resource Planning (MRP II) software, which synchronized materials with production requirements, optimized the production planning and execution process in the 1980s. Production, purchasing, inventories, and distribution might all be supported by it.

This was a step in the direction of an enterprise-wide resource management syste. The Gartner Group coined the term ERP in the early 1990s. Initially, the accounting and operational departments of the company were combined. ERP systems soon made it possible to integrate purchasing, distribution, and planning across functional departments (marketing, design, accounting, and HR). Multifunctional integration resulted from this (Rashid et al., 2002; Majstorovic et al., 2020). A central database was part of the client-server design of the ERP (Jacobs & Weston, 2007).

The comprehension of ERP development grew increasingly intricate after the 1990s. Authors are increasingly suggesting alternate advances to represent the future stages of ERP, when before most mainstream authors agreed on the timing and nomenclature of ERP developments.

Developments in the 2000s included new features like CRM and SCM and enhanced existing ones to make them more sophisticated and efficient (Rashid et al., 2002). Additional developments included mobile access, service-oriented architecture, and internet usage.

ERP cloud computing (CC) as software as a service model (SaaS) was the primary ERP trend in the 2010s (Majstorovic et al., 2020). Functional innovations slowed down as ERP reached a certain level of maturity .ERP began to include new technologies like BD, AI, and IoT in the late 2010s and early 2020s.These ERPs are referred to by many names by authors, including in-ERP, ERP III, and ERP 4.0. The portions of this literature study that follow go over this new kind of ERP system.

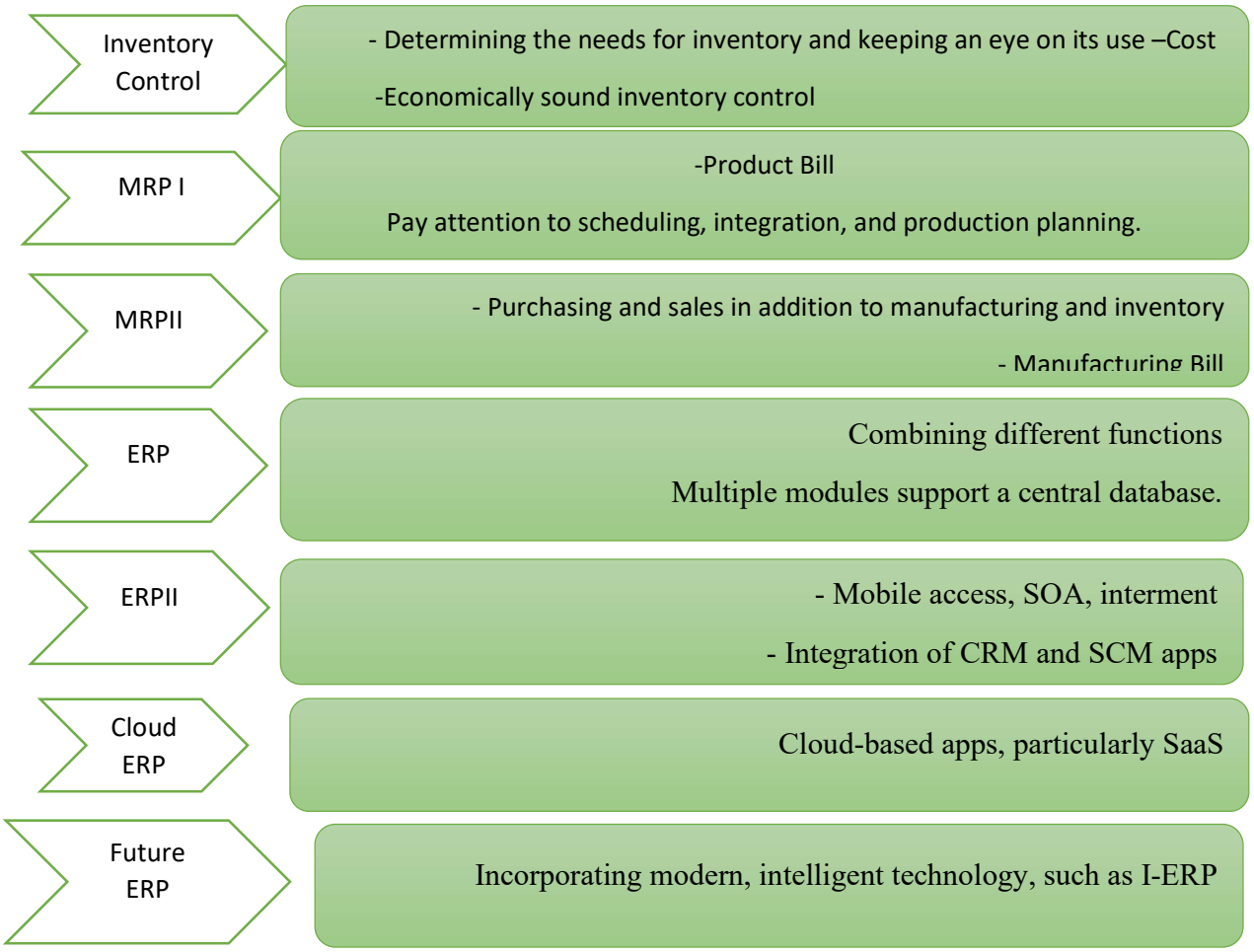

Figure 8: ERP systems' development
Source: Adopted from: (Rashid et al., 2002; Jacobs & Weston, 2007, Majstorovic et al., 2020).

10-Intelligent Enterprise Resource Planning:

10-1-Who Is Intelligent Cloud ERP For?

ERP that is intelligent and next-generation opens up new possibilities for senior leadership, IT, finance, and business lines. Through the integration of business processes and the application of cutting-edge digital technology, you can empower all users to reduce complexity, increase productivity, and utilize real-time data to make more informed decisions.

10-2-Nine Ways to Unlock Value with an Intelligent ERP Cloud Core:

1.Quicker information processing throughout the company.
2. Increase automation to get rid of bottlenecks in the process.
3.Digital out tasking that reduces the need for manual approvals and input.
4.Organize priorities better so that the highest-value tasks get priority.

5.Simplified information presented in a context that makes sense.
6.Cooperative intelligence that fosters quicker, more intelligent work.
7.Real-time optimization to make decisions based on the most recent, correct data.
8.Wiser company to develop and implement the best plan.
9.Use innovation in a way that fits the way your employees operate.

10-3-The Four Stages of Intelligent Cloud ERP Value Creation:

Every day, business is more complicated, and change is happening faster than before. Finding better ways to turn data into value is the issue, even when you may have more data to analyze than ever before. The four steps to creating digital value outline how to develop new organizational skills that will put you ahead of the competition.

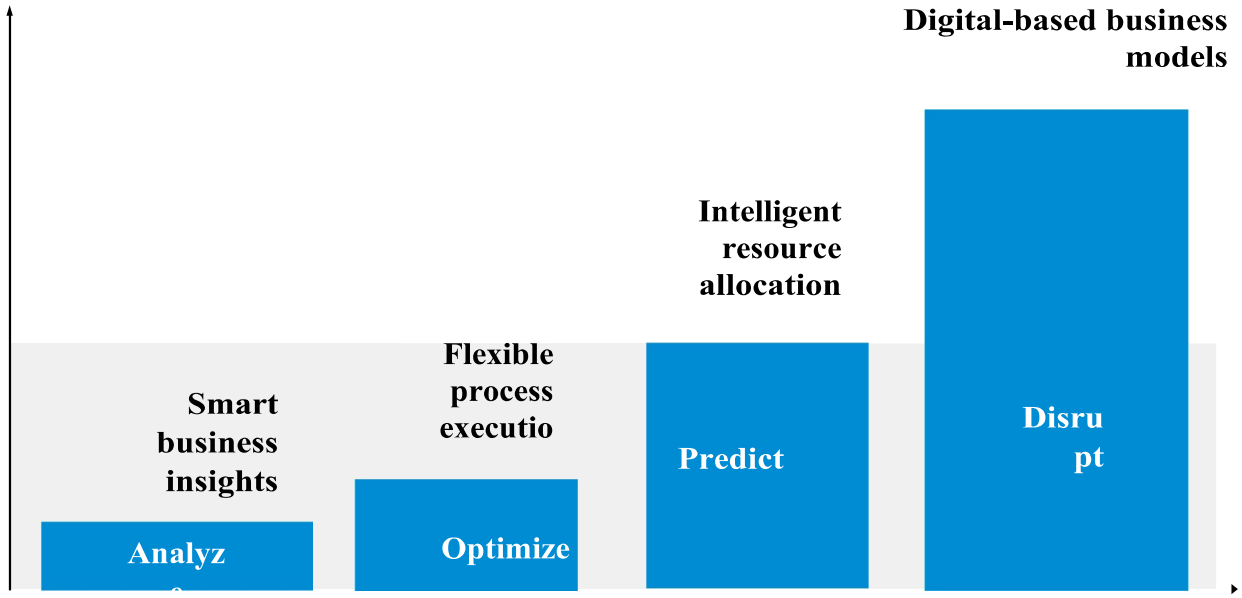

Figure 9: The Intelligent Cloud ERP Value Creation Process in Four Stages
Source:(Hustad, 2019).

10-4- Intelligent Value Creation:

Intelligent ERP offers manufacturing companies a tried-and-true framework for implementing best practices from the sector while achieving operational excellence in the engagement and financial management processes.(Hustad, 2019):

- Decrease in the overall cost of manufacturing.

- Decrease in the manufacturing cycle time.

- Diminished scrap value.

- Shorter lead time for order fulfillment.

-A higher throughput for posting materials.

-Enhanced labor efficiency through "live" production monitoring.

- Separate system consolidation.

- Enhanced profitability.

- Enhanced productivity with customized UX.

- Increased throughput.

10-5- Intelligent Resource Planning Model:

I-ERP is described as employing advanced analytics and machine learning to process data and produce usable information by Jenab et al. (2019, p. 154). When paired with I-ERP, machine learning can assist uncover trends and highlight unusual client behavior. As per Jenab et al. (2019, p.151), the I-ERP represents the subsequent phase in the field of ERP systems. A company's production quality can be raised with the use of the I-ERP system (Jenab et al. 2019 p.159). The data that is entered and kept in the system highlights this phenomena; an I-ERP system can monitor the outcomes and offer statistical process controls (Jenab et al. 2019 p.159). Jenab et al. (2019). explains how the system can automatically alert a user in the event that it detects an issue or abnormality. Compared to a typical ERP system, the I-ERP is more deeply linked into the company, so employees can receive assistance with problem diagnosis and appropriate resolution (Jenab et al. 2019 p.159). Jenab et al. (2019, p. 159) provide examples of complete integration between an I-ERP system and the organization's other systems, including order processing, inventory control, and reception operations. Managers' decision-making process is facilitated by the increased control over production quality assurance made possible by the integration of various systems.

According to Jenab et al. (2019, p.159), an I-ERP system can also learn from its own experience and the requirements generated by the business. Because of this, an I-ERP system can lower the expenses related to manufacturing quality while simultaneously offering real-time predictive analysis and reducing the likelihood that errors and recalls would occur during the production process (Jenab et al. 2019 p.159).

A faster inventory management process is another possible benefit for businesses utilizing an I-ERP system. According to Jenab et al. (2019, p. 159), the internal departmental borders are irrelevant due to the employment of a centralized system. Employees that have more efficient

production half-lives can save time and money when it comes to inventory management, according to Jenab et al. (2019, p. 159). I-ERP systems are capable of monitoring and resolving a wide range of supply-chain issues (Jenab et al. 2019, p. 160). According to Jenab et al. (2019, p. 160), better inventory management leads to faster and higher-quality production. This is because efficient supply chain management also improves inventory control. Consequently, an I-ERP is a desirable planning tool for managers, claim Jenab et al. (2019, p. 160). An I-ERP system can increase a business's adaptability across a range of industries (Jenab et al. 2019, p. 160). An I-ERP has greater flexibility because it can easily integrate with businesses. If businesses need additional functionality, it can be introduced by the vendor (Jenab et al. 2019 p. 160).

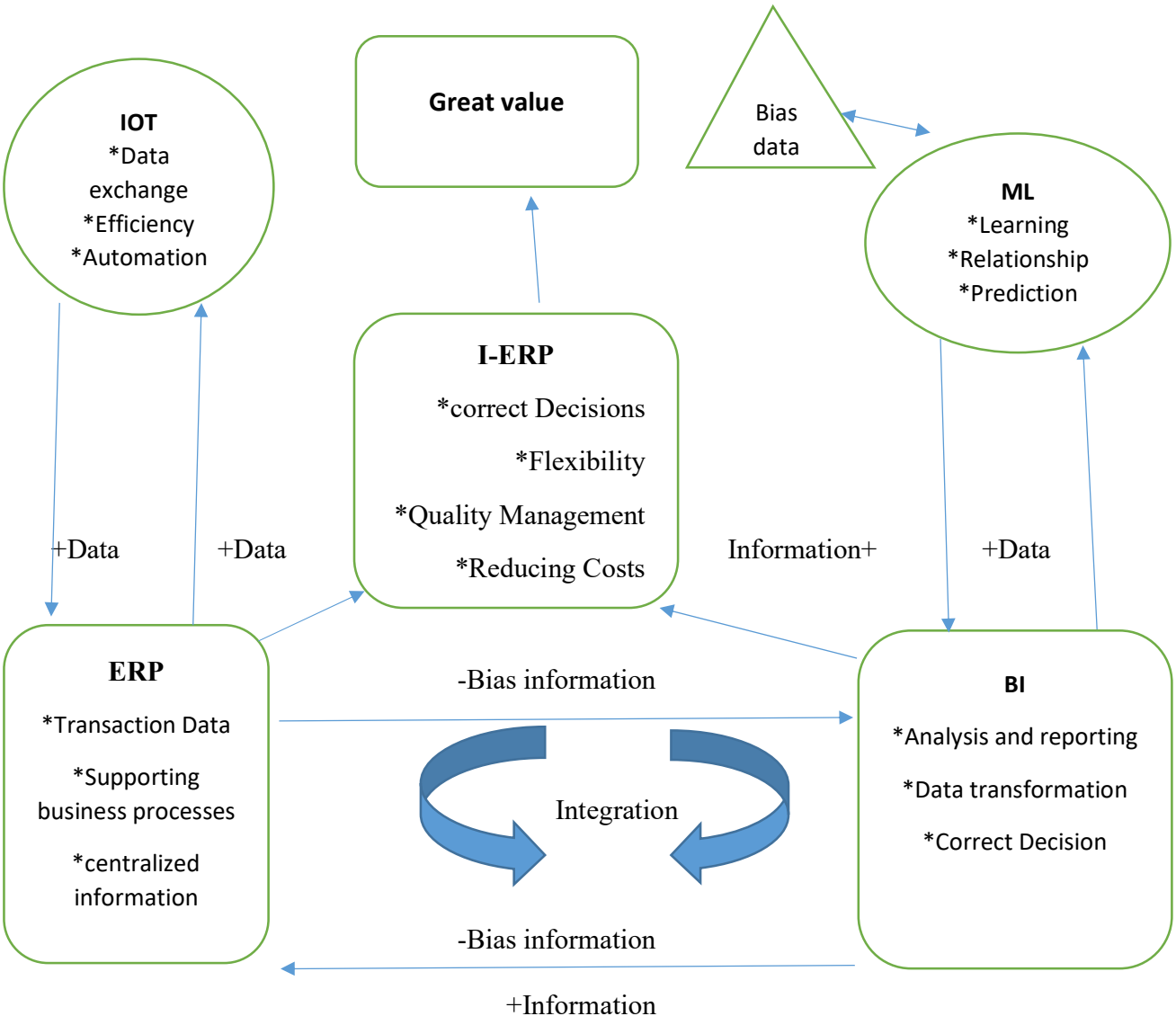

Figure 10: A proposed Framework for Intelligent Enterprise Resource Planning
Source: (The Researcher based on Hedenstrand,2020,p.17).

To create this framework, important ideas from the literature listed in the preceding paragraphs are combined. The framework attempts to present an all-encompassing view of the I-ERP; as a result, relationships are condensed and other significant features are not discussed because of the study's scope. The framework aims to demonstrate the composition of the various components of the I-ERP systems; these components have interrelationships that can have either a beneficial or negative impact on the business. The black arrows in the framework illustrate these relationships. Negative aspects are shown by a (-) symbol, whereas positive aspects are indicated by a plus sign (+).Together with the white fields highlighting the advantages of the ERP and Bi systems, the larger field labeled I-ERP aims to conceptualize what an I-ERP systems pieces are composed of. The two rounded, grey curves stand for IoT and ML, two technologies that are frequently connected to the term I-ERP. The bullet points indicate the business improvements that result from these strategies. The red triangle illustrates the situation in which ML produces inaccurate information due to the usage of biased data. There is a bad result in the analytical framework.

Where biased information is present, which could result in the basis of an inaccurate choice. The inclusion of a negative result in the framework served to illustrate the potential for an inconsistent training set of data, so highlighting one of the potential disadvantages of utilizing an I-ERP system. On the other hand, the favorable result would be that impartial information would be utilized to make wise business choices. The term "integration" refers to the vital symbiotic relationship that exists between the BI and ERP systems; without this connection, business benefits are not possible. Lastly, the information in the headline is intended to illustrate the data transformation that happens when ML and BI are combined.

10-6- Intelligent ERP Model Component:

Table 4 provides an explanation of the suggested model's components. The number of the corresponding model element appears in the first column, the model component's name appears in the second, and the component's description appears in the third.

Table 4: I-ERP Model: Components

N	Component	Description
1	**Physical Organization Environment**	The organization's resources, merchandise, and personnel. IoT devices are used to track, monitor, and control them, and they provide precise real-time data.
2	**Big Data Sources**	A variety of Big Data is produced by various internal and external data sources containing various data types. These are not your typical transactional data.
3	**Flexible Cloud Infrastructure**	The processing power and scalable data storage offered by cloud infrastructure enable the handling of Big Data and the execution of intelligent computing operations. It gives the system adaptability for upgrades, modifications, updates, etc.
4	**Centralized i-ERP Database**	Data from multiple sources is centralized in the central database. The system itself (transaction processing data, master data, etc.) is one possible source. The actual workplace, as well as any additional internal or external resources the organization deems appropriate.
5	**i-ERP Module(s)**	i-ERP features are provided by the interconnected i-ERP Modules. The basic intelligent technology ideas of AI, ML, and DA enable the three aspects of Data, Process, and UX. Big Data can be prepared and processed in real time by the i-ERP components.
6	**External Interfaces**	Interfaces to other internal or external suppliers' or customers' IS are possible for the i-ERP modules. Information and data can be shared.
7	**User Interface**	The UI is conversational, supportive, and adaptive. Intelligent assistants, information dashboards, and chat bots are all part of it. The fourth RPA/i-RPA, an intelligent technology, is present here.
8	**Organization / User**	By providing inputs and getting outputs, the organization or user communicates with and makes use of the i-ERP module(s). To access the system, a variety of local and mobile device types are supported.
9	**Digitized Process**	The procedure is one example of an exemplary process that is digitally mapped and carried out in one or more i-ERP modules. It can be carried out manually by the user via the UI with additions from the i-ERP, or it can be entirely or partially automated by the ERP module(s).

Source: (Bertram,2022).

The suggested components are connected in multiple ways. Table 5 presents model relations that are developed from the model requirements and the literature review's understanding of an ERP system. The corresponding element number in the model is shown in the first column, and the model relationship is explained in the second.

Table 5: I-ERP Model: Relationships

Letter	Description
A	The consolidated i-ERP database houses the data from all of the sources.
B	For the i-ERP modules, real-time data from the physical organization environment is available.
C	Database and I-ERP modules exchange data continuously (CRUD operations). The modules have the ability to enter new data into the database, including transactional data, user inputs, feedback data, etc., and they can access the data instantly to carry out operations, produce output, perform any other task, and astute computation, etc.
D	The various i-ERP components are linked and combined as required. They are constantly exchanging information, such as the intelligent coordination and the state of work.
E	The i-ERP modules provide the organization or user with outputs that are context-specific, real-time, tailored, and specific. The outputs can be in any type or form, including text, audio, and images.
F	The company or user provides inputs to the i-ERP modules. As examples of many forms and formats for the inputs, there are tasks, triggers, audio, text, and images. Feedback is also sent to the i-ERP so that it can learn from its actions.
G	Based on user input and the intelligent features of the i-ERP modules, processes can be automated, optimized, and redefined.
H	Data generated (transaction data, feedback, etc.) during the process execution is received by the i-ERP modules. The module processes it, and the i-ERP database stores the results.

Source: (Bertram,2022).

The description provides a broad overview of the suggested model and demonstrates how the model incorporates the features of the concept's i-ERP. The description adheres to the structure of the sensing, understanding, acting, and learning phases of an i-ERP process. The cloud architecture that hosts the i-ERP modules and database is adaptable and scalable. Data is the foundation of the majority of intelligent i-ERP activities, and the i-ERP contains numerous data sources that enable sensing. The consolidated, adaptable i-ERP cloud database (A) stores real-time data from the physical organization environment as well as data from other internal and external BD sources. Unstructured, semi-structured, and structured data are all supported. Both conventional transaction

processing data and data from i-ERP modules, including master or meta data (C), are contained in the database. The database serves as the primary data repository, which the i-ERP modules (C) can access instantly. The i-ERP modules can directly access data from the physical environment, for example, for real-time tracking, monitoring, and alerts (B). The various i-ERP are interconnected (D), preventing functional silos and enabling communication and cooperation.

One of the modules in the model was enlarged for a closer inspection. The heart of i-ERP consists of the module or modules that include the user interface. The intelligent technologies found in i-ERP enable autonomous action, data understanding, and learning. It is always getting better thanks to user input and fresh data. The precondition dimension is represented through the model, and the three intelligent functional dimensions of i-ERP—Data, Process, and UX—are displayed in the middle of the i-ERP module. The i-ERP modules can handle large amounts of data and perform intricate computations in real time.

By utilizing intelligent technology principles, the i-ERP is intelligent at its foundation. The modules incorporate AI, ML, and DA, which enable the system's functionality and learning capacity. Traditional BI, which was previously outside the ERP core, is now part of DA Multiple interfaces between an i-ERP module and other i-ERP modules, internal IS, or external IS (suppliers or customers) are possible. Interfaces allow for the interchange of data and information.

The i-ERP Module's user interface is accommodating and helpful. It features chat bots and other intelligent assistants to facilitate conversational interactions between the user and the system as well as proactive user support. Simple data insights are possible with data dashboards, analytics tools, and visualization tools. RPA/i-RPA can mimic a user in the UI and initiate autonomous, automatic activities in the i-ERP. The User Interface (E) is how the organization/user receives outputs from the i-ERP module, and the i-ERP modules receive inputs from the organization/user (F). The user interface adapts and responds to each person and the situation. The system's inputs can take the form of data or action triggers, and they can come in a variety of preset and non-predefined formats, such as fields, forms, and voice, text, and images. The feedback on the actions and outputs of the i-ERP is a crucial input since it aids in the system's learning process. The system's outputs, which can take many forms and formats, include data, insights, suggestions, and guidance to assist the user or organization with planning, decision-making, and process execution. Both newly developed data and sophisticated data insights can be obtained via the system. Real-time, context-specific, and customized outputs are offered. Processes that are digitally mapped in i-ERP are carried out by i-ERP module(s). The system (G) can automate the execution, or it can be done manually using human inputs supplemented by the i-ERP (F). Furthermore, by leveraging intelligent technology principles, i-ERP enables support and automation for process optimization and redefinition. New data is produced throughout process execution, and the system receives this data together with feedback to help it learn and take better action in the future (H).

11- EDGE ERP:

With its focus on data processing and storage near the event source instead than on distant servers, Edge Computing is a relatively new paradigm with a lot of promising applications. Gezer et al.2017 claim that edge computing permits higher-performance security by relocating security components closer to the attack's source, applications, and expands the number of layers according to an organization's size and kind that aid in protecting the core against breaches and risk. Beyond security, edge computing frees up resources to operate autonomously while still taking advantage of public and private clouds. It also improves efficiency by offloading workload from centralized data centers, enabling organizations to carry out complex computing procedures. Serving as a terminal endpoint authentication mechanism. Thus, by developing apps that operate on both the edge and the cloud, edge computing has closed the gap between intense computer processing and big data analytics. Specifically, industrial edge computing allows for flexible connection, real-time control, and data optimization while supporting intelligent applications, strict security, and privacy protection (W. Dai, et.al.2019).

Edge computing has the potential to give organizations a significant competitive edge when paired with ERP. A company's Edge computing platform is typically customized in order to enable application suites: The Company frequently uses edge computing in conjunction with distributed infrastructure to lower latency, improve throughput, boost flexibility, and enable instantaneous processing activities (Prakash, 2022).

Therefore, small firms with mission-critical systems and high security needs, as well as those with limited financial resources and a need for business continuity and sensitive data protection, are better suited for E-ERP.

Small and medium-sized enterprises (SMEs) do, in fact, find it difficult to use IIoT applications and technologies with great efficiency. This is due to the fact that those companies usually lack the manpower to investigate markets outside of their current product and product range. Oftentimes, they lack the funds to purchase early adopter technologies. Verify that focusing on the incorrect tactics isn't a waste of money. However, such companies need to be trained to want technology that can be developed efficiently enough to survive in a globalized.

12-Cloud ERP and Edge ERP Model Advantages and Disadvantages for Firms:

The next subsections on ERP, Cloud, and Edge Computing discuss the financial, technological, and organizational perspectives that present appealing options related to service and deployment strategy (Prakash et al., 2022).

1- Innovative Business Model and Cost Savings: The primary financial driver behind the implementation of C-ERP and E-ERP is cost containment. Both C-ERP and E-ERP, indeed, allow for three sorts of cost savings: decreased upfront fees, lower operational

costs, and transparency of the total cost of ownership, all of which contribute to a better financial image for the business .Lower operation and maintenance costs are a direct result of great pricing competition and can be easily applied to cloud computing. It is necessary to have a distinct conversation about hybrid (Cloud/Edge) ERP models because these models are popular among big businesses because they provide an excellent way to reduce expenses while protecting sensitive data. Grubisic, on the other hand, has discovered that SMEs find the C-ERP hybrid model unpleasant because it would result in increased expenses. Achieving a business value from such IT transformation is the last feature that most senior managers look for in C-ERP and E-ERP, aside from cost savings. In fact, the authors have found that new business leads and existing corporate plans can be pushed toward a customer-centric strategy by utilizing the innovative information offered by C-ERP and E-ERP. Indeed, there is a faster response time, the ability to handle large volumes of data regularly, and greater reliability by reducing the downtimes (for larger organizations, if the system is down for numerous hours, then it can result in a financial loss). This is because data are processed close to the head, and only a small amount of information is transferred to a centralized cloud server. Thus, these three benefits enable the businesses to think about new business models. Specifically, E-ERP architecture can assist with this by directing just the most computationally demanding processes and offloading a portion of the effort from the main cloud ERP. Despite the Cloud's plenty of storage, processing power, and speed, customers' usual business operations may be interrupted if the network that connects the Cloud's internal operations slows down because of excessive workloads. Any network outage could endanger the business and lead to bad debts.

2- Flexibility, Agility, and Scalability: One of the main advantages of cloud and edge computing is the increased agility and flexibility that allows businesses to quickly adapt to changing market conditions. Therefore, it should come as no surprise that C-ERP and E-ERP provide businesses with a significant competitive advantage. Lenart noted that the majority of the benefits are due to scalability and administration features. In a similar spirit, scalability allows businesses to utilize their resources more efficiently with simpler upkeep, as noted by Saa et al. With C-ERP, a business can just pay for the services it needs and does not need to maintain its IT infrastructure.

3- Enhanced Business Productivity and Efficiency: Since automation boosts productivity, it is greatly desired in the IIoT arena for services, processes, and procedures like production, purchasing, distribution, and inventory management. Total efficiency is increased by C-ERP and E-ERP, which enable automation and increased output. C-ERP and E-ERP enhanced the company's operations, user experience, and efficiency. As highlights, data uniformity in C-ERP and E-ERP is also conceivable, leading to better operations management. uniformity is crucial in this respect to encourage collaboration among several sites and expedite corporate operations. The integration of C-ERP and E-ERP with other systems, like business intelligence, enhances planning and decision-making. The E-ERP

approach creates an efficient environment for speedier reporting and decision-making by providing real-time information. By sharing workloads with the ERP application server at the core, it achieves low latency and great performance by controlling partial execution at the edge nodes.

Depending on whether the deployment is from the ground up or a migration from a traditional ERP to a Cloud- and Edge-based systems, the main obstacles for C-ERP and E-ERP installation solutions may vary. However, the issues with both paradigms are same. The following is how these challenges are expressed (Prakash et al., 2022):

1- Organizational issues and conservative thinking: Infrastructure, workforce skill sets, strategy, and scalability are already impacted by cloud and edge computing. Converting from traditional ERP to C-ERP or E-ERP necessitates extra financial outlays as well as the restructuring of resources and processes. As a result, when major adjustments are needed to the way organizations carry out their daily operations and procedures, managers are frequently intimidated and demoralized. Because business process re-engineering is the cornerstone of a successful cloud/edge-based ERP adoption, the organization must be sufficiently flexible to support it.

2- In addition, they discovered that, independent of size, businesses with more sophisticated infrastructures are more likely to switch to C-ERP and E-ERP. A more thorough investigation reveals that people are necessary for the successful adoption of C-ERP and E-ERP, both inside the organization (top management and employees) and outside (ERP vendors). Employee familiarity with the technology helps to ease the transition when they are involved in the implementation process. The choice of cloud provider and edge technology bear equal significance.

3- Network balancing and latency: Conventional on premise ERP systems are local area network (LAN)-connected hardware and software platforms. It is imperative that the client and service provider maintain a high-speed network, and the business must understand the consequences of latency and how it impacts operations. Therefore, traffic unbalancing and network slowness may hinder the implementation of C-ERP solutions. In fact, some SaaS customers might not be close to the centralized location of the data center, and traffic peaks could result in subpar networking. In this case, latency and performance issues need to be resolved because the cloud user might want to carry out business operations in real-time with a predictable response time.

4- Protection and Privacy: ERP may disclose sensitive data, such as financial or industrial data, in cloud and edge settings, therefore data protection is essential. When a corporation opts for C-ERP, it also agrees to allow access to sensitive and vital business data to outside service providers. It may be merged with information from other companies. Therefore, because of the Cloud's openness and multi-tenant capabilities, security and privacy may become a problem.

13- Conclusion and Future Research:

Any industry makes a deliberate decision to implement C-ERP and E-ERP. The competitive advantage of ERP comes from its connection with more recent technologies (I-IoT), which masks the ongoing need for operational changes inside an organization. The factors influencing the adoption of C-ERP and E-ERP were the first to be examined in the study of the industrial decision-making process. When it comes to improved query performance, quicker provisional delivery, and client proximity, E-ERP solutions can outperform C-ERP solutions. Numerous ERP modules and systems may potentially make use of edge computing. Edge nodes have the ability to manage task allocations at the edge network, streamlining and segmenting tasks to be carried out in part at the edge and sending only the computationally demanding tasks to C-ERP. Finally, the E-ERP model provides real-time data, making it a more effective and efficient decision-making and reporting tool. Split Low load on partially executed workloads on central ERP application servers and control edge nodes Latency and high performance.

Based on the findings and restrictions of this investigation, a few recommendations for further research are provided below:

- Future research that involves a significant investment of time and resources, such as a case study, may demonstrate an I-ERP in an actual setting.

-In the future, research opportunities could be used to determine how to best convey benefits to organizations so that they can comprehend why they ought to employ i-ERP. In this investigation, the advantages should ideally be measurable.

-using a case study methodology on one or more artifacts and making decisions in light of that.

-Since I-ERP is still a relatively new issue, there will likely be a lot of modifications and new advancements in the next years. Investigating the possible function in i-ERP requires ongoing research on new and developing technologies. In connection with this, more i-ERP dimensions, features, and functionalities could be studied.

- Future research should concentrate on creating a new ERP system based on the Edge computing reference architecture that has the necessary features to get around the drawbacks of the C-ERP and E-ERP that are now in use. This novel reference architecture's primary objective is to accomplish real-time data analysis on nearby devices and edge nodes instead of in the cloud. Additionally, by lowering traffic and data transmission between the edge and the cloud and enabling latency-tolerant apps to achieve lower latency levels for usage in E-ERP, operating and management costs can be further decreased.

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