



## STUDY OF CLOUD BASED ERP SERVICES FOR SMALL AND MEDIUM ENTERPRISES (Data is processed by Text Mining Technique)

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*Abstract*— The purpose of this research paper is to explore the knowledge of the existing studies related to cloud computing current trend. The outcome of research is demonstrated in the form of diagram which simplifies the ERP integration process for in-house and cloud eco-system. It will provide a conceptual view to the new client or entrepreneurs using ERP services and explain them how to deal with two stages of ERP systems (cloud and in-house). Also suggest how to improve knowledge about ERP services and implementation process for both stages. The work recommends which ERP services can be outsourced over the cloud. Cloud ERP is a mix of standard ERP services along with cloud flexibility and low cost to afford these services. This is a recent phenomenon in enterprise service offering. For most of non IT background entrepreneurs it is unclear and broad concept, since all the research work related to it are done in couple of years. Most of cloud ERP vendors describe their products as straight forward tasks. The process and selection of Cloud ERP Services and vendors is not clear. This research work draws a framework for selecting non-core business process from preferred ERP service partners. It also recommends which ERP services outsourced first over the cloud, and the security issues related to data or information moved out from company premises to the cloud eco-system.

### I. INTRODUCTION - ESSENTIALS OF CLOUD ERP

The principles of cloud ERP is originated from the term cloud computing. To explain what cloud ERP means, it will be compulsory to first classify cloud computing and its significance.

Cloud computing are based on the computer terminology Cloud which is seen to be several computers (thin & thick client) and servers connected through World Wide Web (WWW) or internet. Computers can be personal computers (PDAs, Mobile Devices) or network servers; they can be public, private or hybrid.

The term cloud computing means access remotely to computing services offered by third parties (vendor of offering cloud based services).the term Cloud computing was evolved

due to the revolution of internet. Researcher published that cloud computing gets its name as a symbol for the internet (as World Wide Web is life line for cloud services).

Cloud has been used traditionally as a synonym for the internet based services. Most of scholar & researchers agree that cloud based services has three layers.

A group of researchers explained these three layers as three inter-related stacks:

*SaaS web services and business applications (apps) are designed for end-users, delivered over the www or internet*

*PaaS is the set of web services and tools structured to make coding and deploying those services and applications rapid and proficiently*

*IaaS is the Information Technology Infrastructure (hardware and software part) that empowers the organization to outsource these non core activities related to IT Infrastructures e.g. operating systems, storage, routers, distribution systems, servers and networks to third party. Now, Organization can be focused in to core business processes.*

*CaaS – It is another flavor of cloud which facilitate the organization by outsourcing all the communication need of particular business activities.*

Federal Financial Institutions Examination Council Information Technology Subcommittee (2012, 1) concrete the area of cloud computing: “..... *The term cloud computing is a comparatively latest terminology used to express diverse acknowledged business process flows, technologies, and processing techniques. Even though, the cloud technology demand is rising as per change in current business needs still there is no common definition. Several business processes, strategies, technologies, platforms, frameworks and architectures are suggested as cloud computing. Generally, cloud computing is a scheme of immigration from in-house resources to shared resources in which customer employees get enterprise services, on demand, from third-party service vendors by WWW or Internet. These lines present a specific definition of cloud phenomenon.....*”

The National Institute of Standards and Technology (NIST) (2011), presented the terminology in a different words:”.....*As per report it is a model of web services distribution using flexible, low cost and easy available platform. Hence, the model empowers convenience, sharing of pooled IT Infrastructure as per business demand or situation permit. It provide computing resources (e.g., enterprise products, networks, servers, storage, business applications, and readymade services), that can be consumed instantly as trend changes in business and free with negligible management effort or service vendors communication*”

Additionally the report, described the cloud services from usefulness or the relation with user’s viewpoint. The cloud based web services are used through internet (WWW) from a dedicated server that manage and store all related web services within a cloud. If the computer crashes due to some calamity or other reasons, the report created will be saved on the server that hosts the package of web services which can be accessed through web by other users as well. Correspondingly, if we think of ERP packaged services being stored in a dedicated server in the cloud, the ERP system is used through web with predefined access rights. So, cloud ERP is an ERP system which is hosted over the cloud platform by service provider. It will offer equivalent modules & services that are in the standard ERP package that is implemented on the organization’s locations.

There are many advantages if we look cloud ERP as a software project. Group of researcher believed in these advantages when they recommend applying cloud computing to project management.

These advantages consist of faster ERP implementations, minimal operating costs with superior flexibility, scalability, profitability, malleability and consistency to the organization’s business and dependent activities.

Cloud services are a type of web applications or software; it provides solutions that can be accessible at any time, in any location with no physical boundaries in the world and by any person with accessing rights. [3] [4]

Now we can acknowledge that cloud services will change the way of working patters of different ERP users around the

globe, they will not be limited by working location or time as long as they are connected to web.

1. Public cloud - Easily accessed by any user with a connection to the internet and access to the cloud eco-system.
2. Private cloud - It is established for a particular group or company and limits access to just that group.
3. Community cloud – It is shared among two or more organizations that have analogous cloud necessities.
4. Hybrid cloud - It is a mash up of minimum two Clouds, where the Clouds included a mix of public, private or community”.

Most of other researchers and ERP providers SAP (2013), Oracle (2013), Ramco (2013), categorize cloud types mainly in four categories: public cloud, private cloud, community cloud and hybrid cloud. As diagram 1.1 is showing that community cloud is a part of public cloud if it does not necessitate any particular access rights, or else it will come under private cloud with the specific access rights.

I. TEXT MINING TOOLS STEPS USED FOR GETTING THE RESULTS (THE DECISION HAS BEEN MADE BY THE TEXT MINING RESULTS OF THE RAPIDMINER DATA MINING TOOL VERSION 5.3)

**Quick View of Data Mining Steps**

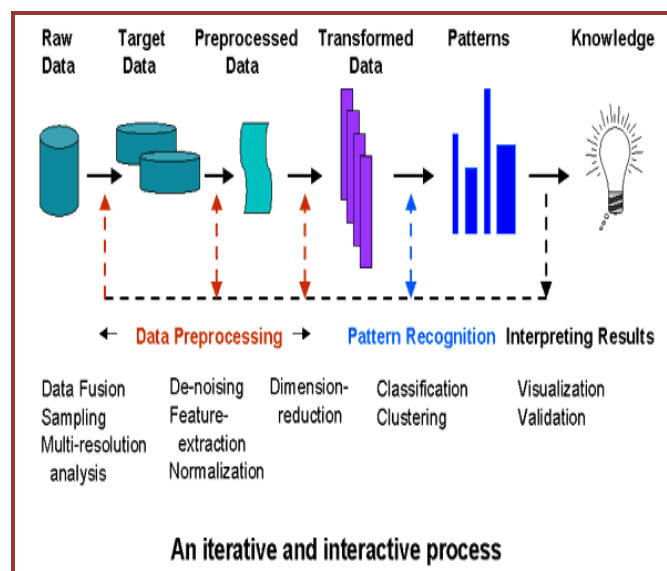


Figure 1.1 – Basic Steps of Data Mining used by mining tool

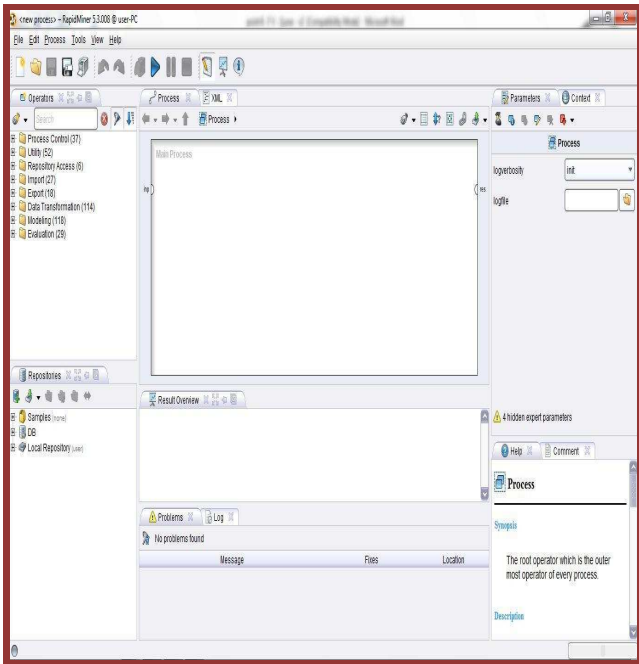


Figure 1.2 – Graphical user interface of RapidMiner version 5.3 – an open source tool for Data Mining

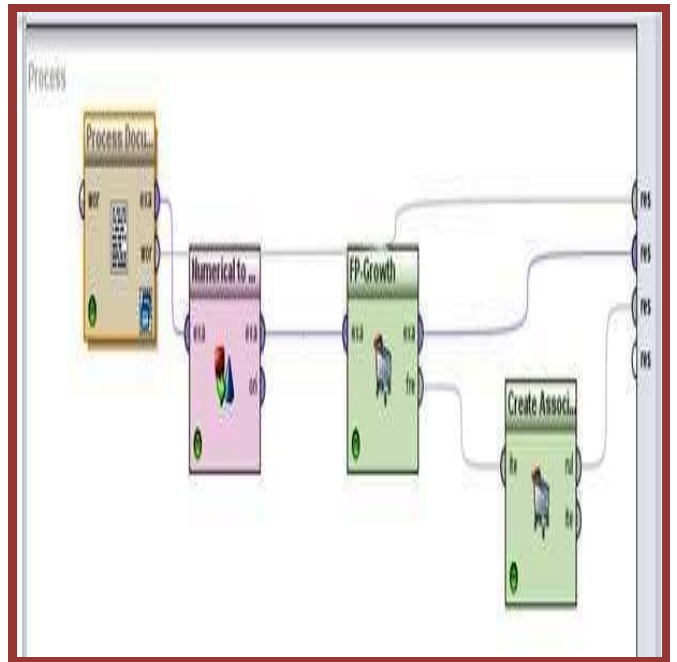


Figure 1.4 – Transformation and processing of data

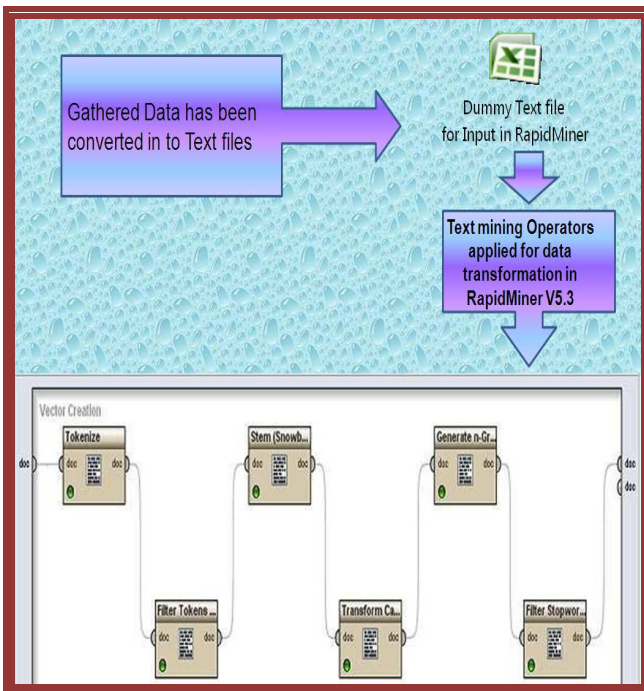


Figure 1.3 – Steps of result generation

No.	Premises	Conclusion	Supp	Confidence
1821	manag	servic	0.917	0.957
1826	manag	time, servic	0.917	0.957
1827	time, manag	servic	0.917	0.957
1832	manag	solut, servic	0.917	0.957
1833	solut, manag	servic	0.917	0.957
1842	manag	time, solut, servic	0.917	0.957
1843	time, manag	solut, servic	0.917	0.957
1844	solut, manag	time, servic	0.917	0.957
1845	time, solut, manag	servic	0.917	0.957
1586	provid	servic	0.875	0.955
1608	provid	time, servic	0.875	0.955
1609	time, provid	servic	0.875	0.955
1632	provid	solut, servic	0.875	0.955
1633	solut, provid	servic	0.875	0.955
1636	product, manag	servic	0.875	0.955
1645	provid	manag, servic	0.875	0.955
1691	provid	time, solut, servic	0.875	0.955
1692	time, provid	solut, servic	0.875	0.955
1693	solut, provid	time, servic	0.875	0.955
1694	time, solut, provid	servic	0.875	0.955
1699	product, manag	time, servic	0.875	0.955
1700	time, product, manag	servic	0.875	0.955
1717	provid	time, manag, servic	0.875	0.955
1718	time, provid	manag, servic	0.875	0.955
1729	product, manag	solut, servic	0.875	0.955
1730	solut, product, manag	servic	0.875	0.955
1747	provid	solut, manag, servic	0.875	0.955
1748	solut, provid	manag, servic	0.875	0.955
1759	product, manag	time, solut, servic	0.875	0.955
1760	time, product, manag	solut, servic	0.875	0.955
1761	solut, product, manag	time, servic	0.875	0.955
1762	time, solut, product, manag	servic	0.875	0.955

Figure 1.5 – RapidMiner Table - Outcome from text files of Companies category



activities. In addition to that payroll outsourcing can release the burden of tax calculations and other lawful rules that can be complex to SMEs but can be easily maintained by specialized third party vendor by fulfillment of payroll business process with the legislation rules.

**Logistics and supply chain activities:** It is a part of supply chain management module and several activities in logistics are necessary to facilitate the flow of manufacturing product from point of origin (raw material exploration) to point of sell (where consumer buys the finished goods). Standard ERP packages contain a separate module that is reserved to logistics business processes. Many of them do not have own transportation vehicles to transport their raw materials and products. Hence, outsourcing this enterprise non core business process over the cloud can be more advantageous in terms of money and time saving. There is one more non-core business process which can be outsourced within logistics modules is the inventory management (compulsory in manufacturing domain) including warehouses and raw material storage. By adapting this business decision, the manufacturing firms can benefit from raw material, toll charges, fuel and market price forecasting. The forecasting (predicting market trends) can be built in cloud based ERP services in sort of added apps and can be embedded in dashboard apps that facilitate visual real time information for management associates. The real time information can be verified on dashboard apps, like raw material availability from different suppliers, locations and prices discount offers. The moving of firm's material can be tracked by implanting RFID in trucks; it can facilitate Just-In-Time (JIT) delivery of raw material and finished goods.

**Outsourcing of marketing related activities:** Cloud ERP facilitates marketing by a separate module on this. As it is already mentioned in point 4 that marketing activities will help manufacturing firms to get response from their existing regular & irregular customers, reach new customers and new ideas on how to be pioneer in new markets (in last quarter Hero Moto Corp launched its flagship bike splendor in African countries which are new market for the Hero). Innovation can be achieved by improving existing products and services or inventing new products and services. Hence manufacturing firms can outsource marketing services over cloud ERP.

Outsourcing marketing to the third party is typically expecting intervention of social media platforms which are rich of customer's information. The information can be: customer's expectations, judgments, and complaints about the organization's or competitors products, new ideas for new innovation; we are living in era where customers drive changes through social network platforms. All this information can be crucial in shaping the manufacturing companies competitive advantage. But the puzzle here is: how can manufacturing firms select the right marketing partner? Special business consultants (e.g. Boston consulting group) may solve this puzzle.

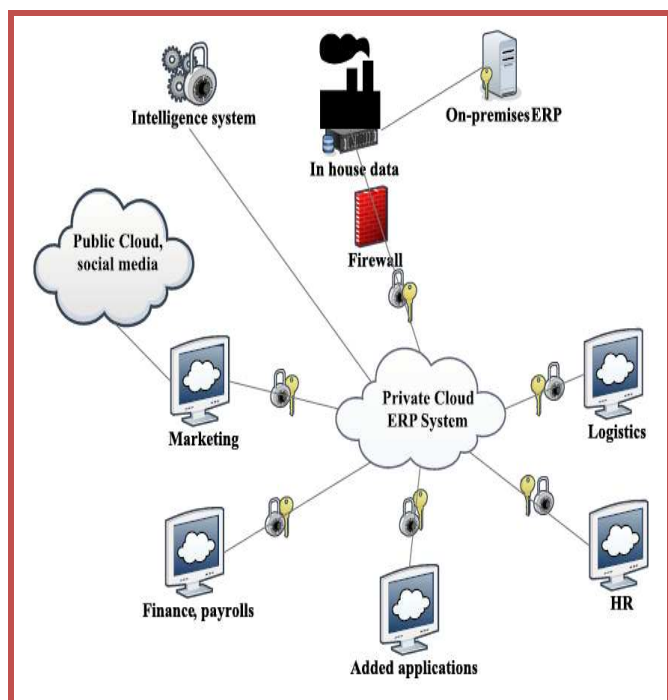
**Data service management:** Outsourcing need arise to this module usually when cloud ERP partner offer only standard ERP system over the cloud. It will necessitate securing and protecting data over the cloud by using third party services. The third party service provider will ensure the data security, safety, control, availability, and accessibility around the clock and data ownership as discussed in point 4. For securing data the service provider generally uses masking or encrypting of the master data, for making leak proof environment for data services provider generally uses discretionary access control (DAC) or Mandatory Access Control (MAC) in combination with encryption algorithms.

**Added-On applications:** these apps can be the extra tools or add-on service offering that are not included in the standard cloud ERP. All SMEs will not utilize same cloud ERP modules with same service offerings; each one practices its own methods of manufacturing processes in a different way even though they might produce same or identical products. One example of these added apps can be dashboards or intelligent user friendly GUI that enables management associates to access real time information with greater transparency.

Hence outsourcing services offerings over the cloud ERP appear quite complex and interfered with each other. As cloud ERP is based on SaaS model, the cloud ERP services consumer need only the internet connection and computer or any mobile device that enables users to log-in with their ID's or usernames and passwords. Physical presence on particular premises does not matter here, so the third party service provider will have their own ID's and passwords. They can use ID's and passwords only for the task they should perform. Similar, to the in-house ERP users from different departments have their own ID's and passwords.

Users can pay and use the needed ERP modules according to their business demand. HRM modules will be handled with HR expert, logistics will be handled with logistics experts and so on. None of these enterprise services will hinder with other activities, users will not necessary know each other.

ERP systems integrations are used in complex organization structure and carefully taken into consideration; it will involve enormous work to convert data to be companionable with all diverse ERP systems. Hence forth before outsourcing services, firms are suggested to select the right cloud ERP that will be companionable with their partners ERP systems it would be easy if the group of partners create alliances that use same ERP system and allows them to avoid the burden of ERP system integration that might consume a considerable time and human resources (e.g. Reliance is using SAP ERP Services across all the business verticals).



**Figure 2.1** Typical scenario of SMEs in Cloud ERP ecosystem

In the Figure 2.1, the locks and keys show that each user from different third party has own ID and password that allow him or her to log in the cloud ERP system. All the data will remain in private cloud of the manufacturing companies. The intelligent system used for monitoring the cloud eco-system in order to ensure the safety and security of the implemented system.

### III. WHICH ERP DATA CAN BE KEPT IN-HOUSE AND WHICH CAN BE MOVED TO THE CLOUD

Cloud is latest buzzword in computer system terminology and platform, the area is widely researched by information system management (ISM) researchers also. According to ISM researchers the cloud is misunderstood technology but still it gained attraction from different industries and communities. On the other hand, the cloud concept is new notion for various SMEs (small and medium size enterprises). The majority of small and mid-sized manufacturing firms see that moving data to cloud and will be a challenging, confusing and worrying task.

The below given data is recommended to remain in the company's location:

**Data of Core business processes:** The data is life-line for any manufacturing company and cannot be shared at any cost. The core data comprises design of core business processes, data related to raw material cost, profit margins, future plan related to new product offerings, planning to grab market in geographical location etc. This type of data is the most receptive data also known as master data. Most of the SME in manufacturing domain will agree that manufacturing secrets or

patented process must remain in the house so that nobody can re-engineer the process and not able become competitor in the same domain. These secrets consist of the manufacturing of products or spare parts and services related to them. The secrets can be designs, secret insights of product recipe, cheaper raw material source, skills and own dynamic capabilities who carry the actual tacit knowledge. All these manufacturing secrets constitute the organization's core businesses and competitive advantage drivers.

**Data of daily transactions:** The data generated on daily basis or due to regular transactions comes in this category. A competitor can analyze any business turnover and average daily limit of product supply on the basis of this data. It is also known as transaction data. This kind of data is another susceptible data generated on daily basis e.g. trillions of bank transactions happen in worldwide bank like Citibank. It contains data that supports the daily operations of manufacturing companies (e.g. transaction related to raw material uses on daily basis). This data is generated regular basis by cloud or in-house ERP's application systems or other in house applications. Since most of transactions are made online, so most of organizations are having fear of losing this data, provided that there are well established security platforms (e.g. Axis Bank is using dual authentication technique to secure its electronic transaction, Reliance is using RSA Algorithm based authentication technique to access their systems on-line.).

**Contracts data (personal data related workforce and partners):** The data is also generated on regular basis, because nobody can assume organization without human resource or intellectual assets. This data comprise of suppliers, logistic vendors, third party, employee's contracts and legal related activities. For the employee's contracts it should be kept in-house and confidential. Previously, I recommended outsourcing HRM over the cloud, the role of HR here just to find the right person for the company; the contract step will be performed and will be kept in-house.

The data related to vendors, suppliers and third party contracts that contain legal duties of each part, should remain in house of each part involved in company's businesses activities. Here all parts involved as partners should protect each other's information from any leak are peeping from outsiders or competitors.

Each type of data and their interchange transactions will need to be managed between all cloud ERP modules. That is why companies have to implement risk management solution for master data. The next point will deal with this problem.

The below mention data is recommended to be moved to the cloud:

**Customer's data:** customer's data encloses information about the organization's customers it should be protected when it will be moved to the cloud due to confidentiality and ethical reasons. Usually, customer's data contains customer's names, addresses, mobile numbers, email IDs, purchase history. Not

all customers accept that their information will be available for public use or used by other unknown parties. The customer's information should be secured by the organizations and their third parties. That is why SMEs are suggested to use private cloud for their cloud ERPs. Policies should be maintained regarding safety and leak of customer data.

**Internal employee's data can be moved into the cloud under authoritarian conditions:** this data can be related to the organization's core and valuable business capabilities. It was suggested that the manufacturing companies should outsource HRM and payrolls activities to third party; this will force the company to send information about their existing employees and new required ones to the third party. As a result, the companies here must build a trustful relationship with their third party partners, especially HR partners. This is possible by setting special rules that will prevent the leak of information from one company to the other through employee's movements. This may occur when an employee decides to join workforce of the competitor for better salary. In well developed countries there are rules that protect company's rights in such cases.

**Data warehouse and cloud storage:** Data warehouse is a need of every SME because this era belongs to information. The data stored in ware house usually contains historical data resulted from transaction data and other source of data. Therefore, data warehouse is updated regularly through online transaction processing. On line analytical processing and transaction processing is the famous tool used for data mining which lead for decision making. Data warehouse is gather data from different ERP system and inter-transaction of used modules; this type of data might be moved to the cloud only in case if the *cloud is having strictly policies related to data security*. I recommended to SMEs to use only private cloud, the data warehouse can be moved to cloud as well. [11] [13]

#### **How secure are cloud ERP service as compared to in-house ERP?**

The scenario of using cloud based ERP is analogous to moving in-house ERP to the cloud. Therefore, before starting data migration process from in-house to the cloud, SMEs have to think about what will happen to their data centers and its repositories in the cloud. The most tormenting issue that kept various organizations from migrating to the cloud is security and safety of the cloud. Many incidents of data (master and transactional data) theft or leak have happened in recent year before the cloud concept born. Cyber attacks or Cyber warfare recorded plethora of on-premises data leaks that belong to large organizations. The data has been either destroyed or exposed to public. These attacks may cripple the manufacturing network with their partners causing major damages such as sending products or raw materials to wrong location or simply delay an important business processing transaction. [14][19]

By the data collected during an interview with few SMEs in manufacturing domain, IT ERP consultants and ERP providers, we concluded that the safety and security concern is the precedence of their businesses. Numerous cloud ERP vendors offer only the ERP system without cloud or security related to it. But they have their co-partners who can offer either cloud or security or both as it was pointed out in point 4. Other cloud ERP providers offer almost everything what small and midsized manufacturing organizations need. The security of the cloud ERP compared to in-house ERP can be study and implemented by using Data risk management.

The data risk management includes not only the SMEs, but all their partners and co-partner who look after of the non-core business services. These partners are linked to the SMEs through cloud ERP models according to their outsourced businesses they expect to offer. Organizations and their co-partners have to safeguard all data traffic that will occur in the cloud ERP modules during various business processes e.g. procuring raw material and selling finished goods. Safety of data (master or transactional) is the accountability of the SME's and all partners who assist their businesses core and non-core business processes.

Data risk management comprises these important data security terminologies: data control, accessibility, data recovery, availability and flexibility. The data control comprises of the ownership of data. The owner must have a full control of his or her data. In this case the SMEs will have the administrative data control in the cloud ERP, for the reason that the cloud ERP belongs to manufacturing organizations. Hence cloud provider can use access control mechanism to handle this data base (Mandatory Access Control – MAC, Discretionary access control - DAC)

Since the data risk management involves the third parties responsibility, the cloud provider has to offer data recovery in case of unwanted disaster (e.g. Tsunami, Earthquake etc.). Cloud provider has to make data accessible from right owner (including data protection) and available 24/7 for the users of the SMEs. The most important point is that organizations have to ensure the availability of the cloud provider. In worst case, if the cloud provider decides to shut down his or her business or went bankruptcy: in this case organizations and cloud vendor have to make sure that their cloud ERP and data related to it is save and can be moved to other provider.

Generally, the security is related to local legislation, defining the cloud vendor and cloud's physical location is important aspect to take in contemplation when the organizations will outsource cloud storage. Legislation in other countries may not give safety and security to the data. Due to this premier reason organizations need to have cloud provider and cloud storage location in countries where the law protects their rights related to security of data in the favor of SMEs.

As data security is one of important concern for SMEs. So forth, data safety over the cloud here are numerous suggestions

of securing own data. In order to protect data over the cloud, SMEs are suggested to create confusing or bogus data. Once the cracker or intruders tries to crack the false data the system sends warning to third party co-partner who is taking care of security then they will have to take the essential safety measures. The bogus data might contain real Id and passwords that allow hacker to get access to bogus data after hard work. The bogus data will be used as hurdle to protect the genuine data. The safety for genuine data must be tight, using new techniques of data protection e.g. using encryption algorithms, Hash Functions or Digital signature for authentication. The protections algorithms and methods must remain top secret.

The basic property of cloud ERP is to be handy from any location thorough the globe, here the SMEs is suggested to build an intellectual system admonition that can recognize ERP user's manners. Further, the intellectual system will identify user's admittance according to time and geographic locations. If an organization user gets admittance to cloud ERP, let's say: from Bangalore, India and he will log off from the cloud ERP services after he or she end his or her job. In a limited period, with the identical ID and password another user gets admittance to the cloud ERP services from geographic location that is remote from India, let's suppose: Far North or China. So, it does not make sense that the user from India will move fast in short time to Far North or China, therefore the intellectual system will involuntarily terminate the user's ID and password. The intellectual system will be made based on time, locations and optimization of user's movements from their last access to the ERP system. In any case of cloud ERP users will shift from their customary location they must notify the responsible person for administrative authentication rights. [16] [17]

On the other hand, the security of cloud ERP in comparison with in-house ERP seems to be more susceptible due to all parts mixed up in it. However by the use of emerging refined technologies there are systems services that can supervise the inner ERP user's manners and outer user's system threats. The safety of cloud ERP must be handled by special experts in system security domain. Implementing the most excellent conventional security solutions is not enough to give assurance of the safety and security of the cloud ERP system.

As my research work recommend here that the SMEs should have their cloud ERP installed in private cloud, but still the organizations need to safeguard the flow of the transactional and master data transmission from and to diverse ERP modules; keeping in mind that this traffic of the transactional and master data comes from diverse outsourced partners and co-partners. The outsourcing co-partner may not have analogous ERP as the SMEs; for central monitoring of data flow will require data integration between different partners in cloud eco-system.

#### **IV. IMPORTANCE OF QOS FOR SMES AND CLOUD ERP PROVIDER**

Quality is a multidimensional word which uses to measure the satisfying level of consumers/clients. In relation with enterprise services if a package of cloud services improves return on investment (ROI) then the package is having higher quality as compared previous product. So it means it is a qualitative term for judging any services or products.

So, to facilitate the service companies and manufacturing firms standards of quality are set in the form of Quality certificate. This is an effort by intellectual communities for measuring quality in quantitative manner. Outcome of these efforts are certificate like six sigma, CMMI, ISO certification etc.

Two famous Quality Standards are:

- Capability maturity Model Integration (CMMI) for software industry
- Six Sigma for Manufacturing Industry

When strategy is designed by lead firm to outsource IT services from vendors then alignment of business process quality is measured and equate with vendor's quality of service (QoS).

In current competitive business scenario every successful organization wants to achieve quality in their products and services. Better quality products can be success formula for any existing or new business. To achieve this, organization use to outsource their non-core activities from third party and some time it become reason for collapsing the whole organization. If outsourced business processes are not compliance with quality standard then how they will give better result to lead firm. So there should be matching of quality standard in both the partner. As example a six sigma compliance manufacturing firm can procure services from Level-5 compliance IT vendor. [5] [7]

#### **V. RECOMMENDATION FOR FURTHER RESEARCH**

Cloud ERP and in-house ERP basically have similar enterprise concept oriented modules and functions. The cloud based web services are predicted to grow in the future. The trepidation and the economic crises have halted the momentum of cloud based services deployment. It will be fascinating to perform researches work in field of Cloud ERP vendors and there business strategy for stimulated the need of cloud based enterprise services. The research therefore should focus on most of the business verticals, industries behaviors and their reactions. Future scope can identify latest technologies and platforms which facilitates cloud eco-system in decade to me e.g. new version of AJAX - Asynchronous JavaScript and XML and virtualization.

New technical and business alliances will be formed, in particular field of data security and ERP systems in order to overcome the issues of ERP systems integrations. The service



outsourcing and customization of service offering will be reshaped; the legislation related to cloud outsourcing will be developed as well. The research work can be carried out with people from different domain e.g. technical, management, law and finance vertical. These researchers can be technical engineering students, law student, finance experts and business oriented students.

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