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A Qualitative Study on CIO Competencies, Cloud-IoT Implementation Challenges & the Organizational Benefits of Cloud-IoT Implementations

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Abstract

The present era has captured and really embraced IoT-cloud implementation, which is now expanding rapidly like wildfire in almost every industry. During the cloud-IoT era, the role of Chief Information Officer (CIO) plays an important part in adoption and implementation of these technologies. The role and competencies of the CIO is expected to change during the cloud and IoT era. However, there has been an absence of research which has inspected the role of the CIO in the cloud and IoT era. The key discoveries show that the role of the CIO has become progressively business engaged and vital. Analysis of CIO competencies is very important for the organizations which are in the mode of cloud and IoT adoptions, and also for the organizations which are already running with these technologies. Notwithstanding, the CIO, despite everything, needs to have a significant level of comprehension of key technology information or access to key capabilities. Cloud computing permits organizations to store and oversee data over cloud stages, giving adaptability in the conveyance of applications and programming as a core role. Cloud computing additionally permits data transfer and capacity through the internet or with an immediate connection that empowers continuous data transfer between gadgets, applications, and cloud. Cloud has been such a superiod technology that there is a flood of executing virtualization among CIOs. This has incited a bigger number of complexities than courses of action. The job of a CIO can differ extraordinarily from somebody simply answerable for the technology and with little communication with business gatherings and management to somebody with a senior management job, dynamic in the system advancement, and impacting a company's key course, authoritative structure and culture. Hence, this paper will focus on looking at the challenges to IoT-cloud implementation, the legacy of CIO competencies coupled with the consequential after effects of IoT and cloud successful implementation

Keywords: IoT, cloud computing, security, fog computing, systems administration, Cloud of Things, networking

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1. Introduction

The Internet of Things (IoT) is, without a doubt, one of the most energizing subjects in the information industry. While customary internet encourages communication between various constrained gadgets and people, IoT interfaces a wide range of associated "Things" into an exhaustive system of interrelated knowledge, making decisions without the mediation of a human. Despite the fact that it is still at its infancy stage, organizations and enterprises have immediately increased the intensity of IoT in their current frameworks, and they have seen diverse improvements already.

IoT and cloud computing is a quickening technology that permits to utilize the IT capacities as per the client's demand or as indicated by the business needs. Internet of Things is a familiar terminology in the data technology

world and communication aspect. To put it clearly, it is a cutting edge technology which gives the capacity to send and get data by means of system communication going from the Internet or an intranet. [1] At a fundamental level, Internet of Things helps with the connection between various service frameworks by means of the Internet and their communication with one another to accomplish the motivation behind giving increasingly effective and progressively clever experience. In addition, with any new technology, IoT appeared to be a confounding idea from the outset. Besides, this technology is characterized by new and remarkable implications particularly with regards to wellbeing and security measures. The fundamental focal point of this qualitative research survey is to break down the procedure of how associations are presently coordinating IoT inside their organizations, while likewise researching causes that thwart interoperability, and assessing the future potential arrangement of the Open IoT biological systems in organizations.

This paper therefore focuses on analysing the CIO competencies in cloud and IoT organizations, challenges faced by organizations in the implementation of cloud and IoT technologies. This study also focuses on the after effects of cloud and IoT implementations as well. Background of the study, review of related literature, research purpose, research design, and interpretation of data, findings and results are all discussed in this paper.

2. Background

Information Communication Technology (ICT) is perceived as a key empowering agent of monetary development and improvement in the world at large. Progress towards modernizing ICT in the public sector has been moderate and the administration slacks the private sector as far as ICT adoption, including cloud computing. The ICT strategy condition stays divided and ICT adoption in the public sector has been hampered by extended approach forms [2].

IoT and Cloud computing, which falls under the space of ICT is seen as having the capacity to advance more prominent efficiencies, combination, coordination, and cost reserve funds across the public sector. Cloud computing is additionally expected to empower the legislature to meet the destinations set out in the National Advancement Plan, including accomplishing better coordination between government divisions and empowering the conveyance of e-taxpayer supported organizations, yet the utilization of these administrations include been restricted within the public sector.

However, there are "siloed" and divided ways to deal with ICT utilization, including cloud computing within the public sector. Thus, numerous organizational divisions stay unique and are definitely not interoperable. Most cloud computing organizations are specially appointed and lopsided across various government divisions as there is no conjured and composed way to deal with ICT throughout all circles of government, which could be tended to by building up a national midway facilitated cloud procedure [3]. There are more extensive procedures, guidelines and enactments that influence the execution of cloud computing administrations in government, including e-government enactment, insurance information systems, information storage, and grouping measures and security insurance that can be extended to cover cloud computing administrations. [4]

3. Review of Literature

The most recent advancements in the aspects of ICT have constrained the private executives, especially the administrative specialists to deal with the difficulties of overseeing multifaceted nature brought by the significant change procedures and development steps that permit them to accomplish their sole objective, all the more effectively and within a shorter time [5]. All advantages related with mechanical enhancements have allowed the growth and collaboration among private and public sectors. In any case, regardless of whether IT is new or not, the appearance of the Internet of things has improved communications and empowered the computerized supply of taxpayer-driven organizations. Changes in numerous territories of government have been encouraged by computerized advances, for example, Internet access through PCs – work area, PC, and palmtop – cell phones, information stands, and computerized TV [6].

At that point, with an expanding measure of time and cash to put resources into information technology frameworks, administrators had a developing attention to their rivals utilizing IT to increase upper hands and perceiving the need to turn out to be straightforwardly engaged with the administration of the new technology. The private companies have gotten all the more quickly mindful about the significance of the CIO in their structures and experienced prior to the advantages of the cloud information officer capable with information technology for interior procedures and for conveying items or administrations to other individuals [7]. Also, while the private sector encountered the achievement of the execution of the CIO, in the public sector, it was at a developmental level. The governments were all the while attempting to distinguish the challenges, legacy competencies of a typical CIO, and difficulties of such positions, utilizing information and communication technology as a basic device in driving the modernization of public organization asserted by the maintainable advancement of our public.

Later on, as an immediate outcome of the successful reliance of governments on ICT, the job of a CIO has become increasingly predictable for administration,

conveyance of services to residents and fulfilling the needs of the for all time developing digital condition. Today, when ICT is seen as a basic apparatus for driving the modernization procedures of public organization so as to get a supportable advancement of our general public, compelling CIOs must take care efficiently of association action, by applying various recipes of progress and by joining specialized information with organizations information, so as to produce positive outcomes. [8]

As a disruptive technology, IoT has been making a high effect over companies' present techniques and plans of action. This ceaseless procedure of progress will have an expanding impact on how industries and enterprises all in all direct their organizations, and is set to have a functioning role towards the advancement of completely new plans of action and markets. With the advancement of IoT technology, and its anticipated exponential spread over all sectors of society, one can reason that the future holds numerous open doors for companies hoping to investigate better approaches for making progress, and yet there are a lot of difficulties to be tended to. [9] While the dispersion and adoption procedure of IoT has been a progressing phenomenon over the previous decade, there is as yet very little certitude about how companies should modify so as to effectively coordinate IoT advancements in their structure and tasks. In equal style, there have been numerous challenges in guaranteeing that distinctive brilliant, associated gadgets and environments can successfully convey between one another, as accomplishing interoperability has gotten one of the significant concerns related with IoT.

At the bleeding edge of this mechanical wave stands the Internet of Things (IoT). IoT represents frameworks where registering gadgets, sensors or machines continually convey between them, by sending and getting data, without the requirement for human intercession. It has been viewed as an advancement with potential to address numerous cultural difficulties, imminent applications to social orders intend to improve vitality utilization, transportation and city arranging, air quality observing and traffic control. In the mechanical and business settings, IoT gives arrangements in a few sectors, for example, farming, assembling, retail, and social insurance, among others. As advancement with such potential and multifaceted nature, it additionally brings along a progression of difficulties and requirements viewing issues, for example, its mix procedure, and gadget similarity. With the expanding measure of accessible arrangements from various suppliers overseeing different frameworks at the same time turns out to be progressively problematic for shoppers who have a somewhat badly designed client experience because of the issue where gadgets made by various makers are generally unfit to viably represent each other, preventing the way toward receiving IoT arrangements in regular daily existence [11].

From the authoritative side, such mechanical advancements give difficulties that expect industries to grow new techniques and plans of action to coordinate them into their organizations, and furthermore staying aware of exterior changes happening industry-wide. The principle point of this research survey is to improve general information in regards to IoT, while exploring current issues and difficulties being looked at by the on-screen characters in the business during the implementation of the IoT advances into their organizations and recognizing factors that encourage the procedure of coordination about such advances. The investigation was performed by leading a thorough research on the current literature in regards to IoT and gathering information by directing meetings with people taking a shot as CIOs at IoT ventures [12]. The outcomes acquired gave these investigations different bits of knowledge that drove us to presume that, in order to receive and oversee IoT there is a requirement for changes in accordance with the ones to be made by companies.

A study conducted by Vasile in 2016 on the competencies of the CIO concludes that “CIO is responsible for ensuring that the organizational information and technologies investments are on the same line with strategic business objectives.”

Another research done by Korsi et al in 2016 emphasizes that a CIO should possess managerial competencies, and technical skills which are vital in obtaining positive organizational results for IT investment and in improving the overall organizational performance.

3.1 Cloud Computing

Largely, there is an absence of lucidity on what "the cloud" is or how it ought to be characterized. This is expected, to some degree, to the term "cloud computing" being abused to allude to a wide assortment of meanings, conveyed at various layers (for example foundation, application platform, software and business process), and executed in various ways (public, private, hybrid and community), for an expansive scope of reasons [13]. For the motivations behind this paper the cloud is comprehended as a model for empowering pervasive, helpful, on-request organize access to a common pool of configurable data documented assets (for example systems, servers, storage, applications and administrations) that can be quickly provisioned and discharged with insignificant administration, exertion or specialist co-op communication. Cloud computing administrations "give companies advantageous on-request access to a typical pool of configurable documented assets, systems, servers, security, storage, applications and services". Also, cloud processing changes a company's framework and the manner in which it conducts business. Cloud computing use software and applications that are situated on the cloud and not solitary gadgets [14].

Cloud framework has turned into a basic factor, as this permits adaptability and empowers clients to switch between one cloud supplier and the other. Cloud computing conveys figuring administrations including servers, databases, organizing, software, and data investigation over the internet to give quicker sending, adaptable assets, and economies of scale. Moreover, the present move from cloud computation to decentralized worldview (fog computing) is taking the feature. The ascent of convenient gadgets, man-made brainpower (computer based intelligence), and cloud computing guarantees a firm establishment for the development of IoT in the healthcare sector [15]. IoT conveys legitimate answers for different applications that spread all parts of life, for example, savvy urban communities, wellbeing checking, security, crisis administrations, store network, retail, modern administration, and human services.

On account of the joining of IoT and cloud processing into the social insurance sector, wellbeing professionals can give quicker, increasingly productive and better medicinal services administrations, which hence lead to better patient experience. Thus, it brings better human services administrations, better patient experience, and less desk work for wellbeing professionals [16]. Besides, cloud processing has recently advanced and social insurance applications dependent on cloud computing have expanded fundamentally. Thus, it has become a major component of IoT in the human services.

3.2 Cloud Services

3.2.1 Infrastructure as a service (IaaS)

IaaS is a virtual, cloud-based platform for physical services, for example, processors, and hard drives. Clients utilize the storage systems, and other registering assets that permit them to send their own software, applications, and working frameworks. The fundamental cloud infrastructure is overseen and constrained by an outsider [17]. The client has authority over the storage, working frameworks and the sent applications, yet may have restricted command over systems administration parts, for example, have firewalls.

3.2.2 Software as a Service (SaaS)

Cloud applications are more often than none featured as SaaS. Under this model, clients can expel complexities and costs engaged with the establishment, upkeep, and updating of complex IT frameworks in their own environment. Moreover, clients exploit suppliers running cloud infrastructure. Clients can get to the cloud through either a dainty customer interface such as an internet browser or a program interface, and have no control over the hidden cloud infrastructure [18].

3.2.3 Platform as a Service (PaaS)

PaaS includes the organization of a client's own applications on Cloud platforms, including programming devices that are on infrastructure claimed and merely monitored by the cloud supplier. For a scenario; application engineers taking a shot at portable applications typically use cloud-based platforms to create and dispatch their services [19]. The buyer does not oversee or control the hidden cloud infrastructure, including systems, servers, working frameworks, or storage, however he/she has power over the sent applications and conceivably setup settings for the application facilitating environment. The PaaS platform empowers CIOs to get to a full collection of highlights, which make up the platform. For instance, a designer dealing with Android applications can utilize PaaS to guarantee that an application can naturally exploit changes actualized in, follow the look and feel of, new arrivals of the Android-working framework as they appear [20].

3.3 Job Description of a Typical CIO

The CIO position has greatly emerged over time as one requiring a dependable individual for the powerful oversight of the organization's design and support, and for progressively present day functions like inside system execution, software improvement, and information systems. Despite the fact that the underlying job of the CIO was a mechanical one, requiring a foundation in the information and communication technology (ICT) area, the CIO duties have been loosened up past its customary job to incorporate solid business foundation knowledge with significant capacities, both at strategic and key levels of the company [21].

The CIO jobs and duties in the public sector are developing quickly because of the expanding job of ICT for government forms and electronic services for residents, accentuating the significance of the CIO this sector, past that conceded inside the private sector [22].

3.4 Research Purpose

These days, numerous organizations commit themselves into the IoT and Cloud computing so as to fulfill future technology slants in the market. Then again, the majority of the organizations do not have an inflexible and organized field-tested strategy before starting with the item structure [23]. Thinking about this methodology and the innovative point of view of those organizations, there are adequate numbers of apparatuses to meet items' plan prerequisites and give the fundamental association with the Internet for empowering the network. In any case, this sort of a methodology would not give a perpetual answer for empowering a total network or improving versatility in the field. With the end goal for organizations to progress and expand upon their abilities they need considerably more than being able in the field [24]. The

need for participation between contenders, better settled connection between B2B clients and well-overseen corporate exercises are what will conclude the fate of IoT[25].

While the primary objective of this research is to examine the challenges faced by CIOs in successfully implementing IoT technology, as well as the legacies of adequate CIO competencies. Finally, the after-effects of successful implementation of IoT-Cloud computing were also held in view. [26]

- Recognizing difficulties and challenges of organization of IoT applications, including the key competencies a typical CIO should have. [28]
- Characterize the key actual challenges faced by CIOs and other executives in order to successfully implement IOT-Cloud technologies. [29]
- Giving outline of potential impediments and challenges looked during the procedure of IoT adoption by ventures after the successful implementation of IOT-Cloud computing. [30]
- Give basic ideas of how IoT-Cloud successful implementation will shape the fate of the IoT advertise, in terms of its consequences both now and in the future. [31]

For this purpose, the research was carried out using a qualitative approach of thematic analysis whereby active CIOs were surveyed with the aid of an open questionnaire, and the results collated and decoded to derive accurate analyses.

4. Research Design

The data collection process starts with the statement of an explicit research question. For the purpose of collecting the right data, a suitable collection method needs to be chosen and the target group needs to be defined precisely by selecting relevant subjects in step 2. As for the collection method, expert interviews proved to be the right instrument to gather data that can be matched with the coding scheme derived from existing factors on the one hand and examined regarding unknown effects on the other hand. [32]

Based on these criteria, interviews were executed with 6 CIOs from various industries. A CIO from one of Indian ministry was the first interviewee. A CIO from a leading IT services company was the second interviewee. The third interviewee was a CIO from an international educational institution belonging to the educational sector. The Fourth interviewee was from a leading Locomotive services industry. The fifth interviewee was from a leading energy services company and finally the sixth interviewee was from a leading logistics company in India. Afterwards, the data collection process ends with the actual collection of relevant data. This includes a clear documentation of the development of a target-aimed interview guide, the administrative work of coordinating and performing appointments with interviewees as well as the preparation of data.

5. Interpreting the Data

The data interpretation process contains three steps: the interpretation of data, the conceptual and theoretical work, and the composition of the results. First, the collected and transcribed data need to be analysed and interpreted in order to gain actual information from the raw material. [33] As for the study on hand, this means that the interview protocols needed to be matched with the coding scheme derived from the literature data results.

6. Findings and Results

Here is the summary of the findings obtained from the respondents:

Q1. About the Interview Participants Roles as CIO

Below were the responses Few of the respondents have part of their current role,

“My role to enable and transform the technology and User experience around it with current designation as CIO and my responsibilities are leading the technology function of India entity and doing a certain number of things with the region and global teams as well and leading the innovation practice leading the strategic alliances practice and contributing to the new product development as well”

Interviewee 4

“I am responsible for IT strategy implementation and benefits in the international regions of my organization. It is primarily a business facing IT where they basically enable the regions through IT and digital solutions”

Interviewee 5

“My current job is practically product development, solution provider, cloud architecture, identifying IoT devices, integrating them, running with use cases for machine learning as part of product development. The second is actually defining solutions and making customers happy, then sales enablement. Third is better delivery to users, offering this as a SAAS solutions under project management and operations”

Interviewee 6

As part of current CIO role for the rest respondents, they are responsible for the hardware management, ensuring that the systems are working fine, the network uptime is maintained and more or less the in house ERP that will be used, ensure that those ERPs are used properly and then do one or two initiatives in terms of rationalizing the vendors. They claimed that over the last couple of years the role has become significantly different, a CIO has to also assume the role of a business process improvement agent and nowadays, it is pretty much called as a digital transformer that is the expectation from any CIO has grown multi-fold because that is a classic catch whenever an IT is setting within an organization.

Within a non IT organization or a traditional organization, what happens is the catch 22 situation over there is if one propose a solution to business, one should be telling the business and educating them about that IT Solution or else IT doesn't go through very well so the expectation is now to ensure that the business processes are aligned with the IT processes or with the IT flow so no one else better than the IT experts can tell this to the business.

Interviewee 1 and 2

Q2. How is a CIO Different from Other administrative position?

A good number of respondents agree that CIOs role might be relatively new but it had been around for some time now, having said that the role has moved forward and typically the CIOs everywhere who previously called EDP managers whose major job is to run those big line printers for printing, a payroll of the organization and so on and so forth, now it has moved ahead and became from EDP to MIS, MIS to IT manager, from IT manager to IT head so on and so forth. Finally it is transformed from being an 'order taker' IT person to a business enabler. [34] One of the criteria that really said in very simple term,

"The business and IT are now so intervening with each other that irrespective of each other they cannot function without each other which effectively mean is that the business and the IT are so intervening into each other that without IT business cannot function. Whether it is a support function or a product line or a line of business so on, it has become imperative for a CIO to understand and to enhance the business well so as to enable or transform it"

Interviewee 6

"The journey from order taker to transformation and it is only feasible when he or she picks up trade of business understanding or business value, probably I would also like to quote it like this in a very simple term we call it as 'Chief Information Officer' probably that name has to be little bit tweaked it should be called as chief involvement officer because he has to involve himself into every line, every function, every aspect of it and deliver that value"

Interviewee 1 and 2

"A CIO has to be a change agent and lead all of the innovations happening in the organization because firstly, whatever new technologies or initiatives are to be put in, they need to deal with whatever is existing in the current architecture and that is one case where a CIO can really perform a steering function to ensure that that happens appropriately. And the second is that with changing technology and changing paradigm of business lot of times the business itself is not being aware of what is possible in a specific function or area I think the CIO is a position to write them"

Interviewee 3

"A majority suggested that basically Chief Information officer is at the heart of ITs data and information and as any organization scales up, it needs to get more and more sophisticated in terms of creating, collecting, analysing and leveraging information both for its top line and bottom line; so literally speaking the role will always be relevant because you will always have to leverage data specifically in today's digital economy where most things are coming to your mobile and almost everything is available on internet"

Interviewee 3

Interviewee 6 also obliged to the number of ways in which a CIO can help an organization. There is a need for somebody to bring in an information view and make sure that the right information is available to the right set of people within an organization. There is a process automation capability that is becoming more and more available. The coordination between people can be automated instead of depending on individuals. They think these are the two key areas where it can avoid waste of time, avoid waste of energy and companies can attain high performance. They think that there is a need for a person who focuses just on this inside the organization similar to someone take care of revenue or money.

Q3. Difference of CIO When Compared with other Administrative positions like CEO and CFO

"Many would not say CEO is not a function, he is the leader of the organization and the leader among the equals or somebody who is having the same vote but being the administrative head, also hence being the chief executive. Talking about the fact that the CIO has become somebody where all the trajectories meet, he is the one who is enabling whether it is administration, supply chain,

finance, HR, sales, marketing, products, line of businesses, etc. Because IT is the one which is either enabling or transforming them hence CIO is sitting in a hot seat, while he has lot of powers to transform that he equally has lot of responsibility and accountability to ensure that the organization talks about live projects"

Interviewee 4

"In an enterprise every function has a role to play to collectively achieve the business objectives and goals the enterprise has defined for itself. It is very difficult to draw a comparison which is more critical or less critical and that varies from time to time, from situation to situation. If we draw that parallel to the IT industry, the IT industry is a little different compared to other industries and because in an IT industry every employee is responsible for the services provided as an enterprise customer. Many a time the people who deliver sophisticated services for end customer are equally good if not better and will challenge the decision, the approach, the road map and the paths that you take internally within the Enterprise so that brings the role of CIO in IT services company to an extremely sensitive, at the same time tricky to manage and handle. In their views, the best way to overcome the situation is partner with your business functions and be the fast bouncing boat for any new ideas, new thoughts that come as a possible service offering to be tried internally; fast create that use case and experience and then take it to the customer. So if a CIO can partner with its business units delivery functions and the people inside the organization and work together this objective or initiative, the role of CIO gets completely changed from a service provider to a business enabler part of the same time the strongest ally of the business"

Interviewee 5 and 6

Q4. Education to Become CIO

"Learning is a part of life, it keeps you educated. As you keep growing, you're learning curve never ends, actually it keeps increasing. The curve increasing does not mean that the time to learn increases, it basically means that the learning adds such areas which you have not chartered in to it or you need to get into. Effectively if I say there is no curriculum in the formal world called a CIO degree or something, most are from within Engineering or which could be an electronic, computer science or other backgrounds about IT with management degree to add to that. It is very important to learn on the job because whatever the classroom training can be good to build the theory part"

Interviewee 1

"When you say training, what exactly is meant is in a practical way you are trained every moment, in a current digital era if you are not training yourself for a single day you are outdated. I will possibly say that it's not a role that you probably take it out of the glue, it is a gradual journey that you reach and by the time you reach that place you are already trained. Any CIO today has been groomed in the industry, nobody has become a CIO out of the college. No specific education to reach that regular qualifications and experience"

Interviewee 6

One interviewee claimed that "I have not received any formal education in IT management. I have received education on a few specific Technologies in my initial years of getting into it. I had to implement some Technologies at the enterprise scale like CRM and analytics and I attended the most advanced training of those to develop an appreciation for technology and how it works, etc. In terms of managing IT, my formal inputs have been through my interactions with industry Consultants so we have an expert advisory organization like Gartner, Forrester, IDC and all that. We have the consultants who help you with the specific programs like IT strategy, outsourcing which would be Ernest and Young, KPMG and all that. Lot of my education has been on job training while trying to solve business challenges and taking advice from the experts and learning in the process".

Interviewee 2

"If you look at the dimensions of complexity across Industries, Technologies and processes, this complexity cannot be addressed by a superman so a CIO cannot be a Superman. What really works is a couple of things; one is to have the right operating model. This operating model should have a mix of experts in technology or I would say subject matter experts on business processes and a great governance driven partnership with your functions and there is a huge external ecosystem of vendors both on product side as well as on system integrator side , a lot of expertise is there so you need to have strong vendor management function able to leverage the right experts from outside of your organization and therefore if all of this has to be done then one of the biggest competencies of a CIO has to be a great collaborator; somebody who can create a win-win partnerships somebody who is constantly learning primary because your Technology landscape is changing very fast so somebody who is open minded and constantly learning and really big competency would be able to create seamless teams cutting across the organization, somebody who can provide a leadership across the organization"

Interviewee 3

"CIO comes from all areas. It is not necessary that he has to be a computer scientist. In their opinion, CIO needs to understand the core functions of the company more. They need to have more what I need to term as "knowledge engineering" capability. The CIO should be capable of understanding how people think and act rather than just

computer science. Computer science knowledge is more like knowing type writing and it is more of a tool to execute rather than the core capability types. In their opinion, the training that is required for managing people is actually a tricky one because IT brings another very interesting problem, one side you need to make sure that the existing system is running smoothly; on the other side you need to continuously change and innovate. These are two ends of stability/credibility. This dichotomous thinking requires very careful people management and it needs to be said that CIOs need to be capable of differentiating between hunters and farmers and use them in the right places. The hunters are people who bring new technologies, new ideas and keep pushing the envelope. We need them on one side on the other side they need to make sure that the SAP instance or oracle instance runs without any failures.it is a very tricky element and this is an area where CIOs have to get formal training on education and I believe that there is not enough focus on that area. Much of the respondents have not gone through any formal trainings, what happens is based on some independent leadership training programs for example: an MLT program or a similar individual leadership development program has helped me a lot in finding what is the right direction and I think CIOs greatly benefit from formal HR or people management training"

Interviewee 4 and 5

The other respondents claimed "it was more of on the job training in terms of their qualification, that is having an MBA in IT, that was the formal qualification that they had for entering the industry and later on the on the job training over the years as and when the business started growing, they started understanding the business because without understanding the business technology implementation is just not right thing. A technology implementation can happen but it might not be used by the business so how do you ensure that both the things are getting in inclined. You need to understand business and understand what part of it can be automated and what is underlined technology for that so in terms of education obviously it has to be a continuous education now a lot of online education is available and there are a lot of short time courses. The teams which are into technologies side to get a good grasp of the business side as well as have their skills upgraded"

Interviewee 6

Q5. CIO Competency in IT

Many said that they are not experts in technical competencies, "it is just like can you be an expert of Google? Information technology is a two word 'Information and Technology' and it is a vast ocean, hence a single person can never be expert. [36]

I can only think of two people; one is God and the other is Google. Leadership is not a person who is sitting in the room should not be the one who knows all the answers but he is actually the one who knows how to reach to get that right answer. A CIOs role is not to be an expert in each and every technology domain but to understand and know how to seek the technologies, how to integrate those technologies together and get the business value out of it. As long as you are good in integration and architecture you are doing your job"

Interviewee 1

"Many also agreed he/she should be aware; when you say expert there are different levels of expertise and different forms of expertise. So a CIO does not need to be able to administer each and every system to a level 4, which is not really required. What the CIO needs to be aware of are the technologies that are existing in the organization and in the overall world absolutely.

I keep saying there is a what, why and how in any topic. So from a CIO perspective, the CIO needs to know completely what is required, what are the options available, why this is required, why this and why not that and these two the CIO should completely be aware of. The third is how, which is basically how to do it, how exactly to implement salesforce. If they know it is great, if they don't know then as long as they clearly founded on this knowledge of "what and why" I think they can run the entire enterprise. If they know "how to" then the team will respect them more because they have a deeper understanding, even if they don't know then they need to have the right people or the team who can save deficiency around how to implement. Even a CTO or a specific functional manager from applications and infrastructure can fill the gap"

Interviewee 2 & 3

"As claimed by other interviewees, a CIO would try to understand what the business is expecting and the underlying technology towards it is generally driven by the CTOs of the organization. Some of the organizations which are fairly new, an organization approximately of 1000 people or more should have these two designations within the company and should essentially have. Some used to have both as the same person, ideally the CIO should be more towards the business needs, understanding what the technology is required and the tech-pack should ideally be built by the CTOs. There is a very thin line between the CIO and CTO some people combine it and put it as one but in my views these two are very different roles and these roles have got the utmost importance in the organization. The CTO should own the complete technology landscape and the CIO shutdown the complete business landscape and the underlying Technology required for that"

Interviewee 5

Q6. Financial competency of CIO

Many agreed it is very important quite because it is necessary for transformation, value change, business growth, etc.

"Which function today works without financing part of it? As a CIO, I have to ensure the top line grows so that my residual Technology cost gets distributed and my percent is dropped at the same time. I have to ensure I don't increase my cost so that my number doesn't get skewed. Any business function today has a financial component to be aligned with. Others too confirmed it is very important because everything nowadays is to suit ROIs and justify requirements, everything ultimately boils down to numbers so a CIO should absolutely have financial knowledge"

Interviewee 1 and 2

"I would say it is necessary but not sufficient. Yes you need to be able to understand numbers. Everybody would demand technology today so there is always a big question around the benefits of the business case so a CIO should be somebody who can transparently dig through the business cases and identify if the real benefits are there or not. A CIO should know sufficient financial management but he/she should have somebody managing the finances for them because you can go into the details and make sure that all the things are in place"

Interviewee 3

"I would think it is very important because it is not for the IT management because IT management finance function alone by itself is not so extensive and maintaining IT function in finance is very complicated because there are all kinds of vendors, you have P AS vendors, you have recurring expenses, fixed expenses, variable expenses, pre-approved ,not approved. Hence there is a huge amount of understanding required to do the actual projection order from an IT perspective more than that the CIO should be able to view all other IS function requirements in the light of finance then doing that initiate your work we will create a financial impact to the company or not is a is a positive or negative and that deep understanding is extremely important for a CIO"

Interviewee 4

"Financial management obviously has become the norm for the day because the technology has become more efficient, but you need to understand what is a ROI because the CEO and the CFOs are measured on the ROI and the amount that is getting spent, and how it is benefiting the organization in terms of reduction in manpower because ours is a very labour intensive organization, reduction in the manpower or redeploying the manpower for some other activities. For any technologies spending, you should be able to justify, you should be able to quantify in terms of the numbers and how fast would the payback period be all these things are required to be understood in greater detail by the CIOs. This was attested to by all the interviewees"

This concurs with a study done by Popovic and Hocenski, (2016) who posited that "CIO must possess capital planning and investment skills in a company in order to analyze the entire cost of possession, multi-year trade plans, and return on investments.

Q7. Non-Technical Competency of CIO

Most of the respondents said that the most important for any leader; I would not say CIO alone is communication. He has to be a communicable and a communication enabler; a silent guy can kill everything. [37]

"If you look at the world today, what you do definitely has importance and relevance to your role and objective that you drive but how you communicate and how well you manage your stakeholders on the different deliverables and the value additions that you indent and planning to do or are doing it, is what probably creates the difference. And that sincerely states that your stakeholder management and your communication is very key to you being successful or probably treated differently as a support function. it is more critical for a CIO to be extremely aligned to the stakeholder management perspective and understand the priority of each and every stakeholder because you cannot have a single formula, single rule to put across each and every stakeholder so you will have unique requirement by different stakeholders and you need to align your thought process to handle those components differently compared to your next field. So managing stakeholder is the most critical one communication, networking, peer connects so on so forth these are all very critical"

Interviewee 1 and 2

"There are a whole bunch of skills that they need to have in the adaptive space. It includes things like negotiation, communication, conflict handling etc. They should have a deep understanding of finance because most people don't focus on finance. We need to look at identifying skills and structuring the organization, they need to have good Organizational Management skills or communication/behavioural skills. The third and very important thing is the interpersonal skills where their ability to interact and understand people without creating any pressure or negative residual feelings making others feel like their friends. These are the key capabilities a CIO should have"

Interviewee 6

"The rest agreed he/she should have a daily understanding of the business and from the Technology side, the latest

trends in the market, what would it take for his/her specific industry and the technology aspect of it. The CIO should know the overview of it, there should ideally be a CTO who should be supporting him for the Tech pack but in companies where the CIO plays a dual call role as a CIO and a CTO, he should have a good amount of hands on experience of the technology stack"

Interviewee 5

Q8. CIOs knowledge of IoT and Cloud Computing

"There are no formal University curriculums around this, so what you do is you attend a symposium, you attend a seminar. The biggest learning is from the problem statement, when you have a problem you can understand and then you can relate to your organization. Some confessed that in their previous role at Tata Motors they spent a lot of time with the cloud providers to understand the technology, benefits, constraints and all of that, and there was a big movement towards cloud that was started in IoT. They also claimed they used to have deep dive sessions with the vendors who wood basically bring and share their expertise us, full day session around what is the subject, what are the tools and technologies, what are the limitations etc"

Interviewee 2

"Most of the respondents said they would rate themselves as 7 or 7.5 out of 10. There is constantly new innovation happening and there is a need for us to keep abreast of what is happening. We are continuously going through a learning process. Conferences and seminars helped understand the broader high level perspectives. Very interestingly more than individual classes I have learned a lot by talking to vendors. When they come and make presentations about what is possible and what is new and they share with us details of individual solutions and why would they need importance that list of learning of what and why can help"

Interviewee 4

"We did a lot of sessions in-house before we migrated to AWS Cloud. AWS has conducted lot of workshops within our organization, for our users at least the overview was given how the AWS cloud would help us in the whole journey in the strategy of cloud and for doing the implementation the team had gone through couple of sessions, almost two or three sessions and then they understood the whole thing before we got into the implementation. So my only point is we did a couple of rounds of session but at various levels, the first and foremost level was that the overview level which was given mostly to the CEO and his direct reportees, the CFOs who is going to approve the plan, then the operations guys and basically myself and couple of my colleagues. So I have a fair understanding of cloud computing and IoT. We have to understand the overall thing come up with various queries those got answered"

Interviewee 5 and 6

Q9. Importance of Cloud and IoT in an organization

"Much belief that nothing is indispensable inclusive of humans also; cloud is not the definition for all the problems. Most of the organizations which are regulatory and enforce either in case of BFSI or any other are still not on cloud, many other organizations are still on hybrid cloud. It has helped to achieve the scale faster for the organization and reduce the capex. In the coming years it will grow, the potential is there, the market is moving to that as well as security and other aspects. People are not so confident in putting their classified information into the cloud due to security concerns.

Let's first touch up on the cloud side of it. If you look at IT services industry, what is the biggest challenge today, the customer expectation is rising every day and while each customer is expecting to add 20 new features to give the state of art look; and that experience nobody is ready to probably sell/chill out equivalent percentage of money or investment to get what they are expecting so they indirectly create a cost pressure on every industry and that is where the innovation starts and this cost pressure on innovation possibility take you to look at options on how you can get into more of move where model which allows it to get aligned to your business requirements because nothing is permanent here. If a plan of 18 months plus is treated as long term in the current age, earlier a plan of 3 to 5 years is treated as long term wherein today's context anything more than 18 months is treated as a long term plan and if I am talking about visibility of not more than 18 months it is very critical for me to look at all my Investments which is aligned to short term or such timeline. If I do an investment, the procurement of network, servers, storage and so on and so forth and create that everything into my data centre in my physical premises, I am making a commitment of 5 to 6 years that is the typical depreciation cycle of an asset so if I have to be more aligned to the agility to probably scale up or scale down because my business is dynamic. And if I am not dynamic and not in an environment which allows me to be dynamic, I will only be able to achieve that when I move to a cloud computing environment where based on the requirement I can get more resources by click of a button and if I don't need it tomorrow I can just surrender it and I have a clear visibility in terms of what I am spending, what I am getting and I do not have to spend anything when I do not need that resources with me and that is what the dynamic requirement of the business today and cloud comes as the most handy tool to manage those situations and give you the agility for handling different business challenges"

Interviewee 3

"So in a nutshell, cloud is a must for every Enterprise, it is not a question of anymore further or not. It is just a matter of time that Enterprises are moving their loads and possibly compute to the cloud environment depending on which industry they belong to and how mature they are in terms of the processes, security framework, cyber framework and so on. IOT is a little different ball game if you look at I can say cloud has already become BAU now it is no more in a hype cycle but IOT is immense on the hype becoming a reality. As we speak it is yet to get into the BAU mode, people are possibly trying to find an absence of use cases which will enable IOT as a Technology to the domain your industry belongs to. If you are in a services industry, IOT becomes little use as cases does not become that lieu but if you are in a logistic, product or manufacturing industry you cannot live without it today so depends on the industry you belong to and based on that obviously decisions has to be taken depending on the maturity"

Interviewee 4

"These Technologies can become your competitive differentiators so there is another perspective which you need to look at. In the past the major expectations from IT was to improve efficiency of your business processes, to make your account closing faster, to make your procurement process more rigorous, addressing of your customer's needs, faster responses to customer, everything was around making it faster. IoT and cloud both have an opportunity to make the business, to create impact beyond just the productivity or just the cost. They are like revenue side enablers as you need to bring out a customer facing service much faster or if the customers' demands can scale up. We don't have any other option other than to go for cloud. For example; Service like Hotstar, if you look at Hotstar when it was launched as a TV on your mobile kind of service. It was launched around the time of a cricket world cup and this became a major hit and the kind of search they saw in terms of their volume and revenue. In terms of revenue, if they were not on cloud they would have not been able to scale up"

Interviewee 5 and 6

"If you are going to use IOT and cloud for revenue side opportunities then you can really get limited in your efforts using these Technologies especially cloud. Now in IOT, you have both revenue side opportunities as well as cost Optimization opportunities, but these cost Optimization opportunities can be very tangible"

Interviewee 2

"The cloud technology takes away the need for deployment capital for buying own hardware, own servers, own software and all that because of that the capital becomes unlocked for them to deploy on a sales side or product development side and that is a huge plus point. In the opinion of other respondents, any company trying to innovate, grow, build processes, build practices, build new solutions, unless it's a hard core engineering company they would really benefit from cloud technologies and the second reason is also the stability to scale as and when scaling is needed becomes much more easier and quicker with cloud technology. It also becomes much more adaptable, much more flexible for scaling. These are the two important reason because anything that can be done on cloud can be done on in premise as well. Secondly, cloud also brings generally available skill set which are commonly available in the market place where as very highly focused on solutions. When they are developed, they will actually become much more difficult to maintain because there is the local cyber knowledge, that is, on an ongoing basis the cyber knowledge becomes very specific to the company. They could use more open and general technologies which are available on the cloud. It will become much easier to find skills from outside.

People are bit sceptical if the cloud companies can assure you that it is going to be 100% protected then cloud will become indispensable for all the organizations. Currently I see that most financial organizations are adopting the cloud for strategy already"

Interviewee 6

Q10. How CIO Learns about cloud and IoT

Many of the respondents agreed they learn from platforms such as IDC, Forrester, Gartner, Teck Talks and Workshops to stay updated. Some said it is the same that they do for any other changes in any other technology area which is keep abreast of use, keep abreast of research. They used to meet lot of ISPs and OEMs for proper orientation and tutoring.

"I believe one is being connected with the ecosystem, talking to your fellow CIOs about the practical use cases, talking to vendors about technology evolution in between reading research about how things are revolving and all. It is a lot more on the job talking to people attending specific sessions from vendors"

Interviewee 2

"Be part of the some of the regular updates channels which are like tech targets, Gartner, Mckinsey. We also keep looking at the industry reports like CIO insight. Mckinsey gives strategy, tech target gives new technology solutions available and off course the individual vendor communications that comes to us. These are the channels. We determine the relevance of it in the organization and go deeper into it. Attending some of the conferences, Gartner events have been interesting and also some of the

local vendor community creations for example: cisco, Microsoft and oracle"

Interviewee 3 and 4

"We are continuously working with our partners, we understand that what is it the world is moving towards which are the specific industries that are adopting this, how they are doing this because the moment we implement this in the cloud there is another concept which came in was a hyper-convergence infrastructure then there is something now coming up in terms of hybrid strategy so some say some of your servers needs to be in an on premise environment and some should be in cloud, it is mixed reactions. I think the future is cloud provided the security measures are quiet strengthened and then the industry gets fair amount of confidence to adopt the cloud for strategy because unfortunately you cannot drop. I also refer to Gartner, Forester and all for staying updated on technologies"

Interviewee 5 and 6

Q11. IoT and Cloud – Implementation in the Organization

"The implementation part is probably trying to tell that this is a domain which is emerging, you may not have well qualified people inside your organization to possibly venture into it and probably give you what you are looking forward to depending on your internal skill set that you have possibly the better to get partnership or some kind of services relationship with Experts and create your framework. Your roadmap and work on the road map in terms of implementation, generally the mistake people do is everybody wants to start which small piece for some time then take a larger decision. whether I want to go or not and suppose that the decision is yes, let's go ahead the challenge comes is i have not created that blueprint or that architecture from the beginning which will support me to kind of get into the cloud in a larger scale so hence it is very critical and important to know and kind of ensure that before you jump in to it have a clear cut strategy and architectural blueprint ready you can have a defer deployment, no issues on that you may test it, try it then get into it try small loads, run it for 6 months or for a year, see if it is working then go to the next level but do not do the mistake of creating something without a framework. And after 1 year take a decision to move large Mobic, then you have to recreate everything whatever you have done a year back, that is the challenge I see in many enterprises across the industry so it is very critical for any industry for that matter to have those architectural reference points and the models to be created from the beginning and you create your workload based on your implementation plan, go in the way you are comfortable"

Interviewee 2 and 3

"We are working towards a strategic direction to have zero data centre by 2021. We started this plan around one and half years back so we are in a process of moving our current on-premises workload to cloud and we are going stages to a large enterprise. We cannot do it overnight it takes time, as we speak our entire computing platform, collaboration platform and productivity platform runs on Cloud hundred percent. We are almost 70% done and 30% would be covered in next two quarters so that will take care of our entire people, productivity, compute and collaboration platforms on cloud after that what is left out is our enterprise side of or financial side of it which is ERP so that is something we will pick up in the next financial year and completed by 2021".

Interviewee 1

"We did that in various phases in various shapes and forms, I have focused more on cloud computing not much on IoT, cloud is what we have been doing since 2011. We began with private cloud and then moved to other things starting off with infrastructure as a service, then moving onto software-as-a-service and finally to platform as a service and we have taken various initiatives during these times, as far as my role is concerned, it is virtualizing it, identifying suitable Technologies as to which one to go and in which specific area, evaluate different providers in that specific area and then finally implementing and making sure that it works".

Interviewee 4

"In my current organization we have used it for a component tracking so I can't divulge any details. I was the programs sponsor we had requirement to track sort of utilized hours on a component, prevent breakdowns and all of that we used RFID technology coupled with mobile application. This was an inaccessible component so we used remote Technology like RFID and this make sure that the components doesn't fail and also that components doesn't get overhauled before time just because somebody is worried.

"Our Locomotives are fitted with 3g chips as well as an edge device which collects information from hundred plus sensors which are fitted on our locomotive and all the data which we collect from different parts of the locomotive before the locomotive comes to the service shop data is available and it helps people be prepared for service and get it out faster from the workshop and when the locomotive comes to workshop lot of data gets downloaded and analysed, and that helps us to improve that uptime of the locomotive helps us prepare for gives us advance warnings locomotive health. So our company has lot of IOT-enabled stuff on their products for diagnostics and other purposes".

Interviewee 5 and 6

"From a consumer perspective, we were running a data centre of hybrid cl 350,000 sq feet, 60 megawatt capacity in a single data centre from 75000 servers for data hole, it is active data centre. There is the need was to know continuously how power is being utilized, in which rack, how much is the cooling requirement, what is the temperature in each rack, how much is the cooling required, implement in an adaptive way where if the server is used at this moment and time to 100 percent the heat ejected is higher and if the server is not fully utilized heat ejected is only 3 percent. These variations in heat, cooling and power consumption required an adaptive balancing of the entire data centre. So to do this we need to collect information from each location, in each rack, each server if possible is a plus point and indicate all the data and analyse how the whole data centre is running and what can we do to make it better. To do this, the traditional approach was to go and implement very complex control systems from Schneider, Siemens, Motorola etc. Those are big specific kind of hardcoded solution where any change that we need or modification that you need will require huge amount of expenses whereas when we deployed IoT technologies and extracted the data, we moved the data into the cloud instead of storing this in the local premises. We could bring data across all the data centres into a central one location and we are able to provide a portfolio wide administration capability. This is how I consume this technology as a customer.

As a provider what we do, we do not only for data centres but we do it for call centres, we do it for medical based companies, we do it for hotels, we already have 4 hotels running with our solutions where we actually monitor the temperature inside and analyse the occupancy of guests inside the room using an application. And a complete cloud based control system which act as the brain. this is a very interesting direction, which we are now not only focus on one area which is electricity but because we are doing central processing we could now start thinking in terms of maintenance, predict failures proactively go and fix it all of that could be value add happening over a period of time and those all cannot be done in from one Central location in the cloud; as confirmed by much of the respondents"

Interviewee 5

"If I have to give you one direct answer for IoT and cloud, I was working as a program manager and I had the teams who were supporting right from doing the UATs, SITs and all and there was one team who were working on setting up the infrastructure along with our cloud partner, sanity solutions in implementation so my role was pretty much as a program manager. We started doing some pilot last year and now we are fairly in the process of implementation all these IoT applications for some of our customers so in both these things what I realized is unless these things are driven from the top there is fair amount of waste-ness on the ground so you have to ensure that it is driven by the CXOs so that it becomes very successful, because not everyone would be able to appreciate the value at this point of time so it becomes imperative to get in the right stakeholders to get in the right bind from stakeholders and then ensure that those things are rolled out and the moment you hand it over to the vendors and all then the ownership lies with them and then they secure you. It is all the more important the CIOs to own this, work as a program manager or portfolio manager whatever you want to tell that and then ensure that complete governance lies with them otherwise things won't happen"

Interviewee 6

Q12. Cloud and IoT Implementation Process

"Look at cloud it has IaaS, SaaS and PaaS. If you look at IaaS and PaaS, the Other department are agnostic about it because they sit at a layer which is lower to the application and presentation layer, rest of the department HR, finance and all they are consumers they are consuming the services which are being rendered by an IT Department. [40] For them it doesn't matter where it is being offered from, so for us the availability, performance, the scalability aspects are taken care of. What matters to them is what kind of services which you are offering which is more like an application. So SaaS based applications it not only provides the business requirement but also the functional aspects of it along with the user experience. If I am going for IAAS and SaaS it can be across the departments, it doesn't matter if it is SaaS and if I am going with a specific function which could be again process of an organization like p2p (procure to pay), hire to retire so on and so forth"

Interviewee1

"This strategy varies from Enterprise to Enterprise, there is no correct rule, there is no Thumb Rule for that so the way we drive things, the way we are going across the Enterprises are kind of deferred by Geo's like Europe, US etc, but there are few weaks here and there, not that the same things are going to happen in stages; it is not in that way but we are going across the Enterprise not going load by load or module by module"

Interviewee 3

"Generally what you do is you take one at a time there is always a learning curve you cannot say that tomorrow onwards I will put everything on cloud, you have to find some use cases awesome new initiatives. If you don't need CAPEX investment then you can host it on cloud its suits everyone because you are asking for less money and you make a success out of it, your teams will learn about it,

your teams gets comfortable with it and next time when a request comes in, can we put our next few initiatives on cloud so there is an experimentation dimension to it as there is a learning curve for the team. As a CIO, if you decide that I am going on cloud, your teams may not agree because they are not comfortable with it so you need to make them comfortable with it, you need to train them, before you go on cloud you need to make sure that all your critical team members who are going to be involved in that project they get trained and they appreciate the power of Technology. Then what happens once you have your teams ready, once you have acceptance and results coming out from initial experiments, that is, when it creates an automatic enabler for more stuff on the cloud"

Interviewee 4

"From a Data centre perspective, we looked at electricity as 1 stream so we implemented electricity monitoring then we implemented temperature monitoring as a separate stream because I cannot just do one air conditioner. I have to do for all the air conditioners in the room so we try and pick up use case areas because for every use case take it as one methodology and approach however when we look at hotels or Bank branches or other customers for all of that. What we do if we try and choose a subset for example there are 1000 branches, we choose 200 branches do them first, if the solution is completely matured and if it is a plug and play kind of solution then probably more geographical collection especially is a distributed solution so this is the strategy we use.

For cloud, it was more to do with our internal ERP so we did not offer it to any of our customers I would say so it was more for our internal organization being migrated to cloud ERP. [41] For IoT we were doing it for our external customers so both the projects are going in parallel however for IoT we did a couple of rounds of POC one or two customers to begin with and now we are on the verge of implementing it, for initially to begin with two customers, then once the roll out for these two customers happens we would like to record the learning and improve on those learnings and then once those results are seen positive after that only we would see repeating some it to some other customers"

Interviewee 5 and 6

Q13. Cloud and IoT Implementation preparation in an organization

"When we say cloud we are now talking only about us because IaaS and PaaS are internal to IT which is easier to manage because you have to put those processes in place but it is within the IT Department. On a SaaS based part you have to really go through the most important aspect is the change management and the Change management is a fundamental shift, a paradigm change where people have been consuming it in all aspects there are areas which are not able to customize when SaaS-based comes into picture, this is where we need to take a decision based on what I need compare to what is available. The change management needs to be communicated properly. Over communication is welcome rather than under communication"

Interviewee 1

"This is a pure change management component in terms of changing the culture of people your employees from one particular way of doing things to a different way of doing things requires huge amount of pre work and that is part of the change management. So we partner with the function owners and we have a team called employee engagement who focuses on these kind of change management across the Enterprise and Technology together so there are exhaustive connect planning and programs which runs across the enterprise aligned to the migration or transformation that we are doing so the value to the employee is why it is being done. What is being done and the day they see the value, they will understand why it is being done, how it is going to help them, be it an experience, be it less amount of time, less amount of effort, better result as long as that is visible then things becomes much easier because you are not driving it alone, it is now you and your entire workforce who is driving this transformation change and that is how it supposed to be done"

Interviewee 2

"I don't think the organization has to prepare too much for anything because it is a question for rolling out set of services or users, at the end of the day users don't care it is working in cloud or it is working in premise they just want the service what they want at the expected levels of quality and response time and reliability. So the organization did not have to do much at all, it is what IT has to do"

Interviewee 3

"IT gets funded by business, business leaders have to see the power of it. In the initial part or during the preparation part you have to look at or you have to prepare your teams, you have to train them, you have to organize sessions for them so there is an organization alignment part where your teams are supported, then have to look at the business part somebody in the business leadership who is ready to experiment with you and who is ready to put stuff outside of typical comfort zone like our own data centers, traditional sets of Technologies and all that, but you always start as small you don't assume that just because it works for everybody it will work for you so you put some amount of seriousness and certain amount of organizational effort on making it successful and once

something is successful, then you have to communicate it effectively across different stakeholders so basically create momentum

So the preparation was done in parallel looking at what we should use, a hosting solution or we should use something like an AWS solution or azure or Google so that choice was the first choice which we have to do. So we actually did a small pilot of all the Technologies, also it is a function of what kind of queues you are tracked as a company. So we kind of zero in choosing azure as our platform that was our first choice then the second choice was we have to choose a real time database which could be a Sequel server, it could be multiple solutions available in the market. Then we evaluated a few of them and we choose that a second function and third was to identify all the devices and gateways which are actually deployed in the distributed location so due to some initial Pilots which we ran. Then we chose which solution was apparently easier and quicker to implement. It took almost a year for us to zero in what cloud, what IOT devices, what IOT gateways to be deployed and then integrate that to overall azure architecture"

Interviewee 4

"The cloud decision was going on for some time I would say it started a year before I joined sometime in the year of 2017 beginning and the discussions were on. When we say preparation first and foremost we wanted to assess is what was the overall need for the organization .We have been growing ironically as an organization so there were lot of servers with each acquisition which we used to inherit, the data centres also used to come along with the acquisitions so there was multiple sets of data centres there was multiple sets of servers, there was mix of servers used to be owned by many companies and by us and some of them where rented out so what we did as a first step was to ensure that the complete count off the data centres and the servers was taken into consideration, we started doing the complete inventory of all devices then we demarcated to rentals and the ones that were owned by us, some of the assets were end of life so we did the complete risk assessment as the first step once we did the risk assessment we identified that there was a huge amount of pause that we were spending towards the rental hardware that was the second step we took these two things and then had a chat with the CEO and CFO so that we brought them up to speed in terms of what exactly was the overall business needs for us to migrate, apart from hiring an advanced infrastructure, and advance elasticity of ensuring that the servers are being used optimally, apart from these two things we took them through the risk assessment that we have done and also the need because of a completely scattered environment and the cost that we born towards the complete setup, once we did that whole thing then we started to work with our team, identified which are the Ultra most critical applications that needs to be migrated to the cloud then we identified ok fine a test Staging and light server is there what is the pain point that the business is complaining, is it the speed, is it the slowness, is there something else that they are looking for, so what we realized is as and when the company uses getting added to the ERP what we realized is the performance getting degraded significantly that was one of the need for us to ensure that the user infrastructure is set properly and we took a right time for us to migrate it and get the infrastructure base corrected and migrate it to cloud that is how we started doing the whole thing and then for the preparation we worked with partners and had couple of rounds of discussions with our CEO, CXO. We alerted them with the business risk in case if the implementation would have failed and we have to rollback we made everyone aware, we chose the period which was non critical for the financial transactions. March is typically year end closing and if any issue happens it was big no no from our CEO as well as our other business stakeholders so we took up a month which was leaner in terms of the business as well as in terms of transaction so we chose February 2018 as the Month and we all aligned the resources all our vendors, partners everyone and we worked towards the plan and ensured that on 19th of February 2018 we migrated to cloud" Interviewee 5 and 6

Q14. Resources Employed In the Implementation of Cloud and IoT

We used our own internal mediums that we have on our internal social platform effectively, we use something like a radio which we use that effectively, email it goes the impact is minimal as you have enough data from the industry the impact is below 20% on email but more workshops, more personal connects, more road shows. We do practical roadshows in each and every building across the country on non-India locations where we have offices and those are the ways to possibly create the enthusiasm and excitement and make people aware the time has come and this is what we look forward to. It is part of the project when you talk about large transformation projects, there are definite amount of resources aligned to that so this is one of the component of that, not outside of that.

Interviewee 1 and 2

There would be different points to each of these initiatives for example, going back to the ERP or HANA, we used certain HANA utilities, we had used other utilities like that party utilities etc. As long as the initiative goals are planned I don't think we had any significant of hiccups in the entire 1 team, it is not very resource intensive. Interviewee 3

Most agreed it depends on the amount of work that you have to do. The initial initiatives can be taken up as a small experiment which may not require too much of

resources but once you are ready to scale up, that is a time you include these things in your financial planning.
It's not so resource intensive, I think it's more of people staying focused on that problem and getting that part. We used an agile development methodology, so we use one week and two weeks developments so we had a product manager defined, we had a cloud architect between and there was a control engineer, the key who gives you exactly what signals to get, where to store them that is from the engineering side. The azure architect is focused more on how fast we can process and was telling us what use cases we should be doing for the customers.

Interviewee 4

I would say in our case it was too much resource intensive because we were the first logistic services company in the region to migrate to cloud and the fear of unknown was a bit too much, so we had to be extra cautious. Now everyone likes to get some guidance from us then we can appropriately tell them because we have gone through the learning. We know the things that we should be doing, what would be the right set of process but we wanted to be bit cautious and failure was not an option. Some of those resources were not utilized properly however we had kept them as standby just in case the infrastructure fail and if we have to do a roll back in terms of cloud.

Interviewee 5 and 6

Q15. After effects of cloud and IoT implementation

"We did the collaboration, the computation and the productivity platform migration around a year back and today we are heavily on our social platform for data points. Around 18 months back social platform was a taboo within my organization, nobody was ready to go into that and today, it is one of the widely platform in my organization"

Interviewee 1

"It is required when you are going on the cloud you do not exactly know how much bill you are going to get because it is a variable pricing. It is pay as per use you will have to work with the finance and tell them how cloud works. They will need some certainties; we need to give them at a range in which you will control your outflows. On HR side you will have to work with HR for creating training programs for your team in terms of hiring the right talent for scaling up these initiatives, so you have to really look at what does it need. Your strategy has to be in place and then you have to create examples of successful strategy by taking up pilot initiatives and then you have to really publish your strategy, identify all the process changes that need to be done, identify all the organization. I would say talent profile changes that you will have to do, identify the success metrics; you have to look at it as a strategy once you are ready to scale up"

Interviewee 2 and 3

"At different time what happens is the focus is on a different component initially it's on the software then it becomes on the IOT devices and the gateways and then security becomes high priority and then overall product management becomes the ultimate because that's what helps ultimately. So over a period of time, you are absolutely right we have to change the focus and the controls in such a way that initial period the software guys had a fail and they controlled everything out, then it moved on to control engineering and they became the big deal as they controlled everything. Now it is a product manager who is controlling everything, that is the transition behind it"

Interviewee 4

"For cloud I would say it was more of a bye in thing, there was not too much of a business process thing as it was not a new ERP implementation. It was the same ERP which was being used by the same organization, we just moved the data centre from on premise to cloud"

Interviewee 5 and 6

Q16. Organizational feedback after cloud and IoT Implementation

"Once it was implemented, the trajectory was always up because people loved it. People said that we used to take three days to do the same activity and now able to do independently within 30 minutes. The success we get is success, don't go ballistic about it, you be cautious and thorough about making it work first till the time you create a low profile. Once it works, you should have communication plan in place in terms of making more and more leaders believe in it, training of your team to make your team believe in it and creating those success stories showcase and communication materials for all other departments who are good candidates for these implementations"

Interviewee 1 and 2

"I think the gap is always there, I have done this in this way and if you do in this way it's not going to work there will be heavy debates. The more we are able to face that conversation and explain with them we actually make them change so it's a continuous dialogue, so the way which I used to do is to get all the key stakeholders, jump on a call once in every 15 days. I invite people from operations; I manage IT so I used to bring operations guys, finance guys. So I had once in 15 days what I call as IT committee, I call it as IT strategy committee, that strategy committee was basically high delegates of other departments including marketing and sales, finance, operations and everybody and consumption; all of that

come on the same call and provide a continuous update about the various IT initiatives given to them. [43] Then they tell us whether the priority is correct and what outcome they are expecting that is given by them and we go ahead and tune the process once in every two weeks" Interviewee 2 and 4

"The good part in our organization is that the leadership team is very tech savvy and they are quiet receiptous I would say. My CEO and MD are big proponent of technology so the reluctance is fairly less so it is a leadership team they were quite open. Fine we are going to cloud, however the underline statement was very clear - my profit should not stop because of the cloud migration strategy so you have to ensure that you do things correctly without disrupting the work so that was only message that they gave in all the meetings that we had with them. I would say if it was an organization where we would have to do lot of bind with internal stakeholders then it would have been difficult however over the year it was easy because everyone was with proponent of using the latest technology, it was a fairly simple journey I would say in terms of getting the bin"

Interviewee 5 and 6

Q17. Emergency situations during cloud implementations

"There were plenty of such situations when you have to migrate a data and data is not coming up, it becomes a big issue when you are sitting on a go live. These are the learnings which comes as part of any implementation"

Interviewee 1

"Any larger transformation projects will always come with possible risk built into it and you need to have the framework of risk management to handle the situations. You can't plan for it because that is not known you are getting into some newer Technologies which is not known many a times you are the first across the world who is trying it, so it is unknown. You cannot have a mitigation plan before the problem arrives and lands up, hence you need to be ready you need to have your ear and eye opened do extensive testing in all possible environments, in all possible scenarios and do testing for failures do not do testing for success, testing for the success is the easiest task to achieve do not wait for the process to run the way it is expected to run your only objective"

Interviewee 2 and 4

"The typical challenge was that the deployment was supposed to follow certain process, certain security settings were supposed to be done and those setting will interrupt 300 to 400 locations or 500 items which you are adding you tend to do mistakes, we do compliance audits periodically and those compliance audits will identify some non-compliances those are the types of bad situations which tells us "oh my god, let's fix this today"

Interviewee 3

"We are using an Agile methodology so if there is a fainting like that today in the next front go ahead and fix it which is only one week pack. In worst case it will be a 2 weeks. Within the matter of 15 days to 20 days we were always able to fix any deviations, god willingness we didn't had any major incidents which created a trouble"

Interviewee5

"In IoT implementation I would say the POC went well, however the batteries on the IoT devices were dying out so what are the options data required so that the IoT devices are continuously charged and last for long, that was one learning that we saw. Once IoT devices are dead it is difficult to capture the data then the whole process of implementing IoT will be affected, in IoT this is one of the biggest challenge unless the IoT devices operate with the solar power or it should be built with some other Technologies so that the devices last for long. The issues are still going on I would say what we have done is an implementation of for example: we have considered a one is to two scenario so if we find any faulty devices then we replace it with other device but at the same time there are companies which are coming up with long lasting batteries because what happens is; these IoT devices continuously emit signals and the data is also continuously send so it is like a mobile phone, so it is just like your mobile is on roaming you will see that battery is getting consumed more because it is continuously trying to locate that, if your GPS is on it gets drained out more frequently pretty similar to that IoT works. It is continuously sending data to the cloud what happens is depending upon the need, the specific business need for example every 30 minutes if you have to send the data versus every minute then obviously the devices needs to be powered frequently"

Interviewee 6

Q18. Cloud and IoT Implementation Results

All the interviewees believed that it is a continuous learning process as it gives one opportunity to find how to do things better and you learn out of it. [46]

"Yes we have done successfully, almost 60% of our workload was moved to cloud that means we have successfully done it. There will be challenges, there will be possible hurdles on the way and we have to mitigate those situations as a team. Together and collectively to find a more suitable solution for that moment of time and go ahead with it"

Interviewee 1

"As a small company we are trying to deploy and implement a large number of devices in multiple locations we tried doing it ourselves. Recently we have started using partners who would actually go and do on behalf of us that is one of the learning. The second learning is that we don't have to have all the skills within the group, not all the skills are required all the time, we don't have to hire a security expert and could fit them inside the office so we changed the model saying that we don't need to hire and keep everybody inside. [47] We can actually use external consultants, so these are the two key learnings"

Interviewee 2

"It was successful in terms of cloud implementation since we were the first logistic Company to adopt the cloud for strategy, we were not having any anyone to guide us, even though the partners were there, from our end we were not having enough information on what the things we need to take care and all of that: as noted by interviewee 3"

"We did a fairly decent job and we have collated all the learning that we have done through this whole implementation and now we can guide someone how to make it better but if you ask me in terms of the testing we were bit cautious. Instead of doing all the testing, we got multiple rounds of testing which I wouldn't say that it is bad because the more you test it in live environment, you will have less issues. We did module by module testing and then the complete one was migrated to cloud so the checklist was very important for us, there was one person who was continuously monitoring that"

Interviewee 4 and 5

7. Conclusion

The IoT is portrayed by the heterogeneity of its gadgets, protocols, and advances. Henceforth, dependability, adaptability, interoperability, security, accessibility, and productivity can be extremely difficult to accomplish. It gives different highlights, for example, convenience, and straightforward entry, with low organization costs. The IoT is turning into an inexorably universal computing administration which requires colossal volumes of data stockpiling and processing capacities. The IoT has constrained capacities regarding processing force and capacity, while there likewise exist weighty issues, for example, security, protection, execution, and dependability; in that capacity, the mix of the Cloud into the IoT is valuable as far as defeating these difficulties.

The study states that CIOs role is to enable and transform the technology. Being a C Level employee the CIO also has to be an IT strategist. In some organizations the CIOs plays a role in finding solutions to business by connecting with the technological pyramid. At the executive level a chief information officer can become a chief involvement officer by intervening in all the business problems by solutioning them through cutting edge technologies.

The competencies and abilities, which we recognized in the survey of the 6-CIO respondents to be basic for the CIO to be fruitful in his/her job, have been mapped out as exceptionally basic to effective CIO incorporation. The study states that the CIO role is achieved with continuous on the job learning as there is no formal course to make someone as CIO.

The major competencies of CIO are greater collaborator, negotiation, communication/behavioural, open minded, constantly learning, leadership skills, vendor management, create win-win partnerships, people management, skill to structure the organization, mind-set to continuously change and innovate the organization. The CIO should have the ability to "what and why" which becomes a major factor in decision making.

The CIO should also have the financial management skills as the business ultimately points at financial aspects. Most of the CIOs had acquired basic knowledge in cloud computing and IoT through various workshops, forums and technical/business magazines. Communication was seen by all interviewees as the most significant competency of the CIO. Open communication takes into account agreement and purchase in on key choices at all degrees of the organization. For the CIO to be effective in driving development and intensity, the job has seen the CIO, moving endlessly from the customary job of the data processing administrator offering utility assistance, to one that gives more worth adding administrations to the organization. The CIO in the present business condition is required to have a decent comprehension of the business, and requires new abilities as a key and business pioneer to use ICT to drive the organization to improve its presentation and effectiveness. These aptitudes are required so the CIO can comprehend and disclose to the organization how IT can help management in settling on vital choices to meet the business targets. Likewise, for an organization to maintain its upper hand, it requires a strong business-IT design to incorporate arrangement between forms, frameworks, data, and infrastructure.

This qualitative survey gives are the key employment capacities in the role of the CIO in figuring out what present and future business condition. It likewise recognizes capacities and competencies rudimental for the CIO to be fruitful in driving advancement and intensity by utilizing ICT in the present business condition and clarifies why these are significant. To succeed, the CIO needs a decent comprehension of the business as a key chief and necessities to have great communication aptitudes at all levels in company and have the option to discuss successfully with business customers. The CIO needs to comprehend the business at all levels and have the option to team up with others as this is basic for the

conveyance and dealing with the ICT frameworks and foundation as ICT now pervades all aspect of organizations.

Even though cloud is not the definition for all the business problems, it has helped organizations to reduce the Capex. As per the study cloud and IoT implementation in an organization from a CIO perspective is by creating the right roadmap and framework for Cloud or IoT Mission. These strategies vary from enterprise to enterprise. The strategy also has relationship in changing the culture of the organization as many people would be against the changes. A clear roadmap and change strategy has to be created for any IoT or cloud implementations. The resource consumed for the implementation would also vary on case by case basis as in some cases the implementations were too much resource intensive due to last minute surprises. The after effects of the cloud and IoT implementation were always positive and the emergency situations were address with the help of better transformation experts.

While utilizing data gathered from different CIO administrators astutely, reliance of IoT on mobile systems, essentialness of the data created from various gadgets, significance of systems close by data centres, need of a made sure about assistance foundation with remote control choices, development of interoperability principles, heterogeneity, and receptiveness are a portion of the issues that should be tended to, security, and protection of data will assume a significant role in how the image of IoT will look like in the coming decades. Corresponding to it likewise comes the difficulties looked by this innovation, that represent a danger to its prosperity. Each angle including innovation, business, society, and law oppose the achievement pace of IoT. Acknowledgment of innovation by individuals is additionally basic and ought to be thought about during its advancement as individuals who are not attached to utilizing devices, shrewd gadgets, and don't feel good managing innovation will make some troublesome memories working with the intricacy usefulness IoT will draw in them with. It's high time to manage the elements that may fundamentally cut down the compelling fate of IoT. With these data, the sustainability of successful cloud-IoT implementation without consequent challenges is still feasible

The IoT is becoming an increasingly ubiquitous computing service which requires huge volumes of data storage and processing capabilities. The IoT has limited capabilities in terms of processing power and storage, while there also exist consequential issues such as security, privacy, performance, and reliability; As such, the integration of the cloud into the IoT is very beneficial in terms of overcoming these challenges. The IoT is becoming an increasingly ubiquitous computing service which requires huge volumes of data storage and processing capabilities. The IoT has limited capabilities in terms of processing power and storage, while there also exist. Consequential issues such as security, privacy, performance, and reliability; As such, the integration of the cloud into the IoT is very beneficial in terms of overcoming these challenges.

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A study by Gartner in 2017 revealed that driving CIOs describe their components in terms such as' creative energy," Chief Innovation Officer' and 'CIO income generator’

8. Recommendations

Based on research findings, the researcher made the following recommendations

1. Organizations must always ensure that the CIO role aligns well with the requirements and expectations across the C-Suite so as to ensure great organizational performance. Any misalignment can result in organizational failure as far as performance is concerned.
2. CIOs should possess competencies such as knowledge engineering skills, finance management skills, innovation management skills, communication competencies, project management competencies, change management competencies as well as contract management competencies when adopting new technologies in an organization.

9. Limitations and constraints of the study

Cross-sectional study was utilized for investigation. This structure has its own confinement as the information is gathered just once and at one point of time from the participants, which further limits comparison between groups elusive. Selection of the employees from different hierarchical positions used purposive sampling to attain representativeness. Although the attempt was made to have representation from different levels of hierarchy in

this research, it was not practically possible to draw a random sample from the sampling frame.

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