

Contemporary Trends in the Information Technology (IT) World and its Transformational Effect on Chief Information Officer (CIO) Roles: Analytical Study



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1. ABSTRACT

The word of IT is not, any more, exclusive for IT people and, to the contrary, it is becoming dominated more and more by business objectives and plans. Because IT is becoming a service or tool that was found and developed over decades to help business doing better using computers and networks to achieve business goals such as efficiency, resources utilization, making profit, reducing expenses, and expanding market share. If we look at few elements of the IT world such as devices, users and applications developed since the first decade of IT in mid 1940s, we can clearly see that users' community has grown from thousands to billions of users all over the world. Similarly, software applications have grown to reach millions of software applications covering, again, billions of devices from desktop computers, notebooks, wearable devices, swallow-able chips and insulin pumps embedded in human bodies of some patients. Personalization and customizations are becoming major trend in every application and smart device that can monitor and track individual's actions during day-today life i.e. travel, purchase, calls, transactions and many other types of uncountable actions. This research is going to explore the new image of IT world in the light of new trends that are shaping the directions of the IT world. Furthermore, the research is discussing the impact of these trends on related factors such as people, processes, technology, business, environment, and governments. This research will browse new trends in the IT world – Social, Mobility, Analytics, and Cloud (SMAC) – and their impact on the current role of Chief Information Officer which is clearly passing a major shift in its responsibilities and duties in the light of dramatic changes from business perspective and the security threats encountered within these emerging trends.

2. KEYWORDS

Information Technology, Chief Information Officer, Social Media, Mobility, Big Data, Cloud service, Internet of Things.

3. INTRODUCTION

Since the first decade of IT in the mid-1940s, the IT has passed several eras of development via its main elements such as software, hardware, and networks, as shown in Figure 1. The first era started in 1950-1970 was marked with terminal workstations, mainframe computers, manual, and expert-dependent environment to run various data processing tasks manually. The second era from 19970 till 1995 was recognized by client-server computing, local area networks, and emerges of the Internet as new environment for networking and information dissemination. Finally, the third era of IT computing is marked by the new utilization of modern tools, software, hardware and other technologies that are Internet-based media such as iPad, smart phone, tablet PC, wearable devices. Moreover, the vast coverage of computing is tremendously covering our life at home, business, car, transportation, multimedia equipment, even latest models of vehicles and home equipment such as smart refrigerator and smart TVs. Interoperability between long list of digital devices is becoming industry de facto in such a way that people are expecting their computing devices to be in continuous interaction with their wearable devices and mobile/smart phone all the time so that they can check their needs, anywhere anytime in a smart fashion. Several features are distinguishing the current IT world in 21st century, these features are:

- A Shift-To-Business service: the successful and most fortunate companies are moving business models from make-sell to sense-and-respond approach such as IBM,

Microsoft, Google according to [1] according to recent international surveys (Gartner, IDC, Waterhouse) in this regard [2]. And this is changing the way business is engaged with customers. As business strives to be agile, IT is required to align with it.

- The rise of Internet of Things (IoT): lots of devices are becoming internet-based i.e. connected, smart, and faster than before. Examples are computers, mobile devices, applications, digital universe. In overall, products and services are delivered at high speed to their beneficiaries. The Internet of Things is one of the most important innovation accelerators for growth and expansion [3].
- Innovation Everywhere: the business is increasingly driving technology initiatives.
- Leverage IT Both On/Off Premise: due to the emerge of cloud-oriented technologies; this has change the way that CIOs are running strategic initiatives at business towards responding to cloud wave.



Figure 1: Innovative Industry Solutions [2]

4. CHALLENGES OF THE CIO

Due to these major changes in the world of IT, the role of CIO is changing too as a natural result of the latter changes. According to recent survey [2], the future challenges of CIO rule is the following list.

1. Managing IT governance, risk and compliance
2. Obtaining budgets for IT investment
3. Measuring ROI from IT investments
4. Aligning IT and Business needs

5. THIRD ERA AND ITS EFFECT ON THE ROLE OF CIO

Several surveys have been carried in 2013 and 2014 by independent partners to explore the relationship between current changes in the world against the new role of CIO within the business firms and the way it has been redefined by these changes (new tools in software and hardware). It has not only changed the role of the CIO but it also has changed the role of IT divisions within business firms. In IDC survey (IDC 2014- CIO sentiment survey [4]); it was found that "in the next two years, over 70% of CIOs will change their primary role from directly managing IT to become an innovation partner who delivers information insights and value-added services". These changes in the CIO's role is creating tremendous pressure on CIOs finding proper resources and adapting to these changes both internally at their divisions and externally toward business functional areas. Examples on these pressures are lack of financial resources, scarcity recruitment of new positions that never existed before [2] and changing the surrounding culture of IT staff to adapt new IT roles. Major Key players in the market of analysis and market survey of IT are expecting the title of CIO to be replaced by Chief Innovation Officer rather than Chief Information Officer as shown in Table 1 so that CIO role will be more focused on strategic directions rather than operational and/or tactical directions.

	Operational CIO	Business Services Manager	Chief Innovation Officer
1993	90%	10%	0%
2013	70%	20%	10%
2018	10%	40%	50%
Goal	Keep the Lights on	Provide an agile portfolio of Business Services	Business Innovator
Focus	Costs and Risk	Service Excellence	Business Value
Jobs Scope	Data Center, IT Ops	Business and Technology Service Catalogue	Business Processed, Capabilities and Analytics

Figure 2:CIO role predicted in 2020 [3]

In summary, over the next few coming years of this decade 2015-2020, it is very much expected that the whole world will see an explosion of innovation and value creation of IT-based value in the 3rd platform era [3].

6. THREATS ENCOUNTERING CIOs AND EMERGING TECHNOLOGIES

It is the nature of things - in the IT world - that along with emerging technologies new types of threats appear in new format or different style from the known forms of threats. Threats are focused in the security arena and translated in several fashions. Due to the fact that old

equipment, not designed to be part of the Internet, is joining the wave of being connected to the Internet is creating new security hole in our personal and business life. The reason behind such new threats is that hackers may find, and ultimately they do find, breaches in this new structure of equipment and by going to our home networks through these breaches; hackers will be able to do various bad things such as getting personal and private information causing various types of disruption to our financial life-side. In USA's Government Accountability Office (GAO) report [5], it confirms that "smart networks" is one of the most critical infrastructure networks (beside others such as water, power, communication) because other traditional networks are currently heavily depending on the Internet as one of its fundamental operational components. New channels (such as internet, mobile banking, mobile apps, multiple platforms) which represent growing complex puts IT security as a major priority. Possible threats addressing smart networks are:

1. Multi-layers: current smart network consists of several layers and any layer is a candidate of becoming victim. Several actual attacks on oil industry leader's company ARAMCO in Saudi Arabia (in 15-Aug 2012 via Shamoon virus) resulted in several millions of dollars' losses and damage of 30,000 computers [6]. This is the level of companies that represent precious target of attackers.
2. Connectivity: because several non-identical networks are being connected for the purpose of operating and connectivity with other facilities, the possibility of risk exposure and being attacked is getting more and more.
3. Network size and expansion: in case the attacker managed accessing any of the networks and compromise that network, the effect of the damaged will be cascading to other networks. And by having big networks, the attack's impact is going in ascending fashion i.e. positive relationship. In [7] it is mentioned that attackers in 2014 used back-door approach and managed to gain access to power facility in USA due to the system vulnerability. Similar attacks were reported in 2014 in Spain, France, and Italy by the same web site. Security measures need to be proactive, not preventative or reactive.
4. Security-cross platform threat: security threat is the most common threat across all new IT trends (SMAC) since it is heavily involved and affects these trends.
 - a) Social media: data loss, malware, governance are the related threats to social media.

- b) Mobility: Cyber-attacks, malware (viruses, worms, Trojans), social engineering, spyware, and eavesdropping are the most related threats in mobility trend.
 - c) Analytics and big data: data security, governance issues are main security concerns
 - d) Cloud: data loss, data integrity, data availability, and various attacks are common concern for business firms during various phases of considering moving to any level of cloud.
5. Other types of challenges are facing CIOs in business and technical areas; these challenges are the main driver for changing delivery and operating models for organizations. The challenges can be categorized as: driving innovation, managing vendors and users' expectations, connectivity, and ensuring IT performance and availability of services.

Third platform technologies will drive organizations to constantly review existing security policies to avoid business interruptions and negative impacts on business growth. Skills and policy will remain major challenges and "Identity Management Systems" will be of importance to protect users and information across the third platform assets. Therefore, security policies are critical and it is mandatory – from business continuity point of view – for the organization to Plan, Update and Enforce these policies.

7. NEW TRENDS AND TRANSFORMATIONAL TECHNOLOGIES (SMAC)

Several surveys have been conducted by Gartner[8], IDC [4] and IBM to explore the new trends in the world of IT. One can summarize these trends as follows: a) Mobile device diversity and management; b) Mobile apps and applications; c) The Internet of Everything; d) Hybrid cloud and IT as service broker; e) Cloud/client; f) The era of personal cloud; g) Software-defined anything; h) Web-scale IT; i) Smart machines; j)3D printing.

The most common trends between these studies Cloud, Analytics, Mobility and Social (SMAC) are expected to move the entire business from its traditional reaction form into proactive and prediction mode (sense-and-respond) [2] in order to improve the efficiency and overall performance of life quality via IT systems. In the following paragraphs, each trend will be focused on to better understand trends and their effects, problems encountered and challenges.

7.1 social media

Social media contains a wealth of information that can help organizations better predict future trends and trace customers' behaviour, as an example, and subjects of interest.

Mobility-based elements (devices, applications, technology, and network) are becoming major driver in the expansion of social media. Wearable devices enable the user to take and view pictures or video, read text messages and emails, respond to voice commands, browse the web. Examples that are common to vast majority of users are Google Glasses and the Apple iWatch. But other devices are heart rate monitoring, clothing, watches, glasses, and shoes.

7.2 mobility (enterprise)

Mobile-based technology is becoming the users' environment like the second era of IT computing when Client-Server was the default. In addition to the computing environment, applications and experience of wide spectrum of customers is becoming mobile-based. Location-based application and contextual information is becoming required for infinite list of applications and devices for IT and non-IT users. The status, as of 2014, of mobility consists of utilization of advanced network technologies such as virtual private network for mobile devices and smart phones including implanting corporate security and access policies on users and devices accessing the network anywhere and anytime. This situation is dramatically changing and moving forward towards establishing new policies and strategies to handle this non-stopping stream of tools trying to connect various users to the corporate network. Mobile devices, mobile management, mobile apps and applications are becoming industry de facto. Mobility is one of the main driving factors behind spending in developing countries as stated in [9] where KSA has spent more than 27 billion USD during 2013 on information and communication sectors in the country.

Telecom operators in partnership with global cloud providers will continue to position cloud offerings contributing positively to market maturity and paving the way for future investments.

7.3 analytics big data / business intelligence

It is quite normal to have several software applications at any organization forming silos of information and making integration an endless suffer for both IT and

business. Analytics can combine the silos phenomenon into one unified, integrated, and coordinated source of information in accordance with various standards. Emerge of Internet of Things (IoT) technology has enormously and massively increases the amount of information available for analysis. Adding to the analytics trend cloud and mobility trends makes the necessity of analytics an imperative option. The estimated size of data all over the digital universe in 2014 is around 6ZB (6 trillion terabytes) and it is growing every second [10] due to many reasons and it is expected to reach. The status of corporate today in the area of BI is utilizing query and reporting BI tools known as Dashboards. Due to the massive distribution of mobile devices, business managers are ambitiously looking to have all these techniques and tools on their smart phones without the need of any savvy IT person setting next to them. They are asking for Dashboards that are Mobile-based and data warehouses that can be easily analysed using these new intelligent devices. According to IDC surveys, data volumes double every 18 months and this drives the need for more advanced and proactive information management and analytical models to be the leading tool in this regard. As a proof on the strong direction dictated by big data, it was reported that spending on analytics in Saudi Arabia is expected to grow 21.5% year on this year 2015 to reach \$54.2 million [4].

7.4 cloud service

One can define cloud-based service as a means of software application designed in a standard approach using web-based languages (such as HTML) and can be accessed using a browser via some protocol (HTTP/HTTPS) to do a job(s) for the user through the Internet. This web-based service can perform a function(s) to user without installing any of its basic requirements on the user's PC, and can be available in various fashions on the Internet. The form in which the web service is available can be private, public, or hybrid. Each form of the later forms has its own unique nature and the firm may choose the suitable form based on its business objectives and other types of requirements. Apart from the form in which the web service is available, the main key drivers behind adopting cloud-based technologies (and web services) are cost savings, software quicker development, better IT skills, and enhanced maintenance for hardware and software. Cloud solutions are scalable different and depends on organization's business requirements. So, Private, Public, and Hybrid cloud-based solutions can be

implemented in various suits according to a list of requirements (user, business, government) and all together are forming new computing style widely adopted. Cloud technology - the new delivery vehicle for the application - together with mobility are forming new nexus that connects users with social application and forming new trend, architecture and experience and feeding analytics. International and local companies all over the world are revisiting their approach regarding cloud computing [11] and more attention is being given to cloud computing due to its ability to reduce infrastructure investments, while enabling increased business efficiency and profit. It is worthwhile recognizing that computing costs drop in half every two years. It is clear from Figure 2 that resources assigned by organizations to operating IT and keeping the lights on is decreasing by the time and it is expected that cloud computing trend is changing the picture by 2020 to be in a different fashion in which organization will assign more resources for innovation and lesser resources for operating, support, and infrastructure.

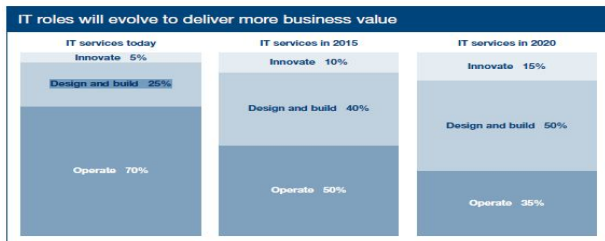


Figure 3: IT Roles today and tomorrow [11]

8. FUTURE CIO ROLE

After going through all the new trends, threats, and challenges emerging in the IT field, what are the future responsibilities of the CIO according to independent surveys [11]. In the past, and till these days for many organizations, the role of the CIO is to keep things running smoothly at the business in term of availability, security, efficiency, and business profitability. Even with the new major changes, the CIO role will continue to be the sourcing and delivery of technology through oversight and management of IT but it will be one duty out of many new duties. The CIO role will remain as technology leader and broker since it is the only specialized player in scene. The role of CIO is used to be led by several players and tends to be follower and not creative or leader, therefore these latter facts of technology advancements are changing the whole picture. It is of no doubt that new responsibilities added to the CIO role will determine its new picture in addition to the environment in which that CIO is taking place [12]. Concerning the

environment effect, it is highly expected that organization's culture will be of strong effect on the new shape of the CIO due to the uniqueness of organizations in term of their local cultures. Because of the various trends in the IT world and because of the new changes in both IT and the business domains, the CIO will continue evolving in reactive mode due to the continued growth in strategic importance of IT technology. The CIO role is expected to be more externally oriented (contrary to the old or current situation) to give more attention to transformational issues mentioned above as SMAC. Some of the expected duties that CIO is going to do very recently: 1) assist the organization designing new strategy focused on the third platform technologies and standards in business and IT 2) working on bridging the gap between business and IT and align solutions to meet common objectives like social media and customization of customers experience and needs, internet sales and support 3) create a vision and imprint it with a mission statement 4) create a strategy and design a roadmap to implement the vision 5) ensure funding for the complete transformation 6) build a financial justification for the adoption of new solutions that responds to the new trends 7) maintaining technology governance [12]. The CIO role will continue to be focal point at any progressive organization but its duties, responsibilities, and tasks will change as a reaction of natural adaptation to these newly emerging trends and it will continue to be the leader of technology brokering and delivery [11]. The success will be gain via implementing new solutions in business will drive the business to have extra enthusiasm for more successes consequently. The CIO role under any forecasted change will remain in bringing the organization to achieve its strategic objectives via using digital products and services, indeed. It is vital for any IT-oriented organization to ensure that CIO'S understanding of its business models and objectives is crucial for its development. For those CIOs who choose not to adapt changes around them and keep focusing on technology-oriented traditional role, they are hindering themselves and the business organizations from making real benefit of these new trends in IT world[12].

9. RECOMMENDATIONS TO CIOs

Because new trends are creating, both, chances for some people and threats for others, good thinking CIO should lead him/her to plan very well for near future and to improve their personal competencies in various trends including their goals, business domain, strategy planning, budget planning and other needed areas that might arise during this task.

CIO should consider, carefully, the organizational culture in which he/she is working for since has an important impact on

possible accountabilities to be added to the CIO'S new roles and responsibilities.

Establish, and implement whenever it is possible, IT plans for the organization that are dynamic to acquire future changes and provide the second-line leaders with proper knowledge, skills, and training to carry on the way.

Having these new technologies, CIOs have great chance to utilize or liberate organization's existing resources towards getting more value and innovation [11].

New skills in the IT domain are inevitable and CIO should work on developing his team to accommodate new changes by alerting their awareness to the opportunities and possible threats, as well, that might accompany new technology solutions. New titles connected with business will appear and some existing titles may disappear and the focus of current IT will change and its impact will be much higher for business since it is going to be the backbone of the whole organization.

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