



# The Necessity of Formation of Health Information Technology: Goals and Strategies for the Future of the Healthcare with the Approach of Maturity Assessment and Risk Analysis

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## Mini Review Article

### Abstract

In this paper, the goal of the effort is to determine the future of healthcare and to explain the importance of establishing strategic roadmap in this area. Identification of strategies for future of healthcare includes adaptive and dynamic learning through the industry, governments, and universities. The most important part in generating strategies is to determine the goals with high levels expectations and exclusive path. Healthcare technology goals which are presented in this paper could be inspiring to make a better future. Future developments of medical and health care depend on investing in research, development, and education today. So that health managers achieve goals of the health care system by making appropriate decisions and allocate resources. With appropriate goals and strategies, risk, maturity and reliability level of HIT system could be calculated by using COBIT and best scorecard (BSC) method.

**Keywords:** Healthcare Information Technology, COBIT, Best scorecard, Maturity approximation, Risk approximation, Reliability, Strategic plan

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### Introduction

Health Information Technology (HIT) is a perfect combination of information technology and medical science known. HIT is one of the most important elements to

improve the quality of medical care, reduce the cost of the healthcare and improve its incomes. HIT is proposed as a comprehensive tool for effectively, efficiently and securely sharing medical data in time and space.

According to the progress of HIT during the past two and half decades it can be seen

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that although HIT at first glance was meant as a use of computer in healthcare systems and was used to obtain the online records of patient's conditions, but HIT takes much broader and more comprehensive concept with the advancement of technology. With the HIT, community and health care providers will be moved in the direction that health services and medical care will be provided with the individual pattern at home and outside of health centers. Therefore, the treatment will be less expensive and better for patients. HIT greatly improve the health of society by continues monitoring of individuals outside the hospitals and treatment centers. HIT will provide the condition to achieve the slogan of prevention better than cure by recognizing the warning signs and adopting appropriate strategies. HIT can help health care providers to recommend treatments that are more suitable conditions for individual use. HIT also helps to patients have a faster diagnosis and are treated better by doctors outside the medical centers. So the impact of treatment decisions will be increased for patients and the quality of the services will be improved simultaneously with reduction in the cost of health care. HIT caused the development of society in the long term.

According to what was said in today's world, all societies require to moving from traditional medical systems towards personalized health information technology. Such a change in the system of health system services requires the movement of large volumes of information between individuals, providers, and organizations which lead to a high degree of partnership between diverse systems. This information should be shared with qualified persons at a correct time with the high-security factor, which requires vast infrastructure in the IT sector. On the other hand, the sensitivity of the information is also very high because misinformation can lead to death or deterioration of the patient's disease. So HIT system is a broad participatory system with large volumes of data with very

low error threshold. Future advances in medical information technology depend on today investment in research, development, and education. So decision makers of healthcare strategies achieve the goals of the health system by making appropriate decisions and resource allocation.

Like all other organizations and businesses, a strategic plan should be developed for future of the HIT based on its prospects, goals, missions, and etc. The Office of the National Coordinator for Health Information Technology (ONC) is among the most important organizations that develop strategic plans for HIT. HIT strategic plan was presented for the first time in 2011 [1]-[5]. This strategic plan was released when adoption of HIT was in its early stages, implementation of the Affordable Care Act was at the beginning, and the mobile health applications was unfamiliar for consumers. Implementation of this plan caused to creation a strong foundation for achieving next Plan's goals and objectives. Over 450,000 professionals and 4,800 hospitals investigated capital, time, and hard work to convert the documents of their patient from paper system to the Electronic Health Record system (EHR). Also, they reconstruct and adapt their workflows based on the electronic healthcare delivery system. So the new healthcare system needs to infrastructure that shares information with the high-security level across multiple platforms, providers, payers and consumers. The second strategic plan was developed and released in 2015 for years between 2015 and 2020 [6]. By implementation of this plan, high-quality care with lower costs must be obtained and caused to a healthy population and engaged individuals.

In this paper, the goal of the effort is to discuss about the importance of developing a strategic plan for future of health care and consider desired visions, missions and goals of HIT strategic plans. After that HIT, like any other IT based system, will be analyzed from three aspects of risk, reliability, and

maturity. In the field of information technology investment some engineering tools are existence that are used to evaluating the reliability and risk level. In this paper first HIT system will be analyzed based on connecting network topology with emphasis on best practice card models (BSC) and IT Architecture Framework (Cobit). Then results will be provided in terms of maturity, reliability, and risk.

The organization of this paper is as follows: The necessity of developing a roadmap of HIT is explained in section 2. Then fundamentals of a roadmap and strategic plan of the healthcare systems will be examined. Also, strategic visions, missions and objectives for the future of HIT will be discussed in this section. Section 3 will be devoted to the estimation of the risk, maturity and reliability of HIT services by using COBIT and Best Scorecards (BSC) theories.

**Principles of strategic plan for HIT**

In past decade HIT is among the most important factors in the strategic planning of health care future. Create a clear vision of the future of health technology and smart investments in technology are crucial factors for success. It should be noted that economic and social issues related to health and health care are inextricably linked to aspects of medical technology. ICT4D is a conceptual framework for analyzing the parameters such as, technology, economic, political, social, that are constantly changing at three levels: local, national, international, for the identification, prioritization, policy and coordination of human resources, stakeholders, and contractors [7]-[11]. This framework is shown in figure 1.

Based on this framework, the conceptual model of quality health information technology is provided as shown in figure 2.

By personalization of health system simultaneously competitiveness cost will be reduced and quality and accessibility of health services will be improved. In Fig 2, The top corners represent the kind of quality

and bottom edges represent high-quality standards [12].

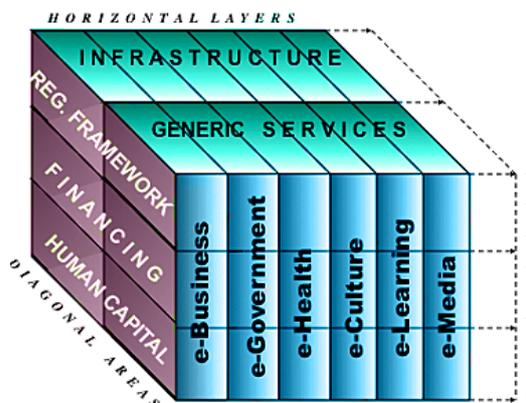


Figure 1. Conceptual framework of ICT4D

**Levels of HIT strategic plan:** HIT Strategic Development Plans can be presented in three levels. Each of these levels has its own specific strategic framework and scope.

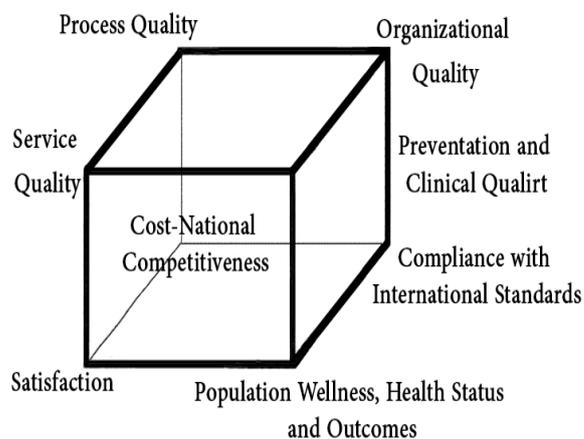


Figure 2. Quality cube in the context of health technology

These levels include future of health and health technology, the future of the smart environment and foreign intelligence in health, and strategy for the future of health. In the framework of the "The Future of Health Technology", four strategic areas are available; Attitude to the future, speed-up to health technology, speed-up to intellectual leadership, improve the global health information

infrastructure. In this area, health technology has become a key issue in the field of smart health care by wide effort to continuously collect medical data, immediately analysis of medical information, accurate analysis results, emotional calculations with emotional intelligence, surgical robotics, nano-surgery, gene therapy, medical remote online training patients, and bioinformatics.

The next framework is "Future of smart environment and foreign intelligence". This framework reflects the need to link the traditional information technology and natural sciences with nanotechnology. It expresses that the human body and the world in which it operates is a complex adaptive system that constantly changing and the real challenge is in understanding the dynamics of that data. Smart biomechatronic systems and health care equipment and mathematicians, understand, record and analyze this system.

In this framework strategic areas are consisted of goals and unsolved problems, consumer/Social IT environment, dietary and nutritional supplements, implanted bots, implanted antennas and sensors, embedded sensors in clothes and textiles, human-machine integration, long life/range of life expectancy, future development of care for older people, intelligent care devices, treatment and care through advanced technology (Hi-Tech Cure), global health care, healthcare compliance management process.

In the framework of the "Strategy for Future Health," five strategic areas are available such as healthcare strategy, E-health strategy, strategy of longer life and extend life, nanomedicine strategy, development of human capabilities, public health strategies. The main items that are used to slow aging is discussed in this area such as reconstruction of organs, neurological signal transduction mechanisms to control physical robots, quantum mechanics and molecular imaging for detection of human thought patterns, "immortality" lack of cellular and molecular decay. Better

prevention of disease, reduce medical errors and "the continued integrity" in modern life is created by issues of access, availability, quality and cost of care services, access to definitive and unambiguous tests, computerized patient records and use of artificial intelligence to monitor and control hospital infections, access global data, within the framework of biological and memory map, physiological and molecular data analysis and argument by consumers, data preparation, reality extraction of the raw data.

According to what was said, HIT has become a key issue in smart health. Strategic planning process and development of a strategic roadmap is a long process that will summarize in the following steps:

1. Determine missions
2. Determine the long-term and short-term visions:

By determining the long-term and short-term prospects, the desired image of the future will be traced.

3. Determine the strategic goals and objectives:

The strategic goals should be set in such a way that lead the healthcare system from missions to short-term and long-term prospects.

The strategic goals should have the following characteristics:

- a) be accurate and measurable.
- b) be challenging and realistic.
- c) have a key role in the development and decisively follow-up.
- d) have a clear and accurate schedule to achieve them.

4. Determine the strengths and weaknesses/opportunities and threats

5. Determine the strategic actions required to achieve desired strategic objectives

6. The allocation of required resources

**Missions, Visions, and prospects in HIT strategic plan:** HIT provides a collaborative ecosystem that enables the right information at the right time to the qualified people in the organization. So these people can use the data with high reliability for the diagnosis

and treatment of patients. HIT echo system should be such that support the overall health of the community in sensitive situations such as epidemics of diseases such as nebula or events such as earthquakes, accidents with high casualties, flood and etc. So the mission of HIT system, in general, is to improve the health, healthcare of individuals and communities by using the information technology. Also, data obtained in the health system could be used to conduct research priorities and allocating funds in the health system. So HIT is caused to improve the quality of health care services without the need to raise the frequency of services to patients.

The aforementioned visions are summarized as follows:

- Improve the quality of healthcare
- Reduce the costs of health care and treatment
- Expedite detection using continuous monitoring of the physical condition
- On time treatment before serious symptoms of the disease.
- Increase the performance of older people and reduce the speed of aging process
- Reduce the level of medical errors

All of these visions require their own infrastructure and technological devices. Technological innovations that should be developed until 2050 in order to achieve these visions are shown in Tables 1-7 [13].

Proposed technologies are arranged in six broad areas of research and cover the most likely cause of future developments and innovations in health care.

Specialized Alternatives for parts of the human body not only can make sense to people without feeling back but can also strengthen the common features and convert them to stand out features. Details of Augmentation schedule are shown in Table2.

Development and distribution of advanced detection sensors will turn guess like diagnosis with incomplete information to the individualization diagnosis based on data-driven instructions. Details of Augmentation schedule are shown in table 3.

**Table 1.** HIT technological areas until 2050

Number	Schedule
12	Augmentation
15	Diagnostics
12	Telemedicine
7	Bio gerontology
10	Treatments
9	Regeneration
65	Summation

Global networks and mobile technologies will fix the problem of necessity of being doctors close to patients for the diagnosis or treatment. Details of telemedicine schedule are shown in Table 4.

**Table 1.** Augmentation schedule

No	Areas	Plan	Technology	Year
1	Augmentation	Neuroprosthetics	Exoskeletons	2028
2	Augmentation	Neuroprosthetics	Neuroprosthetics	2030
3	Augmentation	Neuroprosthetics	Enhanced metabolism	2034
4	Augmentation	Neuroprosthetics	Optogenetics	2038
5	Augmentation	Neuroprosthetics	Neuroprosthetics	2044
6	Augmentation	Sensory augmentation	Hybrid assisted limbs	2020
7	Augmentation	Sensory augmentation	Auditory vision substitution	2024
8	Augmentation	Sensory augmentation	Myoelectric prosthesis	2024
9	Augmentation	Sensory augmentation	Augmented olfaction	2028
10	Augmentation	Sensory augmentation	Augmented hearing	2034
11	Augmentation	Sensory augmentation	Telescopic & microscopic vision	2038
12	Augmentation	Sensory augmentation	Sensory augmentation	2048

**Table 2.** Diagnostics schedule

No	Areas	Plan	Technology	Year
1	Diagnostics	Sensors	Sensors : internal-external	2044
2	Diagnostics	Sensors externa	Non-invasive glucose sensors	2024
3	Diagnostics	Sensors externa	Rapid gene sequencing	2028
4	Diagnostics	Sensors externa	In-clothes	2038
5	Diagnostics	Sensors externa	Ingestible sensors	2038
6	Diagnostics	Sensors externa	Medical tricorder	2038
7	Diagnostics	Sensors externa	At-home	2044
8	Diagnostics	Sensors interna	Epidermal sensors	2024
9	Diagnostics	Sensors interna	Tissue-embedded sensors	2030
10	Diagnostics	Sensors interna	Blood stream sensors	2038
11	Diagnostics	Big data	Open health records	2020
12	Diagnostics	Big data	Question answering computing systems	2028
13	Diagnostics	Big data	Data-driven patient communities	2030
14	Diagnostics	Big data	Data-driven diagnostics	2038
15	Diagnostics	Big data	Big data	2044

In the decades ahead, the development of knowledge will enhance our understanding of aging and to slow the aging of the action. Details of biogerontology schedule are shown in table 5.

The manufacture and distribution of a miracle drug binding are not enough for the entire population. Treatment can be precisely targeted to everyone's unique characteristics. Details of treatment schedule are shown in table 6.

The problem of desperately searches to match donors and non-replacement of major organs and extremities will be fixed through the further development of organic growth for the order. Details of regeneration schedule are shown in table 7.

Based on the prospects, goals and objectives of HIT strategic plan can be determined as follows [1], [6], [12]:

1. Self-Managed Health system with individual pattern
2. Transform traditional health care Delivery system to smart It-based system
3. Improve quality, accessibility, safety, effectiveness, and efficiency of health care system
4. Reduce the cost of healthcare services
5. Support the delivery of high-value health care
6. Follow up research and development activities around the smart HIT
7. Enhance national Infrastructure of HIT

**Strategic actions to achieve strategic goals:** The objectives mentioned in the previous section at the operational level means the following:

- Start thinking seriously about long-term solutions and invest in them.

**Table 3.** Telemedicine schedule

No	Areas	Plan	Technology	Year
1	Telemedicine	Remote virtual presence	Robotic healthcare assistants	2038
2	Telemedicine		Ai therapists	2038
3	Telemedicine		Virtual triage	2028
4	Telemedicine	Remote virtual presence	surgery assistance	2024
5	Telemedicine	Remote virtual presence	Full body simulation	2040
6	Telemedicine	Remote virtual presence	Full brain simulation	2048
7	Telemedicine	mhealth	Telemetrics	2030
8	Telemedicine	Remote virtual presence	Robotic surgery	2024
9	Telemedicine	Mhealth	App-driven diagnostics	2024
10	Telemedicine	Mhealth	Natural language processing	2028
11	Telemedicine	Mhealth	Mhealth	2042
12	Telemedicine	Remote virtual presence	Remote virtual presence	2044

**Table 4.** Bio gerontology schedule

No	Areas	Plan	Technology	Year
1	Biogerontology	Cryonics	Suspended animation	2030
2	Biogerontology	Cryonics	Full-body cryopreservation	2034
3	Biogerontology	Cryonics	Reverse cryonics	2040
4	Biogerontology	Cryonics	Cryonics	2044
5	Biogerontology	Life extension	Anti-aging drugs	2034
6	Biogerontology	Life extension	Genetic engineering	2038
7	Biogerontology	Life extension	Life extension	2044

- Start unpredictable manage and organize the process of creating and applying technology.

- Start addressing critical condition Health Emergency as national and international issues.

It also means that we must:

- Health technology supports current and future outlook of the future of our health care.

- Distinct and promising areas to define health technology research.

- Show that the rising costs of health care and health-oriented technology can be stop or reduced by a new allocation of R & D resources.

- Define Fruitful areas for research and development that have the impact on health and health care.

- Identify new technologies and applications that are essential to health and wellness.

### Reliability

Over the years, IT has become the backbone of business to the extent that in many cases work is impossible without it. As a result of its increased role of merchandising, IT function is changing and it is transforming from

technology provider into strategic partner.

IT Governance Institute suggests that "fundamentally, two things are related IT Governance: IT adds business value and reduce risks." This IT governance leads to four main focus areas, all of which are determined by the value of the beneficiary. Two of them are add value and reduction of risk that are results and two other are strategic alignment and measurements of performance that are stimulant. As noted Van Grembergen [14], while the increase of value is focused on creating business value, risk management focuses on the market value.

In this section first the control objectives for information and related technologies (COBIT) are explained. Then IT BSC with a particular focus on strategic alignment and performance measurement is demonstrated as a supportive mechanism for the development of IT governance within an organization.

**Control objectives for information and related technologies (COBIT):** COBIT designed to help IT governance with understand and manage the risks and benefits related to information management and related technologies.

**Table 5.** Treatment schedule

No	Areas	Plan	Technology	Year
1	Treatments	3d printers	3d-printed drugs	2020
2	Treatments	3d printers	Personalized medicine	2028
3	Treatments	3d printers	3d printers	2038
4	Treatments	Anti-aging stem-cell treatments	Stem-cell treatments	2020
5	Treatments	Anti-aging stem-cell treatments	Prenatal gene manipulation	2024
6	Treatments	Anti-aging stem-cell treatments	Gene therapy	2034
7	Treatments	Anti-aging stem-cell treatments	Anti-aging stem-cell treatments	2044
8	Treatments		Bioelectronic drugs	2034
9	Treatments		Enterotype treatments	2040
10	Treatments		Nanocomposite drug carriers	2040

**Table 6.** Regeneration schedule

No	Areas	Plan	Technology	Year
1	Regeneration	Synthetic & artificial organs	Synthetic blood	2020
2	Regeneration	Synthetic & artificial organs	Tissue regeneration	2024
3	Regeneration	Synthetic & artificial organs	Artificial vascular system	2028
4	Regeneration	Synthetic & artificial organs	Artificial muscles	2034
5	Regeneration	Synthetic & artificial organs	3d printed organs	2038
6	Regeneration	Synthetic & artificial organs	Artificial general-purpose cells	2038
7	Regeneration	Synthetic & artificial organs	Artificial limbs	2040
8	Regeneration	Synthetic & artificial organs	Artificial retinas	2044
9	Regeneration	Synthetic & artificial organs	Synthetic & artificial organs	2044

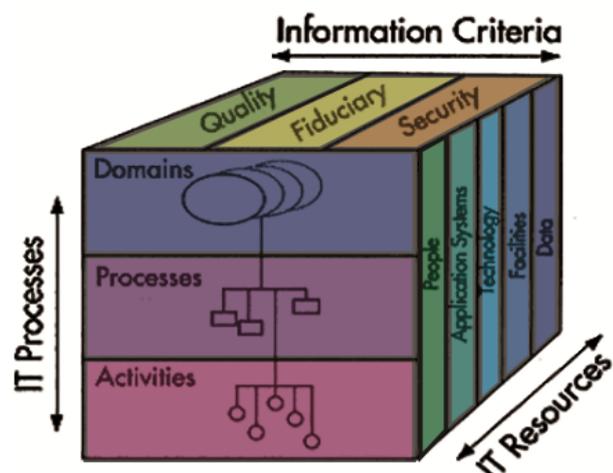
COBIT is independent from platforms adopted in an organization, and it is standard for control over information technology developed and upgraded by the IT Governance Institute. COBIT is designed to help three distinct audiences:

1. Managers, who must often unpredictably adjust their risks in IT environment and control the investment.

2. Users, who need to ensure about security of IT services used to deliver their products and services to internal and external customers.

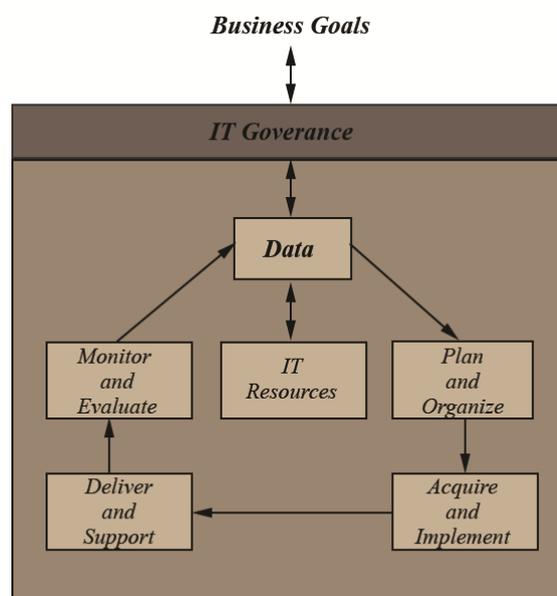
3. Auditors, who can use COBIT to prove their opinions and / or provide recommendations on internal controls management.

**COBIT framework:** Conceptual framework of COBIT can be considered from three points of view can be considered: (1) IT processes, (2) information standards and (3) IT Resources. These three aspects are presented in COBIT cube and are shown in figure 3.



**Figure 3.** COBIT cube

**IT processes:** This framework recognized 34 processes divided into 4 domains. The relation between these domains are shown in figure 4. Also, this framework presents high-level approach to control these processes with 318 detailed control objectives and audit guide to assess the IT processes.



**Figure 4.** COBIT domains

Four main domains of IT processes are:

1. Plan and Organize, this domain covers strategies and tactics and is associated with the identification of the way IT can best contribute to achieving business goals. In addition, the realization of the strategic vision should be programmed, communicated and managed for different views. Finally, the appropriate organization and technical infrastructure should be placed in their own places.

2. Acquire and Implement, for the realization of the strategy of IT, IT solutions need to be identified, developed, implemented, Acquired and be integrated in business processes. In addition, this domain should cover changes in the systems and maintaining existing systems to ensure that the life cycle of these systems is continuous.

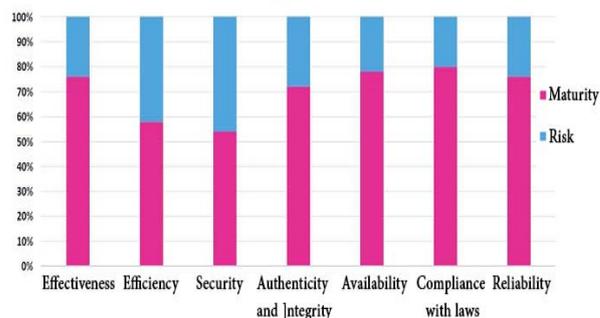
3. Deliver and Support, this domain is associated with the actual delivery of required services, which its range is extensive from traditional operations over security and continuity aspects to training. Also, the necessary support processes must be established to deliver services. This domain encompasses the actual data processing by software system which are often classified as the controls of software.

4. Monitor and Evaluate, all IT processes should be evaluated on a regular basis over time in terms of quality and compliance with control requirements. So this domain to neglect the management of the organization control process and independent assurance provided by internal and external auditors or obtained from alternative sources handle.

**Information criteria:** COBIT considers quality requirements and safety control of commercial companies and suggests 7 information criteria that will be used for general definition of IT in the field of business.

- Effectiveness: information is related to trade and should be delivered in suitable, correct, consistent and usable manner.
- Efficiency: the provision of information through the optimal use of resources
- Confidentiality: Protecting sensitive data against unauthorized disclosure
- Integrity: The accuracy and completeness of the information.
- Accessibility: information exists now and in the future, whenever it is needed.
- Compliance: Compliance with laws, regulations and contractual arrangements.
- Reliability: Provide appropriate information for managers to fulfill their responsibility of financial reporting and adapting.

The previous information metrics provide a general method for identifying business requirements. In Fig 5, the rate of maturity and risk caused by the organization's deviation from business goals is shown for each criterion.



**Figure 5.** Risk and Maturity evaluation based on COBIT and BSC

**IT Resources:** COBIT framework defines 5 class for IT resources:

- Data objects in the broadest sense (text, shape, sound).
- Software systems: manual and programmed procedures.
- Technologies: hardware, operating systems, middleware, networks, databases, multimedia.
- Features: environmental resources, including electricity, buildings and water.
- people: employees, skills and productivity apps

**IT Balanced Scorecard (BSC):** Kaplan-Norton [15] have introduced Balanced Scorecard (BSC) at an enterprise level. The idea is that the assessment should not be limited to traditional financial evaluation and should be completed with the usual measures of customer satisfaction, internal processes and ability to innovate. BSC have been mainly used in evaluation of the performance of IT and its processes [16]- [19]. Accepting the fact that IT is internal service provider, the present work confirms that the balanced scorecard approach should be changed based on the following perspectives: the role, orientation client, operational

excellence and future orientation. These perspectives are shown in figure 6.

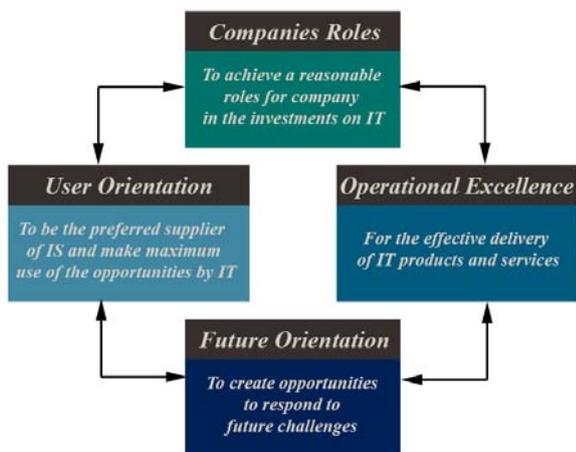


Figure 6. Perspective of IT BSC

In the Fig7, the aggregation of the status of business goals is presented in four areas of the BSC. From the COBIT perspective, the goals of a business organization can be categorized under BSC framework. Accordingly, each BSC criteria includes a number of business goals and can fulfill through them. In this Figure, the maturity and risk indicators for each domain are calculated and presented. Also, the maturity and risk of the organization from the BSC methodology perspective calculated and listed.

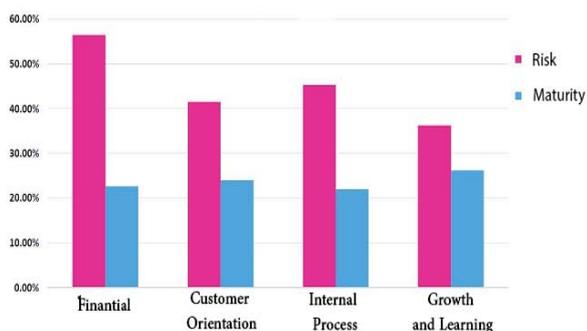


Figure 7. Risk and Maturity evaluation based on COBIT and BSC

**Risk Model:** Risk model helps organizations manage risk while managing their business. This model has been formed from a set of guiding principles and risk management process.

Risk model will support the following

principles:

- Continuous assessment of risks
  - Integrate risk management in every role and every function
  - Positive approach to risk identification
  - Use risk-based schedule
  - Create an acceptable level of formality
- The risk management process is provided in figure 8.

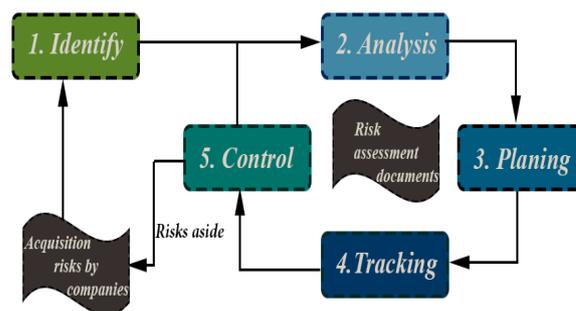


Figure 8. Process of risk management

Risk management steps are as follows:

- 1) Identify: Determine the source of risk, failure modes, conditions, consequences, business results and operating results.
- 2) Analysis: Determine the risk and its impact and use this information to calculate exposure levels to help rank risks relative to each other.
- 3) Planning: Determination of styles that entirely prevent from the risk, it will transform risks to other parts or reduce the effect of risk.
- 4) Tracking: collect information on how to modify risk factors over time.
- 5) Control: implementation of the planned response against specific changes.

To achieve a reasonable role in the investments on IT in company.

### Discussion

IT organizations are increasingly using IT and IISM and no doubt that this trend will continue. In our opinion, in HIT road map maturity, risk, and reliability of HIT system can be achieved by expanding the concept of a public BSC assigned to business goals (BG),

IT goals (ITG) and the architectural framework of the COBIT. Such an analysis of the objectives of the strategic alignment and provide powerful auditing capabilities for IT managers. The use of COBIT with BSC method simultaneously was demonstrated as novel tool for analysis and evaluating the maturity, risk, and reliability in order to align with business goals during the service-oriented approach and it will be key to success in IT management.

### Conflict of Interests

Authors have no conflict of interests.

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