Measuring the Value of Information Technology – A Framework

Navneet Bhushan
Wipro Technologies
53/1, Hosur Road, Madivala,
Bangalore 560068, India
http://www.wipro.com
Emails: navneet.bhushan@wipro.com

Abstract

Over the years there has been an increasing call for understanding, measuring and managing value of IT in the overall business context. Increasing adoption of IT with its ever expanding influence on what the enterprises can do with new technological pieces has increased the value of IT to such an extent that most enterprises now regard IT as central to their business strategy. However, in the world driven by measurement and quantitative financial benefits, value of IT has remained in the realms of perception. The problems lie in a not so overt connection between IT adoption and direct business benefits. This paper describes a framework for measuring the impact of various IT initiatives using the well-established balanced score card (BSC). Since IT measurement has expanded into measuring IT value and alignment with enterprise vision the framework described here uses the Analytic Hierarchy Process (AHP) to establish the linkages between IT initiatives and enterprise vision as reflected in the BSC. Further there is a need to include judgments of multiple stakeholders for which this framework provides a structured approach for generating consensus.

Introduction

Information Technology (IT) metrics in the enterprises are now shifting from operational metrics to value measures coupled with measures for alignment with the business objectives. This shift is driven by a growing demand for IT transparency. Further, since IT is becoming one of the fundamental pillars if not the only one, to execute business strategy, it is imperative that IT should be measured for its contribution to business value. Combine this demand with a growing trend of Enterprise measurement on other dimensions besides the financial dimension alone – this translate into an immediate need for measuring the value of IT on the Enterprise as a whole. Existing metrics are based only on operational benefits thereby lead only to IT impact on cost savings or market reach. For a holistic view, metrics need to include impact of IT on Enterprise's customers and employees. Customers and employees are the two clear influencers of profit that an enterprise will be making in future. Even if in the current scenario, the enterprise may be ahead of its competition, it is not necessary that it will continue to remain so. To maintain its lead, enterprises have to invest in its people and how they bring more value to the customers. If in the current scenario, an enterprise is lagging behind, it can leapfrog its competition by improving its employee's capabilities or increasing the type or quantum of value that it adds to its clients.

In Section 2 a brief description of Balanced Score Card (BSC) is given. In Section 3, the problem areas and issues regarding multiple stake holders are described. Section 4 gives step by step description of the framework. An application of the framework is described in Section 5. Lastly in Section 6, possible applications and further pointers for research are provided, which also summarizes the findings.

2. Balanced Score Card

Kaplan and Norton's four performance perspectives for an enterprise are well-documented [3]. It is explained that a properly constructed Balanced Score Card be able to explain the company's strategy. As against the traditional performance evaluation which is based solely on financial metrics, balanced scorecard (BSC) propose a more comprehensive method that covers Customers, Innovation, Learning and Growth of employee, and the business processes of the Enterprise. Having these four perspectives,

managers can translate strategies into specific measures that can monitor the overall impact of the strategy on the enterprise. The goals and measures in each perspective are extracted from the enterprise strategy [3-5].

3. Incorporating Multiple Stakeholders – Enterprise Strategic Vision

Large organizations with distributed and delegated leadership spread across geographies require that the framework for strategic analysis should provide a capability to incorporate multiple perspectives. These multiple perspectives may be based on sound logical reasoning, deep experience of the leaders or insight or intuition based on comprehensive analysis. Whatever be the source, often these perspectives are based on strong egos of their proponents. It is imperative that the framework for understanding what is collective enterprise strategic vision should be able to incorporate these strong, often conflicting view points of strong leaders who all may be correct at the same time. Hence there is a need to create a consensus on the strategic vision of multiple stakeholders to propel the enterprise further ahead.

4. The Framework

The framework for measuring IT value uses the methodology of Analytic Hierarchy Process (AHP) at various levels. The methodology incorporates inputs from multiple experts at all levels. Due to its robustness and flexibility the AHP is best suited to incorporate consistent multiple views and judgments for measuring IT Value. It also helps create a consensus amongst various stakeholders. A brief overview of the AHP is given in Section 4.1. In Section 4.2, the framework steps are explained.

4.1 Analytic Hierarchy Process (AHP)

The AHP [1, 2] provides a means of decomposing the problem into a hierarchy of sub-problems which can more easily be comprehended and subjectively evaluated. The subjective evaluations are converted into numerical values and processed to evaluate each alternative on a numerical scale. The detailed methodology of AHP is as follows:

- Problem is decomposed into a hierarchy of categories and parameters.
- Data is collected from experts corresponding to the hierarchic structure, in pair-wise comparison of alternatives on a qualitative scale. Expert can rate the comparison as equal, marginally strong, strong, very strong or extremely strong. The comparisons are made for each criterion and converted into quantitative numbers on a 9 point scale.
- The pair-wise comparisons of various criteria generated at step 2 are organized into a square matrix. The diagonal elements of the matrix are 1. The criteria in the ith row is better than criteria in the jth column if the value of element (i,j) is more than 1; otherwise criteria in jth column is better than criteria in ith row. The (j,i) element of the matrix is reciprocal of (i,j) element.
- The principal eigen value and the corresponding right eigen vector of the comparison matrix gives the relative importance of various criteria being compared. The elements of the normalized eigen vector are termed weights with respect to the criteria or sub criteria.
- The consistency of the matrix is then evaluated. Comparisons made by this method are subjective and AHP tolerates inconsistency through the amount of redundancy in the approach. If this consistency index fails to reach a required level then answers to comparisons may be re-examined. The consistency index, *CI* is calculated as

$$CI = (\lambda_{max} - n)/ (n-1) \qquad (1)$$

  Where, λ_{max} is the maximum eigen value of the judgment matrix and n is the order of the matrix. This *CI* is compared to that of a random matrix, *RI*. The ratio derived, (*CI /RI*) is termed the consistency ratio (CR). It is suggested that the value of CR should be less that 0.1 [1, 2].
- The ratings of each alternative is multiplied by the weights of the sub-criteria and aggregated to get local ratings with respect to each criterion. The local ratings are then multiplied by weights of the criteria and aggregated to get global ratings.

4.2 IT Value Alignment with Enterprise Vision

- STEP I: Relevant Enterprise Scorecard metrics related to top level parameters of - Financial Results, Customer, Business Processes and Employees Innovation, Learning and Growth are identified. For example, a representative list may be as shown in Table 1.

Table 1: High Level Balanced Score Card Metrics

Financial	Business Processes	Customer	Employee
• Existing Revenue Stream • New Revenue Stream • Cost of doing business	• Process Efficiency • Process Speed • New Process Development/Deployment	• Access to Enterprise • Customer Experience and Enterprise Responsiveness	• Innovation, Learning and Growth

- STEP II: Organize the BSC metrics as pair-wise matrix and invite relative priorities from multiple stakeholders in the designed formats. These are qualitative comparisons. Using the AHP convert these inputs into relative quantified weights.

- STEP III: CIO collects information for all IT initiatives planned for the year. These are the initiatives planned for the year and may be proposed by various departments. There can be some specific centralized initiatives as per CIO yearly plans.

- STEP IV: For each of the metrics identified in BSC (Step I), carry out a relative comparison of each of the initiatives using the pair-wise qualitative comparisons. This will generate a relative impact of each of Initiatives on each of the metrics.

- STEP V: Synthesize the relative impacts of each of the initiatives on all metrics to compute the relative business value of each initiative.

- STEP VI: For each initiative, there are two more parameters that need to be evaluated for the purpose of relative prioritization besides the Business Value. These are Urgency and Enterprise readiness. It is quite possible that despite a particular initiative adding large business value, enterprise may not be ready for the due to variety of reasons. Similarly, the urgency of funding a particular initiative may not be much despite it being added business value. Each initiative is also evaluated in terms of Enterprise readiness and Urgency using the AHP methodology.

- STEP VII: Each initiative is evaluated on relative business value, relative urgency and relative enterprise readiness. These evaluations are combined to get the relative value of each IT initiative.

- STEP VIII: Once the initiatives are chosen, developed and deployed, their effects on the relevant BSC metrics is evaluated further with the questions now inverted in terms of what has been the impact on the BSC metrics.

In the next section, an example will illustrate the framework and its usage in measuring value of IT.

5. A Hypothetical Case study

Let us consider a large global enterprise which has been investing millions of US Dollars year on year on multiple IT initiatives. Before the start of each year the CIO gets requirements for IT projects/ initiatives from various groups within the enterprise. The CIO's department as per the feasibility and prioritization

choose the relevant initiatives for that particular year and allocate available funds for the projects. There may be many initiatives that CIO's department generates. These are also considered as the central pool of initiatives to be considered. Over the years it has been observed by the CEO's as well as the board that the cost of IT is increasing rapidly. Once the initial euphoria of a new IT system dies, the cost and problems associated in managing and maintaining increases. Further, it is not clearly understood (meaning quantified) what value the IT system has added. Since the enterprise is measured on the revenues and profits, it is imperative that the value of new IT spending be measured and IT initiatives aligned with the Enterprise business metrics.

5.1 Using the Framework

Let us assume that there are three main stakeholders – the CEO Office, the office of Chief Sales/Marketing Officer, and the office of Chief Technology Officer who looks after R&D as well. The group decides to track following parameters as their key metrics in the BSC:

- a) Existing Revenue Streams
- b) New Revenue Streams
- c) Cost of Doing Business
- d) Business Processes
- e) Customer's Access to Enterprise
- f) Customer's Experience and Enterprise's responsiveness
- g) Employee Innovation, Learning and Growth

Pair-wise comparisons are invited from all relevant stakeholders in terms of these metrics. The key question being asked is how much relative importance the stakeholder assigns to one metric compared to other for the year ahead. The format for asking these questions in a pair-wise matrix form is shown in Figure 1. The illustration is that of an AHP tool created and customized to enable easier pair wise comparisons and mask the eigenvector computations. For example, cell C8 compares Existing Revenue Stream with New Revenue Stream. The CEO believes Row is Marginally Important (Row MI), i.e., Existing Revenue Stream has been given marginally higher emphasis then generating new revenue stream.
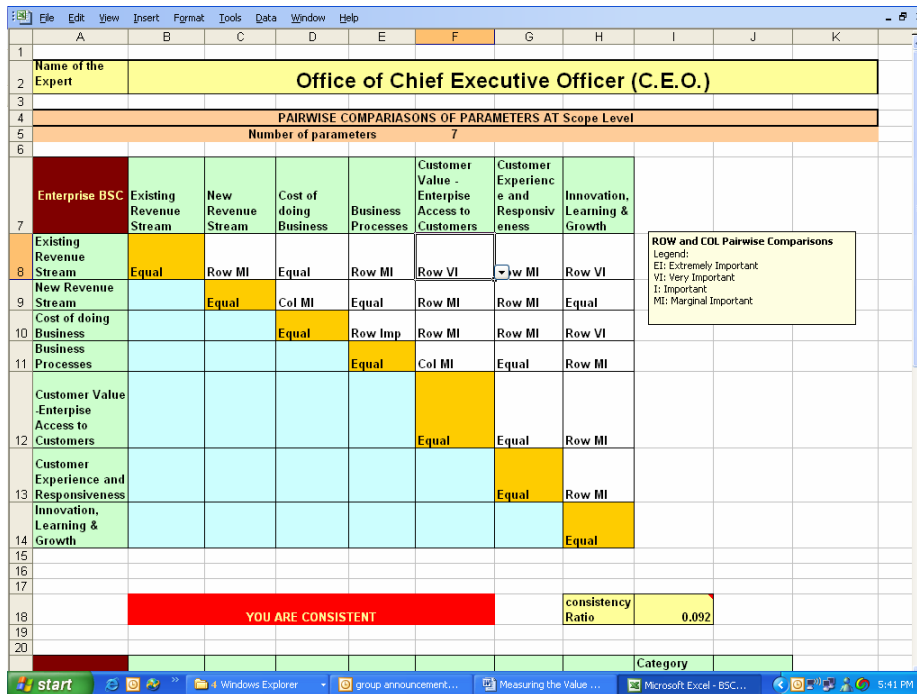

Figure 1: BSC Metrics relative prioritization obtained as Qualitative inputs

These qualitative inputs are converted into relative quantitative weights through the process of AHP as described in Section 4.1. The computation results are shown in Figure 2. As one can see the MS Excel based tool automatically converts the inputs of the C.E.O. into relative weights. Further it gives a self-check for the C.E.O. to evaluate her consistency.

Figure 2: Relative prioritization obtained as quantified weights

Similar inputs are obtained from the Sales and Marketing and CTO offices. These are shown in Table 2. The problem is that despite each one of them being consistent there is no consensus amongst them. The Kiviat charts shown below for CEO, CMO and CTO depict the relative differences in prioritization. The CEO is completely focused on Existing Revenue Stream (ERS) and Cost of doing Business (COB). The CMO needs the enterprise to focus on New Revenue Streams as well customer metrics while focusing on Existing Revenue Streams. However, the CTO need the Enterprise to look at New Revenue Stream and Customer metrics. To get a consensus view – a normalized geometric mean of the three inputs is taken. This gives the emergent consensus view. The Kiviat Chart shown in Figure 4 shows the consensus view of CEO, CMO and CTO. As the final part of this step, all the stakeholders are shown the computations and relative weights obtained. As per the discussions, a final view of the relative weight of each metric is considered for proceeding further.

It is evident that the management has decided this year's main focus is on new revenue streams (21.1%) generation besides maintaining existing revenue streams (20.3%). Further they believe that Customer Experience and Enterprise Responsiveness (17%) and Cost of doing business (16.8%) are two other metrics that the enterprise should focus on this year. Further, they believe that Enterprise access to customers is also an important metric (12.8%), to be considered this year.

Table 2: Creating consensus amongst various stakeholders

| BSC Metrics	C.E.O.	C.M.O.	C.T.O.	Geometric Mean	Final Weights
Existing Revenue Stream (ERS)	0.299	0.225	0.087	0.180	0.203
New Revenue Stream (NRS)	0.121	0.225	0.241	0.187	0.211
Cost of doing Business (COB)	0.283	0.075	0.157	0.149	0.168
Business Processes (BP)	0.080	0.028	0.035	0.043	0.048
Enterprise Access to Customers (EAC)	0.093	0.209	0.075	0.113	0.128
Customer Experience and Enterprise Responsiveness (CEER)	0.081	0.209	0.203	0.151	0.170
Employee Innovation, Learning & Growth (E-ILG)	0.043	0.029	0.203	0.063	0.071
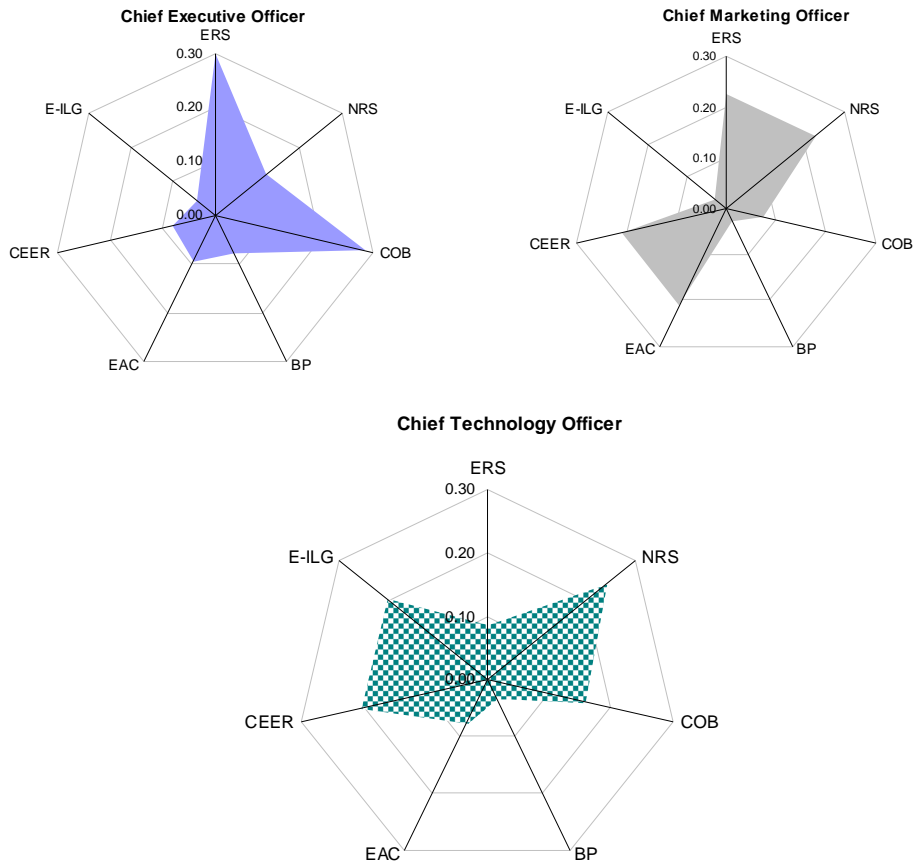
Figure 3: Kiviat Charts of BSC weights by Top Leadership
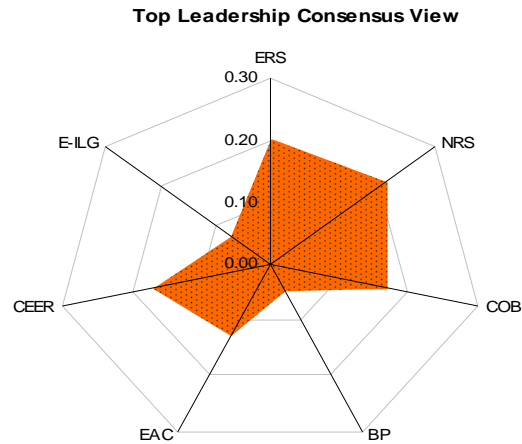
Top Leadership Consensus View

Figure 4: Consensus View of BSC weights by Top Leadership

After obtaining the enterprise priorities for the BSC metrics, the CIO looks at various IT initiatives that have been obtained from various departments as well as the central initiatives. Let us say, there are 7 initiatives planned in the current year – (a) Mobile Access to Enterprise Systems, (b) Online Booking/Auction Site Development, (c) BI/DW Server Farms, (d) Application Maintenance, (e) Specific R&D Application Development, (f) Field Force Applications Development and (g) Patent Mining and Analysis Application. All these initiatives are evaluated on each of the BSC metrics from the point of view of their impact on the metric. These impacts are computed relative to each other for all the projects using the AHP. For example the MS Excel format for existing revenue stream is shown in Figure 5.

Figure 5 Relative Impact of each of the IT Initiative on Existing Revenue Stream

Table 3 provides the relative impact of each project on the BSC metrics. These are combined with the relative weights of BSC metrics obtained in Table 2 to compute relative value of each IT initiative.

Table 3 Relative Business Value for each IT Initiative

	ERS	NRS	CoB	BP	EAC	CEER	E-ILG	
Rel. Weight from Table 2	0.203	0.211	0.168	0.048	0.128	0.170	0.071	
IT Initiatives Alignment	**ERS**	**NRS**	**CoB**	**BP**	**EAC**	**CEER**	**E-ILG**	**Rel. Biz Value**
Mobile Access to Enterprise Systems	0.242	0.105	0.299	0.498	0.026	0.094	0.067	0.170
Online Booking/Auction Site Development	0.223	0.052	0.121	0.087	0.095	0.096	0.100	0.116
BI/DW Server Farms	0.137	0.065	0.283	0.118	0.086	0.098	0.069	0.127
Application Maintenance	0.189	0.087	0.080	0.040	0.204	0.103	0.067	0.120
Specific R&D Application Development	0.069	0.199	0.093	0.102	0.308	0.354	0.060	0.180
Field Force Applications Development	0.069	0.173	0.081	0.087	0.065	0.128	0.060	0.103
Patent Mining and Analysis Application	0.073	0.320	0.043	0.069	0.216	0.128	0.578	0.183

As one can see from Table 3, relative business value of Patent Mining & Analysis Application (18.3%) and Specific R&D App Dev (18%) are the two top most IT initiatives that has come out in the analysis. Mobile Access to Enterprise Systems (17%) is a close third. Interestingly BI/DW Server farms (12.7%) and application maintenance (12%) comes out to be quite close in relative business value.

As is usually the case, it is impossible to carry out all the initiatives simultaneously in a specific year due to budget and/or resource constraints. The Enterprise should prioritize based on the business value as well as two other factors which are – Relative Urgency and Enterprise Readiness [1]. Once again for urgency and Enterprise Readiness pair-wise comparisons are obtained for all IT Initiatives. Further relative importance of Business Value obtained from Table 3 as well as Urgency and Enterprise readiness are also estimated. The final computations giving the final relative rating of IT initiatives using the Business Value, Urgency and Enterprise readiness is shown in Table 4.

As one can see, taking the urgency and enterprise readiness into account, Patent mining and analysis application relative score has increased to 33.7%. Further, the Mobile access to enterprise system has now a higher relative score of 15.7% compared to Specific R&D Application (12.2%). This indicates that from the urgency and enterprise readiness point of view Mobile access is of more relative importance than the R&D application. The framework is adaptable to variety of such tradeoff analysis, that the CIO typically faces in responding to relative prioritization of IT Initiatives.

Table 4: Relative Score of IT Initiatives

Relative Importance of Parameters	0.5	0.15	0.35	
IT Initiatives Alignment	**Relative Enterprise BSC Index**	**Urgency**	**Enterprise Readiness**	**Relative Value Score**
Mobile Access to Enterprise Systems	0.170	0.327	0.067	0.157
Online Booking/Auction Site Development	0.116	0.099	0.100	0.108
BI/DW Server Farms	0.127	0.084	0.069	0.100
Application Maintenance	0.120	0.071	0.067	0.094
Specific R&D Application Development	0.180	0.071	0.060	0.122
Field Force Applications Development	0.103	0.062	0.060	0.081
Patent Mining and Analysis Application	0.183	0.286	0.578	0.337

Kiviat chart shown in Figure 6 depicts the relative score of all the IT initiatives with respect to Business Value, Urgency and Enterprise Readiness to absorb the IT initiative. One can clearly see the relative value of each of the IT initiatives to the Enterprise.
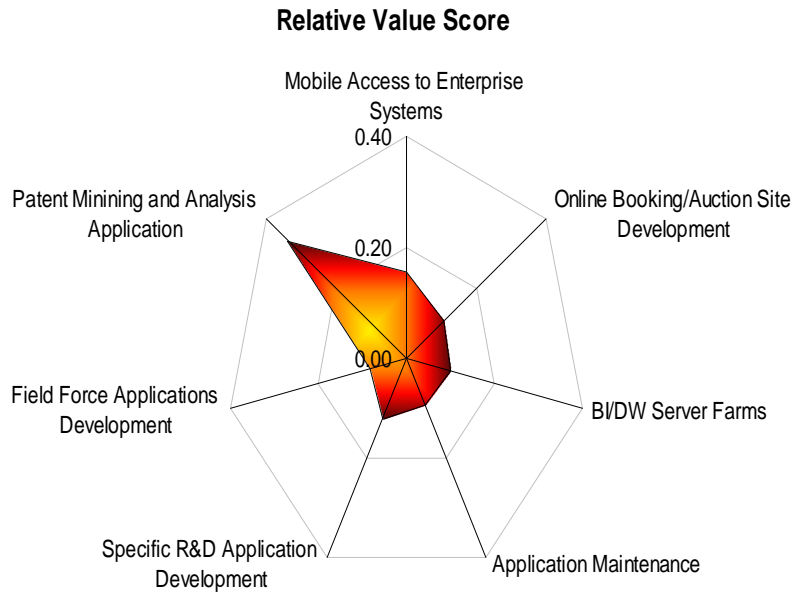

Figure 6 Relative Value Score of IT Initiatives

6. Conclusions

A framework to measure value of Information Technology initiatives in an Enterprise setting is described in this paper. The basic elements of the framework are based on the Balanced Score card as the fabric on which Enterprise can create its strategic direction and initiatives. Further Analytic Hierarchy Process (AHP) as a means to align IT initiatives and evaluate its impact on various enterprise metrics, is proposed as the basic methodology at various levels of the framework.

This framework is generic enough to be deployed and used by enterprises of any scale – SME to large global organizations. Further it can be adapted to evaluate the IT initiatives and their impacts on enterprise strategic performance.

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