December 2004

# Methodology To Determine Security ROI

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## ABSTRACT

This study explores the vast Information Technology (IT) payoff literature to develop a methodology for assessing the impact of IT Security Tools and Products (STP). Lack of methodologies to assess impact of investment in STP's, has forced investments to be mostly driven by regulations or by the Fear, Uncertainty and Doubt factor (FUD factor) and not by the results of a cost-benefit analysis. STP's create intangible assets such as increased protection of database, increased customer confidence etc. Lack of measures for measuring these intangibles provides a challenge for assessing the value of investment on IT STP's. The current work explores past IT payoff literature for methodologies used in assessing the impact of IT investments. In this light, we present a Complementarity Based First-Order Effects (CoBFOE) approach to determine the benefits of security investments based on Barua et al.,'s (1995) Business Value Complementarity (BVC) model. An illustration of how CoBFOE approach could be used in an organizational setting is also discussed.

## Keywords

Return On Investment, IT payoff, information systems security, computer security

## INTRODUCTION

International Data Corporation (IDC) predicts that spending on Information Technology (IT) security and business continuity will jump from $ 66 billion in 2001 to $ 155 billion in 2006 (Scmagazine.com). This increase amounts to about 40 to 50 % compound annual growth rate mainly due to the increased web-presence of industries and the threats exposed because of the vulnerable infrastructure. Some of the factors driving the increasing investment in security are new government and industry regulations, auditing, risk management issues, and customer trust issues (Bishop, 2003).

Investments in IT Security Tools and Products (STP) have been driven mostly by regulations or by the Fear, Uncertainty and Doubt factors (FUD factor). Investments in security have no apparent direct financial rewards to the user. They prevent the losses due to breach of security. But the rewards because of these preventions show up in many intangibles such as increase in protection of database, increase in system integrity and increase in customer confidence. Lack of measures for measuring these intangible provides a challenge for assessing the value of IT security investment.

An exploration of the vast IT payoff literature is useful in determining a method for assessing the impact of STP and how organizations can use it for assessing the impacts of STP. This leads to an examination of the characteristics of the domain of study (STP) and an explanation as to why the present measures of assessment cannot be used. Finally an exploratory set of analysis on how investment in STP can be assessed using our Complementarity Based First-Order Effects (CoBFOE) approach is proposed based on the BVC approach by Barua et al., (1995).

## PRESENT MEASURES USED FOR ASSESSING IT INVESTMENTS

A number of studies have investigated how to assess IT investments. IT investments can be classified into strategic IT investments (investments made with long term goals relating to competitive advantage), informational IT investments (investments made with medium term goals or improving management decision making) and transactional IT investments (investments made to reduce costs of doing business by substituting capital for labor) (Weill and Olson, 1989). Most researchers concur that while there are problems with defining costs associated with IT investments, the bigger challenge lies in defining or quantifying the benefits from those investments. Based on when IT payoff is assessed, the studies can be summarized in two parts, Pre-Investment Assessment and Post-Investment Assessment.

## Pre-Investment Assessment

Pre-Investment assessment techniques are used to evaluate the IT projects before investing, to decide on how much to invest, the feasibility of the project and to make a decision on whether to invest or not. Traditional tools for project evaluation include Internal Rate of Return (IRR), Net Present Value (NPV) and Real Option Analysis (ROA). The inadequacy of IRR and NPV to cope with the high uncertainty that characterizes most IT projects and the inability to take into account of the futuristic values created by IT projects, led to a shift to Option Pricing Models (OPM) (McGrath, 1997). Project evaluations using real options has been researched in depth since the 70's (Brennan and Schwartz, 1985). Research in IS also recognized the importance of utilizing the theory of irreversible investment under uncertainty to take advantage of the option like characteristic of IT project investments (Dixit and Pindyck, 1994; Kambil et al., 1993; Kumar 1996). Real Options are embedded in IT projects when it offers management the opportunity to take some future actions such as stopping, deferring, exploring, scaling, abandoning, outsourcing, leasing, compounding or growing the project (Benaroch, 2002). But further research has been limited to Black-Scholes (B&S) (Black and Scholes, 1973) model and its extensions that originated from the field of Finance. B&S assumes that the cost of the project is known with certainty. B&S has been used in the analysis of various IT projects like deployment of point-of-sale debit services, document image processing, adoption of SAP platforms and in e-business (Benaroch and Kauffman, 1999; Benaroch, 2002; Kulatilaka et al., 1999; Panayi and Trigeorgis, 1998; Scwhartz, 2003).

## Post-Investment Assessment

Once the benefits of an IT investment have been analyzed with the Pre-Investment analysis and the best choice for investment has been made, the IT investment becomes a strategic resource. One way to analyze them is as a strategic weapon that helps to secure competitive advantage by creating business value and increasing productivity. The majority of IT payoff studies in the past fall into this category. They assess the impact of IT on productivity and profitability after investment (Barua et al., 1995; Menon et al., 2000). These studies address three general questions - *what* is measured, *how* is it measured, and *where* is it measured? (Banker et al., 1993; Berger et al., 1988; Mahmood and Mann 1993)

In terms of *what* is measured, past studies propose that IT performance is associated with variables that transcend traditional measures and include measures of productivity, in addition to profitability. For example, a study by Roach (1987) compares the productivity of information and production workers in which he concludes that information worker productivity has neither declined nor has kept its pace with production workers. Loveman (1994) in his study on the productivity impact of IT in the manufacturing industry finds evidence of a positive impact. In his study on savings banks, Turner and Lucas (1985) conclude that there is an unexpected lack of relationship between organizational performance and resources allocated to data processing. One of the reasons for the equivocal results with IT payoff studies may be a lack of a consistent set of performance variables, thus the data source and the method of analysis have an effect on the IT payoff result (Brynjolfsson and Yang, 1996).

*How* IT payoff is measured is based on the duration of data collection and the process of IT investment. Some studies collected data at one time (Prattipati and Mensah, 1997), while others collected data over a period of time (Barua et al., 1995; Hitt et al., 1996; Menon et al., 2000). The duration of studies along with the number of firms studied, determines the sample size of the study. The measures in IT payoff literature can be classified into Productivity measures, Accounting/Financial measures and Expense based measures. Productivity based measures are used in studies measuring IT payoff in terms of productivity and performance. These measures are mostly used in studies involving the manufacturing, production and healthcare industries (Barua et al., 1995; Menon et al., 2000; Hitt et al 2000). Productivity measures include savings per product and savings per unit production hour. Accounting/Financial measures typically reflect past information, are not forward looking, are not adjusted for risk and are insensitive to the time lags necessary for realizing the potential of capital investments in IT (Bharadwaj et al., 1999). These measures are mostly used in studies involving financial performance and to quickly determine dollar figures in order to market specific products (Weill and Olson, 1989). Accounting/financial measures include Return on Investment (ROI), Return on Assets (ROA), Return on Net Worth and Sales by Total Assets. Expense based measures are used in studies measuring IT payoffs on IT investments made to reduce cost (Menon et al., 2000; Weill 1992). Expense measures include adjusted patient days, incremental firm performance and conversion effectiveness.

Prior studies have indicated that approaches for measuring IT payoffs differ with industries, which makes the answer for the question *where* is it measured, hard to answer. IT payoff measures differ with studies on the types of investment rather than with industries. As discussed above, irrespective of the type of investment or the type of industry, prior studies measured IT payoffs on their impact on productivity and its savings on expense. But the production-based approach lacks the ability to pinpoint where and how IT impacts are created, which makes it unsuitable for assessing the impact of STP's. Factors like management strategies and policies can mask the effect of value created by STP on the productivity figures. Shifting

radically from the production-based approach, Barua et al (1995) developed BVC approach which assumes that "IT investments should be first related to intermediate performance measures such as time to market, customer service response time, and extent of product mass customization rather than to high-level measures such as profitability" (Barua and Mukhopadhyay, 2000). This approach assumes that IT expenditures have to be converted into IT assets, which does not necessarily lead to improvement in productivity (Barua and Mukhopadhyay, 2000; Soh and Markus, 1995). These intermediate impacts could be measured instead of productivity or profitability.

## INFORMATION SYSTEMS SECURITY

Information Systems Security (INFOSEC) can be generally defined as ".. the protection of information, systems and services against disasters, mistakes and manipulation so that the likelihood and impact of security incidents is minimized" (Boran.com) Information Security consists of the three elements of CIA (Confidentiality, Integrity and Availability). Confidentiality issues arise when sensitive business specific information and processes are disclosed to an unauthorized person. Controls are required to restrict access to authorized personnel only. Privacy goes hand-in-hand with confidentiality. Integrity highlights the assurance that authorized personnel or processes are the ones modify information. Availability refers to the ability of authorized users to access the information when desired. Compromising the security of a business can lead to potential loss and damage (Archer et al 2001, Bishop, 2003).

Security planning for an infrastructure starts with a risk analysis, which determines a network's exposure to threats and potential harm. A risk analysis consists of identifying core assets and their values, identifying threats and vulnerabilities, assessing risk, evaluating current controls and performing a cost-benefit evaluation in order to choose the appropriate STP to fit the business need.

The primary goal of a STP is to provide a secure environment for conducting the business, to secure the data, and to increase the reliability of the business. While more firms have realized the importance of security, the assessment of the value of security has proven challenging due to the creation of ubiquitous intangible assets. Extending Barua et al's (1995) BVC model, information security could be viewed as a value creator that supports and enables business, rather than simply as a cost of doing business. Appropriate use of STP's can create a secure environment for information and transactions for the organizations as well as their partners.

STP's, which are a subset of IT, are not just products of IT. They also secure IT and expand to the whole infrastructures of the organization. This all-pervasive nature of STP makes it challenging to assess its benefits. Just like normal IT products such as email, Intranet or servers; the impact of security products on productivity or firm performance is also difficult to measure. Since STP's act as a business enhancer, their benefits such as increased security of information or data integrity, system availability, or increased customer confidence, doesn't directly reflect the productivity measures like product savings, operating revenue and inventory turnover as used in the literature. For example, increased system availability in turn may affect increased business opportunities, which might lead to increased sales and thus an increase in performance. It would be worthwhile to note the path from increased system availability and firm performance. These indirect impacts cannot be measured by the direct impact measures used in the past IT payoff studies.

In the following section we detail our efforts on taking cues from previous IT payoff studies to identify a set of appropriate measures to be used to assess the impact of STP's in both pre-investment and post-investment modes.

### Pre-Investment Assessment

Based on the classification of Weill and Olson (1989), investment in STP should be classified as a Strategic Investment, which is futuristic and when rightly invested can help in gaining a strategic lead and a competitive advantage in the industry. Just as other investments, investing in STP's also require appropriate cost based evaluation techniques to decide on the appropriate amount to invest and when to invest. Investing in STP's includes high cost uncertainty (as it involves change in costs due to some new threats or vulnerabilities during the project) and high cash flow uncertainty (due to the futuristic benefits flow of the investment). These peculiar characteristics of investment in STP's, are considered in the model developed by Schwartz and Zazoya-Gorostiza (2003), which helps in deciding on money to be invested and the option to invest or not. The model is based on the B&S model of ROA.

Investment in STP's, also includes the consideration of multiple options during investment. Not only due to the uncertain nature of investment, but also due to the ever-evolving threats and vulnerabilities, it becomes imperative to consider multiple options while doing the pre-investment evaluation. Benaroch's (2002) extended model of B&S, includes the multi-option scenario. Some of the options, which could be considered while doing a pre-investment assessment using Benroach's model, are to defer the investment, to explore the benefits, to stage the investment and to expand the investment. Further research in

this area is not dealt in this paper. We limit our efforts in this paper to develop a methodology for post-investment assessment of investment in STP's only.

Researchers from University of Idaho take a formula based approach for calculating the ROI of an Intrusion Detection System (Wei et al 2001). Similar to the productivity-based approaches in post-investment IT payoff literature, this model calculates direct dollar savings gained by stopping any number of intrusions through the introduction of an IDS, which in practice doesn't directly reflect the effect of increased security.

*Post-Investment Assessment*

As discussed before, the indirect impact of STP's on the productivity and profitability of the organizations leaves the past post-investment IT payoff measures like ROA and ROI useless. This leaves us the challenge of finding an effective way to assess post-investment effect of STP's. It is interesting to examine the methodology used by research studies and by insurance companies. Cavusoglu et al (2002), have used event study methodology to assess the impact of Internet security breaches on the market value of the breached firms. The breaches are a clear indication of the security level of that particular company's infrastructure. Their results show that the market responds negatively for major security breaches that also positively affect the security developers by providing incentive to develop new STP's to secure the infrastructure. The market might have reacted to a compounded effect of security breach in the organization with other factors such as loss of customer base, legal cases against the company.

Insurance companies like American International Group, Chubb, Lloyds of London and J.S. Wurzler, offer cyber-risk insurance policies to the additional risks firms face as a result of being a part of the digital economy. In designing these policies, insurance companies have addressed issues related to pricing, adverse selection, and moral hazard. Insurance pricing traditionally relies on actuarial data. Due to the relative newness of the Internet, present repositories of crimes and breaches cover only a short time span. The data collection process has also been hindered by fear associated with revealing details concerning security breaches. Due to the high uncertainty involved with calculating actuarial value of cyber-risk insurance policies, insurance companies have proceeded with less-credible pricing schemes for computing the premiums for cyber-risk policies (Gordon et al, 2003). The vice-president of e-business solutions at Fidelity and Deposit states, "These insurance products are so new, that the $ 64,000 question is: Are we charging the right premium for the exposure?" (Radcliff, 2001)
In light of the unsuitability of most of the prior measures used in post-investment IT payoff literature for assessment of investments in STP we propose the CoBFOE approach of post-investment assessment of investment in STP's based on the BVC approach by Barua et al., (1995).

The empirical research on complementarities focuses on production economics and business value (Brynjolfsson and Yang, 1996; Hitt et al., 1997). The BVC approach by Barua et al (1995) and Barua and Whinston (1998), suggests that investments in IT should be first related to intermediate, performance measures rather than to high-level factors such as profitability as in the past post-investment literature. Some of the intermediate measures quoted by Barua and Mukhopadhyay (2000) are time to market, customer service response time, and extent of product mass customization. Figure 1 depicts the generalized BVC model with complementarity relationships based on Barua et al., (1995).
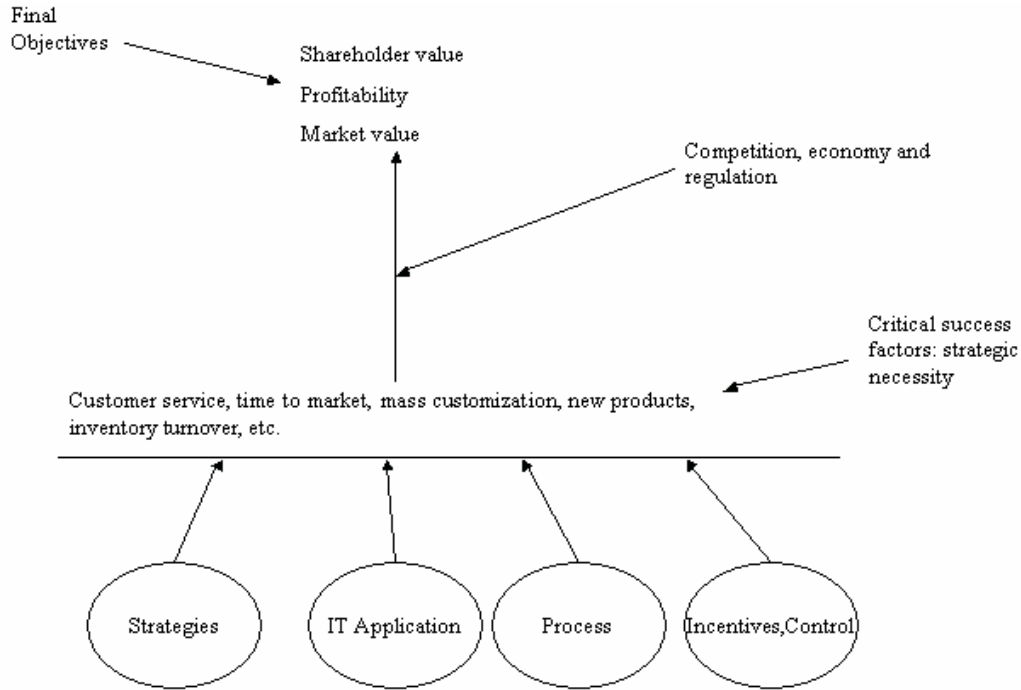
**Figure 1. A Generalized Business Value Complementarity Model (Adopted from Barua and Mukhopadhyay, 2000)**

BVC approach, which is pinned on the theme that complementarity exists at each level in the model, is the basis for our Complementarity Based First Order Effects (CoBFOE) approach. Critical success factors depicted in the model are the Intermediate Business Objective (IBO) on which IT application has a complementarity effect along with strategies, processes and incentives. Figure 2 depicts the skeleton of our first order model.

Barua et al., (2001) in their work on finding e-business drivers, classify the main Business Objectives (BO) of a company into customer-oriented objectives, supplier oriented objectives and internal oriented objectives. Customer-oriented objectives for an online company include customer attraction, customer satisfaction and better customer service. BO's form the top of our model. These BO's stay common for the three type of companies; brick and mortar (e.g., businesses like Subway, TacoBell with very low revenue generated from their Interent operations); click-mortar (e.g., businesses like Barnes & Nobles, Wal-Mart which have both traditional and internet customer bases and depend on both traditional and Internet operations for their revenue) and dot-com companies (e.g., Ameritrade, Ebay whose business model relies solely on their Internet operations).
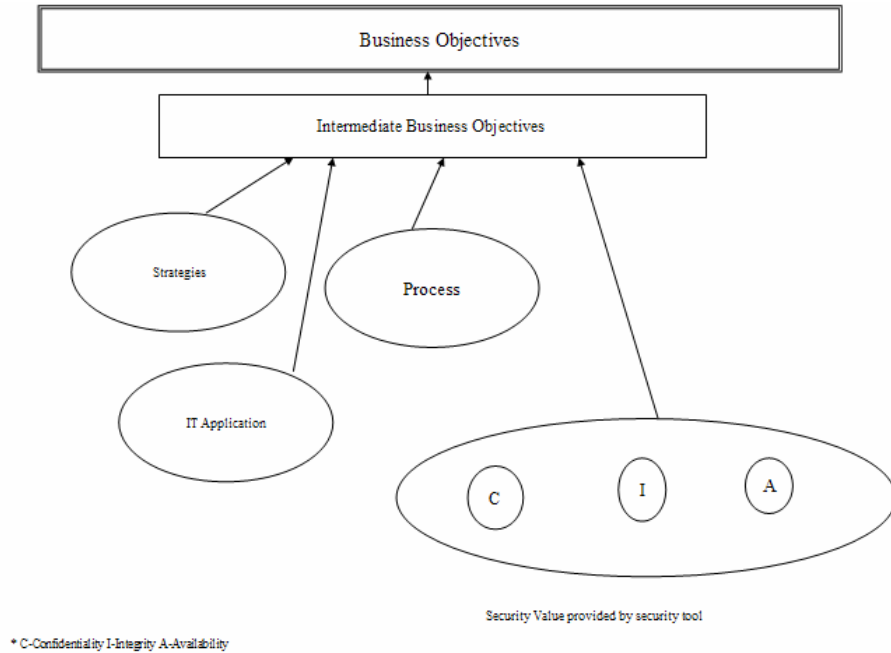
**Figure 2. Building Block of Complemantarity Based First Order Effects (CoBFOE) Approach**

Various IBO's should be realized to attain each of the above BO's, which also differ according to the type of company. These IBO's also complement each other in their contribution towards an intended business objective. For example, an online store should realize the intermediate objectives of appealable systems, better customer service and better marketing strategy, to increase their customer oriented BO of increasing their customer base.

A high level of complementarity can also be seen among the low-level factors like strategies, processes, IT application and the security value provided by the STP, on their impact on intermediate business objectives. Their effect on the IBO's then complement other IBO's to affect the high-level business objective which contributes to the overall productivity and profitability of the organization. The complementarity effect of the low level factors differs between the IBO's. For example, the security value provided by the installation of a secure transaction system in an online trading company may have little effect on the IBO of a better marketing strategy for increasing the customer base, but the increased security level may have a much higher effect on improving customer trust on the payment system which in turn affects the business objective of increasing the satisfaction level of customers.

The security value provided by a STP can be assessed by the level of value it creates towards the three main components of security; confidentiality, integrity and availability. Each of the IBO's would require a different level of security depending upon its involvement with customer data, Internet etc. For example, the IBO of providing an appealable system would require a security product, which emphasizes the level of confidentiality and availability; whereas an IBO of increasing the trust of the transaction system would require a security product, which emphasizes confidentiality, integrity and availability. Thus, the impact of a STP on an IBO can be analyzed though the level of value it creates on improving Confidentiality, Integrity and Availability of the system. The impact of the value created by the STP in complementarity with other factors, on the IBO's can be measured by various operational excellence measures and financial measures of that business objective. For example, some of the operational excellence measures for the BO of increased customer satisfaction may be percentage of returned goods and percentage of satisfied customers. Some of the financial measures for the same BO may be revenue per transaction and revenue saved from litigation fees against fraudulent transactions. This could help in deducing the approximate ROI of the STP rather than the productivity and profitability measures used in the past literature. Table 1 lists the steps to be followed in determining the ROI of a STP using the CoBFOE approach.

| Steps to be followed during the CoBFOE approach |
|---|
| 1. Identify the type of company |
| 2. Identify the customer oriented, supplier oriented and internal Business Objectives (BO) |
| 3. Identify operational excellence and financial measures for each of the BO's. |
| 4. Identify the various Intermediate Business Objectives for each of the BO's |
| 5. Identify the low level factors associated with each of the IBO's |
| 6. Map the flow between various BO's |

**Table 1. Steps to be followed to determine the ROI of a STP using CoBFOE approach**

## ILLUSTRATION OF THE COBFOE APPOACH

In this section, we detail the use of the steps to be followed during the CoBFOE approach (as listed in Table 1) to identify the ROI of installing a STP to increase the security level of transaction in a dot-com company such as Ebay. Customer-oriented BO's for Ebay could include customer attraction, customer satisfaction and customer service. Similarly, supplier oriented BO's could include seller attraction and seller retention. Internal BO's could include employee satisfaction and management issues. Some of the factors that could impact the IBO's are IT Tools, Strategies, Policies and the Security Value of the security product. In Figure 3, the mapping of one of the customer oriented BO's, i.e., customer satisfaction, its Intermediate Business Objective's and factors is presented. From the figure below, we can trace the impact of increased level of security of the transaction system provided by the STP. The value created by it would complement with other factors and would have an increased effect on the IBO's of increasing the customer's trust on the transactions and their trust issues related to privacy, than on the IBO of providing appealable systems and thus would translate into increased BO of customer satisfaction. By keeping the policies, IT tools and strategies as constant; the ROI of the STP could be seen in the operational excellence/financial measures of the BO of customer satisfaction. As discussed above, some of the operational excellence measures for the BO of increased customer satisfaction could be percentage of returned goods and percentage of satisfied customers. Some of the financial measures for the same BO could be revenue per transaction and revenue saved from litigation fees against fraudulent transactions.

If the complementing BO's of customer satisfaction (like customer service, customer attraction) are negatively affected by the low level factors and the impact is to be seen on the profitability figures, the positive impact of the STP on customer satisfaction could be masked, eventually leading to it not showing up in the profitability figures. This further provides support to the approach of assessing the impact of STP's on IBO's and BO's and not on the final productivity of the organization. Further research in a corporate setting would help validating the CoBFOE approach.
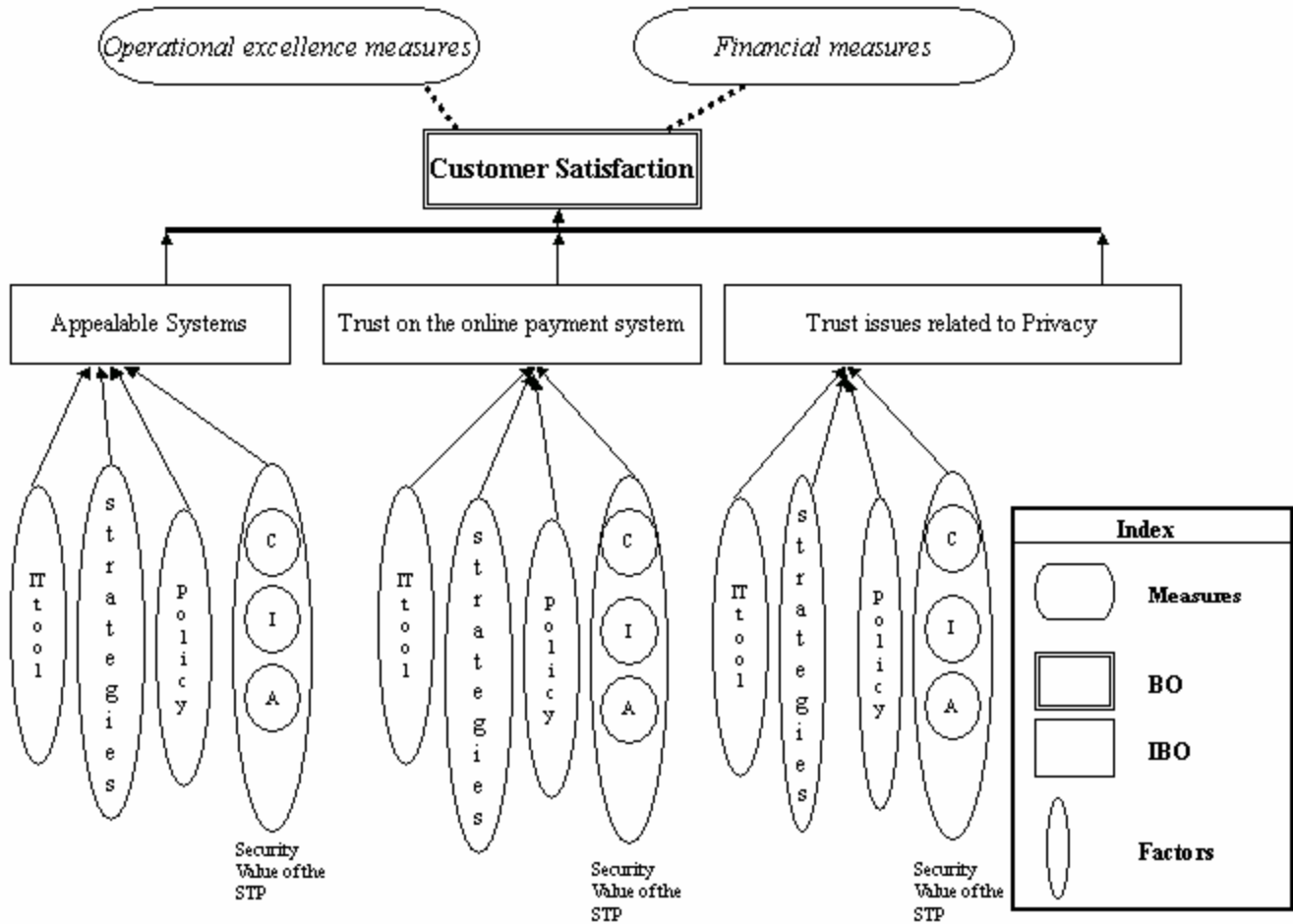
**Figure 3. Mapping of BO's, IBO's and low-level factors for an Online Company based on the CoBFOE approach**

## CONCLUSION

Previous studies of IT payoff include measures that dealt with productivity and performance. Based on the analysis of the characteristics of securing the infrastructure using STP's, which are application specific, and create more ubiquitous, intangible and futuristic assets, we found the need for a methodology to assess first order effects on the Intermediate Business Objectives rather than on productivity or profitability. An initial attempt to develop one such methodology based on BVC approach by Barua et al (1995) has been made, which could be used by companies who wish to invest money in IT STP's. Future research will seek to validate this methodology in a corporate setting and refine the financial measures.

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