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On Identification of IT Capabilities to Achieve Maximum Business Outcome

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On Identification of IT Capabilities to Achieve Maximum Business Outcome

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Abstract— *Outcome-based business (OBB) is a business model that links a service provider's revenue to the value delivered by the IT services to the client. For the model to be profitable to a service provider, it is critical to align key business outcomes of the client with underlying IT assets that support these outcomes. In addition, the financial construct in OBB allows for a shared risk, shared reward model where the service provider earns its fee upon meeting mutually agreed benchmarks that affect these key client outcomes. An OBB engagement typically requires establishing a long-term relationship with the client and reduces the risk for the client during the business transformation.*

A successful OBB engagement requires the service provider to have a deep understanding of the client's business and the corresponding business value drivers to achieve the desired goal. The first step is to identify the business value drivers which if improved, will provide most business value to the client to complete the business transformation. The second step is to identify the appropriate assets that best enable a client's transformation plan to improve their business outcomes. The final step is to quantitatively correlate the business transformation to key financial or operational performance indicator improvements for the client. In this paper, we outline a framework to help service providers identify the key IT assets that will help achieve the maximum business outcome for the client. The framework includes two type of analysis.

First, we utilize gap analysis to identify gaps in the client's financial or operational performance. Then, we identify the business capabilities that can improve those financial or operational gaps. Next, we map the prioritized business capabilities that will help improve financial performance to the underlying IT solutions that impact these capabilities. Based on the causal relationship between the IT solutions and the prioritized business drivers, we can identify the priorities of the IT capabilities for gap improvement.

In our second analysis, we assume that each business driver can be measured by a key performance indicator, KPI. We link the business drivers (or KPIs) of interest to the underlying IT capabilities that can impact them. This is accomplished by: 1) creating a casualty relationship called service-value map to associate the business drivers with the underlying business value drives and IT capabilities; 2) creating two baselines that define the bounds of the KPI; and 3) using maturity analysis, defining the degree of completion for business transformation, to predict the KPI performance within the bounds.

Keywords—Outcome Based Business; Business Capability; IT Capability; Gap Analysis; Trade-Off

I. INTRODUCTION

Today's economic environment, characterized by macroeconomic changes and rapid technology evolution is forcing business leaders to look at business transformation as the only means for growth. To carry these transformations out, business leaders need to understand factors that impact their financial goals and analyze the impact of these factors on their business. In particular, they need to understand the role of the rapidly changing technology on their key business outcomes. Therefore, there is a need to open the business dialog with client business executives both from traditional bottom-up IT approach, and the top-bottom business value approach. By changing the sales pitch from a bottom-up IT to a top down business value discussion, solution provider has a much better chance of a productive discussion with their client.

On the other hand, service providers are facing a serious threat of services commoditization, resulting in the value proposition is shifting towards delivering strong client centric business outcomes. Further, IT budgets are shrinking worldwide, placing additional burden on the need to link IT capabilities to business outcomes for the service providers to be successfully. Therefore, it is very important to understand the causal relationships between business outcomes and IT capabilities.

Besides the top-bottom approach starting from business value to identify the route for business transformation, to be successful, service providers are experimenting with a new business model, known as outcome based business that attempts to align the IT assets to enterprise business outcomes. The new model contrasts against a fixed-price model where the client pays a fixed price and bears the risk for all the consequences, an outcome based model is a 'pay-for-results-only' pricing model, This emerging business model has the potential to dramatically change the business relationship between the client and the service or solution provider.

Due to the complex nature of the causal relationship between the IT assets and business outcomes, and the dependence of the business performance on other external factors such as macroeconomic conditions and enterprise performance issues, precise quantification of the impact of the IT assets on business performance is an extremely complex task. However, through a process where we carefully map financial metrics to business drivers, and in turn are mapped to IT assets through their enabling capabilities, we can attempt to link IT assets to business outcomes. This paper focuses on such an integrated, systematic approach to identify the most relevant IT assets for achieving a client's business objectives. The illustrative example in this paper is from the retail industry, but the methodology developed can be applied for generic services transformation for other industry sectors such as telecommunications and banking easily.

The paper is structured as follows. First, in Section II, we outline the methodology for this analysis. In Section III, we create a detailed analysis for the retail industry using a mathematical formulation. In Section IV, we provide a concrete example that uses the formulated model. In Section V, we discuss related work, and in Section VI, we conclude the paper with a discussion of future work.

II. METHODOLOGY FRAMEWORK

Outcome based business is typically driven by strategic business objectives of an enterprise to find out optimal business drivers. The objective of the outcome based business is to optimally drive towards achieving the strategic objectives of an enterprise. It requires carefully planning, without focusing on an individual project or IT investment to achieve the strategic goals. The critical elements required for such a proposition are:

- A clear alignment between the client's business objective and the proposed transformation;
- Accurate information about each proposed IT asset regarding their usage, contribution to capabilities and outcomes, and their maturity in different deployment modes;
- A set of processes to systematically move the enterprise along the path to the strategic initiatives of the client goal.

To enable the analysis, we will next layout the fundamental steps and concepts for this framework.

A. Gap Analysis

The development of this framework begins with a gap analysis of enterprises' current financial or operational performance against its desired performance. It is determined by comparing the current performance to various benchmarks. The gap analysis answers two fundamental questions: "The enterprises' position as compared to its peers" and "Where does the enterprise want to be in next 5 or 10 years?"

Gap analysis can be performed at the strategic or operational level of an organization that requires a different set of data than what is often provided by financial or operational data. Usually, the initial gap analysis starts from using public financial data of targeted client. Companies like *Finlistics* Solution[1], provides comprehensive financial reports and financial or operational gaps from peers.

Obtaining operational data for an enterprise depends on access to company confidential data which only happens when the solution provider wins the trust of the client. At that point, the data can be used to validate the outcome analysis by complementing information obtained from the gap analysis. Examples of typical outcomes are the churn rate for telecommunication and insurance companies as well as employee attrition rate for retail companies.

B. Service Value Map and Business Value Driver

With the completion of gap analysis, it will be easier for us to define the business goal or target. Often, the goals of an enterprise are related to several levels as well as lines of business of an organization. Therefore, an outcome based business model must fundamentally explain how value is created at the different levels as well as with different stakeholders connected to the organization. Further, it must clearly demonstrate the IT capabilities that will most effectively influence these outcomes, and explain why.

A *service value map* is used to causally connect IT to business outcomes using business value drivers as the fundamental connecting blocks. It has to be industry specific. Business value drivers are the key elements that either build or protect the value of the business. An enterprise has to work hard to define the right drivers, to create and maintain, and manage value drivers. This will help the enterprise determine what capabilities it must enable or improve, and from there, the right set of projects and activities that will help the enterprise achieve them. Those activities are the most likely to help them meet their objective of increasing business value over time.

For any service provider helping enterprises transform is not easy. Just as it is with any finely tuned system, the different components of an enterprise have to be delicately balanced. A thoughtful approach needs to consider business strategy, processes, information, infrastructure and applications in concert with the organization's perspectives on business objectives and investments.

C. IT Capabilties[2]

From an information management perspective, business capabilities are enabled through IT capabilities realized through either software offerings (referred to as package applications) or customer application development (CAD). These IT capabilities need to be linked to the business strategic goals. Now, we can use causality analysis to infer the IT capabilities from business goals and use reverse inference to identify items of mutual importance.

D. Time-to-Value and Business Impact

Although the continuous improvement of technology has dramatically accelerated time-to-value to transform the core businesses of an enterprise, we still have to factor in the time involved with these transformations. Certain IT capabilities can effectively improve business outcome only when other capabilities act as enablers. That is especially true for

[1] http://www.finlistics.com – provides annual financial data for last five years for targeted company and comparison with peers and industry average using SIC code

[2] IT capabilities are only port of the capabilities required for business transformation. Other Non-IT capabilities are also needed to completed for a successful business transformation.

information syndication and analytics capabilities. Second, the enablement of IT capabilities also needs to consider the compatibility of underlying assets. Third, as stated earlier, there is always a finite amount of time required for an enterprise to adopt any new IT capabilities into their business practices.

E. IT Asset Selection

IT asset selection is the final step in the output of the whole decision process. Besides asset identification from the top-to-bottom approach using the causality analysis, we have to add cost and compatibility analysis to ensure that the selection is constrained by financial and technological considerations.

The IT asset selection should be based on the following principles.

- Support the identified business drivers determined to be improved and corresponding IT capabilities need to be enabled;
- Constrain the IT asset enablement cost within the parameters of business investment;
- IT time-to-value should be addressed to ensure the earlier business benefits.

From the cost perspective, preferable solutions will be to always to choose existing software solutions or assets to reduce the custom specific development. Another important aspect is the compatibility of the existing assets over the newly selected assets to support the new business capabilities.

III. ANALYSIS

A. Overview of the Methodology

In this section, we utilize mathematical notation to shape the analysis into a rigorous framework. The framework has the following steps: 1) using the publicly available financial metrics of targeted enterprises to carry out gap analysis to identify business goals; 2) utilizing the industry specific *service-value map* as causality model to create the linkage of business goals with business drivers and IT capabilities; 3) Defining the inference matrices among hierarchical business value drivers and IT capabilities to quantify the relative importance from IT capabilities to business goals; and 4) applying trade-off analysis to identify IT assets based on constraints of cost, maturity, time-to-value and dependencies.

B. Gap Analysis of Business Goals

Gap analysis provides a foundation for determining if an investment (business transformation), in terms of time, money and human resources, is beneficial to achieve a desired business outcome. For a public company trading in the US market, the most accessible data is the 10-Q and 10-K financial data. They are quarterly and annual reports mandated by the United States federal Securities and Exchange Commission (SEC). These give comprehensive summaries of a company's performance. These reports generally compare last quarter (or year) to the current quarter (or year) and last year's quarter to this year's corresponding quarter. The 10-K includes information such as company history, organizational structure, executive compensation, equity, subsidiaries, and audited financial statements, among other information.

A performance comparison is usually the starting point for a gap analysis. For the performance comparison, there are multiple ways select the benchmarks for a given enterprise, such as industry average, best player in this sector, or future stated goals. But it is important to ensure that the comparison happens within the same business or industry sector. The SIC (Standard Industrial Classification) code is a good starting point to determine the metrics for gap analysis.

In Table 1, we summarize the financial performance gap analysis using 10-Q and 10-K data for any given financial metric such as total revenue or EBITDA (Earnings before interest, taxes, depreciation, and amortization), the two most important metrics to evaluate the market size of an enterprise and its operational profitability. In Table 2, we translate the numerical gap score calculated in Table 1 to a verbal expression.

Table 1 Variables and Formula Used for Gap Analysis

Variable and Equations	Note
n	Number of years being assessed, typically $n = 5$
x_i	The median value of the benchmark being used
y_i	The KPI value for the i-th year
$z_i = s(i)\dfrac{(y_i - x_i)}{\lvert x_i \rvert}$	Gap value for a given year (*i-th* year). Here *S(i)* is a sign function, it is +1 if higher values of the KPI being studied are good for the enterprise, it is -1 if higher values are worse for the enterprise, or 0 if it is hard to judge
α_i	The weight for the i-th year. Typically, the weight decreases from current year to previous years to ensure more importance is given for recent performance
$g = \sum_{i=0}^{n} \alpha_i p(z_i)$	Gap computed for a given KPI or metric. It will be used as input into the logistic function to be normalized
$p(t) = 2\left[\dfrac{1}{1+e^{-2t}} - 0.5\right]$	$p(\cdot)$ is a logistic function, it is introduced for normalization.

Table 2 Conversion from Numeric to Verbal Expression

Gap Range	**Digitized Gap**
1 >= Gap >= 0.66	Excellent
0.66 > Gap >= 0.33	Very Good
0 <= Gap < 0.33	Normal
-0.33 < Gap < 0	Needs Improvement
-0.66 < Gap <= -0.33	Needs Substantial Improvement
-1 <= Gap <= -0.66	Very Poor

A *service value map* is a method of linking IT assets and capabilities to business outcomes and complements the gap analysis presented in this section. Using service value maps in addition to gap analyses, a fuller picture of the performance of a given enterprise begins to emerge. The next section has a detailed discussion of service value maps.

C. Service Value Map

Mathematically, a *service-value map* consists of a collection of *entity nodes* and *causality association of nodes*. The model is presented as a directed graph consisted of nodes (*node*) and edges (*associations*). The *association* is relationship starting from one node and ending at another node, representing a causal relationship of a *service-value map*. For example, a node named "*increasing revenue*" is used to specify a business goal. The edges (*associations*) from the node to offspring nodes represent the causality relationship to achieve this business goal. Those offspring nodes include the nodes representing lower level of business goals and business and IT capabilities as leaf nodes in this graph.

We constrain a service-value map to be a directed acyclic graph, a directed graph with no directed cycles. The rational behind this is two-fold. First, a *service-value map* needs to follow the causal inference of business drivers. Each service-value map needs to have a well-defined causality scope to define its internal value drivers with all the functionalities. Capturing causality linkage naturally forms an acyclic graph. Second, nodes of a model usually are organized into certain hierarchical structures reflecting how an enterprise is operated and managed. Such a hierarchical structure also forces us to have an acyclic representation. Furthermore, we apply more constraints and attributes to the service-value map:

- Connected Graph - The rational is that enterprise causalities have to be integrated pieces, and cannot be separated into multiple isolated pieces;
- Uniqueness of *Association* – between two *nodes*, at most one *association* is allowed to exist. The rational for such constraint is that we want to make sure that each *association* represents a direct causal step of a causality inference. Therefore, any possible ambiguity should be eliminated.
- Weight of Association[3] - There is a business reason for such weighting. We choose the weight with a selection of *{1,2,3}* with the following semantic meanings: {1 = *slight impact, 2 = medium impact, 3 = high impact*}.

D. Prioritization of Busienss Value Drivers using Gap Analysis

The *service-value-map* only identifies the causality relationship (both the causality direction and the strength as selected weight) among the business value drivers. As our ultimate goal to identify the IT capabilities (and corresponding assets) to fill the gaps for business transformation, therefore we need first to transfer the result of gap analysis to prioritization of business value drivers using the previous gap analysis. This is completed by using impact matrix (*A*) from financial or operational metrics to lowest level of business drivers:

$$A = \left[A_{ij} \right]_{km} \text{ with } a_{ij} \in \{0,1,2,3\} \qquad (1)$$

[3] The real impact of the casualty relationship between business value drivers is quite complex. Any precise of defining this using certain percentage could result in misleading the estimation. Therefore, using a simple method of ranking the impact can help us easily capture and validate the domain expert knowledge and map into the framework.

If *m* is the number of business drivers and *k* is the number of financial *KPI*s discussed in Section III.B. Then the normalized priority p, for each business value driver can be computed as:

$$p_j = \frac{\sum_{i=1}^{k} g_i a_{i,j}}{\sum_{i=1}^{k}\sum_{j=1}^{m} g_i a_{i,j}} \quad \text{with } j \in [1, m] \qquad (2)$$

E. Linkage of Business Driver with IT Capabilites

The causality relationships from business drivers to IT capabilities are modeled as the lowest level of causality associations of a *service-value-map*, and are quantified by another impact matrix *B* with element b_{ij} represent the impact of *i*-th IT capability on *j*-th business driver. If *m* is the number of business drivers and *n* is the cardinality of the set of IT capabilities, then the matrix becomes:

$$B = \left[b_{ij} \right]_{nm} \text{ with } b_{ij} \in \{0,1,2,3\} \qquad (3)$$

An implied assumption is that the impact of IT capabilities is propagated to the highest level of business value drivers and business goals through the lowest level of business value drivers. To identify the IT capabilities that support higher level business value drivers, we need to have following analysis.

If we want to incorporate the result from the financial or operational gap, analysis, the above matrix will be modified with priority *p*, defined in (2), then

$$B = \left[b_{ij} p_j \right]_{nm} \text{ with } b_{ij} \in \{0,1,2,3\} \qquad (4)$$

With matrix B defined, we extend the *service-value map* to include the IT capabilities. Each IT capability becomes a node in the graph, an edge will exist from *i*-th IT capability to j-th business driver at the bottom if the corresponding element in matrix B (b_{ij}) is a non-zero integer.

F. Prioritization of IT Capabilities

With the causality defined between the IT capabilities and business value drivers, the determination of the IT capabilities, which can be quantified with normalization as:

$$q_i = \frac{\sum_{j=1}^{m} b_{i,j} p_j}{m} \quad \text{with } i \in [1, n] \qquad (5)$$

In cases where no gap analysis has been completed, the priorities associated with IT capabilities becomes the number of edges that support the lowest level of business capabilities.

G. Static Analysis - Quantifying the Relative Importance

We use '→' to represent a partial order relationship (connection) for *nodes*. For any two nodes of *i* and *j*, we say $i \rightarrow j$ (or node *j* is impacted by node *i*) if there is a path from *i* to j in the *service-value map*. The semantic interpretation of this is that there is a causality relationship from *i* to *j*. With this graph representation, the leaf nodes are the lowest IT and non-IT capabilities, and the root nodes are the highest financial drivers.

We define the relative importance (impact of causality) of two nodes (say *i* and *j*) as zero if there is no path from node *i* to node *j*. We only need to consider cases where there is a path from node *i* to node *j* ($i \rightarrow j$). From a modeling perspective, we want to know the relative importance for a given IT asset to the upper level of business goals and vice versa.

Relative Importance of an Ancestor on Offspring Node

We use the following analysis to quantify the static causality relationship from higher business value drivers to lower level of business value drives or lowest IT (or Non-IT) capabilities. We will consider two different cases.

CASE 1: Assume there is a direct link from *i* to *j*. It is possible that there might be other nodes also having directed edges pointing to node *j*. Together with *i*, these nodes form a subset (say *A* with cardinality as *m*). Then, we define a default relative importance as $x_{i,j} = 1/m$. A notion of relative importance can be introduced by assigning different weights (positive values) over edges based on their corresponding *associations* in a *service-value map*. We can define the relative importance indicator as follows:

$$x_{i,j} = \frac{w(i,j)}{\sum_{a \in A} w(a,j)} \qquad (6)$$

CASE 2: Assume there is an indirect link from *i* to *j*. As an example, i and j are linked through other intermediate nodes. In this situation, the relative importance indicator can be computed as follows:

1. Determine all the paths (from set *P*) from i to j in the *service-value map* (some paths might overlap in parts, but not completely);
2. For each path of $p \in P$, we multiply the relative importance indicator for each edge in path p and determine a value for each path, say $x(p)$;
3. The relative importance indicator of $x_{i,j}$ is computed as the summation of $x(p)$ over all $p \in P$.

If *i* and *j* are identical, we define $x_{i,i} = 1$. For other cases, we define $x_{i,j} = 0$. This measurement can be used to measure the causality importance of an IT capability to a business goal.

Relative Importance of Offspring on Ancestor

The process of computing the relative importance indictor in this case is more of less identical to the process defined above.

CASE 1: Assume there is a directed edge from i to j. We define

$$y_{j,i} = \frac{w(i,j)}{\sum_{b \in B} w(i,b)} \qquad (7)$$

Set *B* (with cardinality *n*) contains the child nodes (nodes) of i. If i has only j as its child, then $y_{j,i} = 1$. In the special case of treating all edges equal, we have $y_{j,i} = 1/n$.

CASE 2: Assume there is a path from i to j (i is an ancestor of j), but linked through other intermediate nodes (nodes). We compute relative importance indicator $y_{j,i}$ similarly to how we did before, except that we use $y_{j,i}$ to replace $x_{i,j}$.

If i and j are not connected, we define $y_{i,j} = y_{j,i} = 0$. If i and j are identical, then $y_{j,j} = 1$. In the case of $j \rightarrow i$, we define $y_{j,i} = 0$.

■

Theorem 1: For *an offspring node (i) and ancestor node j,* the *relative importance of offspring on ancestor,* $y_{j,i} \leq 1$, holds for any i and j for a *service-value map.*

Theorem 2: For *an offspring node (i) and ancestor node j,* the *relative importance of ancestor on offspring,* $x_{i,j} \leq 1$, holds for any i and j for a *service-value map.*

For a pair of $x_{i,j}$ and $x_{j,i}$ (or $y_{i,j}$ and $y_{j,i}$), only one of them could be none-zero value, which is the result of forcing a *service-value map* to be acyclic (See Appendix) .

H. Identifying the Importance of IT Capabilities

Now, we can start to answer the question of which IT capabilities are the most important to a desired business outcome. Usually, the identification of IT capabilities has to consider all the possible financial or operational gaps. In cases where the financial or operational gap analysis exists, the updated matrix of *B* specified in equation (4) will be used. Otherwise, the matrix defined in equation (3) will be used. If we use C as the top level node specifying the gaps in a *service-value map*, then, the overall importance of a given IT capability can be assessed as:

$$\beta_i = \sum_{j \in C} x_{i,j} s_j \qquad (8)$$

Here, $x_{i,j}$ is the relative importance from *i*-th IT capability to *j*-th financial operational gap. s_j is the j-th gap computed using the method specified in Table 1 with value between *[0,1]*. It is assumed that it becomes 1 if a financial metric gap analysis ends as "*very poor*", and becomes 0 if the gap result is "*excellent*". The value can be adjusted when considering the future business transformation focus or competitive position.

Thus far, all the preceding analysis has been static analysis. However, the weakness of using static analysis is that it does not consider the time factor. Consequently, the next set of analyses considers the time factor.

I. Time-to-Value of IT Capabilities

Now, we assume that a set of IT and non-IT capabilities have been selected for business transformation. The relevant question here is, how can we evaluate the impact of this selection on potential business outcomes incorporating time as a factor? We introduce *maturity of a capability as a function of time*, which is affected by an IT capability. Maturity is defined as the percentage of the potential benefit due to this IT capability that materializes after deployment. As example[4], we model the individual IT capability maturity (time-to-value) as a very simple slope function.

$$m_i(t) = \begin{cases} 0 & t < t_0(i) \\ [t - t_0(i)] / T(i) & T(i) \ge t \ge t_0(i) \\ 1 & t > T(i) \end{cases} \quad (9)$$

Here $t_0(i)$ is initial time when the capability has been deployed and $T(i)$ is the time required for full maturity (or full value realization due to the capability being deployed).

The maturity of a business value driver can be computed using the following method. Let *N* be the number of IT or non-IT capabilities (leaf nodes) having causality links to the business value driver (node) with identifier *j*.

$$m_j(t) = \frac{\sum_{i=1}^{N} y_{j,i} m_i(t)}{\sum_{i=1}^{N} y_{j,i}} \quad (10)$$

Here again, $x_{i,j}$ is the relative importance for a given IT o Non-IT capability node *i,* to business value node *j*. The $m_j(t)$ is the maturity curve of an individual capability. This method can be applied to any high level of business value drivers.

Theorem 3: The *maturity* $m_j(t) \le 1$ holds for any j for any *service-value map*. The equality holds if and only if all the IT capability nodes have causality linkages realizing full business maturity.

J. Prediction Analysis

As each business driver typically is associated with a KPI, can we also extend out maturity analysis to predict the future KPI performance? The prediction analysis is completed in two steps. The first step is to compute the difference (called delta function) of the best performance of outcome versus the predicted business as usual, i.e. the base line. Without losing generality, we omit the subscript of the KPI.

$$\delta(t) = x_m(t) - x_0(t) \quad (11)$$

Here, the base-line prediction ($x_0(t)$), is computed assuming no additional business transformation. The prediction utilizes the current business performance and macroeconomic indicators such as the potential growth of national GDP and the potential growth of the industry sector in question.

The best performance for a given outcome is computed with the assumption that all the IT capabilities are enabled and are mature at the beginning of the transformation. The dynamic nature of the business environment is captured using the maturity function. Consequently, the outcome can be computed as:

$$x(t) = x_0(t) + m(t)\left[x_m(t) - x_0(t)\right] \quad (12)$$

Sometimes, the business value of certain KPIs requires the cumulative result, which can be calculated using the integral (or summation) of the KPI value over time. In this case, the business value is:

$$X(t) = \int_0^t \left\{x_0(\tau) + m(\tau)\left[x_m(\tau) - x_0(\tau)\right]\right\} d\tau \quad (13)$$

Thus far, we have not considered the potential cost of each enabling the IT capabilities under consideration. To prioritize the selection of IT assets, the cost of the IT capabilities need to be considered as well and this analysis, called the "trade-off" analysis is discussed in the next section.

K. Trade-Off Analysis

Generally, it is economically infeasible to deploy all candidate IT capabilities that can impact a client's business. Consequently, a trade-off analysis is a necessity to ensure that the most optimal capabilities are chosen. Central to this analysis is a cost and benefit analysis for each of these capabilities which has to be done in a timely fashion. The compatibility of the IT assets with the existing infrastructure also needs to be considered, along with it's dependency on the prevailing information flow protocols. Both of these can be modeled as acyclic graphs.

Assume *L* as the length of the contract time between the client and the solution provider. All the cost and benefit will be estimated within this time range. Five a given time range, the cost estimation can be calculated by adding up the cost over time for all the selected IT assets.

Finally, for cases where outcomes are measured as a function of financial gain, the trade-off analysis can be simplified substantially. Using this method, we still can carry out reasonable trade-off analysis with change the parameters in the model. The outcome and the cost overtime can be mapped into single numbers of current monetary values. Here, the time value of money is the value of money which includes the given amount of interest earned or inflation accrued over a given period of time. Then we should be able to convert the projected IT investment and the corresponding gain into the current value

[4]Another example is to convert the CMM (capability maturity model) model developed by SEI from Carnegie Mellon to a time-dependent maturity curves. It is a capability has a fixed five level of maturity to describe as a scale from '*initial*', '*repeatable*', '*defined*', '*managed*', to '*optimizing*'. The level can used to help us to determine how we can select the value for *T* and t_0.

and have a comparison for different IT assets that can be selected.

IV. EXAMPLE FROM SMARTER E-COMMENCE FOR RETAIL

In this section, we will use the framework developed thus far to analyze a concrete example from smarter e-Commence in the retail industry. Here, we treat the retail sector very broadly and consider any entity which deals with the sale of goods and services from individuals or businesses to the end-user. Online retailing is a form of electronic commerce whereby consumers directly buy goods or services from a seller over the Internet without an intermediary service.

From our study, we noticed that most retail enterprises have almost identical organizational structures with certain variations in their business models. SIC (Standard Industrial Classification) can be used to classify the different business models. They are:

- 5331- Variety Store (Walmart)
- 5311- Departmental Stores (example, JCP and Kohl)
- 5961- Catalog and Mail-Order Houses (Amazon)

A generic *service value map* has generated which broadly covers all these different business models. For example, online business is the major business portion of SIC 5961, but only a relatively small portion of the business for enterprises with SIC 5331 and 5311.

A. Identification of the Finacial Metrics and Analysis of Gaps

For the purpose of this analysis, we selected financial metrics generated from *Finlistics, which is an independent* online reporting tool. We group the financial metrics (KPIs) into high level categories that are industry agnostic and could be used beyond the retail industry to healthcare, building, materials, insurance and telecommunication industries as well.

In Figure 1, we give an example of a gap analysis we performed for a departmental store in Latin America. The company has expressed a desire to move to online business to enhance the cost saving. To begin with, their financial report is compared with the industry average in North America, which is considered a mature market. From Figure 1, we notice that the company under consideration has good potential for revenue growth, but is weak in terms of gross profitability. This fits the generally observed pattern for growth markets.

Using gap analyses, we can either help identify business goals or bolster the case for existing business goals. Some common client goals in the retail industry sector include:

- Increase *revenue growth* by expanding multi-channel sales
- Invest in technology in order to improve merchandise management and availability
- Expand into emerging markets

Weight factor

Gap Analysis	Gap Analysis (Text)	Client Data (Specific Company	0.3	0.2
			Current Year	2011
		GROWTH & PROFITABILITY		
1.00	Excellent	Revenue Growth	10.34%	15.00%
-0.07	Need to Improve	Cost of Goods Sold/Revenue	69.80%	72.70%
-0.12	Need to Improve	Gross Profit Margin	30.20%	27.30%
0.23	Reasonable	Selling, Gen. & Admin/Revenue	21.00%	19.20%
		Research & Dev/Revenue	NA	NA
0.20	Reasonable	EBITDA/Revenue	9.40%	7.90%
		Depreciation & Amort./Revenue	NA	NA
0.42	Very Good	Operating Income Margin	7.10%	6.00%
0.11	Reasonable	Effective Tax Rate	29.50%	31.90%
		CAPITAL UTILIZATION		
-1.00	Extremely Bad	Days Sales Outstanding	89	89
0.22	Reasonable	Days in Inventory	89	84
0.86	Excellent	Days Purchases Outstanding	95	85
-0.18	Need to Improve	Cash Operating Cycle (Days)	83	83
-0.07	Need to Improve	Revenue/Fixed Assets	4.13	2.95
		OVERALL PERFORMANCE		
0.09	Reasonable	Return on Capital	10.60%	9.90%
-0.24	Need to Improve	Free Cash Flow/Revenue	2.20%	1.80%
		LIQUIDITY & LEVERAGE		
0.26	Reasonable	Cash & Equivalents/Revenue	7.00%	6.50%
-0.69	Extremely Bad	Net Cash (Cash-STD/Rev)	-0.50%	-4.60%
0.20	Reasonable	Funds from Operations/Revenue	6.70%	5.10%
0.40	Very Good	Debt to Equity	0.24	0.2
		Client Specific KPI Analysis		

Figure 1 Example of Gap Analysis for Retail

B. Building Service Value Maps

A retail specific *service-value map* helps map the business value drivers which will transform the high level goals due to the introduction of lower level IT capabilities. As shown in Figure 2, we have identified four layers of value drivers with top two layers being general enough to be used for any profit-oriented enterprise. The third layer begins to introduce certain characteristics unique to retail industry, but the majority of business value drivers in this layer are still cross-industry. The forth layer has more retail specific business value drivers, including the online business value driver.

Even though individual IT capabilities continue to evolve to support retail specific business drivers, the overall organization structure of retail enterprises are quite stable, with standardization the norm across the industry. Thus, standard *service-value-maps* can be developed for specific classes of retail enterprises, which can then be tailored for an individual client with minimal customization needed.

In Figure 2, we display the business value drivers as part of the *service-value map*. In this example, we use an Excel spreadsheet to capture the causality relationship. The highest level drivers in this map are:

- ***Increased Net Operating Profits*** *(supported by a) Increased Gross Profit and b) Decreased Operating Expenses), and*
- ***Improved Capital Costs & Allocation*** *(supported by a) Increased Capital Deployment and b) Decreased Cost of Capital).*

The remaining three levels of business value drivers further define the proper sub-business drivers to achieve the upper business goals (drivers). Thus, a clear casualty relationship is established. The *KPI*s can be defined for the business drivers with financial *KPI*s at the top and the operational *KPI*s at the bottom.

The business value drivers themselves form a sub-section of a *service-value map*. The completion of the map requires establishing the connections to underlying IT capabilities, which have an impact on the business value drivers. This is accomplished by the linkages of IT capabilities to the bottom layer of multiple business value drivers using appropriate weight selections. The weights have integer values of {1,2,3} which have the following semantic meanings: {1 = *slight impact*, 2 = *medium impact*, 3 = *high impact*}.

In a standard *service-value map* for retail, the IT capabilities are groups under four categories, which are: a) *Marketing & customer management*; 2) *Supply Chain Networks*; 3) *Merchandizing & Product Management* and 4); *Business & Finance Administration*.

The complete list of IT capabilities can be found in figures 3 and 4. Due to the constraints imposed by this medium, we will only show the capabilities for number 3) *Merchandizing & Product Management,* and, number 4) *Business & Finance Administration*,.

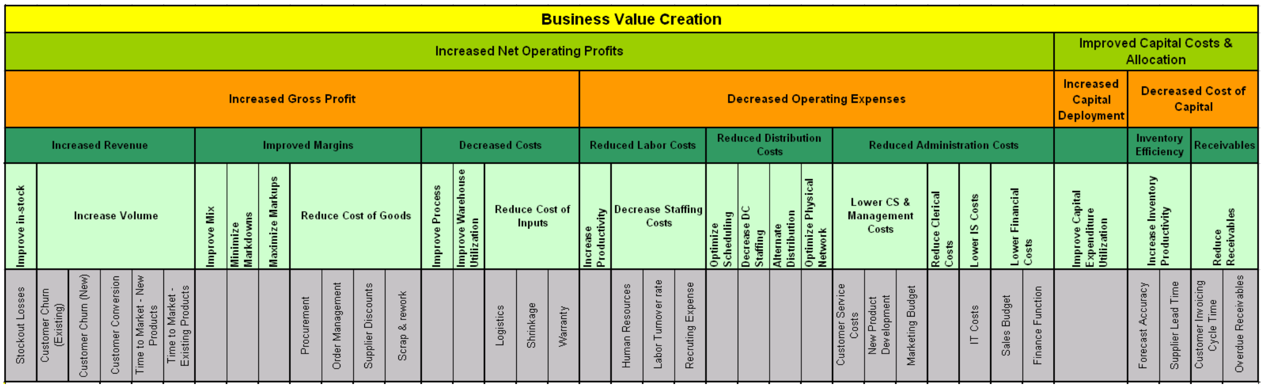

Figure 2 Business Value Drivers for Retail

Merchandizing & Product Management	Assortment Planning
	Inventory Visibility: Retailer to Customer
	Merchandise Planning
	Merchandise Analytics
	Size Optimization
	Macro/Micro Space Planning
	Demand Planning/Forecasting
	Price & Markdown Optimization
	Product Lifecycle Management
	Outsourcing
	Core Merchandising Operations
	Product MDM (Master Data Management)
	Inventory Optimization
Business & Finance Administration	Planning, Budgeting, and Forecasting
	Performance Management
	Strategy Management
	Profitability and Cost Management

Figure 3 Examples of IT Capabilities for Retail

C. IT Capabilites Selection with Priority Analysis

With IT capabilities being clearly defined for the retail industry, we are now ready for the prioritizing the IT capabilities using the results from the gap analysis discussed previously (Figure 1). The priority of each IT capability can be computed using equation (5) in Section III.F. This becomes the initial step for identifying the key IT capabilities that should be considered. In this example, "*customer data and insight"* and "*customer master data management"* are the two most important capabilities for the retail company being studied, to move into online business.

In business practice, asset selection process usually involves a trade-off analysis between the capability of the IT assets to support the business need and the cost associated with these assets. It is important to optimize this process to achieve the best overall outcomes.

D. Baseline Prediction

A *service-value map* only captures static causality links. As discussed in previous section, in order to quantify the impact of IT capabilities on the chosen KPI indicators as a function of time, we choose a heuristics based approach. First we need to determine the following two baselines for a given KPI. The first base line is the prediction of impact without any business transformation, i.e. business as usual (BAU). The second base line is the prediction with all the identified IT capabilities assuming no immediate and full business impact due to the deployment of the capability.

To illustrate this method, we choose a key metric, revenue, as an example. For emerging markets, typically, revenue growth is the major KPI to justify business success. Let us assume that there is a traditional retail company with limited online business, but one who desires a business transformation to increase the share of business using an online retail channel.

To calculate the BAU baseline, we make a prediction purely based on the enterprise performance over the last five years with multiple adjustment factors considered. The adjustment factors are as follows: The first is the national population growth. The second is the per capita growth of the retail company itself. The third is the enterprise's business expansion plan (such as adding more stores) without involving the IT capabilities from solution providers.

When the BAU prediction is complete, the next step is the prediction of the potential growth in revenue by applying all the IT capabilities. This is calculated using the existing evidence from peers and a commonly accepted target for growth from the deployment and maturity of the IT capabilities (Figure 4).

A similar method can be applied to another KPI's such as operating margin or operating profit margin. In a stable market, operating margin might be a more valuable KPI. In such markets, the business drivers to make business sustainable become more important to enterprises. Sometimes, EBITDA, Earnings before interest, taxes, depreciation and amortization, also can be used as the metric to assess the performance of companies.

The revenue and operating margin actually cover the two most important aspects for retailers. The first is the potential growth of a retailer. The second indicates the potential profitability of the retailer.

E. Trade-Off Analysis

With all of the preceding analyses complete, a more detailed trade-off analysis becomes feasible for the retail example in question. After selecting some IT capabilities, the prediction for revenue is calculated using the approach specified in Section III.J, where first the maturity is computed over time, and then the estimation is computed using equation (12). In Figure 5, the revenue growth curve is the middle (yellow) line, and bounded by the two base line predictions.

With the selected IT capabilities and corresponding assets, the cost of the transformation can now be completed using traditional software development and maintenance estimation tools. Considering the dependence of the IT assets, the overall cost can be estimated using the complex system estimation method using QSM SLIM Master Plan, where dependencies and time schedules can be put into same tool.

Business Value Drivers	Improve in-stock	Increase Volume					Improve Mix	Minimize Markdowns	Maximize Markups	Reduce Cost of Goods				Improve Process	Improve Warehouse Utilization	Reduce Cost of Inputs			Increase Productivity	Decrease Staffing Costs			Optimize Scheduling	Decrease DC Staffing
Business Value Drivers (KPIs) IT Capabilities	Stockout Losses	Customer Churn (Existing)	Customer Churn (New)	Customer Conversion	Time to Market - New Products	Time to Market - Existing Products				Procurement	Order Management	Supplier Discounts	Scrap & rework			Logistics	Shrinkage	Warranty		Human Resources	Labor Turnover rate	Recruiting Expense		
Customer Data & Insight		2	2	2			2																	
Enhanced Website Search		2	2	2																				
Enhanced User Interface		2	2	2																				
Wish Lists/ Gift Registry		2	2	2																				
Cross Sell/Up Sell		2	2				1																	
Contact Center		2	2											2										
Mobile / Mobile Apps		2	3											2										
Personalization		2	2	2																				
Value Added Services (Delivery, Installation, Warranty, Maintenance)		2	2				1																	
Customer Order Management		2	2											2										
Customer Master Data Management		2	2					2	2					2										
Transaction Master Data Management	1	2	2					2	2															
Marketing Analytics		2	3				2																	
Targeted Marketing		2	3																					
Marketing Spend Optimization		2	2																					
Promotions & Campaigns Optimization		2	2																					
External Search Optimization		2	1																					
Loyalty		2	3																					
Ratings & Reviews							1							1										
Trade Promotions		2	3																					
Social Sites & Links		2	3																					
Click to Chat/Call		2	2	2																				
Sales Force Productivity		2	2																2				2	
Point-Of-Sale (POS)														2										
Backoffice														2										
Customer Care Center / Service Desk							1												1				1	

Figure 4. Linkage between IT Capabilities and Business Driver

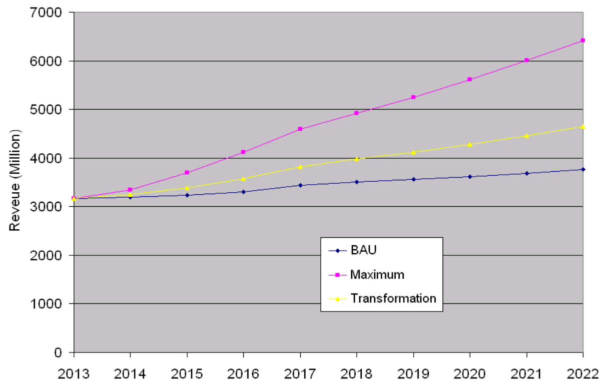

Figure 5. Base Line Predication and IT Asset Selection

V. CONCLUSION

In this paper, we created a semi-analytical method to quantify the impact of IT solutions on a client's key business outcomes aligned with the selected IT capabilities and solution. The quality of the analysis relies on the accuracy of business baselines or benchmarks predictions. The final impact of the business value lies in between two baselines, one of which is the "best in class" baseline and the other is a "business as usual (BAU)" baseline. The estimated performance is calculated based on the contribution of IT assets and the various initiatives to the enterprise's business value drivers. The contribution is quantified by the importance metrics and the gap analysis of the current financial metrics.

The major contribution of this paper is to use a more rigorous mathematical framework to select IT capabilities/assets and even non-IT initiatives. That framework allows us to integrate both the quantitative performance measurement and *qualitative inputs* from domain expert knowledge. It makes a complex problem become tangible. However, the method has its limitations. It is a mixed solution with prediction based on using expert opinions to define the importance of key metrics. Considering the dynamicity of macro and micro economic environment, any long term prediction will have questionable accuracy. At this stage, the application of method should be limited to the initial asset assessment rather than as a full-brown prediction model.

Beyond the initial asset identification and planning, execution of outcome based deals is also a key component to ensure successful outcomes. To achieve this, there is a need to track business performance as well as the contribution of the implemented assets and initiatives. Often, a reprioritization of IT deployment and IT initiatives is required to cope with the dynamicity and uncertainty of client business environment. This method can be extended to be used for tracking project execution as well with a few minor modifications.

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APPENDIX

Lemma 1: For a given node *i* of a *service-value map*, let *E* be the set of all leaf nodes (*ending nodes*) of the node *i*. We have:

$$\sum_{e \in E} y_{e,i} = 1 \tag{14}$$

Proof. If *i* itself is a leaf node, then $y_{i,i} = 1$ by definition. Let us denote l as the length of a longest path in the *direct impact-graph*. We prove the lemma over the value of l recursively. First, if *l=1*, from definition (7), we know the result in (14) holds. Now, assume that Lemma 1 is true for all $l \le n$ (n as a positive integer). For *l=n+1*, we define set *C* as the child nodes of root node (node) *i*. Then, it is obvious that from the definition of relative importance indicator in (7), we have:

$$\sum_{c \in C} y_{c,i} = 1 \tag{15}$$

The total number of paths from i to its leaf nodes (ending nodes) will be the summation of the number of paths of each node $c \in C$ to their own leaf nodes (E_c) of the *direct impact-graph* for *c*. Then:

$$\sum_{e \in E} y_{e,i} = \sum_{c \in E} (y_{c,i} \sum_{e_c \in E_c} y_{e_c,c}) = \sum_{c \in E} (y_{c,i}) = 1 \tag{16}$$

■

Theorem 1: For an offspring node (i) and ancestor node j, the relative importance of offspring on ancestor, $y_{j,i} \le 1$, holds for any i and j for a *service-value map*.

Proof. Without losing generality, we assume that $i \rightarrow j$. We assume that j is not a leaf node. Otherwise, from Lemma 1, we have $y_{j,i} \le 1$ immediately. From Lemma 1 and (5), we know that the summation of $y(p)$ ($p \in P$) of all paths equals to 1. Here, P is the set of the paths from i to its leaf nodes. $y(p)$ is the product of the relative importance indicators of each edge of the path p. Only part of the paths will pass over node (node) j. We denote those paths as set $P(j)$. Therefore, for the summation of $y(p)$ for $p \in P(j)$ will be less than 1, i.e. $y(P(j)) = \sum_{p \in P(j)} y(p) \le 1$.

We will prove that this summation $y(P(j))$ is $y_{j,i}$. For each path $p \in P(j)$, we split it into two parts (p_1 and p_2). The first part p_1 is from i to j, and the second part p_2 is the remaining part from j to the end of path of p. The total number of paths in $P(j)$ is the product of the number of paths from i to j, and from j to the leaf nodes (ending nodes). Let $Q(j)$ is the set of paths from i to j, then

$$\sum_{p \in P(j)} y(p) = \sum_{p \in P(j)} y(p_1) y(p_2) = \sum_{p_1 \in Q(j)} y(p_1) = y_{j,i} \quad (17)$$

The second equation comes from Lemma 1, where the summation of $y(p_2)$ for the p_2 having same p_1 equals to 1. ■

Theorem 2: For an offspring node (*i*) and ancestor node *j*, the relative importance of ancestor on offspring node, $x_{i,j} \leq 1$ holds for any nodes i and j for a *service-value map*.

Proof. The prove process is that same as Theorem 1 ■

Theorem 3: The *maturity* $m_j(t) \leq 1$ holds for any j for any *service-value map*. The equality holds if and only if all the IT and non-IT capability nodes have causality linkages realizing full business maturity. Equality holds if an only if all the leaf nodes achieving fully mature.

Proof. We know that $\exists i \in [1, N], 0 \leq m_i(t) \leq 1$. From Theorem 1, we know that $0 < y_{j,i} \leq 1$ It is obvious that:

$$\sum_{i=1}^{N} y_{j,i} m_i(t) \leq \sum_{i=1}^{N} y_{j,i}$$

If we divide the left hand side of the inequality by the right hand side, we complete the proof. ■