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MEASURING THE RETURN ON KNOWLEDGE EMBEDDED IN INFORMATION TECHNOLOGY

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Abstract

We propose a methodology for measuring the return on knowledge in company processes. We argue that one promising approach is to formulate the problem within the context of a knowledge management framework. That is, we will demonstrate that it is possible to measure the impact of knowledge embedded in information technology (IT) deployed in an organization’s core processes. In this sense, the core process knowledge embedded within IT is a particular instance of knowledge used to produce core process outputs. We provide a case example of the application of the knowledge value-added (KVA) methodology to provide a “proof-of-concept” example of how measuring the value added by IT might be approached. We discuss the implications in terms of the generic requirements for any methodology attempting to solve this problem as well as how the results of the use of KVA can be applied to analyze the potential value added by IT.

Keywords: Knowledge management, value added, economic performance assessment.

INTRODUCTION

There have been numerous approaches to assessing the impact of information technology on firm economic performance at the corporate and sub-corporate levels. A theoretical framework that would unify analysis to address this problem at any level of aggregation has yet to emerge.

Corporate Level

In the process of elimination corporate level approach, the various costs for capital (e.g., equipment, real estate, raw materials) are removed, leaving the cost of technology. Once the costs for capital are accounted for and income proportionately reduced, the remainder is asserted to be revenue attributable to knowledge capital and/or information technology (Strassman 2000a, 2000b, 2000c). Following this approach, all costs attributable to all cost categories except IT would reduce the income proportionately, leaving the income attributable to the IT.

Others use production theory to determine the various contributions of inputs to the firm’s output. The resulting production function (Brynjolfsson and Hiitt 1996, pg. 545) can be modeled using economic theory to determine the unique contributions of IT with computer capital, noncomputer capital, information systems staff labor, and other labor expenses as the inputs (which
One might argue that these approaches all use the common units of dollars. This might be the case at the firm level but not at the sub-corporate level in the allocation of revenue dollars.

Various criticisms have been leveled at these approaches including that the research using these approaches does not “adequately control for other factors [i.e., other than information technology] that drive firm profits” (Bharadwaj 2000, pg. 170). Strassman (1997) indicated that using typical aggregate level financial ratios, or variations thereof, offer no help in attempting to determine the relationship between investments in IT and a company’s economic performance.

In light of the problems in IT investment decision making, the application of option pricing models (OPMs) has attracted increasing attention recently. Benaroch and Kauffman (1999) investigated the value of applying real options analysis in the context of a case study involving the deployment of point-of-sale (POS) debit services by an electronic banking network. One of the significant contributions from this research is the establishment of a formal theoretical grounding for the validity of the option-pricing model in the context of the spectrum of capital budgeting methods that might be employed to assess IT investments.

Even if this study enables the generalizability of the application of OPM to IT investment evaluation, there are some implicit assumptions in using this model that potentially limit the validity of the analysis. For example, using net present value (NPV) in OPM for the calculation of risk requires an assumption about projected cash flow. There is no cash flow directly attributable to corporate core processes since the outputs of those processes are not salable without the outputs of all the other core processes.

Researchers using the resource-based view attempt to link a firm’s performance to IT resources that are firm specific such as knowledge, capabilities, and unique core processes (Bharadwaj 2000; Jarvenpaa and Leidner 1998). Resources can include financial assets, IT, employees, and company brand. Capabilities are specific to a company and refer to management’s ability to leverage the resources to produce economic value. Jarvenpaa and Leidner (1998, pg. 343) summarized the approach: “Focusing on the firm level analysis, the resource-based view emphasizes the resources possessed, developed, and deployed by an organization and understanding the relationship of those internal resources with performance competitiveness.”

The assumption is that these unique resources and capabilities are difficult, and very expensive, to copy and, therefore, provide competitive advantages leading to superior economic returns. IT is a resource that can provide a firm with such competitive advantages as long as the firm’s management knows how to best deploy it.

A limitation of this view is that it does not posit a common unit of analysis at the sub-corporate level that would allow an unambiguous linkage between a firm’s use of IT and the firm’s performance. Using this approach, it would be difficult to unambiguously determine the specific contribution of a given IT initiative to the firm’s performance.

Sub-corporate Level

Sub-corporate level approaches use a wide variety of methods to assess the contribution of IT to firm performance. Two representative approaches include cost-based and family of measures.

Activity based costing (ABC) is one of the most common cost-based approaches. One reason for ABC’s popularity is that finding the true costs of process activities is clearly useful in evaluating them (Johnson and Kaplan 1987). Applications of ABC to measuring the impacts of IT assume that any costs saved or processes simplified (and thus costs reduced) by the IT are a direct reflection of its value. This assumption may be true in given cases where costs are reduced and process outputs remain constant or increase.

The limitation of these approaches is the fact that if cost is used as a surrogate for value (Johnson 1992), then all the information is contained in one term of the ratio, i.e., the denominator. Conceptually, when performance ratios are used to measure the benefits of a given IT initiative, it would be illogical to use the same data source (i.e., cost and its variants) for both the numerator and denominator. The data source for value should come from the revenue side of the firm’s performance (i.e., numerator) and the data source for cost (i.e., cost) should come from the cost to produce the firm’s outputs.

1One might argue that these approaches all use the common units of dollars. This might be the case at the firm level but not at the sub-corporate level in the allocation of revenue dollars.
<table>
<thead>
<tr>
<th>Approach</th>
<th>Focus</th>
<th>Example</th>
<th>Level of Analysis</th>
<th>Key Assumption</th>
<th>Key Advantage</th>
<th>Limitation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process of Elimination</td>
<td>Treats effect of IT on ROI as a residual after accounting for other more easily measurable capital investment</td>
<td>Strassmann (2000a, 2000b, 2000c)</td>
<td>Aggregate corporate-level only</td>
<td>ROI on IT difficult to measure directly</td>
<td>Uses commonly accepted financial analysis techniques and existing accounting data</td>
<td>Cannot drill down effects of specific IT initiatives</td>
</tr>
<tr>
<td>Production Theory</td>
<td>Determines the effects of IT through input output analysis using regression modeling techniques</td>
<td>Brynjolfsson and Hitt (1996)</td>
<td>Aggregate corporate-level only</td>
<td>Economic production function links IT investment input to productivity output</td>
<td>Uses econometric analysis on large data sets to show contributions of IT at the firm level</td>
<td>“Black-box” approach with no intermediate mapping of IT’s contributions to outputs</td>
</tr>
<tr>
<td>Resource-Based View</td>
<td>Linking firm core capabilities with competitiveness</td>
<td>Jarvenpaa and Leidner (1998)</td>
<td>Aggregate corporate-level only</td>
<td>Uniqueness of IT resource = Competitive advantage</td>
<td>Strategic advantage approach to IT impacts</td>
<td>Causal mapping between between IT investment and firm competitive advantage difficult to establish</td>
</tr>
<tr>
<td>Option Pricing Model</td>
<td>Investors/managers</td>
<td>Benaroch and Kauffman (1999)</td>
<td>Corporate/sub-corporate</td>
<td>Timing exercise option = Value</td>
<td>Predicting the future value of an IT Investment</td>
<td>No surrogate for revenue at sub-corporate level</td>
</tr>
<tr>
<td>Family of Measures</td>
<td>Managers</td>
<td>Kaplan and Norton (1996)</td>
<td>Sub-corporate</td>
<td>Need multiple indicators to measure performance</td>
<td>Captures complexity of corporate performance</td>
<td>No common unit of analysis/theoretical framework</td>
</tr>
<tr>
<td>Cost-Based</td>
<td>Managers</td>
<td>Johnson and Kaplan (1987)</td>
<td>Sub-corporate</td>
<td>Derivations of cost = Value</td>
<td>Captures accurate cost of IT</td>
<td>No surrogate for revenue at sub-corporate level—that no ratio analysis</td>
</tr>
</tbody>
</table>
In the family of measures approach, researchers advocate the need to measure multiple indicators to derive the unique contributions of information technology (e.g., Edvinsson and Malone 1997; Kaplan and Norton 1996). The balanced scorecard typically provides four or five key performance indicators selected by management to determine the success of a given strategic organizational thrust. In the case of an IT initiative, the organization’s management team might select this initiative for assessment via a key performance indicator, such as level of customer satisfaction.

Edvinsson and Malone’s intellectual capital navigator allows a firm to identify up to 140 variables that account for the performance of its intangible assets including IT (i.e., a subset of its infrastructure assets). Examples of these measures would include laptops/employee, IT expense/employee, IT staff/staff total, IT literacy of employees, and so on (Edvinsson and Malone 1997, pg. 109).

The limitation of these family of measures approaches is that they do not provide a common theoretical framework that ties investments in IT unambiguously to a firm’s economic performance (Bharadwaj 2000). A theoretical framework robust enough to solve this problem must be able to account for IT’s contribution by allocating revenue directly to the IT deployed throughout a firm.

**KNOWLEDGE VALUE-ADDED: RESEARCH METHODOLOGY**

Knowledge value-added (KVA) provides a theoretical framework that enables allocation of revenue to IT initiatives in proportion to the economic value they add. KVA assumes that the most basic activity of humans, technology, firms, and industries is that they change inputs into outputs. It assumes that units of change, or complexity, are universal units and can be described in a common language based on the knowledge required to reproduce the changes. Knowledge, in the current context, is one convenient way to describe the thermodynamic changes caused by information technology embedded within core processes. In essence, the total amount of knowledge required to produce a firm’s outputs is a surrogate for those outputs and the outputs are a surrogate for the revenue they produce at a given point in time.

KVA can be used to generate a ratio, return on knowledge (ROK), that allocates revenue to the knowledge required to produce all of the firm’s outputs, including that knowledge embedded within IT. The allocated revenue is the numerator and the cost to use the knowledge is the denominator. KVA is an analytic tautology in that it operates on the assumption that, at a given point in time, all of the knowledge required to execute processes is known and this knowledge is a surrogate for the economic value it produces. KVA makes no explicit assumptions about the prospective value of knowledge.

One way to estimate the amount of knowledge contained within a process is to estimate how long it would take the average person to learn how to produce the outputs of a process including those currently produced by IT (Kanevsky and Housel 1998; Smart et al. 2001). The basic assumption is that the average time it takes to learn a process, with predetermined outputs, is proportionate to the amount of knowledge acquired and that this is in turn proportionate to the thermodynamic change produced by the process. Since, knowledge in the KVA context is proportionate to value added, it follows that learning time is proportionate to value added.

**Knowledge Value-Added: Theoretical Antecedents**

The theoretical antecedents of KVA are derived from a more general theory of business based on a computational complexity or thermodynamics. In the current context, IT changes process inputs into outputs. Conceptually, this technology is no different than any other process capability.

Businesses are open systems that exchange information, substance, and energy with their environments. As such, businesses have the capability, through their processes, to change the structure of raw material inputs (i.e., substance, energy, information) into final products/services. In the language of thermodynamics, this change in structure can be measured in terms of the corresponding change in entropy, when an input state \(a\) is transformed into output state \(b\) by process \(P\) (i.e., \(b=P(a)\)).

Assume that this change can further be represented as a set of “elementary” changes that are minute enough to become identical in terms of the corresponding amount of entropy they cause. This assumption about the equivalence of elementary changes can be expanded across any finite number of processes with predetermined outputs. This allows comparison in terms of the entropy among any set of processes by means of the number of elementary changes. The elementary changes introduced by the use of IT within a process can be measured within the context of this formulation.
It is important to emphasize that a change in entropy when state \( a \) is transformed into state \( b \) depends only on \( a \) and \( b \) and does not depend on process \( P \). This means that any process \( P \) that changes \( a \) into \( b \) introduces the same change in entropy or, in a business context, adds the same value. For example, if a process is fully or partially automated via the use of IT, then the amount of entropy or value added by the technology can be measured precisely as long as \( a \) is changed into \( b \).

Further, it is reasonable to assume that the minimal set of instructions, or the minimum knowledge required, to execute \( P \) reflects the corresponding change in entropy given the current state of technology. In other words, the length of the shortest description of the change provides an acceptable approximation to the change in entropy given the current state of technology. Execution errors in the process due to poor quality, lack of training, or poorly designed IT would be captured in terms of the cost to execute the predetermined shortest description of the process, or the denominator of a return ratio.

Using information systems as a context, this would mean that the length of the shortest program or learning time required to change \( a \) into \( b \) would be an acceptable approximation of the corresponding change in entropy. Given the relationship between entropy and change, the concept of value-added can be addressed with the following assumption:

If business process \( P \) is such that output \( b \) is equal to input \( a \), i.e., \( b=P(a)=a \), no value is added by process \( P \).

In other words, no changes = no value is added. Consequently, it is possible to infer that the amount of value-added by process \( P \) can be associated (proportionally) with the corresponding change in entropy. This relationship, while fundamental, does not provide a practical way to calculate the value-added by process \( P \), i.e., the entropy increment. A simplification of this logic is offered in Figure 1.

Within the framework of thermodynamics, a fundamental parallelism between transformation of substances and information processing has been established (Li and Vitanyi 1993). If a substance is transformed from state \( a \) to state \( b \), then the difference of the entropies, i.e., \( \Delta E=E(b)-E(a) \), is proportional to the amount of thermodynamic work required for the change. In parallel, the amount of thermodynamic work required to transform string \( x \) into string \( y \) by the “most efficient computer” equipped with the “most efficient program” is proportional to the length of the shortest program to execute this transformation, i.e., to \( C(y/x) \) the conditional complexity (C) of output \( y \) given input \( x \) (see Cover and Thomas 1992; Li and Vitanyi 1993). Conditional complexity, \( C(y/x) \), can be viewed in the business context as the shortest description of the process, i.e., effectively, the value added by the process.

We recognize that the introduction of IT changes processes. In the context of KVA, the changed process would require a description using the same assumptions provided here. What this formulation of the problem allows is the comparison of how introduction of the technology-caused changes translates into higher or lower returns on the knowledge embedded therein. For
example, simply introducing more knowledge without increasing revenue or significantly decreasing costs would lead to a dilution of the price per unit of knowledge with the context of KVA. From a KVA perspective, “throwing more knowledge” at a problem without attendant improvements in company performance provides no benefit and likely leads to a reduction in return.

KVA Example: SBC Telecom Case

At the time of the case (1999-2000), SBC Telecom was a proposed subsidiary of SBC corporation, the second largest telecommunications company in the United States. A team of researchers, the company executive management team, management level process owners, and company process subject matter experts (SMEs) performed a corporate level KVA analysis of the proposed processes of the new subsidiary. The purpose of the KVA analysis was to help management assess the projected benefits of their IT investments.

The results of the analysis are summarized in three tables that present an estimation of the reliability among the three learning time-based estimates (Table 2), the ROKs of the process areas (Table 3) and the ROKs of the IT supporting the areas (Table 4).

<table>
<thead>
<tr>
<th>Table 2. Reliability Table: Multiple Knowledge Estimates</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Column 1</strong></td>
</tr>
<tr>
<td>Multiple Knowledge Estimates Reliability</td>
</tr>
<tr>
<td>Marketing</td>
</tr>
<tr>
<td>Ordering</td>
</tr>
<tr>
<td>Provisioning</td>
</tr>
<tr>
<td>Maintenance</td>
</tr>
<tr>
<td>Billing</td>
</tr>
<tr>
<td>Customer Care</td>
</tr>
<tr>
<td>Corporate</td>
</tr>
<tr>
<td>Sales</td>
</tr>
</tbody>
</table>

The team calculated the amount of knowledge contained in the processes by working with the SMEs to estimate the actual time required to learn how to produce the outputs of the core processes including the outputs produced by the IT supporting the processes. Because the processes had been well documented by the process design team, including the IT requirements, and because the new employees had to be trained in the processes, it was a relatively straightforward task to generate the learning time estimates for each process.

The team used a single point of reference for these estimates (i.e., one of the team members) to ensure that biases would be evenly distributed across all of the estimates. Ordinal rankings of the processes were generated by a combination of the management team and process managers in terms of the difficulty to learn the processes. In addition, they generated relative learning time estimates based on the amount of time it would take to learn how to produce the process outputs given that the learner had a total of 100 months to learn all of the core processes. This normalization to 100 months technique has been used to benchmark the telecommunications industry as well as other industry segments, including the consulting industry (Housel and Hom 1999).

These estimates were then correlated with actual training times where available, resulting in a range of 74% to 94%. The relative learning time estimates were highly correlated (94%) with actual training time estimates and were used for all estimates in Tables 2 and 3. The added advantage of using the relative learning time normalization to 100 months was that the ROK estimates could be compared with industry ROK estimates for a number of the process areas.
Table 3. ROK Estimates with IT Fully Depreciated over 10 Years

<table>
<thead>
<tr>
<th>Process Areas</th>
<th>Relative Learning Time (LT) With 100 Months Normalization</th>
<th>% IT</th>
<th>Head Count (HC)</th>
<th>Total Learning Time: Rel. LT * (HC+(HC*%IT))</th>
<th>% Total LT</th>
<th>Annualized IT Capital Investment</th>
<th>Total Annual Cost Per Process Area</th>
<th>Annual Revenue Allocation Based On % Of Total LT ROK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marketing</td>
<td>6</td>
<td>30%</td>
<td>28</td>
<td>218</td>
<td>1.5%</td>
<td>$600,000</td>
<td>$2,700,000</td>
<td>$3,800,672</td>
</tr>
<tr>
<td>Ordering</td>
<td>12</td>
<td>75%</td>
<td>25</td>
<td>525</td>
<td>3.6%</td>
<td>$1,000,000</td>
<td>$2,875,000</td>
<td>$9,136,230</td>
</tr>
<tr>
<td>Provisioning</td>
<td>36</td>
<td>60%</td>
<td>120</td>
<td>6,912</td>
<td>47.7%</td>
<td>$3,583,720</td>
<td>$12,583,721</td>
<td>$120,285,000</td>
</tr>
<tr>
<td>Maintenance</td>
<td>20</td>
<td>60%</td>
<td>120</td>
<td>3,840</td>
<td>26.5%</td>
<td>$1016279</td>
<td>$10,016,279</td>
<td>$66,825,000</td>
</tr>
<tr>
<td>Billing</td>
<td>7</td>
<td>80%</td>
<td>15</td>
<td>189</td>
<td>1.3%</td>
<td>$2,900,000</td>
<td>$4,025,000</td>
<td>$3,289,043</td>
</tr>
<tr>
<td>Customer Care</td>
<td>11</td>
<td>70%</td>
<td>37</td>
<td>692</td>
<td>4.8%</td>
<td>$2,000,000</td>
<td>$4,775,000</td>
<td>$12,040,682</td>
</tr>
<tr>
<td>Corporate</td>
<td>4</td>
<td>60%</td>
<td>75</td>
<td>480</td>
<td>3.3%</td>
<td>$800,000</td>
<td>$6,425,000</td>
<td>$8,353,125</td>
</tr>
<tr>
<td>Sales</td>
<td>4</td>
<td>70%</td>
<td>240</td>
<td>1,632</td>
<td>11.3%</td>
<td>$2,000,000</td>
<td>$20,000,000</td>
<td>$28,400,625</td>
</tr>
<tr>
<td><strong>TOTALS</strong></td>
<td>100</td>
<td>660</td>
<td>14,488</td>
<td>100.0%</td>
<td>$13,900,000</td>
<td>$63,400,000</td>
<td>$155,925,000</td>
<td>246%</td>
</tr>
</tbody>
</table>

Table 4. ROK Estimates with IT Partitioned from Total Learning Time

<table>
<thead>
<tr>
<th>Process Areas</th>
<th>Relative Learning Time (LT) with 100 Months Normalization</th>
<th>% IT</th>
<th>Head Count (HC)</th>
<th>Annualized IT Capital Investment</th>
<th>IT Partitioned LT</th>
<th>IT LT %</th>
<th>Revenue IT LT = 38% of Total LT</th>
<th>ROK on IT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marketing</td>
<td>6</td>
<td>30%</td>
<td>28</td>
<td>$6500,000</td>
<td>50.4</td>
<td>15%</td>
<td>$540,180</td>
<td>90%</td>
</tr>
<tr>
<td>Ordering</td>
<td>12</td>
<td>75%</td>
<td>25</td>
<td>$1,000,000</td>
<td>225</td>
<td>4%</td>
<td>$2,411,517</td>
<td>241%</td>
</tr>
<tr>
<td>Provisioning</td>
<td>36</td>
<td>60%</td>
<td>120</td>
<td>$3,583,720</td>
<td>2,592</td>
<td>47%</td>
<td>$27,780,672</td>
<td>775%</td>
</tr>
<tr>
<td>Maintenance</td>
<td>20</td>
<td>60%</td>
<td>120</td>
<td>$1,016,279</td>
<td>1,440</td>
<td>26%</td>
<td>$15,433,707</td>
<td>1519%</td>
</tr>
<tr>
<td>Billing</td>
<td>7</td>
<td>80%</td>
<td>15</td>
<td>$2,900,000</td>
<td>84</td>
<td>2%</td>
<td>$900,300</td>
<td>31%</td>
</tr>
<tr>
<td>Customer Care</td>
<td>11</td>
<td>70%</td>
<td>37</td>
<td>$2,000,000</td>
<td>284.9</td>
<td>5%</td>
<td>$3,053,516</td>
<td>153%</td>
</tr>
<tr>
<td>Corporate</td>
<td>4</td>
<td>60%</td>
<td>75</td>
<td>$800,000</td>
<td>180</td>
<td>3%</td>
<td>$1,929,213</td>
<td>241%</td>
</tr>
<tr>
<td>Sales</td>
<td>4</td>
<td>70%</td>
<td>240</td>
<td>$2,000,000</td>
<td>672</td>
<td>12%</td>
<td>$7,202,396</td>
<td>360%</td>
</tr>
<tr>
<td><strong>TOTALS</strong></td>
<td>100</td>
<td>660</td>
<td>$13,900,000</td>
<td>5,528</td>
<td>100%</td>
<td>$59,251,500</td>
<td></td>
<td>426%</td>
</tr>
</tbody>
</table>
This simple correlation between learning difficulty rank order and the 100 month learning time normalization was much lower than the correlation between the actual training time and 100 month normalization learning time estimate. The rank order was a more aggregated view of the amount of knowledge with the 100 month normalization technique with the actual training time the most detailed estimate. The effort and cost required to obtain each estimate was relative to the level of aggregation of the estimate. However, the level of precision was based on the needs of the management team utilizing the results of the KVA analysis. For the purposes of the SBC Telecom management team, the relative learning time estimates were acceptable to determine the relative contributions of IT to the various processes along with benchmarking the projected performance of these processes.

The assumptions used for projecting annual revenues in Table 3 were based on an average revenue per employee company benchmark of approximately $236,000. The costs were based on projected costs for employee salaries (i.e., $75,000 per employee except for the corporate area with $100,000 per employee) and the IT (i.e., fully depreciated over a 10 year period) to support the processes. The fixed costs for physical infrastructure (e.g., buildings, air conditioning, energy, etc.) were not included in the estimates. The goal was to generate relative return performance estimates and, since such infrastructure cost would most likely be spread evenly across all the processes, the team decided not to include these in the cost estimates.

The relative learning time estimates were weighted by the number of employees and supporting IT automation in a given core process. A more precise method would have been to actually count the core process area outputs and the attendant knowledge executed to obtain the outputs over the annual time frame. Two conditions prevented this approach: the company had not yet begun operations and the policy group top management team planned to make additional IT allocation decisions based on the outputs of the KVA analysis.

Given these constraints, employee head count was used as an approximation for the average number of times the knowledge in the core process areas would be used during the annual period. SMEs also estimated the percentage to which the process areas were automated. The basis for their estimates was the amount of knowledge required to produce the outputs of the process area supporting IT. In other words, if all the IT was taken away, how much time would it take the average learner to learn how to produce the outputs of the IT. These estimates were possible because the team of management SMEs had developed operational scenarios in the event that all of the IT failed.

The percentage supporting IT was added to the head count to increase learning time weighting proportionately. For example, there were 28 employees in the marketing area. The area was estimated to be 30% supported by IT and 30% of 28 was 8.4. The 8.4 was added to the 28 head count to arrive at a total weighting factor of 36.4 for the marketing process. This number, when multiplied by the relative learning time estimate of six months, resulted in a total learning time of 218.4 units (i.e., of knowledge). This total for marketing when added to the weighted totals for the other core process areas resulted in a total of 14,488 units of knowledge. This was used to generate the percentage learning time estimates for each area so that the revenues could be allocated to each area proportionately.

Interpreting the results of the KVA analysis would lead to general conclusions about the relative performance of the various processes. Some of the processes, e.g., billing, were forced to subcontract usage of legacy systems from the parent company because there was not sufficient time or capital to recreate them. Other processes, e.g., sales, were free to take advantage of newer, web-based technology. It is clear from the process level ROK analysis that the returns on the provisioning and maintenance processes were substantially higher than on the other processes in spite of their relatively high costs.

KVA also allows the partitioning of ROK to any knowledge asset including the knowledge used by IT to support a process. The ROK on IT was partitioned by taking the percentage of the process that was supported by IT and multiplying that times the relative learning time number. The result was multiplied by the weighting factor (head count). To take an example from Table 4, 30% of the marketing process was supported by IT with 1.8 (or 30% of the relative learning time of six months) months of the total learning time for marketing. The 1.8 months when multiplied by the weighting factor for number of executions of the knowledge in this process, or 28, resulted in 50.4 units of knowledge.

This partitioning made it clear that some forms of IT support provided better returns than others. For example, the IT supporting the sales process provided substantially better returns than the IT supporting customer care with the best ROK on IT for the maintenance process. It appeared that one of the reasons for the projected differential return on IT was the fact that the better returns on IT appeared to be for processes that utilized newer IT (Web-based sales and using a database). However, two processes—provisioning and billing—were slated to make primary utilization of legacy IT support. Clearly, the provisioning
legacy IT provided a better return than the billing legacy IT and the provisioning legacy IT provided a better return than the Web-based IT supporting sales.

It follows that pure reliance on type of IT (e.g., Web-based, file processing system/legacy systems) may not be the critical differentiator in terms of overall ROK on processes. Process design may be the most crucial issue in predicting and maintaining the highest ROK as long as attention is focused on issues of how to distribute knowledge assets among employees and IT in processes.

This proof of concept case example demonstrated that the KVA measurement methodology can be operationalized. This approach provided a theoretically grounded way to allocate revenue to IT such that the performance of this knowledge asset could be accurately estimated at the process level.

CONCLUSIONS

Measurements alone do not provide management with an easy decision about how to proceed, no set of numbers, however, reliable and valid can replace the creative prerogatives of management. But given that managers are informed by numbers, it is imperative to provide measurements that are relatively easy to generate and that can be directly tied to the firm’s performance.

KVA is one potential theoretical framework that researchers interested in measuring the impacts of IT initiatives at all levels of aggregation might use to focus their efforts. It offers the advantages of positing a common unit of analysis that allows allocation of revenue as well as cost enabling the development of ratios to measure and model the returns on IT initiatives. It is grounded in a mature epistemology from physics that enables a transparent review of its underlying assumptions as well as a means to determine the reliability of its measurement estimates. It is also a practical methodology for assessing the value added by IT to corporate and sub-corporate performance.

As in any theoretical frameworks, KVA has a number of limitations. It was expressly designed for processes with predetermined outputs. This makes it problematic for measuring inherently creative processes, such as research and development. However, for the outputs of research and development to be of value, firms must eventually find their way into core processes with predetermined outputs. In this way, it is possible to use KVA to track the conversion of such creative outputs into value as they are embedded in processes with predetermined outputs.

References


