CRITICAL BUSINESS REQUIREMENTS MODEL AND METRICS FOR INT*RA*NET ROI

Grant A. Jacoby*
Department of Computer Science
Naval Postgraduate School
grant.jacoby@us.army.mil

Luqi
Department of Computer Science
Naval Postgraduate School
luqi@nps.edu

ABSTRACT

This research provides the first theoretical model, the Intranet Efficiency and Effectiveness Model (IEEM), to measure intranet overall value contributions based on a corporation's critical business requirements by applying a balanced baseline of metrics and conversion ratios linked to key business processes of knowledge workers, IT managers and business decision makers -- in effect, closing the gap of understanding between them and enabling better software to be designed for Intranet portals.

Keywords: Intranet, Value, Metric, Portal, ROI

1. Introduction

Under current and projected growth rates of information stored in corporate *intranets* and the increasing need to determine how valuable new portals are in collecting and applying information contained to meet specific business needs, employing a method to holistically, uniformly and regularly measure improvement and take related actions to effectively optimize these portals is of mounting importance. As information technology (IT) professionals and business decision makers (BDMs) seek ways to forge their information into knowledge capital that can be leveraged quickly for competitive advantage, they require a model and supporting metrics to do so. Across any give corporation today, most intranet portal measurements are based almost exclusively on usage statistics – with little or no thought given to design and user experience factors – and are applied in a freelance and non-standardized manner, providing no meaningful insight into how well intranets help corporations achieve their strategic objectives. What has been missing is a comprehensive model and methodology to base measurements from logically related groups of metrics which, when measured periodically, provide actionable steps to optimize efficiency and effectiveness of intranet portals to better bolster key business requirements in pursuit of value.

This research provides the first theoretical model for the popular *Family of Measures* approach to measure Web activity as well as a unique holistic framework and multi-disciplinary approach in viewing and measuring intranet contributions in the context of a corporation's overall critical business requirements. This is accomplished by applying a balanced baseline set of metrics and conversion ratios linked to business processes as they relate to knowledge workers, IT managers and business decision makers seeking to increase value.

An essential fact when measuring effectiveness of corporate portals is to recognize and account how their purpose is similar to, but fundamentally distinct from, Internet portals. Intranets exist to fulfill different purposes for different constituencies than does the Internet. The key difference lies in the underlying mission of the portal itself: on the Internet, the portal sites' business model is based on attracting a portion of the advertising budgets of corporations that might otherwise advertise in other media (print, TV, radio, etc.). Thus, the general purpose of the

Some abbreviated portions of this paper were presented at the 2004 International Multi-Conference in Computer Science and Computer Engineering during the Internet Computing and Web Services Applications session. The authors would like to thank Professor Thomas Housel for his insights and input, Mary Lee Kennedy, Executive Director of Harvard Business School Library, for her encouragement to pursue this research and friends in the Knowledge Network Group at Microsoft in Redmond, WA for their enthusiasm in the early stages of this endeavor.

public portals is to attract large numbers of repeat visitors, to build online audiences with the inclination to buy what portal advertisers have to sell. These portals have essentially settled into a one-directional relationship with viewers.

Inside the organization, the portal takes on an entirely different character. It usually takes its purpose from the overall mission of the organization: to add sufficient value for its customers to create a sustainable business model. It takes its features and functionality from the mandate to operate at world-class efficiency and effectiveness in order to remain competitive. Achieving this competitiveness requires a bi-directional model that can support the employees' increasingly sensitive needs for pertinent, helpful, timely content and interactive information management tools.

A fundamental shortcoming today in trying to increase value from corporate intranets is due to a lack of comprehensive and credible means in which to measure how effective the portals meet the demands of their employees (*knowledge workers*) and other intended audiences in pursuit of carrying out business objectives. As Figure 1 below illustrates, most approaches to metrics do not begin from a strategic management viewpoint that takes into account a prioritization of critical business requirements essential for value creation. Far more work in the IT community has been done to apply metrics to processes of knowledge workers as they impact immediate costs and benefits, failing to recognize longer term payback as they relate to company competitiveness, e.g., processes that sustain key business activities that generate and support the creation of value. The premise of this work asserts that in order to write better software to design intranet portals and measure their performance, *value* must be understood and linked to critical business requirements with the proper balance of metrics which can be used to further derive better estimates of ROI – in effect, closing the gap of understanding between knowledge workers, IT professionals and BDMs.

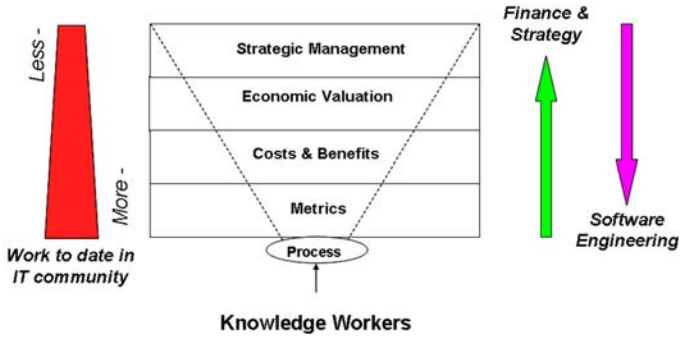


Figure 1: Software Engineering Approach to Metrics [Favaro, 2003]

2. Intranet Efficiency and Effectiveness Model

Information technology contributes more than data; it impacts a wide range of business processes that produce the required results to sustain value. It is in the analysis of these processes that answers to productivity can be derived. However, in most corporations there is no consistent, visible and uniform way to measure, manage and maximize the effectiveness of IT-enabled business processes of intranets. The *Intranet Efficiency and Effectiveness Model* (IEEM) provides a means of measuring the effectiveness of a processes integrated approach to quality through the established application of a baseline set of metrics and their conversions ratios that collectively and logically relate to key strategic business requirements that drive value.

The most meaningful way to measure an intranet is by the effectiveness of its collective portals in support of business requirements. The research surrounding the Intranet Efficiency and Effectiveness Model contributes to the methodology and analytic basis needed to select a baseline group of metrics and conversion ratios that logically and holistically prove out and optimize effectiveness of intranet portals as they relate to and bolster strategic business requirements which steer the productivity factors. An intention being corporations can use the six segment perspectives outlined in the IEEM to define, apply and refine a balanced set of metrics to begin measuring what is important, instead of what is available.

To better appreciate why portals exist and are occasionally re-designed, one should first understand the different domains that support the management of making information findable and understandable, their distinct *constituents* and how these are segmented to sustain key business requirements. The IEEM and its underlying baseline of metrics were determined by a series of model/diagram procedures that were used to break down the composition of an intranet. In order to reveal an abstract *domain analysis* view and the association therein linking metrics groups to critical business requirements, an *affinity diagram* is used to create the conceptual model which separates the

intranet into distinct and unique segments in order to help map out the problem/solution space analysis. On top of this diagram the various users and their roles are identified within each segment. Then an *interrelationship diagram* (see Figure 2 below) is substituted on top of the affinity diagram to highlight where pertinent metrics and their logical relationship between related users and their roles exist. These metrics are further broken down into hard, soft and derived forms[†] and are also outlined on the diagrams as well as put into a *cause and effect tree* table (see Table 1: *Ranking of Key Intranet Metrics by Segment*) which shows the impact of these metrics to users as well as strategic business values. Lastly, the table is put into a *prioritization matrix* (see Table 2: *IEEM Example of Part of One Metric Breakdown for Unique Users*) to illustrate levels of importance and to establish a baseline of metrics in which to commence with measurements.

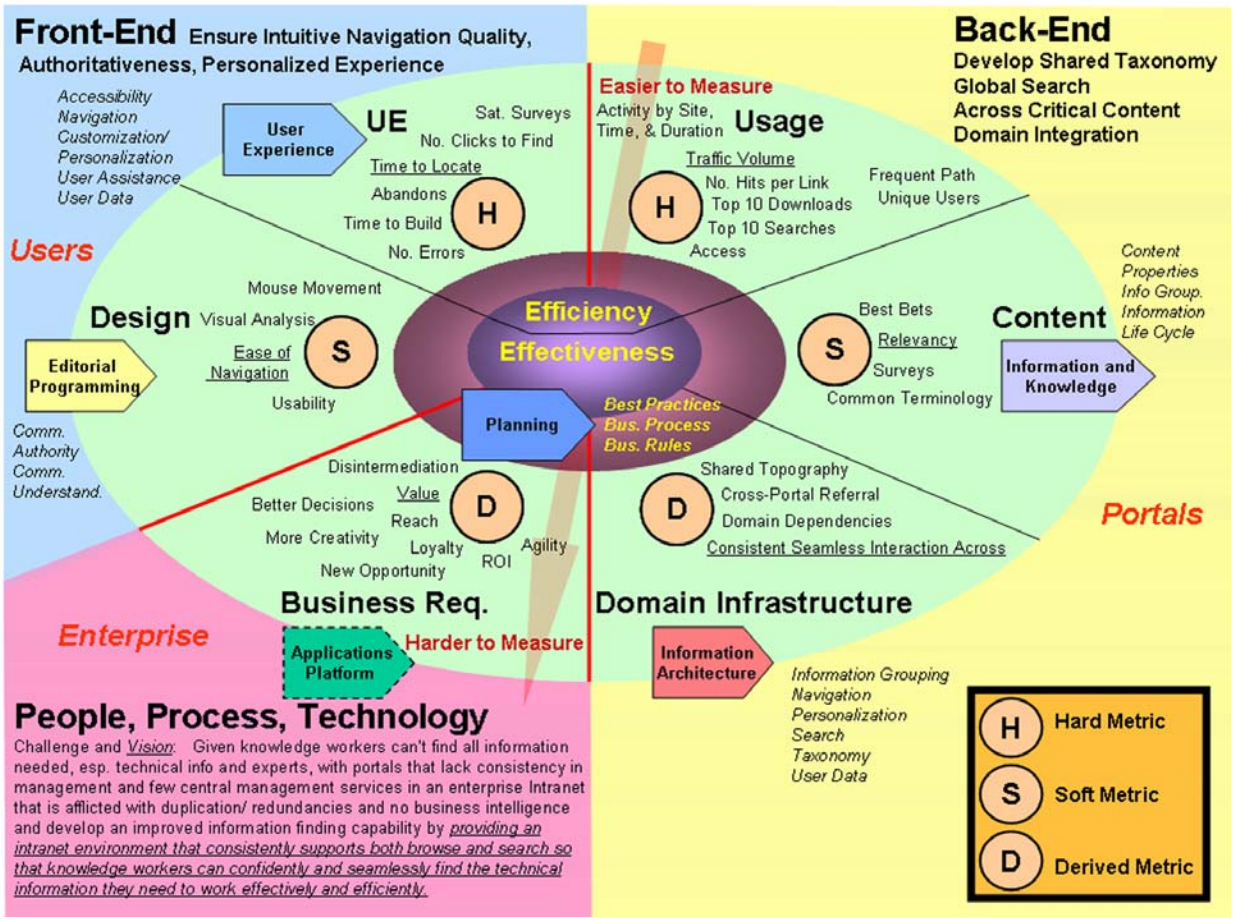


Figure 2: IEEM Metric Types and Examples in All Segments

As a result of these modeling techniques, a theoretical model can be created illustrating the placement of underlying and interdependent domains, segments, constituents and the consequential, logical metrics grouping of

[†] To measure efficacy of a corporate intranet's portals requires a coherent and balanced combination of metrics taken from all segments. When these metrics are collectively and uniformly applied in periodic measurements, they can indicate tractable improvements over time. In order to do this, these metrics should be grouped into metric categories that support business requirements. To this end, there are essentially three types of metrics: hard, soft and derived.

- *Hard metrics* can be objectively measured, i.e., by directly interpreting server log-file data, server requests, number of visitors over a given period of time, etc.
- *Soft metrics* involve many subjective and qualitative aspects that provide a frame of reference to interpret the results, i.e., survey results, visual analysis and usability.

Derived metrics consist of hard and soft metrics from a variety of business and knowledge data involved and an educated assumption to draw conclusions, i.e., estimates of speed to market, loyalty and reach.

an intranet that support business requirements. Furthermore, a distinction can now also be made that separates efficiency from effectiveness: efficiency is measured with predominantly quantifiable or hard metrics, i.e., numbers and durations of time or both; effectiveness is this and more as it takes into account qualitative factors. In addition, the three corresponding three audiences an intranet services are added: *Enterprise* business decision makers, *Portal* owners and managers, and *Users*. The interests of all three of these audiences must be taken into account and distinguished to better organize, prioritize and conduct metrics to measure effectiveness of an intranet. If people are to be given benefits from enhancements to the enabler of process, then it is essential to understand who and where they are as well as the roles they play in fulfilling business requirements.

The IEEM focuses on strategic fit, functional objectives and the opportunity or necessity for making *process improvements* as the keys to success. In addition, the IEEM introduces a common theoretical framework that has been missing in which to measure all important facets of intranet processes critical to assessing value. Nevertheless, its holistic approach does not eliminate subjectivity altogether as it accounts for critical qualitative factors which are often, if not entirely, overlooked in other commonly used measuring techniques which concentrate on usage statistics, such as traffic volume. In short, as a result of being a more comprehensive model some soft metrics must be taken into account which are not strictly quantitative or without human interpretation or assumption. Nevertheless, when parties agree upon a relatively well-defined set of performance metrics, it is possible to have a relatively unambiguous collaborative interpretation of the phenomenon [Baskerville, 1999].

3. Matrix for Metrics and Prioritization

Table 1 shows an initial baseline estimation of the top several metric areas, which segment they come from and some of the business requirements they sustain. The prioritization of these metrics is based on the metric groups most *impactful* on overall value from a business management perspective. The distribution of metrics is of additional interest from a theoretical standpoint because at least one metric area originates from every segment (see underneath Table 1). This substantiates the assertion that more metrics need to be taken from more than the *Usage* segment if accurate and comprehensive measurements of effectiveness are to be indicated. Nevertheless, it is best to limit the number of metrics (the baseline focuses on seven)[‡] to include only those that directly correlate to a business benefit or else the analysis may become overly complicated, risking confusion, implementation and credibility.

Many corporations today focus on routing metrics, such as number of hits per page, top 10 search strings, most popular downloads and number of referrals from other sources (such as banner advertising, search engines and direct links). These metrics are popular and have been created in far greater numbers because they address the issues many departments and groups are facing today, namely accessibility and visibility of their website. These usage-related metrics are also popular because they can be done quickly and are more mathematically straightforward, favoring the proclivity of technically oriented workers who usually do the measuring, than the more time consuming soft metrics concerned with such things as user behavior and experience in the Front-end. In addition, routing metrics are relatively simple to understand at the business level and the data is relatively easy to collect using the Web server log files. In fact, most Web analytics packages provide many routing metrics as pre-packaged reports, so it is natural to defer to these "out-of-the-box" tools. Unfortunately, since they are often used for Internet websites they are mistakenly applied in like fashion to corporate intranets and in a lopsided manner. These simple statistics alone on plumbing are not going to provide business decision makers with all feedback needed to track improvements towards productivity. The audience most overlooked in ascertaining intranet performance is the user, despite the fact that many of the constituents necessary to sustain the requisites of finding information are found in the Front-end domain where the knowledge worker resides. Consequently, when selecting metrics to measure intranet effectiveness, due consideration needs to be given to metrics in the *Design* and *User Experience* segments

Table 2, *IEEM Example of Part of One Metric Breakdown for Unique Users,* presents the reasoning behind the application of metrics to IEEM domains and audiences. The headings provide the What, Where, Who, Why and How this applies and is color coordinated to the IEEM to ensure thorough interpretation of the association between the model and metrics. All metric areas and specific metrics are colored to represent what they support and where they belong in the IEEM as they are used with that metric priority or *What* category. For example, the color pink is

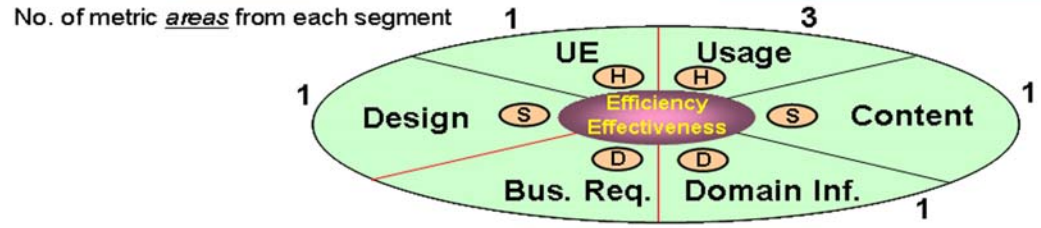
[‡] There are three advantages to specifying down to single metrics logically grouped:

- When the group consists of hard metrics, the data can be pulled automatically and routinely over time, i.e., create, query and retrieve server log files supporting metrics.
- Qualitative data can be derived from logically grouped quantifiable data, for example, *loyalty*.
- When metrics are closely associated to user behavior and business requirements, analysis of the results lead to precision and powerful modifications which optimize the portal more in line with what needs to be done to improve its effectiveness.

used for all metric areas and metrics that relate to business requirements or are derived, yellow for Back-end and hard metrics, blue for Front-end or soft metrics and purple for best bets/practices. In addition to being grounded in a theoretical framework, this approach can be applied practically to obtain estimates based in many common units which can be traced directly back to specific pages, links, design, etc. in a portal. Thus, how to go about deriving effectiveness of portals can be *operationalized* in relatively practical ways. Moreover, this approach is not reliant on any particular software, so it can be applied to any network regardless of its network OS without additional costs to hardware or software, except saving space on a server to store queries of log files.

Table 1: Ranking of Key Intranet Metrics by Segment [§]

Pri.	Type	Metric	Segment	Constituent	Business Requirement
1	S	Relevance	Content	Content Properties, Search	New Opportunity, More Creativity, Better Decisions, Value
2	H	Traffic Volume	Usage		Reach, ROI, Loyalty
3	H	Unique Users	Usage		Reach, ROI, Loyalty
4	D ->H	Cross-Portal Referral	Domain Infrastructure	Domain Infrastructure	Reach, Opportunity, Creativity, Disintermediation, Value
5	S	Ease of Navigation	Design	Navigation, Comm. of Understanding	Value, Loyalty
6	H	Top Downloads	Usage		Optimization, Value
7	S	Sat. Surveys	User Experience		Value, Loyalty, Reach, (Productivity)
*	H	Time to Locate	User Experience	Navigation	Value, Loyalty, (Productivity)
Must	S	Common Terminology	Content, Domain Infrastructure	Taxonomy	Value, Reach
Must	D ->H	Shared Topography	Domain Infrastructure	Domain Infrastructure	Reach, Opportunity, Creativity, Disintermediation
(Business Rules Considered?)					
?	H	Accessibility	User Experience	Accessibility	Value, Reach, More Creativity, (Productivity), New Opportunity (when confidential info. in right hands)

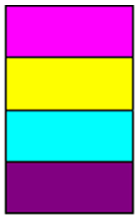


Based on the Unique Users metric priority as outlined in Table 1, Table 2 is but one actual example of the current proposed baseline set of metrics and conversion ratios that result from high-level analysis of intranet efficiency and effectiveness factors that gauge and achieve greater value and value-creating benefits. Confirmation of the utility of these baselines is being studied and refined by a large software company in Seattle. Work is being conducted to determine the best techniques to:

- analyze user behavior,
- employ periodic soft metrics (i.e., short, focused electronic surveys) to confirm predominately hard metric results related to behavior,
- automate capture of optimum processes for submission as business rules and best practices,

[§] A derived metric (denoted in the table by " * ") can become a hard metric within the Domain Information Infrastructure (DIII) segment as the *perceived* physical and software interaction between key elements within the constituent of DII becomes concretely known and measured with precision. Examples within Cross-Portal Reference and Shared Topography above are the ability to capture all unique visitors and information maps (akin to server topography) respectively.

Table 2: IEEM Example of Part of One Metric Breakdown for *Unique Users*



-Business Req. or Derived Metric
-Back End or Hard Metric
-Front End or Soft Metric
-Best Bet or Practice

WHAT: **UNIQUE USERS** (Priority No. 3)

WHERE: Enterprise
WHO: Portal Owner and Portal Manager Related
WHY:

HOW:

<----------BUSINESS PROCESS----------><------BEST PRACTICES ------> ← IP Metrics Model Related →

Business Issue: - *Metric Area*	**Business Question of Web Site Activity**	**Business Significance of Web Site Report Solution**	**Specific Metric Area** - *Specific Metric*	**Who Benefits and Why** (User, Portal, Enterprise)	**IP Segment(s):** *IP* Constituent(s)	Efficiency (E) or Effectiveness(F
Retention: - *Loyalty* - *Value*	How effectively am I building loyalty with my visitors?	Determine how quickly you are building your user base to gage site audience enlargement and shrinkage over time and *vis a vis* other sites.	**Return Visitor Rate** - *Top Visitors (authenticated)* - *Visitors by Number of Visits* - *Visitors Over Time* - *Top Visitors by Hits (Leads)* - *Top Visitors by Hits Over Time* - *Top Visitors by Leads Completed* - *Visits by Length of Visits* **All of above for Returning Visitors* - *New vs. Returning Visitors*	**User** – Gains familiarity to a site which reduces overall frustration. **Portal** – Managers learn where return visitors come from and how many there are, which a partial indication that users find the site helpful. **Enterprise** – When users continue to return to the same site for information, it indicates that they find it helpful and s well as where the sources of richness lie.	Info Architecture.: - *User Data*	F
Optimization: - *Loyalty* - *Value* - *Agility* - *Optimization*	What do my visitors come back for?	Analyze the most popular content for my return visitors in order to load and associate related information to meet demand.	**Return Visitor Target Pages** (correlate return visits with content): - *Top Returning Visitors by Hits* - *Top Returning Visitors by Hits Over Time* - *Top Returning Visitors by Leads Completed* - *Returning Visitor Visits by Length of Visits* - *Returning Visitor Page Views Over Time* - *Top Document and Content Group for Returning Visitors Over Time* **Survey** - *Internal Returning Visitor Session Activity*	**User** – Popular downloaded information remains as well as other information like it eventually being posted or better associated. **Portal** – Managers learn which pages are desired and can load related information to meet demand. **Enterprise** – As portals more accurately monitor what information is sought and add additional information that is related, the enterprise is doing a better job meeting the expectations and business needs of its users.	Info. Knowledge - *Survey* Info Architecture - *Info Grouping* - *User Data*	F

- create a single reporting service for the enterprise in order to compare portal performances to each other in a consistent manner to gauge impact of changes made to processes.[**]

By determining from *all* segments which complementary metrics can be coupled together in groups and which groups collectively best indicate how well a portal supports a business requirement, efficacy indications are attained. It is through refinement of these combinations and groupings of metrics (each organization is unique and therefore should take steps to refine their metrics after periodic measurements) from all segments of the intranet that leads to improvement in critical business requirements, such as Agility, Disintermediation, Loyalty, Opportunity, and Reach.

The intranet is the most measurable medium ever. With respect to legal issues and the compliances more easily demanded within the internal operations for any organization, it is more measurable than the Internet. Yet organizations of all sizes and types fail to measure its full impact because it is considered either too hard or not a priority. A review of the relevant literature reveals that there has not been a successful demonstration of the methods or strategy necessary to successfully implement a measurement technique that can indicate the effectiveness of an intranet. By soliciting the three audiences to determine which metric area is of greatest impact on their performance and satisfaction, metric areas from each segment can then be prioritized, logically grouped and then sub-grouped with specific hard and soft metrics supporting each group. All of which are related back to critical business requirements and divided among the audience most affected.

As the intellectual capital builds in corporate portals, more investments will be made to enhance them and make them greater enablers. Executives will demand from their IT that they implement a program of metrics where each major initiative has defined goals and metrics to indicate whether or not these goals have been obtained. To translate these metrics into financial terms using standard conversion factors, such as the cost to the company of each employee saved, the value of time saved, increased revenue per customer or transaction, or the savings in time and money from fewer defects will require far greater appreciation of intranets and the metrics needed to measure them than is exercised in public and private sectors today. Moreover, IT will be required to communicate these financially oriented results on a regular basis, something many IT professionals today are not versed at doing.

4. Return on Intranet Metrics Investment

4.1. Background

ROI has become a big buzzword in IT, yet few companies are tracking ROI in a consistent and standard manner. Enterprises are increasingly scrutinizing their IT spending and proponents of e-business projects must go to much greater lengths to justify any spending than they were required to do during the *dotcom* boom. As a standard fallback, companies rely on traditional return on investment (ROI) metrics to make e-Business funding decisions. Evaluating the potential return on an IT investment can be fairly straightforward--at least in theory. In financial terms, ROI means profit divided by investment, expressed as a percentage [King, 2002]. But within that definition, there is a lot of room for interpretation and pitfalls:

- Does the initiative fit strategically?
- Does the initiative support functional objectives?
- Does the initiative incorporate opportunities for process improvement?
- Does the underlying technology fit the infrastructure?
- Are ROI numbers based on reasonable assumptions?

By focusing solely on what is quantifiable in terms of dollars and cents to answer these types of questions, companies risk being precisely wrong instead of being approximately right. The problem being that it is difficult to translate many benefits into hard cash equivalents. This applies equally to IT investment in a business context. The tendency is to apply a strictly quantitative ROI when in fact true ROI is both quantitative and qualitative. Nevertheless, corporate managers, who subscribe to the mantra, "If you can't measure it, you can't manage it", want

[**] Hard and soft metrics taken together with consideration given to their strengths and weaknesses allows an enterprise to make informed decision on the investment in, or the ongoing value of its data warehouse and portal system. Achieving success through the use of any performance metric will depend as much on *how well* it is applied as it does on *when* it is used. Studies based on samples and averages over time can make for easier and more credible comparisons. Hence, continuous benchmarking should be instantiated to confirm and correct baseline measurements and conversion rations through periodic (i.e., monthly, quarterly, annually) portal status reviews that measure progress against previous baseline results. For these reviews, portal owners should use the metrics to determine which roles and content are being underserved by the portal and which processes could correct this and better leverage the portals capabilities.

quantifiable statistics to more concretely demonstrate that their departmental effort is pulling and financing its share of the weight in the corporation.

Return on investment is popular because it is a simple concept that everyone can understand. ROI and its cousins, Net Present Value, Internal Rate of Return, Payback Period, and Economic Value Added are concepts that executives have traditionally used to measure performance. These metrics are certainly useful but they fall short of providing a complete financial picture for business planning. With Intranet ROI seen as a metric that ranks a technology investment in relation to other company investments, attempts are made to evaluate intranet expenses in terms of cost savings that are attributable to investments in business process automation. ROI therefore would seem like a logical way to assess intranet related payoffs. In practice however, traditional ROI metrics fail to measure the value created by intranets -- forcing business managers at multiple levels to make e-Business funding decisions based on gut feelings, rather than tracking ROI in a consistent and standard manner with the aid of Web metrics within a business value framework.

Despite having high expectations for portals, only a minority of firms report having formal metrics for documenting portal benefits – and virtually all of these are for Internet and not intranet portals. Astoundingly, 51% percent of firms don't have any metrics to prove portal benefits and another 20% don't know if they have any ROI related metrics at all for portals [Gillet, 2001]. In addition, approximately 66% of IT managers believe ROI is an appropriate metric only "sometimes" for an IT site [Upton, 2000]. Moreover, these opinions on the usefulness of ROI for IT are based largely on Internet e-Commerce sites, not in relation to *intranets* which are perceived more as "sunk costs" of doing business. All the same, the difficulty of determining valid ROI for Internet e-Commerce sites is another reason why IT professionals and BDMs often avoid applying ROI to their intranet portals.

Table 3: Common Approaches to IT ROI [Jacoby, 2003]

Technique	General Definition	How to Calculate	Advantage	Disadvantage
Return on Investment (ROI)	A catchall phrase commonly used for several ways to measure business value of a project. ROI means profit divided by invest-ment, expressed as a percentage. As the numerator, profit can be replaced by cost reductions or productivity gains derived from the operational improvements an IT project yields	Revenue or cost savings divided by investment	Best applied to projects where all costs that will be incurred or all cost reductions that will be realized are known ahead of time, usually from experience on a similar project.	Difficult to apply to entrepreneurial IT projects that are designed to help launch new products, services or businesses that translate to new sources of revenue and profits. ROI doesn't consider risk, flexibility & intangibles.
Net Present Value (NPV)	Refers to the future net cash flow a project is expected to deliver, minus the investment. It defines the value of a project in "today's dollars." The calculation is based on the company's cost of capital used for assessing proposal alternatives. It returns a nominal amount.	Cash inflow minus cash outflows calculated in today's dollars.	Includes all cash flow related to a project. Considers the time value of money, or the difference in the value of a dollar today and what it might be three years from now.	The highest NPV doesn't always correspond to the most efficient use of a company's capital.
Internal Rate of Return (IRR)	One of several metrics that considers the time value of money, IRR expresses the dollar returns expected from a project as an interest rate. Once the rate is established, it can be compared to rates earned by investing in other projects. More informally,	C= all costs associated with the project and call it . R=estimate of all returns resulting from the project. T= how many months or years company will realize returns.	Includes all cash flow related to a project. Considers the time value of money. It enables the comparison of rates of return on alternative investment options. Given two investment alternatives and assuming that both fit strategic objectives of the	Disadvantages: Assumes cash flows are reinvested at the IRR. Cumbersome to calculate interest rate when cash flows vary widely year to year. There is no specific formula that can be used to calculate the

	IRR is also known as the "hurdle rate" because it's usually the lowest rate of return that management will accept. Typically, a project must earn an IRR that is several percentage points higher than the cost of borrowing, to compensate the company for its risk exposure and time.	i= firm's minimum acceptable rate of return Calculate the interest rate: C=R x T (i). Reference a NPV chart listing the value of a $1 annuity and find the corresponding interest rate. Compare that interest rate to the minimum acceptable rate and determine if project will leap over hurdle rate.	organization, the investment with higher internal rate of return should be selected. Conceptually it is the easiest method to understand.	IRR; it is found by interpolation.
Payback Period	How long it will take an investment to pay for itself	Initial project investment divided by cash inflows (or cost reductions) per year.	It's simple and understandable.	Time value of money and cash or other benefits received after payback period are not recognized, which determines profit.
Economic Value Added (EVA)	Measures a corporation's true economic profit. The idea is to understand which business units best leverage their assets to generate returns and maximize shareholder value.	Net operating profit minus an appropriate charge for the opportunity cost of all capital invested in an org. – EVA= Net Operating Profit After Taxes (NOPAT) - (Capital x Cost of Capital)	Can more precisely define value in terms specific to an enterprise.	Complex, proprietary (expensive) and not widely used. Metric is extraordinarily dependent on the size of a business. Big operations/ projects tend to produce big EVAs, while small operations/ projects are much smaller.

4.1.1. Intranet measurement misconceptions

If enterprises are to better realize more productivity from their portals, they need to understand why it is a fallacy to believe measuring portal value is either undesirable or undoable. There are several reasons that perpetuate this false perception:

- Cost cutting is so much easier to understand and measure than effectiveness that it almost always tends to gain prominence, despite a firm's original best intentions.
- A belief that accuracy of data in ROI models is so limited there is no point in calculating them. For example, if one is making up numbers to begin with, it's not really going to help decide whether an IT project makes sense.
- Many applications are so inexpensive to develop and deploy that companies often assume they'll get a return on their investments or they justify these relatively small investments by pointing to intangibles, such as improved employee morale from having easy access to their human resources and 401(k) records and better workforce collaboration, resulting in quicker time to market.
- Managers of intranet portals and their bosses generally believe they don't need anyone to convince them of its business value. Managers and their knowledge workers know that the communities build loyalty, give valuable feedback, and contribute to increased sales. Thus, IT project teams shouldn't jump through financial hoops trying to cost justify essential investments that are "no-brainers."
- Depending on the size of the company, it is not worth the cost or time to determine the ROI for an intranet upgrade or enhancement (effectively conducting an ROI on the ROI). Though ROI calculations are different for different industries and companies, as a general rule it is not always cost effective for small

companies to conduct ROI on modest modifications to their intranet portals. Many IT organizations go to the trouble of doing the ROI math only for expensive projects.

Enterprises lack a business strategic model, an affiliated metrics baseline and a *Business Intelligence Team* (BIT) to conduct the necessary metrics analysis to better discern and balance appropriate quantitative and qualitative metrics. As a backdrop to the above, IT initiatives are increasingly becoming so important that companies are either not evaluating ROI or they are realizing the need to develop new ways to measure ROI to take into account a project's strategic value, i.e., enhancements to their intranet portals and metrics needed to prove and disprove improvement.

In essence, strategic IT investments that improve the overall efficiency of the enterprise will make the business more productive, saving money and improving the responsiveness of the whole company. Thus, improving the performance of an enterprise's intranet portals is of great significance because the greatest impact of portals is improved productivity. Consequently, companies are going to have to start believing in -- and doing -- this hard work of determining productivity benefits because productivity is the most important piece of ROI analysis [Koch, 2002]. Because it is hard to quantify all intranet-related investment benefits and savings to the business, these important factors get short shrift, even though they can result in big savings that can have a direct impact on the profitability and overall effectiveness of a business. Though traditional accounting methods make it awkward to absolutely quantify IT's value, this doesn't mean the issue of an IT's value should be ignored. Business owners and finance executives alike need to be mindful that ROI methodologies tend to focus on short term quantifiable justifications, while ignoring the strategic role IT plays driving new opportunities for the business

4.1.2. Qualitative inputs and raw benefits

The nature of these metrics-related challenges with respect to value should force business owners to find credible ways to rely more on qualitative inputs. As the role of IT becomes increasingly strategic to the success of a corporation, a new set of metrics needs to be applied to investments that attempt to measure IT's ability to enable increased revenue or faster growth for the business. For instance, if an investment improves the time to market for a critical new product or service, it could be said to have added revenue to the firm. In many situations getting to market early results in a big advantage both in terms of more overall revenue in the life of the product or service and in a period of higher margins before competitors create downward pressure on prices. In effect, portals help meet new challenges to compete on the basis of time -- not for the sake of speed for its own sake, but because profitability in markets is increasingly available only to early entrants who can forge brand and business dominance (a parallel could also be made for a government or military in reducing their decision time cycles).

Return on intranet metric investment (ROIMI) has more credibility and is clearer when it's stated in raw benefits, which are sometimes non-quantifiable, rather than translated into short-term return dollars. The numbers tell the story, but not the whole story: Some benefits may not be quantifiable today in terms of dollars, for example ease of use, competitive advantage, customer loyalty, etc. These benefits are worth including in the value story, despite the risk of companies still ending up with ROI results that are not 100% quantifiable. The challenge is to prevent the translation from becoming fuzzy and losing some audiences.

Calculating ROI requires a considerable amount of data, consistent standards, baselines within a company, and at least some financial expertise. Even with such input, the end results are approximate and can be manipulated. Moreover, intranet ROIs from different companies are unique and returns may differ because they reflect rapid changes in technology and knowledge worker behavior which varies from company to company as do their expertise levels and fields. Even with these restrictions, the procedure of pursuing ROI, in whatever format, forces a company to think about the best ways to measure success – specifically, the hard, soft and derived metrics that matter most in measuring the extent to which business values are supported and achieved.

4.2. Axioms and drawbacks

Despite best intensions, ROI can be misleading and its limitations need to be recognized and addressed. Recognizing these, a deeper analysis of the IT portfolio can find truly significant contributions to the corporate health and well-being that should be calculated and communicated. In the past, IT organizations used to be viewed as a necessary expense for a business. Today, however, they are often viewed as an important strategic asset to a company's future success. While many businesses are focused on cost control, IT groups are often focusing on how to generate growth for their business by funding projects to help their company reach new customers and work more efficiently with its existing partners. Perhaps not so surprisingly, only about 8.33 percent of IT spending is perceived in some circles to provide incremental benefit to the organization [Gliedman, 2000]. The reality is benefits often far exceed this perception; otherwise continued large investments into it would not be made. Like metrics for intranets, intranet ROI can also be counter intuitive. Table 4 below outlines seven shortcomings that companies tend not to take into account when calculating ROI on IT and its impact:

Table 4: Axioms and Drawbacks

Axiom	Drawback	Impact
1. ROI must capture all costs, direct and indirect, associated with a project/ technology, including products and services devoted to direct support.	• One size doesn't fit all. • Applying ROI to every activity won't work. • The human factor of computer-assisted work is neglected by the ROI model. • One metric can't characterize the entire IT value.	ROI is useless when it comes to evaluating risk, flexibility, and intangible benefits-factors that have a critical impact on business and should be factored into spending decisions. In addition, ROI can't calculate valuable, intangible qualities.
2. ROI must be based on quantifiable results. The baseline metric is the dollar, often measured through calculating time saved (time is money).	• ROI is both quantitative and qualitative.	Although ROI numbers may appear concrete, they can be misleading. Unless ROI analysis is applied honestly, there is ample room for delusion. The greatest danger is the "concrete" and "measurable"' driving the significant out of the analysis. Because intranet applications are internally focused, it's difficult to get an ROI and is, therefore, neglected.
3. ROI must be based on observable results. Automation has business value only when we can *see* the results such as faster production or higher quality.	• E-business projects often follow the law of unintended consequences because they cross functional and enterprise boundaries, and may produce payoffs in ways that were hard to imagine at the outset.	Taking an accountant's view of IT priorities could actually be counterproductive, because a spreadsheet doesn't tell the whole story. In fact, some of the IT projects that impact business the most can't be measured easily, if at all, some experts now say. However, the only way to grow the bottom line on a sustainable basis is to grow the top line, which is easy to ignore if every project is measured on tangible ROI.
4. ROI emphasizes tangible payoffs that can be measured in financial terms. Often, the easiest to measure returns are bottom-line improvements rising out of cost reductions.	• ROI is a metric that favors cost-saving projects.	ROI tends to favor projects that result in cost avoidance, at the expense of projects that promise revenue growth. This is particularly acute in ROI for intranet initiatives because they are likely to miss at the outset subsequent, positive impacts.
5. Investments in k-worker and partner-facing initiatives result in more effective collaboration and translate into important productivity benefits for all sides.	• ROI measures only the returns that the company sees within its internal operations.	By ignoring the value created for partners and customers, ROI may be missing the real point of e-Business (and the very idea behind creating a corporate portal in the first place). For example, as a parallel approximately two-thirds of the overall benefit of a retail website cannot be accounted for by online transactions alone.
6. ROI calculations for cost-saving projects are more accurate because the enterprise already has the data needed for the equation.	• When calculating ROI for a revenue-generating project like intranet portals, estimates are often used, which makes the ROI calculation less accurate.	The result is that revenue-generating projects are at a disadvantage if they are competing against cost-savings projects based on ROI. Furthermore, not all data/outputs can be known ahead of time with regard to creativity and the volatility of content in data-warehouses and the impact of knowledge applied to it.
7. Most e-business initiatives take time to get accepted and widely adopted. Declaring failure or success is based on a three or a six-month time period (time is money).	• There can be significant time lags between the benefits that will impact revenue and the revenue metrics themselves. The lag time may be six months or more for larger projects. Therefore, companies examining only the metrics most closely tied to revenue risk	Most e-business projects result in payoffs on multiple dimensions. It's a tactical approach to ROI. The shorter the study, the shorter the ROI basis, the more isolated it's going to be and the less meaningful it's going to be in the overall strategy. It's significant but it needs to be put into the larger context.

	cutting off projects for which positive return may be just around the corner. • Not all returns are financial returns in the short run, although they eventually may impact financially.	

In effect, in the rapidly changing world of IT, ROI is ROI -- except when it's not. While CIOs say the payback on most IT projects can be measured in dollars, many utilitarian but necessary efforts, like infrastructure upgrades and installing and supporting collaborative applications, don't translate easily and those projects are not given full credit because of the inability (and in some cases, the non-necessity) to attribute any intellectual gains to new technology. For example, in the real world financial ROI calculations may be 0%, but the overall return of all the measures can easily be well over 100%. Consequently, the ROI model needs to be extended to be more comprehensive and dynamic to take into account *time to value* while factoring traditional return on asset analysis.

Strictly quantitative ROI logic for intranet portals and IT is not sufficient. For example, if every chief financial officer discounted productivity gains, companies would not have PCs on their knowledge workers' desks because they don't have positive ROI without the productivity gains and are too costly to manage relative to the hard savings they provide. Thus, executives should exercise caution when demanding "balance sheet efficiency" on ROI calculations for IT investments.

Though there are many ways to express standard measures of return, when traditional ROI conventions don't tell the whole story, business managers and vendor alike will often place greater emphasis on soft benefits -- like employee satisfaction, improved visibility, improved knowledge transfer, and dozens of other assets that cannot be measured in hard numbers -- plausibly sure, but with no attempt to put a dollar figure on the "smiley faces". Thus, to overcome this weakness when calculating ROI for IT projects, decision makers should consider all techniques available to credibly and better measure the overall impact of the investment; they must look beyond ROI.

4.3. Beyond ROI

Even in some of its strictest applications, ROI is far from being a perfect calculation. It is understandable then that an enterprise would be tempted to judge the success of its intranet portal initiatives on its traffic volume statistics alone; they are the only *value* related indicators that can be exactly quantified that a portal brings to a business, i.e., showing how many knowledge workers visit the site over time and therefore providing some level of value. Because an intranet *does* have a measurable impact on traditional businesses, companies must embrace a set of metrics that gives the portal initiatives credit not only for its online knowledge workers, but also its overall contribution to the corporation at large in improving its competitive advantage.

The key to escaping the ROI trap is to think strategically about the outcomes and the payoffs from intranet portals by focusing more broadly on business value and meeting the needs of knowledge workers. The anchor for any e-business project should be the value created. Focusing on value created for customers as opposed to cost savings for the company by supplementing speculative financial outcomes (some of which are dubiously contrived) and quantitative metrics with qualitative ones that are rationally more strategic in nature (and collectively provide more important leading indicators to gauge the competitiveness of the business) is fundamental in looking beyond ROI. Measures such as customer and partner satisfaction, customer loyalty, response time to competitive actions and improved responsiveness are examples of these soft measures. Subjectivity in these "intangible" measures can actually be quite objective if used consistently over time. For example, customer satisfaction measured consistently on a five-point scale survey can be an objective basis for measuring performance of customer-facing initiatives [Sawhney, 2002].

A variety of ROI techniques exist for managers to assess the value of intangible benefits. "Business value added" and "intangible value" are both concepts used to describe how IT dollars support key business goals that aren't easily quantified. Similarly, "return on opportunity" helps companies examine top-line growth potential rather than focusing on cost savings. "Return on relationship" acknowledges the intangible nature of an e-business by measuring whether relationships produce direct or indirect returns to a company, such as speed-to-market. By contrast, strict financial ROI approaches, though straightforward, can easily stifle opportunities to create competitive advantage and ignore the impact of intangible benefits altogether.

Best-practice organizations realize that outcomes are more important than outputs. Tracking the interplay between *pain points in processes* and the subsequent impact of modifications to intranet portals to affect business in them based on metrics that tie back to key business drivers is the most critical yet underused measure to improve performance outcomes. Metrics must tie back to the original business drivers so more credible and comprehensive justifications can be provided when the intranet project is proposed. Consequently, executive-level ROIs should emphasize outcomes rather than hit rates, which is the norm today. New intranet applications often provide new

ways of working, and companies should approach ROI in this area with sensible notions of "Does the opportunity justify the investment" or "Is perceived value greater than the cost?" Alternatively, intangible costs and raw benefits can often be quantified by measuring the consequences of *not* making the investment in question: money saved versus the prospects of what is to be gained. Thus, in the final analysis, ROI methodology for intranet initiatives is more a cost-benefits analysis (see Section 4.7.2.2: *Activity Based Costing* for how this can be accomplished in the form of process changes through metrics analysis based on the IEEM).

Standard definitions of ROI today are beginning to stray from their original meaning as input metrics are changing to accommodate increasingly dynamic environments such as intranets. Continuing to focus on cost and savings is an operational management contribution to "business management" but it doesn't give satisfactory, complete answers about the contribution of intranet portals to an enterprise's value. These answers can only be found at higher levels – at the level of the strategic management and economic valuation. Benefits may be expressed in many ways, but the key is to express them in understandable terms that focus on value by matching the critical business requirement issues to the needs and inputs of knowledge workers and business mangers in the value creation process down to groups of specific metrics that can be linked and measured in support of these issues and needs within a coherent and comprehensive framework. The IEEM and its baseline metrics and conversion ratios are designed to provide this approach to these linkages and to provide insight on how to take corrective action upon them. The choice executives face is not whether an approach like this should be taken, but which groups of metrics to choose and how to proceed applying them to measure knowledge worker processes.

4.4. Common approaches to measure the return on IT

The primary reason for most investments in information technology is to improve business processes. The problem becomes one of discerning how much value the IT will add to the processes. One way to answer this question would be to determine how much return the IT provides at the aggregate (referred to hereafter as corporate) and sub-corporate levels. There have been numerous approaches to assessing the impact of IT on company economic performance at the corporate level of aggregation and sub-corporate levels [Brynjolfsson et Yang, 1996]. The IEEM distinguishes itself by providing the first framework that can comprehensively unify analysis to address this problem, regardless aggregation level.

Although a great deal has been written on how to calculate return of investments for the Internet, there is an appreciable lack of data on how to measure the effectiveness of an intranet. Current IT measurements either focus predominantly on online volume traffic or its ROI based on some monetary cost allocation calculation. The following table, modified from Models for Measuring the Return on Information Technology [Housel et al, 2001] provides a snapshot of some of the predominant, current approaches. The IEEM is appended at the end to provide a basis of comparison and to highlight its strengths over other methodologies.

Table 5: Common Approaches to Measure the Return on IT

Approach	Focus	Example	Level of Analysis	Key Assumption	Key Advantage	Limitation
Process Of Elimination	Treats effect of IT on ROI as a residual after accounting for other more easily measurable capital investment	Knowledge Capital [Strassmann, 2000]	Aggregate corporate -level only	ROI on IT difficult to measure directly	Uses commonly accepted financial analysis techniques and existing accounting data	Cannot drill down to effects of specific IT initiatives
Production Theory	Determines the effects of IT through input output analysis using regression modeling techniques	[Brynjolfsson et Hitt, 1996]	Aggregate Corporate - level only	Economic Production Function Links IT Investment Input To Productivity Output	Uses Econo-metric Analysis on Large Data Sets to Shows Contributions of IT at the Firm Level	"Black-Box" approach with no intermediate mapping of IT's contributions to outputs
Resource-Based View	Linking Firm Core capabilities with competitiveness	[Jarvenpaa et Leidner, 1998]	Aggregate Corporate - level only	Uniqueness of IT Resource = Competitive Advantage	Strategic advantage approach to IT impacts	Causal mapping between IT investment and Firm Competi-tive Advantage difficult to establish
Option Pricing Model	Determines the best point at which to exercise an option to invest in IT	[Benaroch et Kauffman, 1999]	Corporate/Sub-corporate	Timing Exercise Option = Value	Predicting The Future Value of An IT Investment	No Surrogate For Revenue At Sub Corporate Level
Family of	Measure multiple	Balanced	Sub-corporate	Need Multiple	Captures	No Common Unit

Measures	indicators to derive the unique contributions of information technology at the subcorporate level	Score-Card [Kaplan et Norton, 1996]		Indicators to Measure Performance	Complexity of Corporate Performance	of Analysis, No Theoretical Framework
Cost-Based	Use cost to determine the value of information technology	Activity-based Costing [Johnson et Kaplan, 1987]	Sub-corporate	Derivations of Cost ≈ Value	Captures Accurate Cost of IT	No Surrogate For Revenue At Sub Corporate Level, No Ratio Analysis
Intranet Efficiency and Effective-ness Model	*Use hard and soft combinations of metrics from each segment of intranet*	*Business Requirement to Audience Metrics [Jacoby, 2002]*	*Corporate/Sub-corporate*	*Multiple groups of logical metrics associated to key business requirements of productivity*	*Provides framework and metrics baseline as well as surrogate for revenue at corporate and sub corporate levels*	*Not all subjectivity in analysis is completely eliminated*

4.5. Applying web analytics

The most important benefit of calculating ROI is that the process helps determine which metrics are most pertinent to a particular business. From the outset, companies need to identify and stick to a good starting point when taking measurements to ensure what is being measured at the beginning is also being measured at the end in a systematic and comprehensive manner. This is particularly true in measuring the performance and impact of intranet portals since so little has been previously researched and practiced in how to measure them. Unfortunately, most organizations do not have good data for their intranet ROI. One of the main reasons is because they don't have an adequate and coherent collection of "before" data from each segment of their intranet operation process. Very few companies take comprehensive snapshots of where they are and equally few take comprehensive snapshots of where they are going with respect to overall strategic and value-based objectives.

When building the ROI justification for intranet investments, specific metrics must be predetermined that can be used to properly analyze and report the necessary information. These metrics will be tracked over time so that they can be mapped to actionable solutions related to bolstering business requirements that will prove out the correctness of the original business justification of the project, initiative, or enhancement as well as the solution itself. In addition, the ROI methodology and set of assumptions must be used in a consistent format to better enable quantification of changes in growth and usage patterns. Rather than metrics portraying what happened, a *dedicated, collective effort* to gather this information and analyze it helps to determine what to do next to improve performance (usually conducted in the form of a *Business Intelligence Team* representing and comprised of IT professionals, web analysts and business decision makers). Thus the process of measuring and fine tuning performance intranet portal impacts caused by actions based on metrics analysis is an economic value creator.

4.5.1. Pre-determined metrics

Enterprises need to predetermine the metrics they will collect to assess their critical business value objectives, i.e., targeting customer loyalty, partner assessment, content effectiveness, channel efficiency, etc. ROI projections for portal framework deployments, though useful for project approval, do not provide insight into the real and actualized value derived from the portal. As a result, planning the business case for portal investments will require predetermined operational metrics, both quantitative and qualitative, to be tracked over time. Otherwise, these metrics provide no meaningful insight into how well businesses are reaching their strategic objectives.

The introduction of the Intranet Efficiency and Effectiveness Model (IEEM) in this paper outlining how to breakdown, analyze and gauge the impact of changes made in support of critical business requirement issues all the way down to specific groups of metrics makes it possible to measure the effectiveness of an organization's quality drive toward greater value. It accounts for a variety of factors and indicators that avoid the problem associated with isolating the specific impact of any one of those factors on an overall conversion rate. A single indicator does not gauge the dial measuring overall success but a collection of the right groups of indicators and the metrics to measure them can achieve this task over time. These indicators and the metrics all work in concert to drive an accurate conversion rate. The IEEM is appropriately broad based to tractably gauge and subsequently provide enhancements to dozens of Web-related initiatives that have an impact on conversion rate because the constituents in the model take into account, for example, the following factors: Navigation, Site layout, Site authoritativeness, Prequalification and disposition of visitors, Site performance, Scale, and Speed to fulfillment. In addition, information flood and false alarms are essentially prevented by defining multiple metrics to describe business activities. Consequently, an alert is triggered only if a combination of metrics shows certain behaviors. Even if a single metric tells the whole story, it is better to have two metrics linked to the resultant alert, or another means, such as reviewing earlier analysis, to crosscheck that a problem really exists before alerting anyone.

4.5.2. Intranet analytic omissions and susceptibilities

The following analytic pitfalls in conducting Intranet ROI are outlined to highlight the differences and subtleties that need to be accounted for when assessing and measuring the value added from intranet processes.

4.5.2.1. Quantitative and qualitative

There are some caveats that need to be addressed for both soft and hard metrics with respect to intranets. *Dotcoms* counted the number of "eyeballs" driven to a virtual storefront, but time has shown that the quality of website hits and a site's ability to retain customers, known as stickiness or "recency", is a better measure of ROI and business value than measuring site traffic. Quantitative metrics in and of themselves can be misleading for intranets and therefore should be supplemented with e-surveys to fill in qualitative information that Web logs cannot provide. Because some critical information gleaned from usage data or analysis of intranet Web logs is inadequate for measuring ROI, the quality of the knowledge worker experience can be improved by implementing a feedback loop consisting of regular reviews of quantitative and qualitative metrics. For example, a page can have high traffic because the content is uniquely interesting, it represents a gateway to other sections, or knowledge workers are stuck in a frustrating circular navigation. Similarly, some desirable attributes, such as ease of navigation, relevance of search results, clarity of content as well as the layout of the site, can only be assessed and disambiguated by users. Thus, quantitative metrics must be correlated with qualitative assessments to formulate a complete picture of the user experience, such focused surveys which can be acted upon, i.e., changes to the layout, links and data visibility.

4.5.2.2. Hit counts

Quantitative metrics like popular "hit counts" are most commonly used for intranets today because they are readily available and easier to calculate. Once gleaned from Web logs however, they present a number of challenges to decision makers when used for intranets:

- The number of hits and the level of productivity can be inversely proportional. Organizations moving from a complex static intranet to an employee portal often find that the number of hits goes *down* because less surfing is needed to find relevant information. For example, the portal could do the surfing for the user based on a specific user profile, thereby bringing the information directly to the user via another content provider/department portal.
- When the number of hits is used to justify additional modifications based on traffic volume, a low number can often tell a better story than a high number (e.g., "We need more money or manpower because we're *not* getting hits and therefore need to provide more valuable information."). This can occur as a result of facilitating the delivery of what knowledge workers are seeking through personalization, i.e., placing specifically frequented links on the desktop homepage.
- Intranets and department portals generate a base level of hits even if they are never used, due to auto-starting (with morning boot-up or every time a browser window is launched) and multiple counting (e.g., portals generating multiple hits for each page as "portlets" are rendered). Portal owners should calculate the base level of hits that will be incurred automatically and subtract this figure from total hits to generate the number of live hits, which is a more useful measure of user involvement.

Hit counts out of context are of limited use. Organizations need to tie hit data back to a role- and process-based context, e.g., matching hits with profiles to determine which roles are not being served by the portal and which functionality is most used for each role, determining how often a particular task is accomplished through the portal.

Without thorough analysis, even the simplest metric indicators, like hit counts, can be misleading. Failure to recognize this will degrade portal performance as wasted time and effort in implementing changes based on incorrect interpretations. It may be something small, such as a navigational loop, but it may be corporate-wide affecting tens of thousands. Thus, even the most straightforward hard metrics should not be taken for granted, but meticulously scrutinized in short order. Using the IEEM approach over time, triggers that alert analysts to these potential pitfalls will be well instated because hit counts will be collected with a variety of other metrics, such as e-surveys, which will aid in identifying pain points. Hard and soft metrics analyzed together with consideration given to their strengths and weaknesses allows analysts to identify incongruent analysis. Thus, achieving success through the use of any performance metric will depend as much as how well it is applied as it does on when it is used.

4.5.2.3. Conversion rates

Though counter-intuitive, since so many factors impact on the conversion rate, monitoring a conversion rate does not enable businesses to determine the precise impact of any one factor. Conversion rate measures ostensibly how effective the site is at converting its visitors to browse, download, etc. Hence, it needs to be taken into consideration collectively in a coherent manner that covers a variety of pertinent factors from each process segment, which the IEEM from inception is designed to address. Essentially, a portal seeking to expand its reach and loyalty should deploy initiatives that convert their base of registered users and first-time visitors into loyal repeat customers: Focus on what drives customer loyalty and higher conversion rates will follow. The opposite is not true despite

much attention being devoted to devising new conversion rate techniques to manipulate the numbers rather than what factors can push them upwards.

Although efforts at cost reductions can be fairly easily applied throughout a firm, efforts aimed at increasing effectiveness generally cannot, unless the same model and set of metrics are applied *uniformly* across all key portals in an enterprise. For example, what makes one employee satisfied or productive may not have the same impact on another employee. However with the use of identical metrics complemented with occasional surveys, data anomalies are mitigated with periodic samplings over time because studies from samples and averages based on the same method are easier to compare. In spite of the challenges they may present, it is important to maintain a balanced approach while pursuing soft benefits -- such as customer satisfaction and understanding, market intelligence and knowledge transfer -- because they contribute to middle benefits (derived metrics) -- such as speed-to-market and loyalty conversion ratios -- which directly impact hard numbers that build a company's bottom line.

4.5.2.4. High-end knowledge workers

The best ways to approach this exercise is by letting key knowledge workers express what is useful and believable or not. The payback is great since even a small increase in the effectiveness of a firm's most critical workers can impact the firm's bottom line. One study estimates that improving the performance of general knowledge workers adds about ten times more to the bottom line than facility and IT cost reductions combined [Cantrell, 2001]. For a firm's most important, "high-end" knowledge workers, this ratio is bound to be dramatically higher, cases in point being a software firm or research division. Instead of employing a common compromise for all, an enterprise should consider solutions more oriented toward effectiveness solutions for some, and solutions more oriented toward efficiency solutions for others. Thus, when selecting enhancement solutions, analysts and BDMs alike should bear the following in mind: Effectiveness solutions which tend to be more intangible and soft should focus on high-end knowledge workers (get them involved in the feedback loop) and efficiency solutions should target employees who contribute less to a firm's revenue, such as admin assistants.

4.5.2.5. Knowledge workers ROI fallacy

With regard to different types of enhancements for different levels of knowledge workers, Capers- Jones estimates productivity gains of 50-75% are possible (primarily for software and research firms) by using outstanding programmers and analysts [Capers, 1986]. The first measurement of this kind was the Sackman's Experiment in which large individual differences were found to exist between programmers [Sackman, 1968]. Another study of this kind conducted 20 years later, known as Demarco's Coding Wars [1999], found similar results but not as dramatic. Table 6 shows their research results between programmer proficiencies in an organization given the same amount of time to program:

Table 6: Programmer Productivity Results

	Sackman's Results	Demarco's Results
Debug Hours :	18 – 1	Best people will outperform the worst by 10:1.
Code Hours :	15 – 1	Best performer will be 2.5 times better than the median.
Program Size :	6 – 1	The top 1/2 will outperform the bottom 1/2 by 2:1.

A cursory conclusion to this is that organizations should focus their portal efforts on accommodating their high-end knowledge workers with all the means necessary to do their jobs better. Although this is not entirely incorrect, it overlooks two important factors with respect to ROI: 1) less skilled programmers do not get paid 10 times less salary; and 2) there are normally fewer high-end programmers than the lower-end knowledge programmers that work on any given project (due to a variety of circumstances such as promotions over time of the more experienced programmer to management positions). Thus, corporations need to exercise caution when allocating resources and prioritizing portal enhancements. The payback may be greater for features or changes that affect a wider body of knowledge workers and programmers who are considered median or lower-end than for a smaller high-end group. This of course will be decided on a case-by-case, or portal-by-portal basis, and is why dynamically constructed portals designed to meet the needs of like users is a powerful new development in the IT world. Analysts and BDMs must keep in mind knowledge worker economies of scale when parceling resources to enhance productivity.

4.5.2.6. Knowledge workers and reuse

The combined and logical approach of model based selected hard and soft metrics can lead to better identifying and understanding what knowledge workers are doing with what they *discover* in intranet portals as well as quantifiable and favorable ROI. For example, as a result of hard and soft metric analysis, ROI may appear in some unexpected places such as reuse of software code. Software reuse is a very measurable and desirable as it allows cost per function delivered to be dramatically reduced. "For instance, a 1,200-member IT team at a Cleveland-based financial firm cut its average project turnaround time by an astonishing 45% after it discovered software in a

development team's portal that would suffice for other internal projects. On average, a single software component took 200 hours to design, at a chargeback rate of $74 per hour, or $14,800 per component. When one component was reused in eight different projects, it saved the company more than $100,000" [Frakes, 2003]. Auditing Web log files alone would not have captured this, portal quality tracking complimented with user feedback resulted in spotting and analyzing ROI returns that would have normally gone unrecognized and unaccounted.

With respect to reuse, a promise of software and intranets is lower costs or at least getting more "bang for the buck". Focusing on code improvement through portal optimization is highly desirable because it can result in both higher reliability and faster time to market. However, software reuse until recently has been noticeably missing. Although there is promise of turning this phenomena around with the advent of C# within .NET and free Linux libraries online, many knowledge workers do not even know the code they are writing has already been written or something very similar to it can be modified in its place – even when it exists on their own intranet. If made an objective, properly configured portals will facilitate software reuse and, more important, *knowledge reuse*, by exposing it and providing such things as references to design documents used to implement the module should it be included in other software design templates. Using the same metrics groups over and over again across the enterprise to gauge performance is itself also a form of reuse provided by IEEM domain analysis and metrics baseline (the key to reusable software is captured in domain analysis in that it stresses the reusability of analysis and design, not code). Collectively, these are example of how a best practice can become a business rule whereby virtually all code *must* be made accessible along with clear understandable documentation. If a business rule is not possible, then an incentive program can be devised to reward and recognize portals whose code or documentation is most widely and highly used by other co-knowledge workers.

4.6. Objective of ROIMI

Used properly, Web analytics can provide significant returns in optimizing portal configurations and capabilities if based on a model that accounts for critical business requirements, measured consistently and periodically to determine where refinements are needed in order to keep in step with the dynamic needs of users. This is exactly why the IEEM has been created so these refinements can be conducted in a logical and coherent manner as they impact on critical business requirements, namely to increase value. Figure 3 below provides a theoretical illustration why a portal optimized using focused metrics is more effective and inevitably more productive than one that does not.

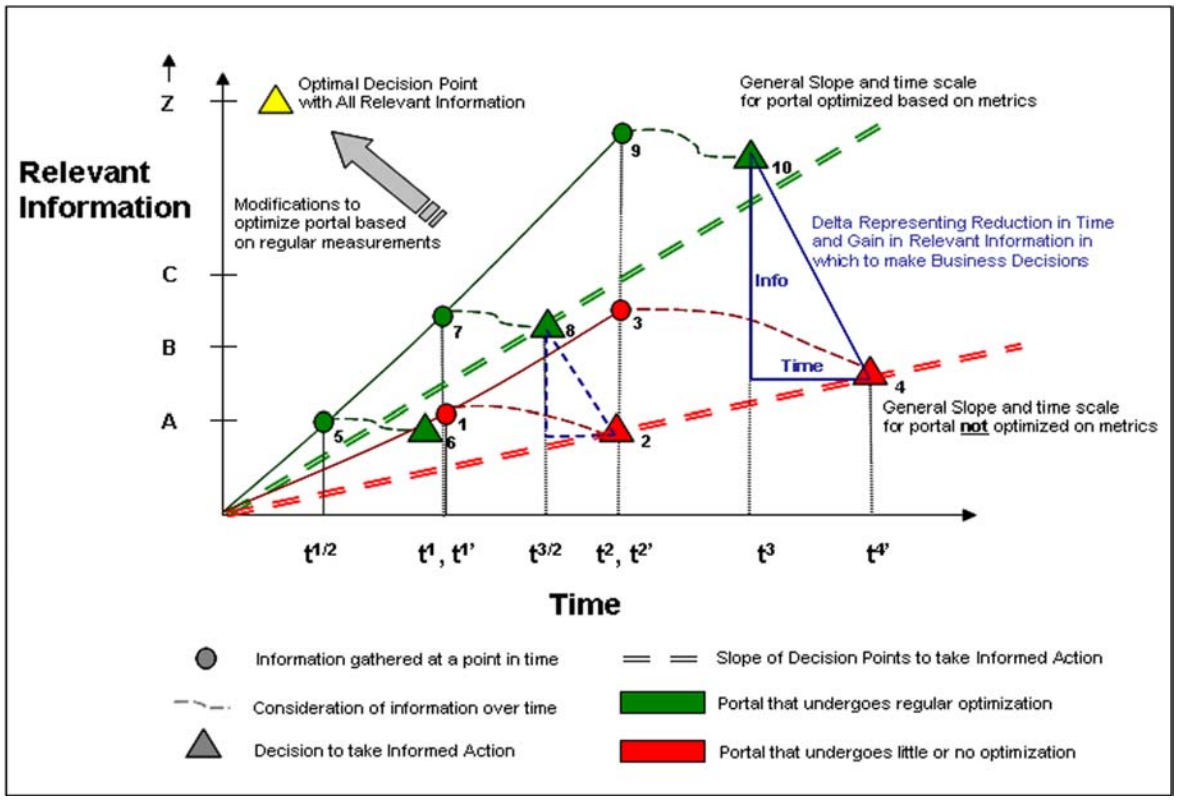


Figure 3: Improving and Reducing the Decision Points

Given the time it takes to find information *A* in time t^1 in an a portal that is not optimized, a portal that is regularly measured to take into account user activity and behavior is more optimized to meet users' needs and, therefore will render more desired relevant information *A+B* in the same time period (point 7 versus point 6). On the other hand, if time is of the essence, information *A* can be found in less time (point 5), thereby allowing the user more time to consider the information or to come to a decision sooner (point 6 versus point 2). Either way the optimized portal will provide as much relevant information in a shorter time period or more information in the same time period. The result is either a business decision sooner or a more informed one respectfully. Another phenomenon is the near exponential affect of this event over time with regard to an increase in relevant information and the decision process itself. Though time is truncated, it may not always be exponential as discovery of relevant information can be a result of better association and placement of documents and information based on user behavior. Moreover, time spent deliberating to reach a decision is truncated by a significant margin in some cases since more relevant information is found providing clarity on what courses of actions are more likely than others.

At any given point in time, there will be as more information found in a portal consistently using metric analytics based on the IEEM, resulting in more informed business decisions being reached in less time. In theory, this is how intranet portals facilitate speed to market. Table 7 below is an extension of Figure 3 above, showing the difference between intranet portals without the guidance of IEEM metrics versus those managed with them:

Table 7: IEEM Analysis Impact on Time to Reach Decision

Best	Portal Type	Time Info Gathered	Amount Info Collected	Time to Reach Informed Decision	PRO / CON
1	Portals using metrics	T1/2	A	≤T1	Best with little time
2	Portals using metrics	T1	A+B	<t2	
3	Portals using metrics	T2	A+B+C+D	<T4 (=t3)	Best with more time
4	Portals **w/no** metrics	T1	A	T2	Worst with little time
5	Portals **w/no** metrics	T2	A+B	T4	

There are many variables that could skew the results for time to reach a business decision to be consistent (i.e., individual skill sets and experience can vary greatly). However, if improvements are made in the other metric areas outlined by the IEEM in Section 2, *Intranet Efficiency and Effectiveness Model*, they will collectively help to minimize the time to locate desired information and the resulting decision reached. *Time to locate* is a classic example that helps put the figure and table above into perspective. Occasionally, users may find what they are looking for sooner, but will also continue to look for long periods of time (perhaps as much as the approximate 50% of their time as they do now) because they are finding more of what they are seeking. Regardless, the time factor is reduced with respect to finding what is sought or considered desirable: If people still spend 50% of their time looking for information, they should have more pertinent information than before in the same amount of time – which should lead to better decision making and ultimately more effectiveness. Time to locate is an *efficiency* metric that is affected by increases in effectiveness elsewhere. The efficiency metric of time to locate in turn affects effectiveness across the board because users will either have or can do more in less time. Thus, this metric area is an example of how effectiveness affects efficiency and then how this efficiency increase in turn improves effectiveness.

4.7. Deriving and employing a common unit of analysis

Time is money and the unit of analysis most appropriate to measure the ROI impact of the IEEM metrics based analytics is indeed time. Although it may be challenging to put *exact* figures on the impact of every intranet portal project, placing a cost-benefit ROI on the worth of applying the IEEM and metrics baseline analytics across a large enterprise is attainable. The key assumption here is that a corporation would assume the IEEM's supporting metrics to serve as a baseline to perform analytics only when it already has an intranet (i.e., sunk cost as part of doing business) and it believes there is room for continuous optimization in it to increase value. The ROI conducted is essentially a cost-benefit between the time needed to invest in applying and acting upon the results of the analytics (i.e., costs to hire an outside analyst or establish an in-house team to conduct the analyses) and the results in time reductions due to subsequent changes introduced by this analysis process, i.e., shorter completion time of a series of business related tasks (sub-corporate level) and speed to market or completion of a project (corporate level). The increases in quality, creativity and knowledge worker or customer satisfaction will be strongly implicit but each falls short of readily breaking down into precise units of time, only approximations of it.

Time savings is sought through the optimization of intranet portals which are directly correlated to impacts on both efficiency and effectiveness gains in support of business value objectives. As outlined in Section 4.6, *Objective of ROIMI*, this can be accomplished only if the same groups of metrics are applied periodically to obtain before and after results. Otherwise, the comparison between the two sets of data collapses and taking subsequent actions to enhance performance related to the results of specifically crafted groupings of metrics are less certain and valid. The reductions in time must be compared against previous baseline measurements to gauge the extent of performance improvements.

Practitioners who redesign business processes require a method for determining how much their process design decisions will impact performance [El Sawy, 2001]. During the lifetime of this approach other metrics combinations deemed more precise may be applied, but this should only take place after at least two periodic measurements have already been fully conducted and analyzed to mitigate anomalies and correct errors. This method thereby provides a convenient way to estimate the returns that alternative process design changes can generate. Thus, the IEEM framework portends to resolve the long-standing problem in the IT community of determining the IT initiative impacts on a large number of *processes* at precise enough levels of the entire find experience to benefit managers who must implement changes at the tactical level and still link them to strategic business objectives.

4.7.1. Entropy concept

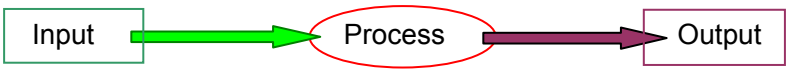
The credibility and applicability of this conjecture are significantly fortified by associating the metric performance indicators to legitimate and logical granular unit of measurement. The technique which meets the requirement of determining the output of time savings as well as enabling its "operationalization" of this theory is the *Knowledge Value Added* (KVA) theory which offers a practical method for estimating the value added by IT via theories rooted in assumptions derived from entropy in complexity and thermodynamics concepts:

> The changes organizational *processes* make in the structure of inputs to produce outputs can be described in a common way in terms of the entropy concept. The concept of entropy is defined as a measure of the degree of disorder or change in a system. In the context of business processes it can be used as a surrogate for the amount of changes that a process makes to inputs to produce attendant outputs. These process-induced changes can be measured in terms of the equivalent corresponding changes in entropy [Housel et al, 2001].

Within the framework of thermodynamics, a fundamental parallelism between transformation of substances and information processing has been established [Li et 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 [Housel et al, 2001]. In other words, application of knowledge is determinant of value. A process must enact some change upon inputs to produce an output of value. Therefore, change can create value and knowledge is proportional to value.

As theorized by Housel, Rodgers, El Sawy and Zhong [2001], by extending this conceptualization of the relationship between complexity and entropy in the organizational context, conditional complexity can be viewed as the shortest description of the process, i.e., effectively, the productivity of the process. Further, 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, by definition, any process *P* that changes *a* into *b* introduces the same change in entropy or, in an organizational context, adds the same value. It is reasonable then to assume that the minimal set of instructions to change *a* into *b*, via process *P* reflects the corresponding change in entropy given the current state of process *P*. In other words, the length of the shortest description of the change provides an acceptable approximation of the change in entropy given the current state of the process. This becomes critical in recognizing that estimations of changes in entropy can only ever be approximations [Housel et al, 2001].

Thus, given that the estimates are derived using the common theoretical framework in IEEM, it follows that a simple correlation between process and outcome leads to reasonable approximation of the reliability of estimates.



Process P is a business process with predetermined outputs.

1. If A = B no value has been added by process P.
2. If A is changed by P into B then "value" ∝ "change"
3. "Change" can be measured by the amount of procedural knowledge required to make the change.
4. Amount of procedural knowledge is proportionate to the time it takes an average learner to acquire the knowledge
5. So "value"∝ "change" ∝"amount of procedural knowledge required to make the change"

Figure 4. Procedural Knowledge is Proportionate to Change [Housel et al, 2001]

At a given point in time, a company's total process outputs produce its revenue. It follows that the procedural knowledge required to produce those outputs is a surrogate for the revenue. Further, if this procedural knowledge, which is distributed among people and IT, can be described in common units, then it is possible to allocate corporate revenue to these units of knowledge. This would allow establishment of a common price per unit of procedural knowledge. It follows that price per unit of procedural knowledge is a surrogate for price per unit of common output. This formulation allows a direct linkage between corporate revenue and the procedural knowledge distributed among the people and IT used to produce the revenue. Hence it would be possible to allocate the proportionate revenue produced by procedural knowledge in business processes including the knowledge contained in the supporting IT. This approach establishes the relationship between cost and resulting productivity [Housel et al, 2001]**Error! Bookmark not defined.**.

4.7.2. Surrogate for value

The relationship between change in entropy and value added, while fundamental, does not provide a practical way to calculate the value-added by organizational processes, i.e., the entropy increment [Housel et al, 2001]. The time it takes the average learner to acquire the procedural knowledge required to produce a process output provides one practical surrogate for the corresponding changes in entropy (see Figure 4 above). This framework can be applied to the context of organizational processes: Processes with predetermined outputs may be described in terms of the amount of time it takes the average knowledge worker to produce those outputs they normally do to complete a business task. It follows, that the procedural knowledge used to produce the attendant outputs may be viewed as a surrogate for the process outputs.

The impact of procedural knowledge can be viewed in two respects in the context of IEEM and portal optimization: one is the reduction of knowledge worker task completion time to exercise the same level of procedural knowledge to create equally if not improved outputs (this respect is how KVA can be applied and is analogous to learning time to conduct a task that has been assigned a percentage of revenue generation for a known outcome whose revenue returned can be estimated); and other is in the context of cost benefit showing how more tasks (ergo more expected outcome) can be accomplished in the same period of time or, alternatively, how the same expected outcome can be achieved in less time (this respect is how Activity Based Costing can be applied, see Section 4.7.2.2: *Activity Based Costing and IEEM*).

In the knowledge worker task completion time approach, the total amount of task completing time required to business-related outputs (i.e., research, code or service) is a surrogate for the revenue derived from a firm's outputs during a given sample period. The outputs of all the company processes used to generate this revenue, at a given point in time, can be described in common units of task completion time. It follows that "price per unit of output," or its surrogate "price per unit of knowledge," (which is derived by dividing company revenue by the total number of units of knowledge) is a constant. However, the cost per unit of knowledge will vary depending on the cost of the knowledge resources (e.g., people and technology) used to produce a process output [Housel et al, 2001].

One task for example in which the IEEM can be calculated with KVA is through greater awareness of content which allows for greater opportunities for such things as software reuse or the reduced time to complete any standard business routine. Even more important than reuse or number of lines of reduced code per se is the derived benefits portals provide in improving the chances for faster development and time to market. For example, many additional products are produced as a result of discovering code or useful information that would have been otherwise inconceivable. Thus, the usability of valuable documents and artifacts previously unrecognized creates competitive advantage. *Since the over-arching objective of an intranet is time reduction to complete all tasks, enhancements to process design as a result of IEEM analysis to optimizing portals for knowledge worker productivity needs is therefore the most crucial issue in facilitating and maintaining the highest returns possible for an intranet. The advantages of employing the Knowledge Value Added and Activity Based Costing methodologies in conjunction with IEEM are that, while grounded in a theoretical framework, they can be applied practically to obtain estimates grounded in common units and that these units can be used as a surrogate for value as well as compared to each other to ensure opportunities to increase value are not overlooked.* How these two approaches to estimating ROI compliment each other are addressed in more detail in the remainder of this section.

4.7.2.1. Knowledge value added and IEEM

As changes in process design may be the most crucial issue in predicting and maintaining the highest ROIMI to best leverage knowledge embedded practices within and across intranet portals, good old-fashioned ROI modeling does not permit enough time to develop the business case for either the metrics or the changes suggested by their results. Therefore, calculating returns using the KVA approach in conjunction with the IEEM works like an investment-portfolio approach: the changes made to process are thought to payoff and improve value, but a period of time is needed to collect the data periodically and analyze it before value realizations can occur, generally in the

form of recognizing greater savings in time or, conversely, more productivity-related activity in less time as a result of the application of and enhancements to the exercise of procedural knowledge.

The essence of KVA is that it takes knowledge utilized in corporate core processes and translates it into a numerical form that allows allocation of revenue in proportion to the value-added by the knowledge as well as the cost to use that knowledge [Baskerville, 1999]. Tracking the conversion of knowledge into value, while measuring its bottom line impacts, enables managers to increase the productivity of these critical assets -- namely in this study, the crucial process activities that take place in portals that drive productivity.

Although the KVA methodology can be applied at any level, it takes on significant value when applied at the enterprise level. A form of the KVA methodology when used within the IEEM framework allows a business intelligence team to iteratively generate estimates of return on portal information system related initiative/process changes as they test/tweak various process designs modifications within and across a variety of portals. In this manner, competitive advantages of this faculty, i.e., changes brought about by the induction and deduction of metric results based off the IEEM, can be reflected in contributions to the company bottom line over time, not overnight.

ROIMI essentially boils down to a delta in time savings as the time devoted to applying, analyzing and taking subsequent actions based on the IEEM metric conversion rates results in a net gain in time -- or what can be accomplished in that same period of time -- in the work of *all* workers within the enterprise. By extension, this gain in time can be plausibly extrapolated into a gain in value (see *Time to Locate* explanation in first paragraph under Table 7). One high level method of expressing the time in terms of savings, which is easier and more justifiable for some parties as opposed to value created, can be done by representing the delta in the time devoted by the small group of people responsible for making all the process changes to portals compared to aggregate statistics at each portal previously and then to the enterprise as a whole prior to the changes taking affect.

For example if *Time* gained (ΔT) as a result of time invested into applying and acting on IEEM metrics, then ΔT equals the amount of time gained by all employees from one measured period of time to the next $\Delta(eT) = eT_1 - eT_2$ minus the total time spent by the business intelligence team (*bitT*) in applying and analyzing a baseline of metrics uniformly across the enterprise, effectively affecting a wide bodies of knowledge workers (as well as others causality speaking). A simple expression of this is $\Delta T = \Delta(eT) - (bitT)$.

An example of how this equation may play out in a large corporation is:

$\Delta T = \Delta(eT) - (bitT)$

$\Delta(eT) = eT_1 - eT_2$

First 30 Period — Second 30 Period

Prior- metric changes — Post- metric changes

eT_1 = *Total No. K-Workers x Total Hours On-Line*

5000 x 4 hr/day x 20 days = 400,000 hours

eT_2 = *Total No. K-Workers x Total Hours On-Line*

5,000 x 3.8 hr/day x 20 days = 380,000 hours

$\Delta(eT) = eT_1 - eT_2$

$\Delta(eT)$ = 400,000 - 380,000 hours = 20,000 hours

$\Delta T = \Delta(eT) - (bitT)$

20,000 hours

(bitT) = Total No. in BIT x Total Hours Worked

10 x 4hrs/day x 20 days = 800 hours

ΔT = 20,000 hours – 800 hours = 19,200 hours gained during second period

In this example, there is a 1:24 ratio in time invested by BIT and time saved to other knowledge worker company wide as a result of their process changes. This assumes that all portals are being measured and that most employees use their intranet to conduct business. Although this ratio difference increases with the size of an organization and its intranet, it will, conversely, diminish at some point and go the other directions as these employee numbers and intranet sizes decrease. Even if one quarter of the estimate above is realized during a 30 day period, this enhancement to the exercise of procedural knowledge would still result in a theoretical saving of over 57,000 hours per year (.25 x 19,200 x 12months). It is these kinds of numbers that will get attention and prove why focusing on changes to process is the key to higher returns.

These results can be expressed as magnitude percentage estimates, something mangers at multiple levels may be more willing to share and allow further interventions since specific dollar amounts resulting from the interventions may be hidden from competitors while being able to share the general results of these interventions. Another tactic in presenting performance metrics and ROI in this case is that it may be wiser to use a range of numbers rather than a single target point. Low-end numbers enable management to make a decision based on conservative projections. High-end numbers dangle the prospect of bigger potential gains in front of them, informing them in any event of the significant scale these changes can make. A clearer understanding of the potential return should encouraging BDMs to take risks (with such investments of time invested by a few knowledge workers to reduce time on task for many knowledge workers) until they have an accurate way of gauging potential value-creating benefits in harder numbers.

In summary, this method provides a means – as well as a rational justification -- in which to calculate ROI for the metrics investment (time saved and better used by enhancements to procedural knowledge within processes) with a common unit of analysis: time to exercise procedural knowledge to produce an expected outcome, which can always be translated into money saved or earned as well as anecdotally accepted as boosting competitive advantage, i.e., time to market.

This example also helps to explain why a form of the KVA methodology can be made to be applicable. For one its basis in entropy concepts takes into account change or the process that enables this and that these changes/outputs are the thing of value since customers pay for the output of the corporation at any given point in time. Simply put, it allows allocation of revenue to the corporate and sub-corporate levels and it allows description of all process outputs in common units. These common units are proportionate to revenue and thus revenue can be allocated to these units allowing the generation of a numerator for an ROI ratio that is not based on any form of cost including, cost savings, cost avoidance, investment cost, etc.[††]

In the case of the example above, KVA could be applied to the IEEM for the time it takes someone to do their job without optimizing changes being made to the process compared to someone who has the same tasks but with the optimized settings. It would be something akin to learning or doing a job and not having to learn or do as much to in order to accomplish the same requirement as a result of the application of knowledge exercised by the analysis team in the form of the changes they make to crucial productivity processes of portal intranets.

In other words, the time to exercise knowledge based off the metrics and applied to impactful productivity process changes of portals can sow even greater knowledge gains into the enterprise at large, i.e., the 1:24 time savings ratio given above. With regard to efficiency and effectiveness, time is saved and value created by virtue of people being able to do more in less time -- again, be it learning or doing. Concomitantly, since these process changes ultimately go across multiple portals there is an effectiveness gain as well, creating value.

4.7.2.2. Activity based costing and IEEM

Another and complimenting technique that can be used to measure ROIMI for IEEM based metrics is Activity Based Costing. ABC is a popular cost-based approach because finding the true costs of process activities are clearly useful in evaluating them [Housel et al, 2001]. Despite the fact that the ABC technique appears to be a very suitable managerial tool for e-business, widely–known published reports about its use in intranet or internet-related economies do not currently exist. Nevertheless, applications of ABC to measuring the impacts of IT assume that any cost/time saved or processes simplified (and thus costs or time reduced) by the IT (namely in this case the *corrective* actions taken after analysis of IEEM metrics and conversion rates) are a direct reflection of its value. This assumption holds true in cases where IEEM metrics analysis is applied causing reductions in cost/time while process outputs remain constant or increase. Thus, the applicability and merits of ABC to IEEM related ROIMI warrants examination.

Criticisms of ABC need to be kept in mind and overcome if it is to have credibility in assigning value to process changes brought about by analysis of metrics. The conceptual limitation of the cost-based approaches to generating a return on investment-type performance ratio is that they do not have a surrogate for revenue [Johnson, 1992]. The problem of using this method for evaluating the value added by IT, is the fact that if cost (or any of its derivatives) is used as a surrogate for value, then all the information is contained in one term of the ratio, i.e., the denominator [Housel et al, 2001]. 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. In the case of IEEM, a form of ABC provides a numerator of *procedures to accomplish an activity* over the time and cost it takes. This is akin to and borrows from the KVA methodology and presents a method to measure and trace value at the sub-corporate level, ironically unlike ABC's originally intended design. Nevertheless, conventional application of ABC is strictly about cost. This approach to ROI can compliment that of KVA and an illustration of this follows.

ABC is a systematic, cause & effect method of assigning the cost of activities to products, services and customers (*cost objects*). ABC uses a simple principle:

- Products, Services and Customers generate the need for activities.
- Activities consume resources.
- The more varied and diverse the Products, Services and Customers, the more activities are generated and the more resources are needed.

ABC measures the cost and consumption of activities and assigns these costs only to the cost object generating the activity, such as the service provided or the demand of a customer [Housel et al, 2001]. ABC introduces the concept of *cost drivers*, which are any factor that cause a change in the level of activity. In the case of IEEM metrics analysis and actions, it is the process changes, specifically the procedures removed, modified or introduced. It is the choice

[††] Housel, email to Grant Jacoby on 19 November 2003.

and use of cost drivers that enables the analysis team to accurately allocate the indirect and overhead costs to the appropriate cost object. For example, assigning resource costs associated with looking and processing information to do a job (activity) to provide a service (cost object) can be accomplished by using the number of searches, navigational steps, clickstreams, and other metrics outlined by the IEEM metrics baseline and conversion ratios (cost driver). The better the service (be it faster or a *qualifiable* improvement), the less time (resource) is used to run through the steps necessary to provide the service, the less costs are assigned to this service. By focusing on the minimization or optimization of an activity by either reducing the number of procedures or strengthening them to accomplish an activity through crucial process changes of intranet practices, the number of procedures *reduced* provides a means to measure consumption of resources as well as a trace to where value is gained. In addition, the trace on value further informs future decisions regarding where process changes have the greatest impact.

Expenses which can be associated with a particular cost object are considered "direct", i.e., salaries and expenses and those which can *not* be associated with a particular cost object are defined as "overhead", i.e., operational costs. It is these costs that can be traced from activities to cost objects. To systematically relate activities to cost objects, the direct and overhead costs of each cost object are added together as "indirect" costs in order to obtain the product cost. The product cost represents an estimate of the *actual* expenditure on the part of a company to generate a cost object, rather than the cost of that object to a customer. The remaining paragraphs in this section provide an example of how this would work in relation to IEEM.

An example of ABC derived ROIMI for IEEM can be illustrated by a division that runs two sets of procedures: one in a non-optimized portal and the other in an optimized portal essentially using a similar process but with less required procedures. Stepping through any procedures to do nearly any activity takes time and resource. Additionally, process changes that result from actions taken from metrics analysis relate directly to procedures taken and take up time and resources as well which need to be taken into account when seeking a ROI.

For instance, during a 30 day period to accomplish an activity, the direct and overhead cost assigned to a section is $2,400. An optimized portal's cost would need to account for the costs devoted in optimizing the portal for that given period. For instance, the costs could amount to $800 and this cost could be accounted for during the period of just one activity or amortized over a longer period. It would be more realistic however to amortize these costs over the course of at least one year over the same activities that take advantage of the same procedure changes made to facilitate the completion of an activity as a part of doing business, i.e., "time to value".

This activity example would include the following:

- 310 procedures are required to perform an activity in a portal not optimized (links, design, help).
- 285 procedures are required to perform the same activity in an optimized portal.
- Procedures in a non-optimized portal require 125 hours of work to be completed.
- Procedures in an optimized portal require 110 hours of work to be completed.
- The additional cost associated to the optimized portal for this activity is $800.

In total, there are 310 procedures to complete an activity in 125 hours that would normally cost $2,400 in one non-optimized portal versus 285 in 110 hours for an optimized portal which requires an addition $800 to cover the optimization costs (albeit for one activity or amortized over the course of a year):

To develop this example further, additional costs imposed by factoring in costs of metrics analysis and changes are factored two ways in two complimentary Tables 8 and 9 below for comparative purposes: in one 30 day activity and then amortized over the course of a year for the same activity conducted multiple times by one k-worker.

Table 8: ABC Costs Assigned to Portals

Indirect cost (time) assigned procedures in non-optimized portal – (310 / 125 hours)	1 procedure per every 24 min. 12 sec
Indirect cost (time) assigned procedures in optimized portal – (285 / 110 hours)	1 procedure per every 23 min. 10 sec
Average indirect cost assigned non-optimized portal over time period to complete the activity (285 / $2,400)	1 procedure per every $7.74
Average indirect cost assigned optimized portal over time period to complete activity (285/ $2,400 x 110hours / 310 hours + $800)	1 procedure per every $10.21
Average indirect cost assigned optimized portal amortized over one year time period to complete the activity (285/ $2,400 x 110hours / 125 hours + $800/12)	1 procedure per every $7.64

Table 9: ABC ROI Returns for 30 Day Activities During One Year

Variable Calculated	Best Case	Worst Case	Difference
Number of Procedures			
No. procedures required to perform activity in a non-optimized portal	310	310	
No. procedures required to perform activity in an optimized portal	285	300	-15
Number of Hours			
No. hours required to complete activity in a non-optimized portal	125	125	
No. hours required to complete activity in an optimized portal	110	116.5	-6.5
Number of Knowledge Workers that Conduct same Task	500	450	-50
Cost of Activity (direct and Overhead)	2400	2400	
Additional Cost (Associated to the optimized portal for this activity)	800	1100	-300
Indirect Costs for Non-Optimized Portal			
Indirect cost (time in minutes) assigned procedures in non-optimized portal	24.19354839	24.19354839	
Average cost assigned non-optimized portal over period to complete activity	7.741935484	7.741935484	
Indirect Costs for Optimized Portal			
Indirect cost (time in minutes) assigned procedures in optimized portal	23.15789474	23.3	-8.526315789
Average cost assigned optimized portal over time to complete activity	10.21754386	11.12266667	-0.905122807
Amortized Indirect Costs for Optimized Portal			
Average cost assigned optimized portal amortized over one year period	7.644444444	7.761555556	0.117111111
Frequency of Activity (answer only one choice below)	12	12	
Weekly (enter the value of 1 if this applies)			
Bi-Weekly (enter the value of 1 if this applies)			
Monthly (enter the value of 1 if this applies)	1	1	
Bi-Monthly (enter the value of 1 if this applies)			
Quarterly (enter the value of 1 if this applies)			
Semi-Annually (enter the value of 1 if this applies)			
Annually (enter the value of 1 if this applies)			
Procedures Gained in One Activity Period	38.86363636	21.88841202	-16.97522435
Percentage Procedures Gained in One Activity Period	4.472140762	3.834971618	-0.637169144
Procedures Gained in One Year for this Activity	166.3636364	142.6609442	-23.70269216
Percentage Change in Procedure Productivity for Activity in 1 Year (%)	4.472140762	3.834971618	-0.637169144
Total Cost of Procedures for this Activity in One Year	29709.09091	29980.25751	271.1666016
Savings of Procedures for Activity in Optimized Portal over One Year	378.8856305	-75.78568462	-378.8856305
Percentage Savings of Procedures in Optimized Portal over One Year	1.280019022	-0.253463828	-1.53348285
Annual Savings to Enterprise for Activity (if more than one employee)	189442.82	-34103.5581	-223546.3733
Percentage Annual Savings to Enterprise for Activity	1.315502	-0.26312241	-1.578624428
Additional Similar Activities Accomplished across Enterprise	291.8660287	213.9914163	-77.8746124
Percentage Additional Similar Activities Accomplished across Enterprise	4.864433812	3.962804006	-0.901629806
Virtual K-Workers Gained for Activity across Enterprise	24.32216906	17.83261803	-6.489551033
Percentage Virtual K-Workers Gained for Activity across Enterprise	4.864433812	3.962804006	-0.901629806

If knowledge workers in the optimized portal worked the same number of hours as the non-optimized portal, they would be able accomplish approximately 39 more procedures within the same time period (310 hours / 612 seconds per procedure). Taken a step further if this activity is done 12 time in the course of a year (125 hours is approximately half the number of hours one person works a month, therefore this activity would only account for half of their jobs) and the costs are tabulated using the amortization of the $800 development costs over that period, the total number of additional procedures accomplished would be 166 procedures ([38.86 procedures accomplished

in optimized portal/ month x 12 months] – [24.19 procedures accomplished in non-optimized portal/ month x 12 months) and the cost would be $29,709.09 (3886.36 procedures / year x 12 months x $7.64 / 1 procedure).

In summary, the additional 166 procedures gained would cost an additional $378.89 as opposed to $909.09[‡‡], providing a 4.47% increase in procedures accomplished during that month. Taken collectively across the enterprise the percentage increase (or ROI) would continue to gradually climb (albeit slightly in some activities and indistinguishable in others if the process is near fully optimized), moreover the cost savings would be profound. The example given is prepared in the context of what one knowledge worker can accomplish in the average amount of work hours per month. If the savings for this one knowledge worker is nearly $379.89, the savings would be even larger every year when applied to an even greater number of them, i.e., $379.89x 500 workers who must accomplish this same activity equates to $189,442.82 annual savings for this one activity alone. Similarly, an additional 291 activities can be accomplished (166 procedures / year x 500 k-workers = 83,181 procedures / 285 procedures per activity accomplished in an optimized portal): the equivalent of adding 24 knowledge workers (291 activities / 12 activities per k-worker per year) or, alternatively, providing a justification to reduce the size of a knowledge worker pool who completes this activity.

Although the percentage improvement appears nearly insignificant for the first activities, the impact of being able to perform more procedures with the same cost or less procedures to accomplish an activity in less time is significant when applied across the enterprise for all knowledge workers (or groups) who perform this same activity over time, as Figure 5 below illustrates in purple (color for efficacy gains). This type of calculating is conceivable and doable for *standardized* processes of work that can be enhanced by portal changes in information access and discovery. However, it is limited in accounting for *creative* processes since the steps of each procedure cannot be known with certainty ahead of time. It can provide approximate accountability by gauging levels of disintermediation achieved through conversion rates, anecdotal confirmations by the knowledge workers through surveys and more general time estimates derived from shorter development times achieved by in-house research and development efforts or cycles within the R&D department itself.

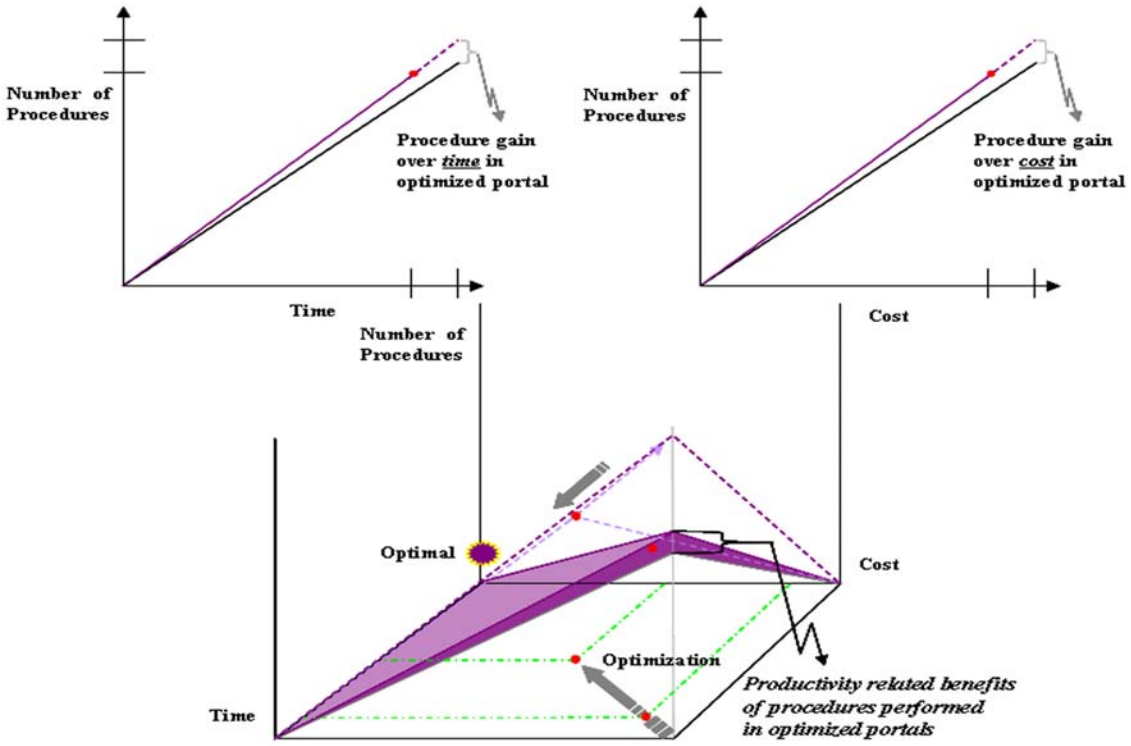


Figure 5: Productivity Pyramid

[‡‡] (Total Cost of all procedures completed in optimized portal) versus (Total Cost of procedures in non-optimized portal had it had to produce the same number of procedures as the optimized portal in the same period of time) -($800 Total Cost of activity x 12 months)

Table 10. One Year vs. Two Year ROI Returns for Different Activities

ONE YEAR RESULTS Variable Calculated	Weekly Best Case	Weekly Worst Case	Bi-Weekly Best Case	Bi-Weekly Worst Case	Monthly Best Case	Monthly Worst Case	Quarterly Best Case	Quarterly Worst Case
Number of Procedures								
No. procedures required to perform activity in a non-optimized portal	50	50	110	110	310	310	1200	1200
No. procedures required to perform activity in an optimized portal	45	48	95	102	285	300	1100	1150
Number of Hours								
No. hours required to complete activity in a non-optimized portal	30	30	68	68	125	125	400	400
No. hours required to complete activity in an optimized portal	26	28.5	57	64	110	116.5	350	375
Number of Knowledge Workers that Conduct same Task	4000	3500	1000	900	500	450	250	220
Cost of Activity (direct and Overhead)	700	700	1200	1200	2400	2400	15000	15000
Additional Cost (Associated to the optimized portal for this activity)	200	300	400	700	800	1100	1000	1400
Frequency of Activity (answer only 1 choice)	48	48	24	24	12	12	4	4
Procedures Gained in One Activity Period	6.923	2.526	18.33	6.375	38.863	21.888	157.142	76.666
Percentage Procedures Gained in One Activity Period	3.846	1.052	3.03	-1.477	4.472	3.834	4.761	2.222
Procedures Gained in One Year for this Activity	92.30	25.26	80	-39	166.363	142.66	228.57	106.667
Percentage Change in Procedure Productivity for Activity in One Year	3.846	1.052	3.03	-1.477	4.472	3.834	4.762	2.222
Total Cost of Procedures for this Activity in One Year	33830.76	33915.78	29277.19	29543.75	29709.09	29980.25	61142.85	61493.333
Savings of Procedures for Activity in Optimized Portal over One Year	1061.538	37.89	395.53	-1169.204	378.885	-75.785	1714.285	-160
Percentage Savings of Procedures in Optimized Portal over One Year	3.140	0.111	1.354	-3.963	1.28	-0.253	2.81	-0.26058
Annual Savings to Enterprise for Activity (if more than one employee)	**4246153**	**132631.57**	**395534.29**	**-1052284.1**	**189442.81**	**-34103.55**	**428571.43**	**-35200**
Percentage Annual Savings to Enterprise for Activity	**3.159**	**0.112**	**1.373**	**-4.059**	**1.315**	**-0.263**	**2.856**	**-0.26663**
Additional Similar Activities Accomplished across Enterprise	8205.128	1842.105	842.105	-344.117	291.866	213.991	51.948	20.4057
Percentage Additional Similar Activities Accomplished across Enterprise	4.273	1.096	3.508	-1.593	4.864	3.9628	5.1948	2.31884
Virtual K-Workers Gained for Activity across Enterprise	170.94	38.37	35.087	-14.338	24.322	17.832	12.987	5.101449
Percentage Virtual K-Workers Gained for Activity across Enterprise	4.273	1.096	3.5087	-1.593	4.864	3.962	5.1948	2.31884
TWO YEAR RESULTS								
Frequency of Activity (answer only one choice below)	96	96	48	48	24	24	8	8
Procedures Gained in One Activity Period	6.923	2.526	18.33	6.375	38.863	21.888	157.142	76.667
Percentage Procedures Gained in One Activity Period	3.846	1.052	3.03	-1.477	4.472	3.834	4.761	2.222
Procedures Gained in One Year for this Activity	184.61	50.52	160	-78	332.727	285.3218	457.142	213.333
Percentage Change in Procedure Productivity for Activity in One Year	3.846	1.052	3.03	-1.477	4.472	3.834	4.761	2.2222
Total Cost of Procedures for this Activity in One Year	67430.76	67515.78	58077.19	58343.75	58509.09	58780.25	121142.8	121493.33
Savings of Procedures for Activity in Optimized Portal over One Year	2353.846	391.5789	1268.261	-1594.659	1666.86	1028.68	4571.428	1173.33
Percentage Savings of Procedures in Optimized Portal over One Year	3.492	0.58	2.186	-2.735	2.8542	1.752	3.778	0.966502
Annual Savings to Enterprise for Activity (if more than one employee)	**9415384.62**	**1370526.31**	**1268261.56**	**-1435193.2**	**833431.08**	**462908.76**	**1142857.1**	**258133.33**
Percentage Annual Savings to Enterprise for Activity	**3.502**	**0.582**	**2.201**	**-2.768**	**2.893**	**1.785**	**3.8093**	**0.97772**
Additional Similar Activities Accomplished across Enterprise	16410.25	3684.210	1684.210	-688.235	583.732	427.982	103.896	40.8115
Percentage Additional Similar Activities Accomplished across Enterprise	4.273	1.096	3.508	-1.593	4.864	3.962	5.1948	2.31884
Virtual K-Workers Gained for Activity across Enterprise	170.94	38.37	35.087	-14.338	24.322	17.832	12.987	5.101449
Percentage Virtual K-Workers Gained for Activity across Enterprise	4.273	1.096	3.5087	-1.593	4.864	3.962	5.194	2.31884

The example of procedures used above can take on other parallel meanings in terms of value that can be derived. For example, if computer code, i.e., instruction sets (another surrogate for procedures), is discovered as a result of it being more accessible, there would also be significant savings. Using the information provided by ABC as a means to monitor impact of process changes (as a result of IEEM metrics analysis), companies in effect can cut costs, identify opportunities for improvement, and determine a more profitable way of conducting business activities. In addition, the output of the ABC analysis is a good basis for revising tactical-level portal changes/ enhancements as well as efficiencies expected of corporate portal strategies. Table 10 below provides worst and best case estimates of process changes to provide BDMs a measure of risk involved with each series of process changes. For example, in the Quarterly Activity estimates, the best case is an annual savings gain of $428,571 but poses a risk of -$35,200 in the worst case. Given this range, BDMs can better ascertain if changes are worth the risk.

Despite the promising benefits of this technique based on the IEEM baseline of metrics and conversion rates, it does require time to gauge and calculate, which runs counter-grain to the fast pace nature of internet economies. An illustration of this using the previous 30 day example is depicted in Table 10 above which illustrates how changes in worst case estimates can go from a negative projection (-$34,103.55 or -0.263% ROI) after one year to a positive return after two years ($462,908.76 or 1.785% ROI). On the contrary, some investments may never – or for an unacceptably long period of time – provide a positive return under worst case estimates, such as the bi-weekly scenario in Table 10 during one and two year returns, providing negative 4.059% and 2.768% ROIs respectively. It is up to the BDMs to decide what is an acceptable risk, but they must first be given the expectations in terms they understand and which can be rationalized by a sound model supported by mathematics. Given the time it would take to realize value gains is *affordable*, ABC-like estimates of savings from IEEM metrics, i.e., semi-annual to annual results, appear to be a good managerial tool to gauge time to value for intranets (as well as internets) of large companies involved in e-business.

4.7.3. Keys to measuring returns on IT

Although they are inter-related, time is the efficiency factor and creating value is the effectiveness factor. A tractable method to prove this with any hard numbers would be similar to the examples above in the form of time reductions in the exercise of procedural knowledge -- much like KVA does in the form of *return on knowledge* in case example it uses showing differences of learning times before and after the application of knowledge [Housel et Kanevsky, 1995]. Consequently, KVA is proposed in this paper as one way to estimate the value-revenue *allocatable* to corporate assets such as people and technology. And ABC is proposed as another means to estimating the return or cost-benefit of ROIMI in a tractable procedure presented in terms of value gain, be it cost, time, activities generated or number of knowledge workers required. In both methodologies, creating value can be conveyed through the increase of conversion ratios (such as those found in Table 2) that constitute critical business requirements, such as loyalty, reach and disintermediation.

KVA and ABC methods of estimating ROI also compliment each other when used together to estimate the same process. For example, audits that result due to discrepancies can be automated quickly while others are more manual intensive and require time to resolve. In any event, significant cost savings can be made if the number of discrepancies that require audits is lowered. In one study, KVA analysis does not make any recommendations for changes in auditing function because *on paper* it has relatively high ROK (cost to learn how to conduct audits divided into the revenue created by them when factoring associated percentage of costs of audits and the revenue generated back). From an ABC perspective, however, the auditing function comes under scrutiny because of the high cost when a discrepancy has to be researched. Intuitively, auditing does not add value for the customer and, therefore, is a target for re-engineering discovered by ABC [Roztocki, 2001]. Thus, when using KVA, an analyst must be careful to factor in qualitative measures (common sense) to ensure a thorough and complete re-engineering effort is made.

On the other hand, ABC has deficiencies when dealing with processes that are complex or involve a large amount of knowledge. In such processes, costs and ROK will not be correlated and, consequently, re-engineering efforts will be focused in different areas. As a result, ABC may misdirect re-engineering efforts. As the economy shifts from a manufacturing to a services emphasis, the value of the KVA methodology increases. Knowledge intensive processes are more prevalent in the services sector and, therefore, will benefit the most from a re-engineering project using the KVA methodology. Thus, while ABC is useful, due to our ascent into the "Information Age", KVA appears to be more relevant for the future [Namura, 2002].

The advantage of combining IEEM and its associated baseline of metrics which emphasizes surveys and includes the key conversion ratios to estimate the improvement of critical business requirements with ROI estimates from both KVA and ABC is that they collectively overcome a limitation of the KVA and ABC techniques when applied alone, not readily representing to the same extent increases in quality, creativity and knowledge worker satisfaction. However, these factors do impact the bottom line and will eventually find their way into processes with

predetermined outputs because the most intangible asset of employee knowledge eventually becomes a tangible asset embedded in company IT. Though it is unlikely that the benefits of these factors will ever be completely quantified, over time this approach does allow for eventual accountability of conversions such as creative outputs into value since they are inevitably embedded into processes with predetermined outputs [Housel et al, 2001]. Taken as a whole, conclusions from these approaches should be plausible and provide management with a more comprehensive picture of the value and direction of their *intranet* refinements and initiatives than they currently get from any other means.

As the academic community points out, there are four key issues that need to be addressed within any framework for measuring the return on IT.

- Unambiguous allocation of value as well as cost of IT initiatives
- Mapping of IT economic impacts at any level of aggregation
- Common unit of measurement
- A supporting theoretical framework

Together the IEEM and its supporting metric conversion ratios and their analysis along with the application of a form of KVA and ABC to determine ROI in measurable common units meet all four of these essential requirements. The collective framework and approach is theoretically-based and "operationalizable". Further, such a framework can prove useful to the practitioners who are struggling to determine which IT process designs will provide the best returns from their intranet portals. In effect, consistent application of the IEEM framework and baseline metrics in combination with KVA and ABC improves insight into how to increase the value of an enterprise in a rational fashion using common units of measurement when and where necessary.

4.8. ROIMI summary

ROI is one of those things that, in theory, makes perfect sense. The problem with relying solely upon financial techniques such as Net Present Value is that they don't necessarily capture all of the business benefits of an IT investment, nor do they help to evaluate all of the options available. Nonetheless, a rational and comprehensive pursuit of ROI can lead to the discovery and optimization of proper metrics that can both demonstrate the business value of intranets portals as well as guide efforts toward enhancements to them that will have the greatest ROI. Assessing soft and derived benefits for intranets -- such as improved customer service, satisfaction, collaboration, loyalty and quicker time to market -- can be one of the most challenging tasks in determining ROI for intranet portals. Thus, by applying the IEEM metrics baseline, conversion ratios and analysis, an azimuth indicator showing how well a corporation is reaching and supporting its strategic business requirements is possible, provided a reasonable return on intranet metrics investment (ROIMI) of the costs of the analysis process is compared to the time benefits using a form of KVA and ABC.

5. Future Work

Successful Web analytics are more a matter of skills than a matter of technology. Nevertheless, Web logs need to be made as automated and quantitative as possible which presents a number of challenges to decision makers when used for intranet measurements. Understanding cause-and-effect is essential to the development of an accurate appreciation of user behavior, traffic volume statistics and a *Return On Intranet Metric Investment*. Many high-end Web analytic features (e.g., session analysis, multiple-site aggregation) offer online analytical processing (OLAP) and data mining functionality via Java-scripted Web pages to collect data. This technology provides significantly more information and scales better than processing of log files. One obstacle to seeing this through is that Java Server page technology doesn't work (yet) with Active Server Page portlets – that means portal providers or integrators must adapt content to a format the portal understands such HTML, XML or Wireless markup language. Work to see how OLAP related technology can be implemented into the IEEM metrics analysis is highly desirable as it would serve as an enabler to deepen the analysis and shorten decision and corrective action processes.

As the find paradigm of the Web shifts from search to match (intelligent queries on a query so not to be under or over specified), new techniques will be required to ensure the proper metrics are used to monitor which content nuggets are sought from where and to gauge the impacts on the user experience. A promising technique that should be explored to assist in this endeavor is *multivariate clustering*; a statistical technique for dimensionality reduction and cluster analysis applied to develop groups of similar online users based on commonly held value characteristics from among a baseline of value-driven variables/metrics. This technique explores different solutions cluster (and sub-cluster) baseline solutions. It should be further researched to see if it could serve as a viable trial for subsequent change recommendations based on the previous metrics results. This type of research and analysis can present more insightful and diverse data in a shorter period of time with less disruption to the organization. As a result, the information gathered from this technique may lead to quicker, more accurate adjustments to the value azimuth indicator of IEEM and eventually to complex algorithmic equations needed in the software engineer community

which reflect the dynamics of the quality paradigm taking place in all segments and constituents that underscore value in corporate portal processes.

6. Conclusion

The intranet is the most measurable medium ever, yet there has not been a successful demonstration of the methods or strategy necessary to successfully implement a model or measurement technique that can indicate the effectiveness of an intranet. To our knowledge, until now there is nothing in the literature on this matter. We have shown by determining which metric area is of greatest impact in driving business value and productivity -- for each of the three intranet audiences, critical business requirements and their supporting metrics from each relevant segment that makes up an intranet -- that metrics can then be prioritized, logically grouped and then sub-grouped with known specific, measurable hard and soft metrics. Understanding how intangible assets affect performance can mean the difference between growth and erosion of value. Intranet analytics can be counter-intuitive and research should be devoted in order to write better software in designing intranet portals and measuring their performance with regard to creating value and productivity from a strategic management perspective.

REFERENCES

Baskerville R. Investigating Information Systems with Action Research, Communications of The Association for Information Systems, Article 2, 1999.

Benaroch, M., R. J. Kauffman. A case for Using Real Options Pricing Analysis to Evaluate Information Technology Project Investments. *Information Systems Research,* pp. 70 – 86, March 1999.

Brynjolfsson, E., L. Hitt. Paradox Lost? Firm-level Evidence on the Returns on Information Systems Spending. *Management Science*, pp. 541-558, April 1996.

Brynjolfsson, E., S. Yang. Information Technology and Productivity: A Review of the Literature. *Advances in Computers,* No. 43:179-214, 1996.

Cantrell, S., Accenture: Art of Work, Vol. 15:55-66, September 2001.

Capers, Jones. Programming Productivity, New York: McGraw-Hill, pp. 21-36, 1986.

Chen, M., Chen, A., Shao, B., "The Implications and Impacts of Web Services to E-Commerce Research and Practices," *Journal of Electronic Commerce Research*, Vol. 4, No. 4, pp. 128-139, 2003.

Demarco, T., T. Lister. Peopleware: Productive Projects and Teams, Dorset House Publishing, 2nd[t] ed., NY: 1999.

El Sawy, O., Redesigning Enterprise Processes for e-Business. McGraw-Hill, Boston: 2001.

Favaro, J., "Managing Requirements for Business Value," IEEE Software, March 2002.

Frakes, W., Software Engineering: Metrics, Virginia Polytechnic Institute and State University, March 2003.

Fruhling, A., Digman, L., The Impact of Electronic Commerce on Business-Level Strategies," *Journal of Electronic Commerce Research*, Vol. 1, No. 1, pp. 13-21, 2000.

Gillet, F., 2001 Forrester Research, Inc: Making Enterprise Portals Pay, August 2001.

Gliedman, C., Giga Information Group: Measure Business Value Created by IT Spending to Fight Perceptions of Little Benefit, June 2000.

Housel, T. J., V. A. Kanevsky. Re-Engineering Business Processes: A Complexity Theory Approach to Value Added. *INFOR*, pp. 248-262. 1995.

Housel, T., W. Rodgers, O. El Sawy, J. Zhong. "Models for Measuring the Return on Information Technology", *Proceedings of the International Conference on Information Systems, ICIS*, pp. 97-106, December 2001.

Jacoby, G., Luqi, "A Metric Model for Intranet Portal Business Requirements'" a dissertation in Software Engineering presented to the faculty Naval Post Graduate School, Depart. Computer Science, December 2003.

Jacoby, G., Luqi, An Intranet Portal Metric and ROI Model. *The 2004 Proceedings of the International Conference on Internet Computing*, Vol. II:676-688, June 2004.

Jarvenpaa, S. L., D. E. Leidner. An Information Company in Mexico: Extending the Resource-based View of the Firm to a Developing Country Context. *Information Systems Research*, pp. 342-361, December 1998.

Johnson, H. T., Relevance Regained: From Top-Down to Bottom-Up Employment. The Free Press, NY: 1992.

Kaplan, R., D. Norton. The Balanced Scorecard. Harvard Business School Press, Boston: 1996.

King, J., Computerworld: 5 Metrics for the Books, May 2002.

Koch, C., Darwin Magazine: Why Doesn't You ROI Add Up? March 2002.

Li, M., P. Vitanyi. An Introduction to Kolomogorov Complexity and Its Application. Berlin: Springer-Verlag, 1993.

Luarn, P., Lin, H., "A Customer Loyalty Model for E-Service Context," *Journal of Electronic Commerce Research*, Vol. 4, No. 4, pp. 156-167, 2003.

Nomura, V., O'Connor, K. Knowledge Value Added and Activity Based Costing: A Comparison of Re-engineering Methodologies, http://www.businessprocessaudits.com/ research.htm, 2002.

Roztocki, N. "Activity-Based Costing for E-Commerce," *Proceedings from the Industrial Engineering research '2001 Conference*, Dallas, TX, May 2001.

Sackman, H., W. Erikson, E. Grant. "Exploratory experimental studies comparing online and off-line programming performance," CACM, Vol.11-1:3-11, 1968.

Sawhney, M., CIO Magazine, p. 37, July 2002.

Shin, N., "Strategies for Competitive Advantage in Electronic Commerce," *Journal of Electronic Commerce Research*, Vol. 2, No. 4, pp. 164-171, 2001.

Strassman, P. A., The Squandered Computer. The Information Economics Press, New Haven: 1997.

Upton, M., *eTrends*: IDC's Executive ePanel Report, p. 17, July 2000.